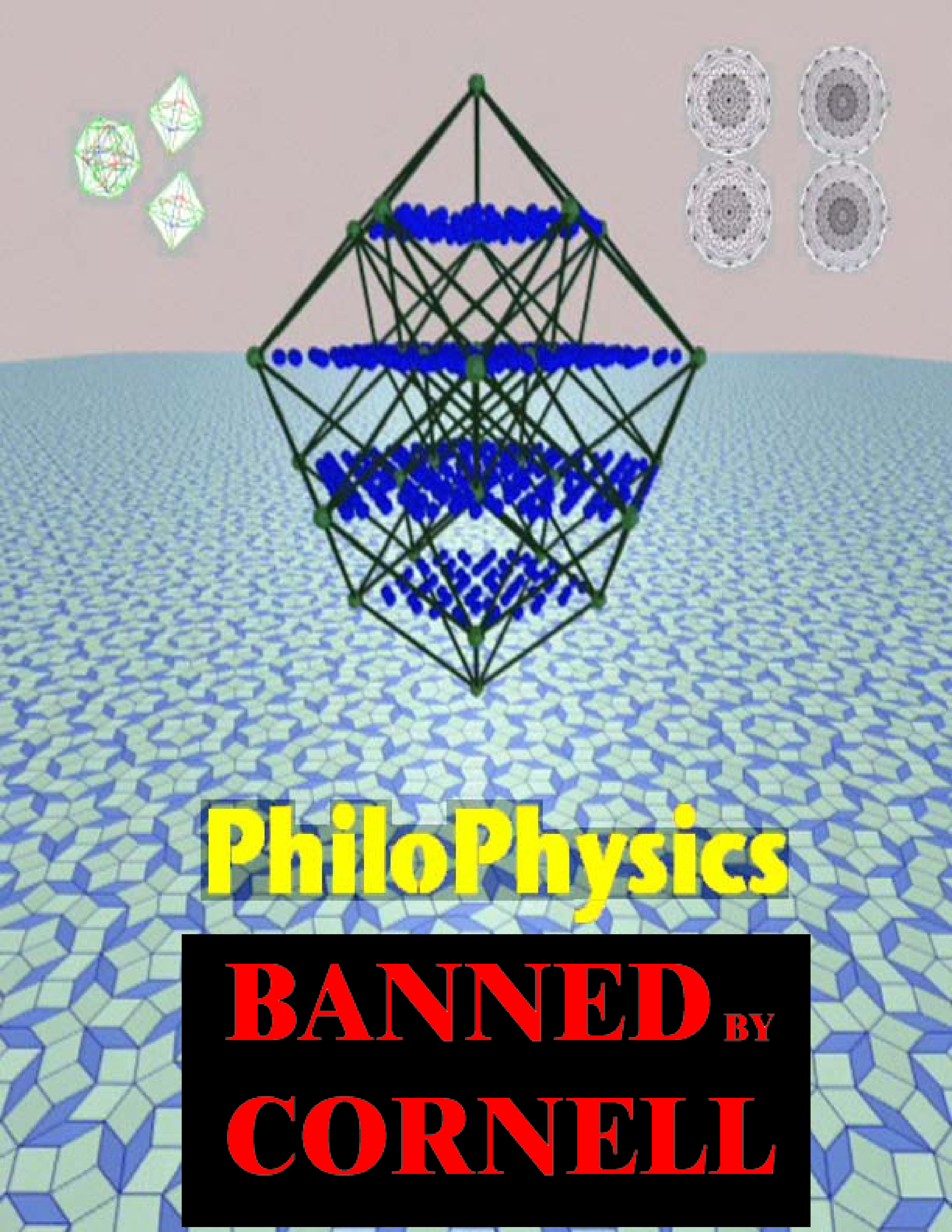


PhiloPhysics

BANNED BY CORNELL

PhiloPhysics

Frank Dodd (Tony) Smith, Jr. - http://www.valdostamuseum.org/hamsmith/TShome.html

This work describes some Religio-Philosophical systems and some Physics models, with comments about some relevant interrelationships. Due to the wide range and many interconnections among the subject matters covered, the sections are not intended to be read in any linear order, but to be read according to interest, with the table of contents and page numbers being provided only for convenience of access. Here are the Contents and Page Numbers:

July 2005 (revised August 2005)

Correspondences between the Sufi Ideas of Ibn Arabi and Physics

In my opinion, the Sufi Islam of Ibn Arabi can be seen as a culmination of the cultivation of human wisdom, with African IFA = Vodou as its fundamental origin and including (but not necessarily limited to) Vedism, Taoism, Buddhism, Judaism, and Christianity.

Here are

Some Correspondences between the Sufi Ideas of Ibn Arabi and D4-D5-E6› E7-E8 VoDou Physics:

The One (ahadiyah) or Absolute Unity which needs no Names	the empty set
Oneness (wahidiyah) or Absolute possessing characteristics which are the Divine Names	binary separation into opposites described by all real Clifford Algebras Cl(N)
thabita are archetypes or fixed prototypes	structures of Cl(8) = Cl(1,7) that are fundamental components of all Cl(8N) Cl(8N) = Cl(1,7) x...(Ntensors)...x Cl(1,7) The 256 elements of Cl(8) correspond to the 256 Odu. The structures of Cl(8) include +/- half-spinor fermion particles and antiparticles vector spacetime bivector gauge bosons The 256 elements of Cl(8) correspond to the 256 Odu

mumkinat are possible things

possible configurations of archetypes
forming quantum possibilities
i.e., worlds of the Many-Worlds
and Bohmian beables

qada is a decisive judgment

dechoherence of a quantum superpostion
of possibilities, i.e.,
choice of which World of the Many-Worlds
at an event, or
choice made by Bohm Guiding Potential

qadar is the outcome of qada

the World or State that is seen to
come into physical existence at an event

al-khalq al-jadid is the
new world that is created at
the occurrence of every event

the branching of the Worlds
of the Many-Worlds at each event

himmah is the spirtual power
of an arif, or knower

quantum consciousness resonant connection

taskhir bi-al-iradah is
constraining by will
whereby a higher order
constrains a lower,
taskhir bi-al-hal is
constraining by the state
or situation in which
a lower order constrains
a higher, and
both together form a cycle

Sarfatti post-Bohm Quantum Back-Reaction wujudiyah is the cyclic ontology of Divine self-manifestations by new world creations

Quantum Game of Many Fates

Here are some of

Ibn Arabi’s Ideas leading to the Correspondences:

According to the book Sufism and Taoism, by Toshihiko Izutsu (California 1983):

> "... Ibn Arabi (born in Spain in 1165 a.D.) died in Damascus in 1240. Fusus al-Hikam ... the Bezels of Wisdom ... written in 1229 ... has often been described as his opus magnum ... Abs al-Razzaq a-Qashani (d. 1330) is one of the greatest figures in the school of Ibn Arabi. ...
>
> ... the absolute, pure Unity (ahadiyah) ...[is]... the Unity of Divine Essence ...
>
> ... the Unity of multiplicity at the ontological stage of Divine Names and Attributes, is specifically called wahidiyah ’Oneness (of Many)’ ...
>
> ... The archetypes are ’permanent’ or ’permanently subsistent’ (thabitah), i.e., they have been fixed once for all in the eternal past and are, therefore, absolutely unalterable and immovable. ...
>
> ... Ibn Arabi often refers to the permanent archetypes as ’essences of the possible things’ (ayal al› mumkinat) ...
>
> ... Ibn Arabi ...[says]... that the ’predetermination’ (qada) is a decisive judgment (hukm, or decree) of God concerning the things ... given in strict accordance with His Knowledge of ... themselves and their properties ..."
>
> ... It is the qadar that assigns to every event its peculiar time ... Ibn Arabi ....[says]... the ’allotment’ (qadar) is the specification of the appointed time at which each of the things should actually occur in accordance with its archetypal state ...
>
> ... Ibn Arabi says that the world goes on being created anew at every single moment ... ’new creation’ (al-khalq al-jadid) ... ordinary people are not aware of the process ... the Absolute is continually manifesting itself in the infinity of ’possible’ things. This is done by .... ’descent’ (nuzul) of the Absolute towards the lower levels of Being ...

... According to Ibn Arabi,

> a 'knower' ... (arif) ... Perfect man ... can, if he likes, affect any object by ... concentrating all his spiritual energy upon it; he can even bring into existence a thing which is not actually existent ... This extraordinary power is known as himmah, meaning a concentrated spiritual energy ... [an] object ... created by himmah continues to exist only so long as the himmah maintains it ... In brief, a 'knower' is ... endowed with the power of taskhir ...[Ibn Arabi says]... A true "knowledge" does not allow himmah to be freely exercised. And the higher the knowledge, the less possibility there is for a free exercise of himmah ...

... even the most perfect of all Apostles (akmal al-rusul), Muhammad, did not exercise himmah ... For, being the highest 'knower', he knew better than anybody else that 'miracles' were, in truth, ineffective ...

... Ibn Arabi distinguishes between two kinds of taskhir.

- One ... is called 'constraining by will' (taskhir bi-al-iradah). It refers to a descending order of taskhir, in which a higher being constrains a lower ...
- the second is an ascending order of taskhir, in which a lower being ... constrains a higher being. ... the higher being is constrained by the ... state in which the lower being is found. It is ... called 'constraining by the state (or situation)' (taskhir bi-al-hal). Here the 'constraining' occurs by the ... fact that the lower and the higher happen to be in a certain relationship with each other.

... Al-Qashani ...[says]...

> ... all the modes of the archetypes are things that have been known to God (from eternity), permanently fixed in potentiality, and God brings them out to actuality incessantly and perpetually ... He goes on transforming the possibilities (isti dadat, lit. 'preparednesses') that have been there from the beginningless past and that are (tehrefore) essentially uncreated, into infinite possibilities that are actually created. Thus everything is in the state of ascending [ascent (taraqqi)] at this very moment because it is perpetually receiving the endlessly renewed ontonlogical (wujudiyah) Divine self-manifestations, and at every self-manifestation the thing goes on increasing in its receptivity for another (i.e., the next) self-manifestation. ...
>
> ... The world in its entirety is perpetually changing. And every thing (in the world) is changing in itself from moment to moment. Thus every thing becomes determined at every moment with a new determination which is different form that with which it was determined a moment ago. ... Thus the Absolute reveals itself perpetually in these successive self-manifestations, while the world is perpetually being lost due to its annihilation at every moment and its renewed birth at the next moment. ... But (ordinary) people do not know the reality of this phenomenon ...

... In this world-view ... of Ibn Arabi ... nothing remains static; the world in its entirety ... transforms itself kaleidoscopically from moment to moment, and yet all these movements of self-development are the 'ascending' movements of the things toward the Absolute-One, precisely because they are the 'descending' self-expression of the Absolute-One. ... The 'new creation' he speaks of in ...[his book Fusus]... concerns the concrete things of the sensible world ...[and]... not the permanent archetypes [themselves] ... Thus in Ibn Arabi's thought, everything in the world (and therefore the world itself) is constantly changing, but underlying this universal flux of changing things there is Something eternally unchanging. ... The Descent is followed by its reversal, that is, Ascent. ... thus the whole process of creation forms a huge ontological circle in which there is in reality neither an initial point nor a final point. ... the whole circle ... is a trans-temporal or a-temporal phenomenon. ... Everything is an occurence in an Eternal Now ...".

According to an Islamic esotericism web page [[my comments are set off by]]:

"... Ibn Arabi saw the cosmos as being ruled by an invisible spiritual hierarchy, consisting of

- the Supreme Pole (Qutb),
  - [[The graded multivector structure of the Cl(8) Clifford algebra is1 8 28 56 70 56 28 8 1 The grade-0 1 is the scalar.]]
- the two imams;
  - [[The Cl(N) Clifford algebra has 2^N dimensions, and for even N there are two mirror-image half-spinors. The Clifford product of a vector by a multivector is in some sense an extension of the set-theoretic XOR from sets and subsets (for which it describes binary distinctions) to vector spaces and subspaces.]]
- the four "pillars" (awtad) governing the four cardinal points,
  - [[The Cl(2) Clifford algebra Quaternions with basis {1,i,j,k} are a subspace of the Octionions with basis {1,i,j,k,E,I,J,K}.]]
- the seven "substitutes" (abdal) ruling over each of the climates or geographical regions;
  - [[There are 7 imaginary Octonions {i,j,k,E,I,J,K}.]]
- the twelve chiefs (nuqaba) ruling the twelve signs of the Zodiac, and
  - [[The 12 signs of the Western Zodiac are related to the 28 signs of the Eastern Zodiac by the ratio 3 to 7. The Cl(8) Clifford algebra has a 28-dimensional bivector Lie algebra which, after factoring out a 16-dimensional subalgebra, is seen to contain the 12›dimensional Standard Model SU(3)xSU(2)xU(1) Lie algebra.]]
- the eight nobles (nujaba) corresponding to the eight heavenly spheres.
  - [[The Cl(8) Clifford algebra has an 8-dimensional Octonionic vector space and two mirror-image 8-dimensional Octonionic half-spinorspaces, all three of which are isomorphic by Triality.]]

... Ibn Arabi also refers to a succession of worlds or planes of existence. These are called the Hadarat or five "Presences" (sing. Hadra),

- [[The first 5 even-dimensional Clifford algebras Cl(2N)

2N	Graded Structure	Total Dimension	Algebra Structure (depends on signature)

```
0                    1                    2^0 =   1= 1x1  (Real numbers)

2                1   2   1                2^2 =   4= 2x2  (Quaternions
                                                         or 2x2 real matrices)
4            1   4   6   4   1            2^4 =  16= 4x4  (2x2 Quat matrice
                                                         or 4x4 real matrices)
6        1   6  15  20  15   6   1        2^6 =  64= 8x8  (4x4 Quat matrices
                                                         or 8x8 real matrices)
8    1   8  28  56  70  56  28   8   1    2^8 = 256=16x16 (8x8 Quat matrices
                                                         or 16x16 real matrices)
```

include the Cl(8) fundamental component of Cl(8N) and the D0 to D4 Lie algebras with dimensions 0, 1, 6, 15, and 28.

Also, there are five known Fermat Primes (2^k + 1):

- 2^1 + 1 = 2 + 1 = 3
- 2^2 + 1 = 4 + 1 = 5
- 2^4 + 1 = 16 + 1 = 17
- 2^8 + 1 = 256 + 1 = 257
- 2^16 + 1 = 65,536 + 1 = 65,537.]]

perhaps because of the Divine Presence in each one, or the five Descents (tanazzulut) or Worlds (alam). Although there are always five levels, there is some difference in detail between the different interpretations, and the levels are usually given different names as well; so in fact more than five are referred to [see e.g. Henry Corbin, Creative Imagination in the Sufism of Ibn Arabi, pp. 225, 260-61]. ...".

According to a web page on Ibn 'Arabi and the Mystical Journey: A First Attempt to Understand Ibn 'Arabi's The Journey to the Lord of Power by John G. Sullivan Department of Philosophy Elon College prepared as part of NEH 1999 Summer Seminar for College Teachers on "The Literature of Islamic Mysticism" held at the University of North Carolina at Chapel Hill [[my comments are set off by]]:

"... Ibn 'Arabi speaks of three basic sources of knowing -- prophetic reports, rational investigation, and unveiling (a knowing from the heart with strong ties to imagination). Some modern religious sensibilities might rate "knowing through reports" as lowest and either rational investigation or unveiling as higher (as both of the latter appeal to some form of experience). For Ibn 'Arabi, on the contrary, prophetic revelation is the strongest and most solid yet he believes we need both rational investigation and unveiling to have complete knowing of that which the Prophet reveals to us. ...

... Ibn 'Arabi speaks of the two categories of the names of God -- correlated with the "two hands of God."

- The left hand tends to dispersion, ignorance, darkness (at least in a sense). More positively it reminds us that we do not know God (tanzih) -- stressing incomparability. So that the rational investigation would be useful to hold that aspect.
- The right hand would tend to unity and self-awareness -- stressing what is similar (tashbih). ...

```
[[ Compare mirror image half-spinors and
the Taoist idea of
left-handed

    __
|__|__
 __|  |

and
right-handed

__
__|__|
|  |__

swastikas that represent expansion and contraction
(somewhat like breathing). ]]
```

... The "qutb" or axis or pivot is the highest station in the Sufi hierarchy. "The qutb is directly responsible for the welfare of the entire world. The qutb is said to be the spiritual successor of Muhammad." (Glossary, Journey to the Lord of Power, p.114) All that has been seen before is, Ibn ’Arabi says, from the world of the left hand. From this station onward, we witness the world of the right hand "and this is the place of the heart." (43) As mentioned above, consider the right hand as representing mercy and unity; the left as representing punishment and separation. From hereon, we more and more realize the unity perspective of the qutb and the mercy flowing from it. .... the qutb harmonizes both aspects ... the incomparableness of the Divine (tanzih) and the similarity of the Divine (tashbih), being able to hold both the universal perspective of timelessness and the "moving image of eternity" in which humans dwell. ...

... Appendix II: ’Arabi’s Cosmic Order using 28 letters of alphabet (from William Chittick Self-Disclosure of God, pp. xxix-xxxii)

> [[The Cl(8) Clifford algebra has a 28-dimensional bivector Lie algebra.
>]]

The Intellective World

- 1. Hamza -- the First Intellect (Highest Pen)
- 2. Ha’ -- Universal Soul (Preserved Tablet)
- 3. ’Ayn -- nonmanifest Nature -- what underlies the "four natures" -- (heat and cold) + (dry and wet)
- 4. Ha’ (dot below H) -- the Last or Dust Substance (Prime Matter) -- like nature, remains unknown except through traces -- fills the Void and is underlying matter/potential of everything in universe except Intellect and Soul

Higher Realm of Imagination

- 5. Ghayn -- The All Body, the Manifest -- a corporeal substance from which every corporeal and imaginal body is shaped and formed.
- 6. Kha -- Shape, the Wise -- through shape, the bodily things of the universe become distinct from one another
- 7. Qaf -- the Throne, the All-Encompassing -- mentioned in Qu'ran (20:5) as where the All Merciful sat. First bodily thing that assumes a specific shape. Encompasses the entire manifest universe including world of imagination.
- 8. Kaf -- the Footstool, the Grateful -- the first imaginal thing -- locus of where God lets down his "two feet" which are the foot of mercy and the foot of mercy mixed with wrath. Above footstool, only mercy -- Footstool embraces the heavens and the earth (2:255) -- the manifestation of cosmos demands good and evil, suffering and happiness, commands and prohibitions. "True gratitude [is] possible only after this division, . . . true gratitude [recognizes and accepts] God's mercy and guidance and [thanks] Him in every state, whether we consider the state beneficial or harmful." Self -Disclosure of God, xxx)

Bodily World starts here with the Celestial Spheres

- 9. Jim -- the starless sphere -- the black satin sphere, the Independent -- free of the specific stars or planets that designate the lower spheres. (In Dante, the Primum Mobile -- source of motion)

  [Paradise is located here between the starless sphere and the sphere of fixed stars]
- 10. Shin -- sphere of fixed stars, the Determiner. The twelve constellations of the zodiac appear here and this sphere can be divided into the twenty-eight waystations of the moon. This disequilibrium 12/28 = 6/14 = 3/7 drives the constant movement and change in the lower realms.
- 11. Ya -- the [7th] or highest heaven -- the Lord -- Saturn (Saturday) -- Abraham
- 12. Dad (dot under D) -- [6th heaven] -- the Knowing -- Jupiter (Thursday) -› Moses
- 13. Lam -- the [5th heaven] -- the Subjugating -- Mars (Tuesday) -- Aaron
- 14. Nun -- the [4th heaven] -- Light -- holds a central spot in bodily/imaginative worlds SUN (Sunday) -- Idris (Enoch)
- 15. Ra' -- the [3rd heaven] -- Form-giver -- Venus (Friday) -- Joseph
- 16. Ta' (dot under T) -- the [2nd heaven] -- Enumerator Mercury (Wed.) -- Jesus
- 17. Dal -- the [1st or lowest heaven] -- Clarifier Moon (Monday) -- Adam
  - [[The 7 heavens correspond to the 7 real Clifford algebras between Cl(0) and Cl(8) that describe the possible structures of the 8-fold periodicity tensor factorization of Cl(N) for large N.

    They also correspond to the 7 different independent E8 lattices. There is a natural 8th lattice that is dependent, so each Cl(8) in a tensor product

    Cl(8N) = Cl(8) (x) ...n times tensor... (x) Cl(8) can be written in 7 different ways, isomorphic to the 7 imaginary Octonions i,j,k,E,I,J,K plus one additional way corresponding to the 8th E8 lattice, which corresponds to 1. Denote those 8 E8 lattices by iE8,jE8,kE8,EE8,IE8,JE8,KE8 and 1E8. Then each Cl(8) can be written with lattice structure in 8 ways

- Cl(81E8)
- Cl(8iE8)
- Cl(8jE8)
- Cl(8kE8)
- Cl(8EE8)
- Cl(8IE8)
- Cl(8JE8)
- Cl(8KE8)

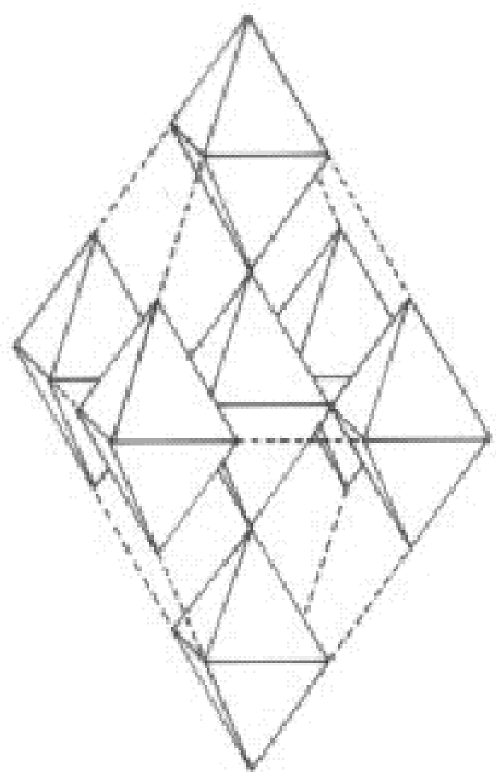
so that there are effectively 8 ways that you can "break down" a given Cl(8) into an E8 lattice structure and if you look at

Cl(8N) = Cl(8) (x) ...n times tensor... (x) Cl(8)

there are 8^N ways (8 for each Cl(8)) that you can break it down into E8 lattice structures.

(Compare the construction of a String Theory containing Gravity and the Standard Model.)

Now, based on the octonionic structure of the 8-dim vector space, if you subdivide its E8 lattices into smaller sub-lattices where the links are shorter, you see that you can get a fractal self-similar nesting into smaller and smaller lattice structures, like Onar Aam described, sort of like this



image

taken from the paper of Battaner at astro-ph/9801276. By doing that, you see that Cl(8) can not only be the basis of a nesting of larger and larger superstructures, but also that Cl(8) can be subdivided into a nesting of smaller and smaller substructures, so that Cl(8) is the key structure of nested super and sub-systems.]]

The Elemental Globes -- pictured as four concentric globes within the influence of moon

- 18. Ta' -- the fire -- the Gripper [The 4 elements can be seen as giving
- 19. Za' -- the air -- the Alive rise to the progeny or kinds of beings
- 20. Sin -- the water -- the Life-giver in the spiritual (though less than God),
- 21. Sad -- the earth -- the Death-giver. in the imaginal and in the bodily worlds.]

The Progeny -- children of the fathers (celestial spheres) and mothers (the 4 elements)

- 22. Za' (dot under Z) minerals -- the Exalted the Spirituals
- 23. Tha' -- plants -- the All-Provider
- 25. Fa' -- the angels (made of light) -- the Strong
- 24. Dhal -- animals -- the Abaser
- 26. Ba' -- the jinn (made of fire) -- the Subtle
- 27. Mim -- human beings (made of clay) -- the All-Comprehensive
- 28. Waw -- the levels, stations -- the Uplifter of degrees ...".

According to an Ibn Arabi Society web page:

> "... The Occult Tradition of the Tarot in Tangency with Ibn 'Arabi's Life and Teachings by Jereer El-Moor. ... the author reviews the known facts of the history of playing cards (and the related history of the Tarot). He sets out to present "a credible case for regarding the Tarot as of Near Eastern provenance", and gives a personal view of its interpretation through the centuries. In the second part he goes on to interpret one of the trumps in the light of Ibn 'Arabi's 'Anqa' mughrib. ...".
>
>> [[The structure of the 78 cards of Tarot are closely related to the structure of the Cl(8) Clifford algebra. For example, the 52-card subset of the 78 Tarot cards naturally corresponds to the 8 vectors plus the 28 D4 bivectors plus the 8+8 spinors.]]

Kent Palmer, in e-mail correspondence, said:

> "... With respect to Quran the numbers just don't work out directly. The place where the trigrams appear the number eight is not mentioned. ... The trigrams are in the Quran definitely. ... the references to Ilm al Raml are in doubtful hadith. ... The evidences for the I Ching are in the coherences of the structure of the book ...
>
> ... in ... the relation between Arabic and Ancient Egyptian ... Maat is like Maut. So Truth is like Death ...
>
> ... we will step out into a place where the rainbow descends to earth. We will be lost in the wonder of ... the rainbow of fate ......"
>
>> [[The hieroglyph for Maat (meaning truth, justice, and order) is an ostrich feather because the god Thoth would judge the fate of each deceased Egyptian by weighing the heart against an ostrich feather (Maat), so Truth was indeed what determined the judgment faced at death.]]

Ibn Arabi and Sufi Islam

According to an Ibn Arabi Society web page:

> "... Muhammad Ibn Arabi is one of the world's great spiritual teachers. Known as Muhyiddin (the Revivifier of Religion) and the Shaykh al-Akbar (the Greatest Master), he was born in 1165 AD into the Moorish culture of Andalusian Spain, the center of an extraordinary flourishing and cross-fertilization of Jewish, Christian and Islamic thought, through which the major scientific and philosophical works of antiquity were transmitted to Northern Europe. Ibn Arabi's spiritual attainments were evident from an early age, and he was renowned for his great visionary capacity as well as being a superlative teacher. He travelled extensively in the Islamic world and died in Damascus in 1240 AD. ...".

Although Ibn Arabi was Sunni, his work transcends Islamic sectarian boundaries. For example, according to a web page of Ted Thornton:

> "... Ruhollah Khomeini was the first Muslim cleric in modern times to create an Islamic government based solely on his personal conception of what such a government should entail. ... Khomeini was descended from the Mussavi Sayyeds, a family tracing its lineage from the Prophet Muhammad through the Shiite seventh imam, Musa al-Kazem. Khomeini's father, Mustapha, a well-known clergyman in Iran, was murdered seven months after Ruhollah's birth. His mother died when he was 16. Ruhollah's education reflected a strong Persian dualist outlook on the world: a tendency to draw sharp boundaries between the worlds of light and darkness, between black and white, between haq ("truth") and batel ("falsehood"). This approach to the world, under girded by a traditional Iranian Shia conviction that the world is unsafe for Shiites, that neither the Prophet Muhammad, his family, nor any of the twelve Shia imams died a natural death ("We are either poisoned or killed."), contributed to the construction within Khomeini of the uncompromising personality of one who feels relentlessly persecuted. Growing up intelligent and introverted in a climate where the religious establishment was losing ground in the face of modernist secular challenges, Khomeini took refuge in mysticism, especially in the works of Ibn Arabi and Rumi [1207-1273] and their notion of the "Perfect Man" who will guide society from multiplicity to unity, from blasphemy to faith and from corruption to a life of absolute perfection. ... On June 5,1963, Khomeini was arrested by SAVAK, the Shah's secret police. Ten months later, in April, 1964, he was released unrepentant. This led the Shah in November, 1964 to send him into exile, first to Turkey, then in October, 1965, to the holy Shia city of Najaf in Iraq, burial place of the fourth caliph and first Shia Imam Ali (the tomb is located four miles from Kufa where Ali was felled by Kharijite assassins in 661). Khomeini moved to Paris in October, 1978. Throughout 1978, demonstrations against the Shah's regime took place in Iran. Ailing from cancer, the Shah departed Iran on January 16, 1979. Two weeks later, Khomeini's supporters recalled him from exile in Paris, and on February 1, 1979, he returned to construct his revolutionary "reign of virtue" according to his principle of the velayet e-faqih ("vice regency of the theologian"). Iran became a pure theocracy ... [By 2003,] Khomeini's own grandson, Sayyid Hussein Khomeini, ... from his home in Baghdad, described the American invasion of Iraq as a "liberation," and said that people in the region welcomed freedom wherever it came from, even a country which his grandfather had dubbed "the Great Satan." He predicted that unless reforms occurred in Iran, there would be an exodus of Shia scholars from Qom to Najaf, one of the major centers of Shiite learning in Iraq and the burial place of the Shia Imam Ali. ...".

Therefore, I like to see the work of Ibn Arabi as useful for all humans.

According to the book Sufism and Taoism, by Toshihiko Izutsu (California 1983):

> "... Ibn Arabi remarks that 'the mystery of qadar is one of the highest knowledges, which God grants only to (a small number of) men who are privileged with a perfect mystical intuition'. If a man happens to obain the true knowldege of qadar, the knowledge surely brings him a perfect peace of mind and an intolerable pain at the same time.
>
> - The unusual peace of mind arises from the consciousness that everything in the world occurs as it has been determined from eternity. ... Instead of struggling in vain for obtaining what is not in his capacity, he will be happy ...
> - He must be tormented, on the other hand, by an intense pain at the sight of all the so-called 'injustices', 'evils', and 'sufferings' that reign rampant around him, being keenly conscious that it is not in his 'preparedness' to remove them from the world. ...".

Tony Smith's Home Page

Frank D. (Tony) Smith, Jr., Cartersville, GA USA, 9 November 2003

VoDou and Physics

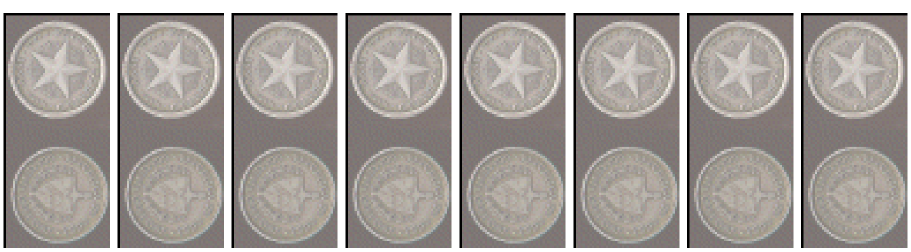
VoDou = IFA divination begins with a binary choice:

To form a string of binary 1s and 0s,

let  = 1 and  = 0.

VoDou = IFA divination is based on 8 binary choices.

One way of divining is to cast a chain (Opele Chain) of 8 two-sided things, such as cowries or palm nuts. Here, I illustrate with a chain of 8 coins:

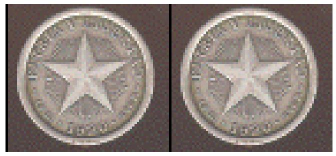


```
There are
2 x 2 x 2 x 2 x 2 x 2 x 2 x 2
= 2^8 = 256 possible outcomes
```

There is only 1 outcome with no 1s (all 0s):

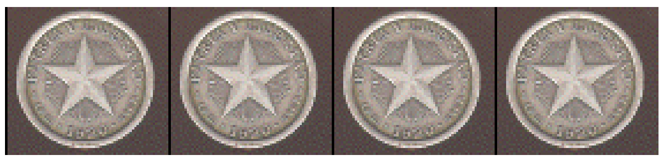
There are 8 different outcomes with exactly one 1:  The 8 are, explicitly:

There are 28 different outcomes with exactly two 1s:



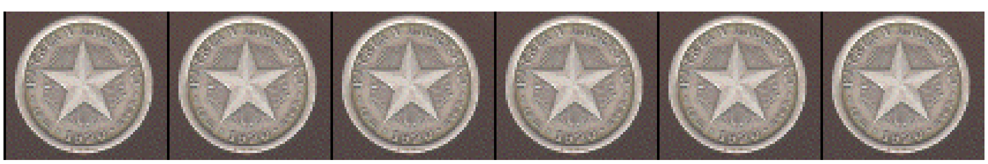
There are 56 different outcomes with exactly three 1s:

There are 70 different outcomes with exactly four 1s:



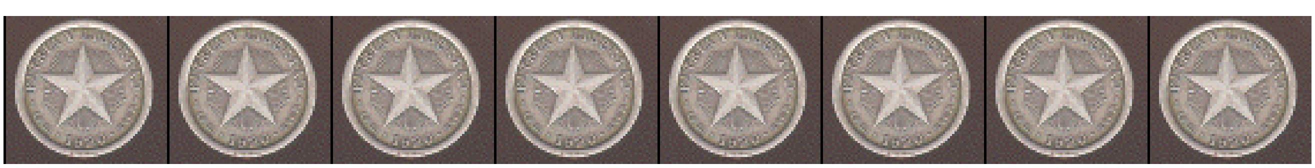
There are 56 different outcomes with exactly five 1s:

There are 28 different outcomes with exactly six 1s:



There are 8 different outcomes with exactly seven 1s:

There only one outcome with all eight 1s:



If we call the number of 1s in a given outcome the grade of that outcome,

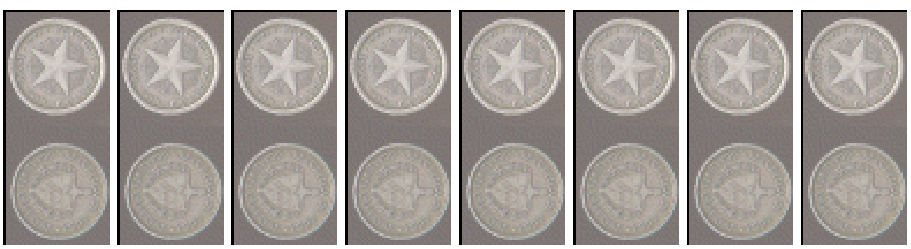
then we can organize the 2^8 = 256 outcomes by grade from 0 to 8:

$$1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = 256 = 2^8$$

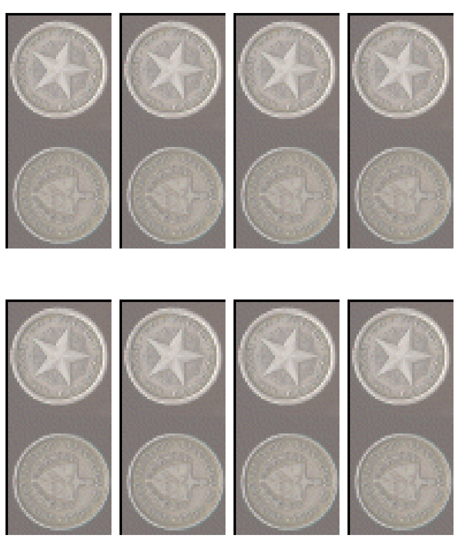
The Opele Chain Casting method of divining describes the graded structure of the 256 = 2^8 outcomes.

There is also an alternate method of VoDou and IFA divination.

It is equivalent to dividing the 8-element Opele Chain



into two 4-element halves:



and then casting each 4-element half separately,

so that each outcome is a pair of 4 binary choices.

Since 4 binary choices have 2^4 = 16 possible outcomes,

a pair of 4 binary choices has 16 x 16 = 256 possible outcomes,

which are the same 256 outcomes obtained by casting the whole 8-element Opele Chain.

Each of the 16 possible outcomes of 4 binary choiceds can be represented by Tetragrams. Here is a traditional Yoruba sequence of Tetragrams, with o representing the binary choice 0 and oo representing the binary choice 1:

```
1     2     3     4

o     oo    oo    o
o     oo    o     oo
o     oo    o     oo
o     oo    oo    o


5     6     7     8

o     oo    o     oo
o     oo    oo    oo
oo    o     oo    oo
oo    o     oo    o


9     10    11    12

o     oo    oo    oo
o     o     o     oo
o     o     oo    o
oo    o     oo    oo


13    14    15    16

o     o     o     oo
oo    o     oo    o
o     oo    o     oo
o     o     oo    o
```

The 16 Tetragrams can also be arranged in a binary number sequence

```
0      1      2      3      4      5      6      7

o      o      o      o      o      o      o      o
o      o      o      o      oo     oo     oo     oo
o      o      oo     oo     o      o      oo     oo
o      oo     o      oo     o      oo     o      oo
```

```
                      X
```

```
8      9      10     11     12     13     14     15

oo     oo     oo     oo     oo     oo     oo     oo
o      o      o      o      oo     oo     oo     oo
o      o      oo     oo     o      o      oo     oo
o      oo     o      oo     o      oo     o      oo
```

in which the first line of 8 Tetragrams (0-7) is the Mirror Image of the second line (15-8) under a reflection through the central point X that changes o to oo and oo to o.

The Tetragram method of divining describes the 256 = 16 x 16 outcomes in terms of 16 sets of 16 outcomes.

The 16 = 8 + 8 sets can be seen as two groups of 8 sets, with one group of 8 (call it <8) being a Mirror Image of the other (call it 8>).

Therefore,

VoDou = AFA, through the Opele Chain Casting and Tetragram methods of divining, give this structure to the fundamental 256 outcomes:

1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = (<8 + 8>) x 16

How can this structure be used to make a Physics model?

In order to make a model of Fundamental Particle Physics, you must describe the basic action by which

a Fundamental Particle moves from an Origin point A in SpaceTime to a Destination point B in SpaceTime.

```
     --B
    /  /|
   /  /  /
  /  /  /
  |/  /
  A--
```

As John Gribbin and Mary Gribbin say in their book Richard Feynman, A Life In Science (Dutton, Penguin, 1997, at pages 85-87):

"... A line ...[from A to B]... represents the history of a particle as it .... move[s] from A to B ... The insight Feynman had, while lying in bed one night,unable to sleep, was that

you had to consider every possible way in which a particle could go from A to B - every possible 'history'.

...[A Particle going]... from A to B is conceived as ... a sum ... of ... all of the possible paths that connect ... A to B ...

[Three of the possible paths are shown in the diagram above] ... For each possible way that a particle can go from one point to another in spacetime there is ...[an]...

amplitude ...[which]... has two parts, which can be thought of in terms of little arrows. An arrow has a certain length, and it points in a certain direction. ...".

As Richard Feynman says in his book QED: The Strange Theory of Light and Matter (Princeton, 1988, at pages 82-83, 91, 129):

"... an event [such as going from A to B] can be divided into alternative ways [paths] ...

each way [path] can be divided into successive steps ... the arrows for each step can be "multiplied" by successive shrinks and turns ...[to get an arrow for each alternative way]...

the arrow[s] for each [alternative] way can be "added" ... to obtain a final arrow, whose square is the probability of an observed physical event [such as going from A to B]...

...[another] basic action is:

[a particle] ... emits or absorbs ...[another particle]...

the amplitude ... to emit or absorb a ...[particle]...[is]... just a number ...[that describes the Strengths of Forces in Physics]...

... the amplitude for a real electron to emit or absorb a real photon ... has been a mystery ever since it was discovered, and all good theoretical physicists put this number up on their wall and worry about it. ... It's one of the greatest damn mysteries of physics ...

... There is no theory that adequately explains ... the observed masses of the particles ... We use the numbers in all our theories, but we don't understand them - what they are or where they come from. I believe that from a fundamental point of view, this is a very interesting and serious problem. ...".

The VoDou = IFA model of Fundamental Particle Physics

solves the mystery of the amplitudes for particles to emit or absorb other particles, which give Force Strengths,

and also

solves the problem of Particle Masses.

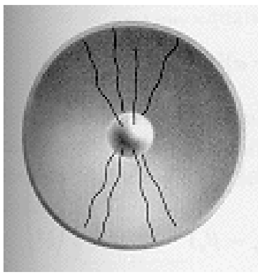
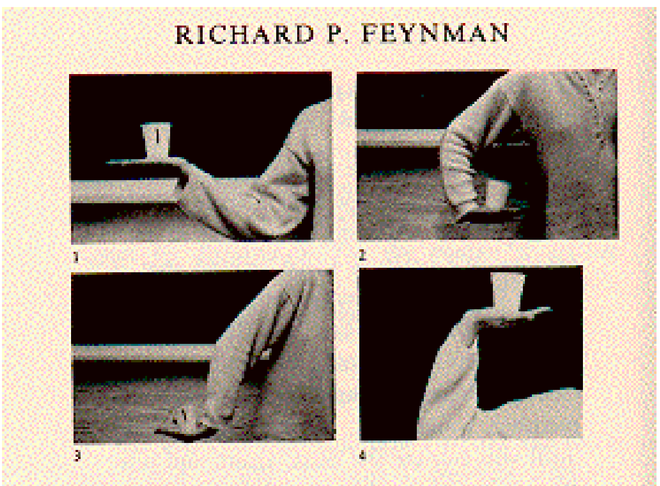
Since the answers to the mystery of Force Strengths and the problem of Particle Masses are numbers, we must see how

the VoDou = IFA structures correspond to the mathematical structures of Feynman's amplitude arrows.

What are the mathematical structures of Feynman's amplitude arrows?

We need a **SpaceTime** so that Particles can move from point A to point B. In the simplest Standard Model and Gravity, **large-scale SpaceTime is 4-dimensional**.

We see that it might be useful to divide Particles into classes, based on how they are affected by rotating them around in SpaceTime:

> The simplest type of Particle is just a point, with no internal sense of direction in or connection to SpaceTime. It is called a **Scalar Particle**, or spin-0 particle. Particle physicists call it a **Higgs Scalar**. In the simplest Standard Model, there is **one Higgs scalar**;
>
> Another type of Particle has an internal sense of direction in SpaceTime, so that if it is rotated one full turn of 360 degrees about an internal axis, it is back to how it was oriented when it started out. Since such Particles act like vectors in that a 360 degree rotation gets them back to where they started, they are called **Vector Particles**, or spin-1 particles. Particle physicists call them **Gauge Bosons**. In the simplest Standard Model of the electromagnetic, weak, and color forces, there are 12 Gauge Bosons. In the Conformal Group that produces Gravity by a generalized MacDowell-Mansouri mechanism, there are 16 Gauge Bosons. Therefore, **for the simplest Standard Model plus Gravity, there are 12+16 = 28 Gauge Bosons**;
>
> A third type of Particle not only has an internal sense of direction, but also has a sense of how it is connected to the SpaceTime in which it lives. Louis H. Kauffman, in his book Knots and Physics (World Scientific Publishing Co. 1991), says that such a particle is like a ball attached to its surroundings by string, as in this picture from Gravitation, by Misner, Thorne, and Wheeler (Freeman 1972):
>
> 
>
> The orientation of the ball is related to the surrounding sphere by the tangle of the strings connecting them. If you rotate the ball 360 degrees, the strings are tangled, but if you go to 720 degrees, the strings get untangled. Here is a demonstration of how the 720 degree rotation works:
>
> 
>

> It is from Feynman's 1986 Dirac Memorial Lecture (Elementary Particles and the Laws of Physics, Cambridge Press 1987), and it shows a cup held by a dancer in one hand. Rotating the cup by 360 degrees gets the arm (which is connected to the shoulder of the dancer) twisted, but turning the cup another 360 degrees gets the arm back straight. In it, picture 1 is the start, picture 2 is 180 degrees, picture 3 is 360 degrees (note how the arm is twisted), picture 4 is 540 degrees, and picture 1 again is 720 degrees. - Such particles that have to be rotated twice to get back to where they started are called **Spinor Particles**, or spin› 1/2 particles.
>
> As Richard Feynman says in his article The Reason for AntiParticles (in the book Elementary Particles and the Laws of Physics, the 1986 Dirac Memorial Lectures, Cambridge, 1987, page10): for Spinor Particles "... there must be antiparticles ...[which look like]... particle[s] moving backwards in time ...". In other words, for each **Spinor Particle there must exist a Mirror Image Spinor AntiParticle** that looks like the original one moving backward in time. Particle physicists call them **Fermion Particles and Fermion AntiParticles**. In the simplest Standard Model, there are 3 sets of 8 Fermion Particles and 8 Fermion AntiParticles. Each of the 3 sets is called a generation, so that there are **8 first-generation Fermion Particles and 8 first-generation Fermion AntiParticles**.

In the VoDou = IFA structure of the fundamental 256 outcomes:

1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = (<8 + 8>) x 16

8 corresponds to a 4+4 = 8-dimensional SpaceTime

1 corresponds to one Higgs Scalar

28 corresponds to 12+16 = 28 Gauge Bosons

<8 corresponds to 8 first-generation Fermion Particles

8> corresponds to 8 first-generation Fermion AntiParticles

At first glance, it looks like the VoDou = IFA structure matches the structure of particle physics, with two exceptions:

- a 4+4 = 8-dimensional SpaceTime and
- only the first generation of Fermion Particles and AntiParticles.

However, if the 8 SpaceTime dimensions are broken down into

- 4 dimensions that we see as the large-scale Physical SpaceTime of particle physics, plus
- a small 4-dimensional ball (called a CP2 space, or Internal Symmetry Space) at each point of the large-scale 4› dimensional spacetime

we can also see where the second and third generations of Fermion Particles and AntiParticles come from:

```
If you reduce the original 8-dimensional spacetime
into 4-dimensional physical spacetime
```

and 4-dimensional Internal Symmetry Space
then
if you look in the original 8-dimensional spacetime
at a fermion (First-generation represented by a single octonion)
propagating from one vertex to another
there are only 4 possibilities for the same propagation
after dimensional reduction:

1

The origin o and target x vertices are both
in the 4-dimensional large-scale physical spacetime

```
4-dim Internal Symmetry Space   --------------


4-dim Physical SpaceTime        ---o------x---
```

in which case the propagation is unchanged, and the
fermion remains a FIRST generation fermion.

2

The origin vertex o is in the large-scale physical spacetime
and the target vertex * in in the Internal Symmetry Space

```
4-dim Internal Symmetry Space   ----------*---


4-dim Physical SpaceTime        ---o----------
```

in which case there must be a new link from
the original target vertex * in the Internal Symmetry Space
to a new target vertex x in the large-scale physical spacetime

```
4-dim Internal Symmetry Space   ----------*---


4-dim Physical SpaceTime        ---o------x---
```

and a new vertex can be introduced at the original
target vertex in connection with the new link
so that the fermion can be regarded as a SECOND generation fermion.

3

The target vertex x is in the large-scale physical spacetime
and the origin vertex o in in the Internal Symmetry Space

```
4-dim Internal Symmetry Space   ---o----------
```

```
4-dim Physical SpaceTime        ----------x---

in which case there must be a new link to
the original origin vertex o in the Internal Symmetry Space
from a new origin vertex * in the large-scale physical spacetime

4-dim Internal Symmetry Space   ---o----------


4-dim Physical SpaceTime        ---O------x---

so that a new vertex can be introduced at the new
origin vertex O in connection with the new link
so that the fermion can, as in case 2, be regarded as a SECOND generation fermion.
```

```
4

Both the origin vertex o and the target vertex *
are in the Internal Symmetry Space,

4-dim Internal Symmetry Space   ---o------*---


4-dim Physical SpaceTime        ------------->

in which case there must be a new link to
the original origin vertex o in the Internal Symmetry Space
from a new origin vertex O in the large-scale physical spacetime,
and a second new link from the original target vertex *
in the Internal Symmetry Space to a new target vertex x
in the associative spacetime

4-dim Internal Symmetry Space   ---o------*---


4-dim Physical SpaceTime        ---O------x---

so that a new vertex can be introduced at the new
origin vertex O in connection with the first new link,
and another new verterx can be introduced at the original
target vertex * in connection with the second new link,
so that the fermion can be regarded as a THIRD generation fermion.
```

As there are no more possibilities, there are no more generations.

Therefore the VoDou = IFA Structure of the fundamental 256 outcomes

1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = (<8 + 8>) x 16

8 corresponds to a 4+4 = 8-dimensional SpaceTime

1 corresponds to one Higgs Scalar

28 corresponds to 1+3+8 + 16 = 28 Gauge Bosons

<8 corresponds to 8 first-generation Fermion Particles

8> corresponds to 8 first-generation Fermion AntiParticles

after breaking the 8-dimensional SpaceTime into 4 Large-Scale Physical SpaceTime dimensions plus 4 Internal Symmetry Space dimensions, with the consequent production of second and third generation Fermion Particles and AntiParticles, contains a representation of the simplest Standard Model plus Gravity.

So, given the correspondence between VoDou = IFA Structure and the Physics Structures of the simplest Standard Model plus Gravity,

how do we set up to calculate the numbers for the Amplitudes for Emission and Absorption of Particles (which are equivalent to Force Strengths and Charges) and the Masses of Particles ?

The mathematical structure used in such a calculation is called a **Lagrangian**, and it is of the form

INT (1 + 28 + <8,8>)
8

where

- the 1 is a term involving the Higgs Scalar;
- the 28 is a term involving the Gauge Bosons;
- the <8,8> is a term involving the Fermion Particles and AntiParticles; and
- the INT over 8 means to sum (or integrate) the Higgs Scalar, Gauge Boson, and Fermion terms over the relevant region of SpaceTime.

The numerical structure form of the VoDou = IFA Structure comes from the correpondence of the fundamental 256 outcomes

1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = (<8 + 8>) x 16

with the Graded Structure and Spinor Structures of the 256-dimensional Cl(8) Clifford Algebra of 16x16 real matrices M(16,R):

```
x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x
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x x x x x x x x x x x x x x x x
x x x x x x x x x x x x x x x x
```

The black-colored 56 + 70 + 56 + 28 + 8 + 1 and 16 also have physical interpretations, some of which are related to the duality between position and momentum that is related to the Heisenberg Uncertainty Principle of Quantum Theory. Those interpretations are:

- The 16, which breaks down into 8 + 8, correspond to
  - a set of 8 matrices (called Dirac gamma matrices) that describe how Spinor Particles move in SpaceTime from the point of view of position in SpaceTime, and
  - another set of 8 matrices (also called Dirac gamma matrices) that describe how Spinor Particles move in SpaceTime from the point of view of momentum in SpaceTime.
- The 56 (corresponding to outcomes with three 1s) is fixed and not dynamically active after 8-dimensional SpaceTime is broken into 4-dimensional Physical Spacetime and 4-dimensional Internal Symmetry Space. At very high energies where the 8-dimensional SpaceTime is not broken, there may be some phenomena related to the 56, but such high energies (possibly Planck-level) are currently beyond the reach of human experiments and observations, such as some subtle phenomena related to Interactions among the World-Lines of Possible Histories in the Quantum Many-Worlds. Such Interactions can be described in terms of an M-theory with global symmetry of the exceptional Lie algebra E7, whose 56-dimensional representation corresponds to the 56.
- The 70 (corresponding to outcomes with four 1s) breaks down into 35 + 35. One 35 is fixed and not dynamically active after 8-dimensional SpaceTime is broken into 4-dimensional Physical Spacetime and 4-dimensional Internal Symmetry Space. At very high energies where the 8-dimensional SpaceTime is not broken, there may be some phenomena related to that 35, but such high energies (possibly Planck-level) are currently beyond the reach of human experiments and observations, such as some subtle phenomena related to the Higgs Scalar.
- The other 35 and the 56 + 28 + 8 + 1 are dual to the 1 + 8 + 28 + 56 and the first 35, and describe in terms of momentum the same physical phenomena that the 1 + 8 + 28 + 56 and the first 35 describe in terms of position.

Taken together, the 56 and 70 correspond to the 126 root vectors of the exceptional Lie algebra E7 that is the global symmetry group of an M-theory describing Interactions among the World-Lines of Possible Histories in the Quantum

Many-Worlds.

All 256 VoDou = IFA outcomes are closely related to the 240 root vectors of the exceptional Lie algebra E8 that is the global symmetry group of an F-theory describing Interactions among the World-Lines of Possible Histories in the Quantum Many-Worlds.

Of course, our Universe and its Quantum Many-Worlds is very big and one set of 256 VoDou = IFA outcomes, that is, one copy of the 256-dimensional Cl(8) Clifford algebra, describes only one small part, or one Event. To describe such very big things, you need a very big Clifford algebra, say Cl(8N) where N can be as large a number as you want. What makes VoDou = IFA effective for such very big things is the fact that any very big Clifford algebra Cl(8N) can be factored into N copies of the basic 256-element VoDou = IFA Cl(8) Clifford algebra:

$$Cl(8N) = Cl(8) \times \ldots (\text{N times tensor product}) \ldots \times Cl(8)$$

Therefore,

our entire Universe and its Quantum Many-Worlds can be described completely in terms of the 256 VoDou = IFA outcomes.

Further,

the VoDou = IFA model can be used to describe Quantum Consciousness, not only on the level of Human Consciousness, but also of our entire Universe, and to give us a framework within which to consider our Future History and our possible Fates.

Details of calculations of Force Strengths and Particle Masses, including comparison with experimental results and further related math and physics structures, are contained in a paper that can be found at these links:

- local html
- local pdf
- web html
- web pdf

It is clear that the VoDou Physics Model meets Einstein's Criterion for a good fundamental physics model, as it is a structure which is based only upon

"... a faith in the simplicity, i.e., intelligibility, of nature: there are no arbitrary constants ... that is to say, nature is so constituted that it is possible logically to lay down such strongly determined laws that within these laws only rationally completely determined constants occur (not constants, therefore, whose numerical value could be changed without destroying the theory). ...".

Tony Smith's Home Page

......

Tony Smith's Home Page

Clifford Algebra VoDou Physics of Wolfram's 256 Cellular Automata Rules

The 256 Cellular Automata Rules of Wolfram correspond to the 256 basis elements of the 256-dimensional Clifford Algebra of 16x16 Real Matrices, Cl(8) and Cl(1,7), and its discrete counterpart, as well as to the 256 Odu of IFA.

To visualize the correspondence, write the rule numbers in binary notation, put them with the pictures of the 30-level actions of each of the 256 rules as shown on pages 55 and 56 of Wolfram's book A New Kind of Science, and organize them with respect to the

$$1 + 8 + 28 + 56 + (35+35) + 56 + 28 + 8 + 1 = 256 = 16x16 = 2^8$$

graded structure of Cl(8). Here is some more about Cellular Automata.

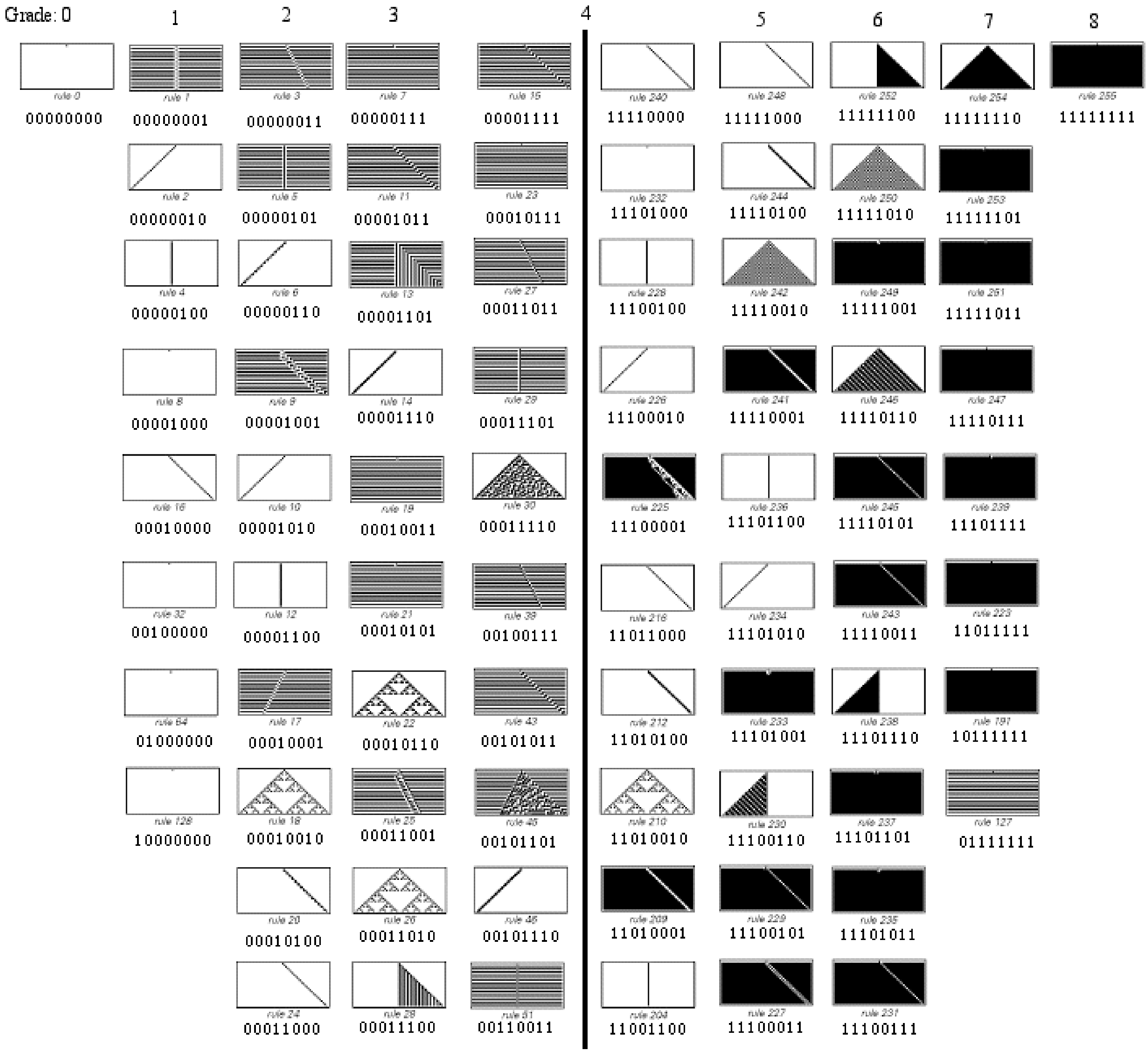
Graded structure details include:

- Grades 0,1,7,, including scalars and vectors;
- Grades 2,6, including bivectors and their Lie algebra;
- Grades 3,5;
- Grade 4;
- All grades 0,1,2,3,4,5,6,7,8 in binary.

Here are 78 of the 256, including:

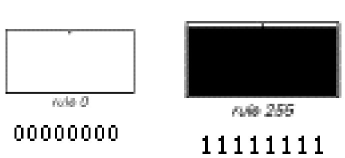
- all 1+8+8+1 = 18 of grades 0, 1, 7, 8;
- 10 of the 28 in each of grades 2, 6;
- 10 of the 56 in each of grades 3, 5;
- 10+10 = 20 of the 35+35 = 70 in grade 4.

The vertical line is a symmetry line of the symmetry of exchanging 0s and 1s in the binary numbers.

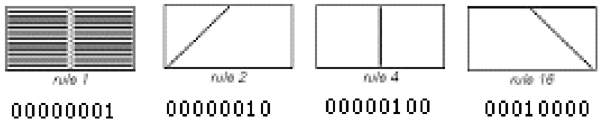


Note that:

- the grade-0 scalars



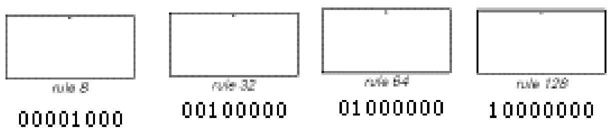
  are related to the Spinors and Primitive Idempotents of Cl(0,8).
- the grade-1 vectors 1, 2, 4, 16 (the subset sequence 2^0 = 1, 2^1 = 2, 2^2 = 4, 2^4 = 16 related to Fermat primes)



correspond to the 4 dimensions of physical spacetime;

- 1 gives a succession of bands, the procession of time;
- 2 gives a slope to the left, one of three space dimensions;
- 4 gives a vertical slope, a second of three space dimensions;
- 16 gives a slope to the right, the third of three space dimensions;

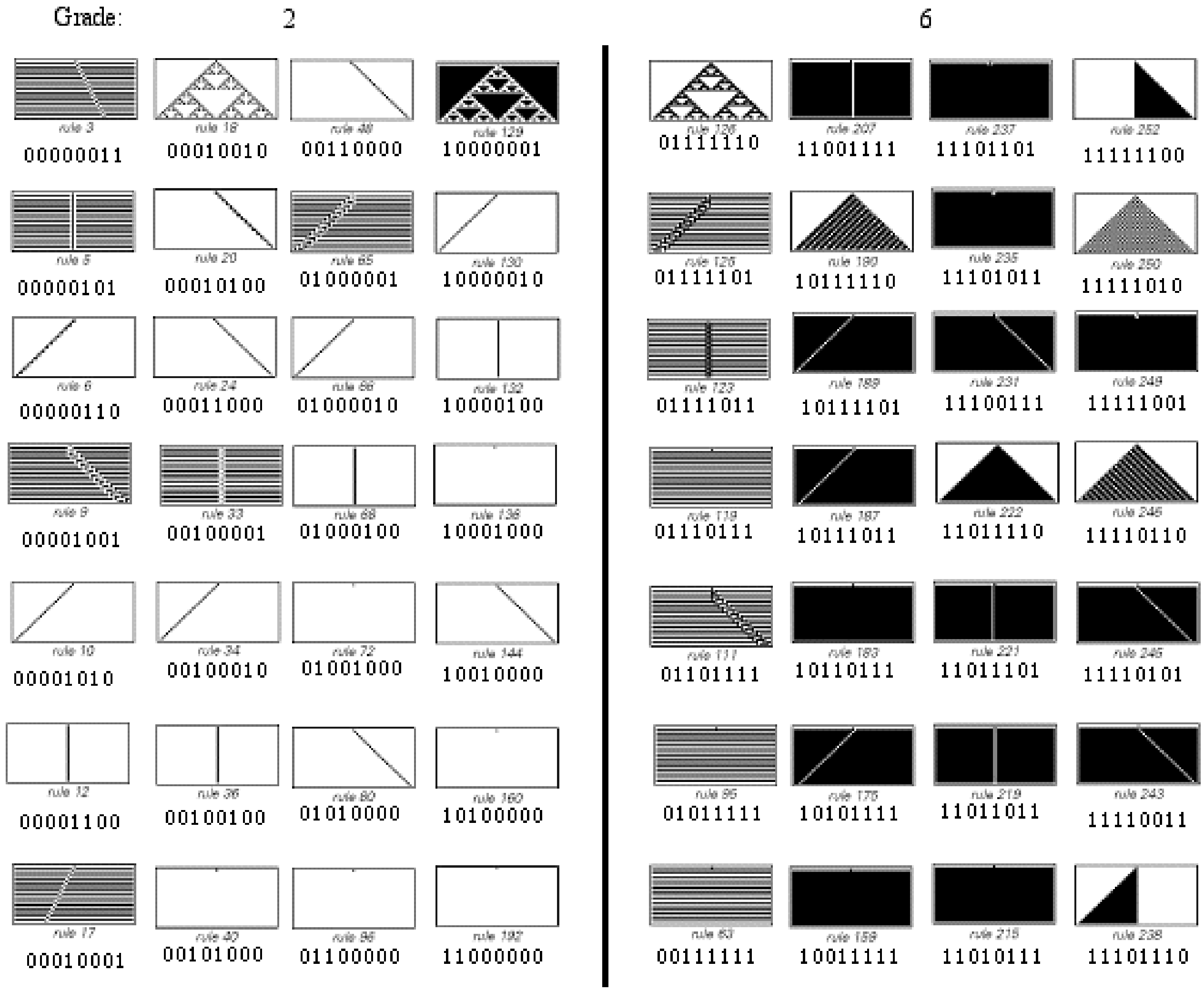
- the grade-1 vectors 8, 32, 64, 128 (all giving all white)



correspond to the 4 dimensions of internal symmetry space;

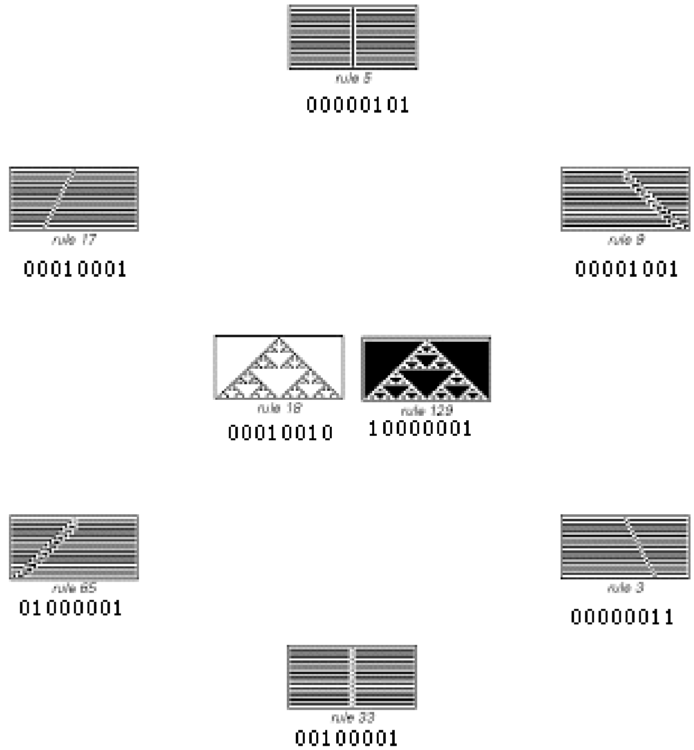
- rule 18 = 00010010 is the first rule to include both 16 = 00010000 with right slope and 2 = 00000010 with left slope and is the first rule with traingular self-similar fractal structure;
- rule 30 = 00011110 is the first rule to include 16, 8, 4, and 2 and is in the self-dual grade-4 and is the first rule with triangular chaotic behavior.

Here are all 28 rules for each of grades 2 and 6.



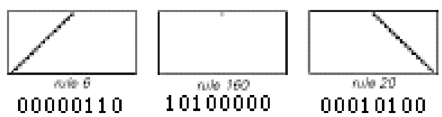
Note that:

- all 28 grade-2 bivectors correspond to the 28 generators of the Spin(8) Lie algebra;
- 8 of the grade-2 bivectors,



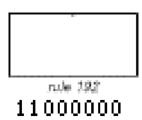
after [dimensional reduction to 4-dimensional physical spacetime](), correspond to [the 8 generators of color force SU(3)](), [whose root vector diagram]() is illustrated above;

- 3 of the grade-2 bivectors,



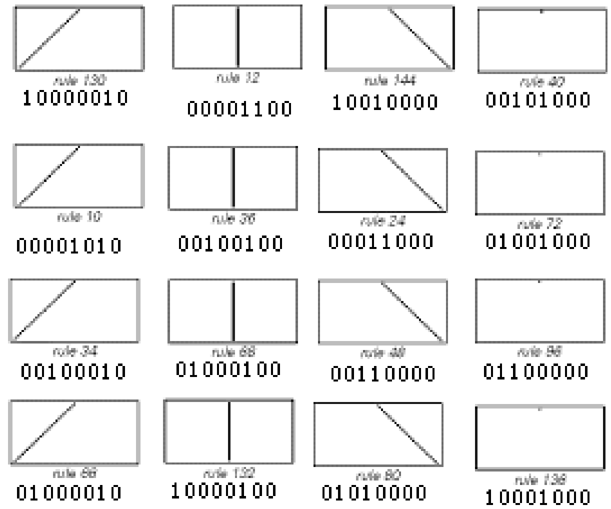
after [dimensional reduction to 4-dimensional physical spacetime](), correspond to [the 3 generators of weak force SU(2)]();

- 1 of the grade-2 bivectors,

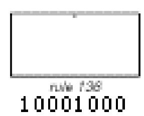


after [dimensional reduction to 4-dimensional physical spacetime](), correspond to [the 1 generator of electromagnetic U(1)]();

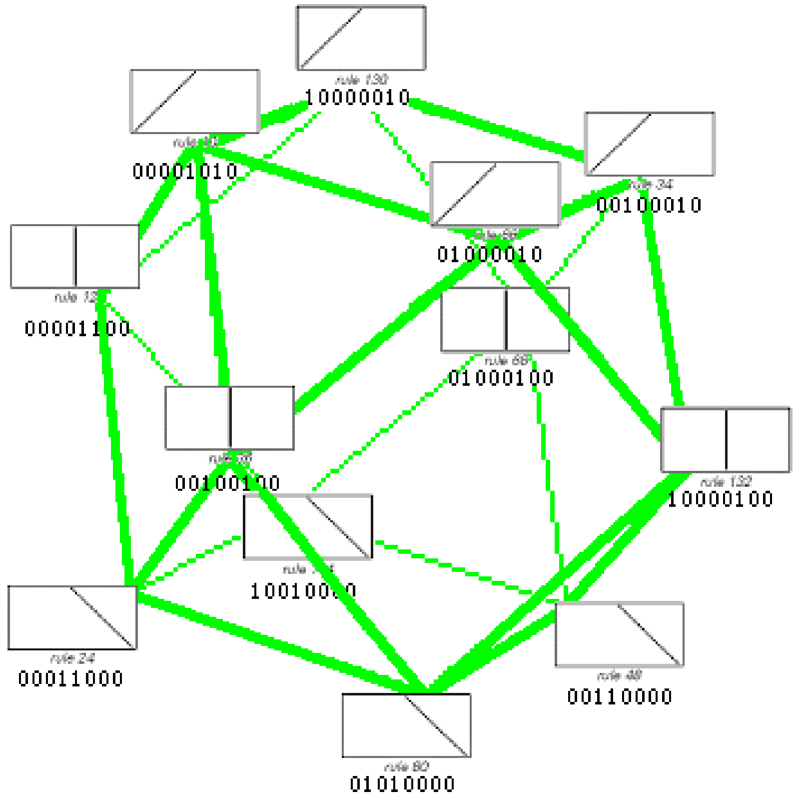
- 16 of the grade-2 bivectors,

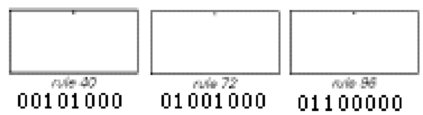


after [dimensional reduction to 4-dimensional physical spacetime](), correspond to [the 16 generators of Gravity/Higgs/phase U(2,2)](). One of them



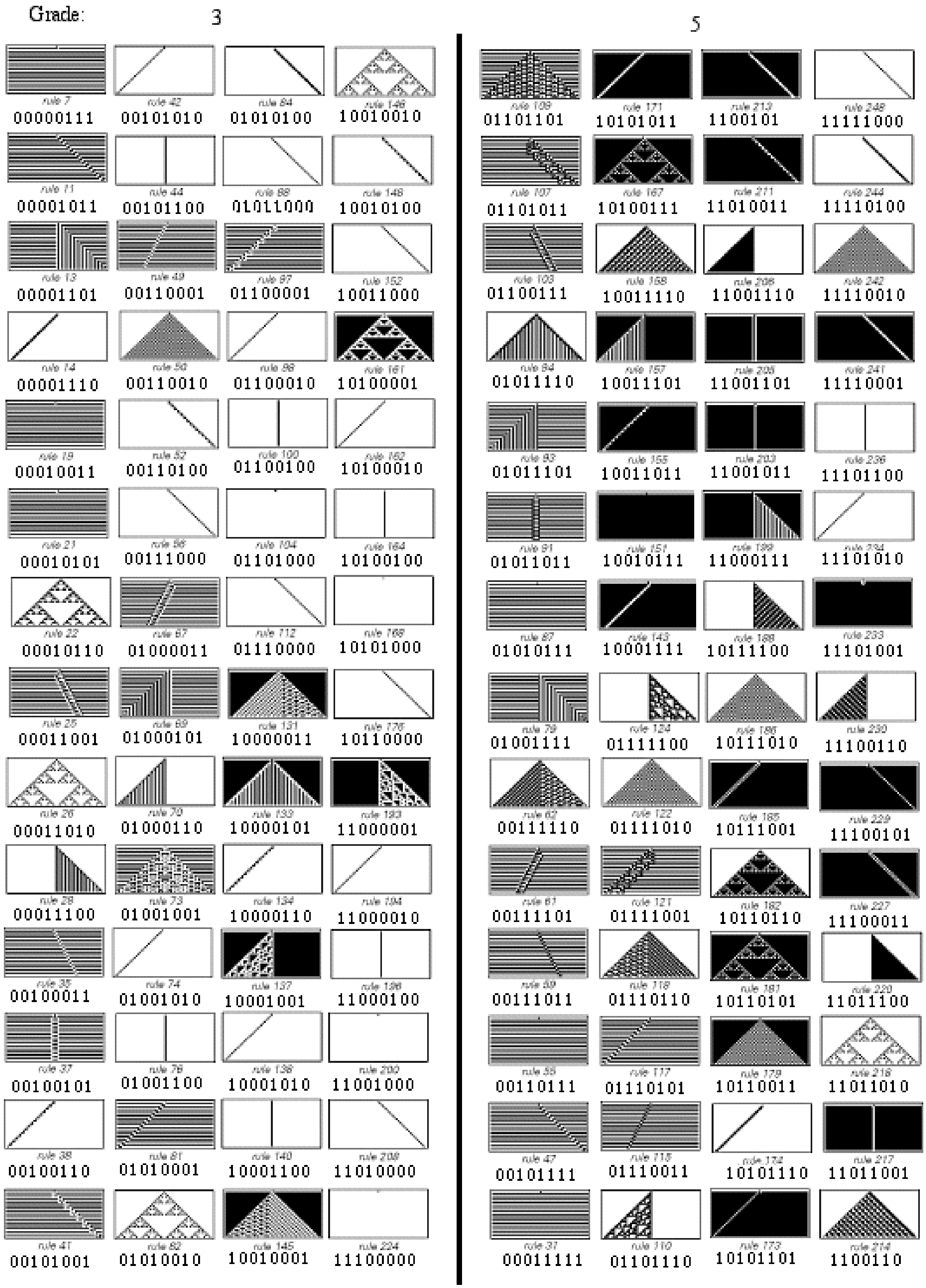
corresponds to the propagator phase U(1) while the other 15 correspond to the [Conformal]() Group SU(2,2) = Spin(2,4) [whose root vector diagram]()





is a 12-vertex cuboctahedron (the other 3 bivectors corresponding to the 3 generators of the Cartan Subalgebra).

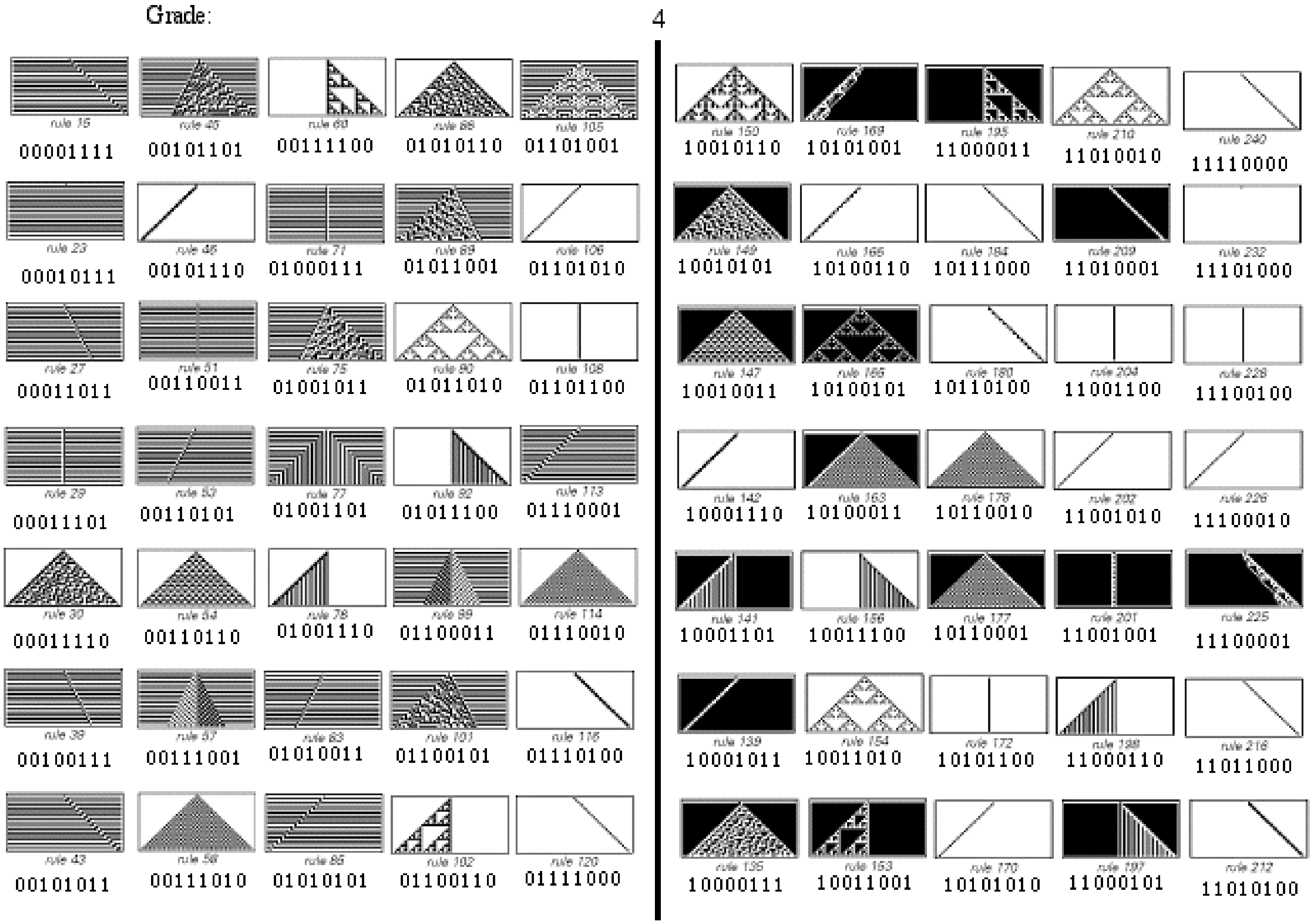
Here are all 56 rules for each of grades 3 and 5.



Note that:

- the 56 rules correspond to the 56-dimensional representation of [the exceptional Lie algebra E7](), which in turn is related to [27-dimensional M-theory]() and [strings, branes, and the standard model]().

Here are all 35+35 = 70 rules for grade 4.



Note that:

- grade 4 is self-dual, has some rules with chaotic patterns, and may be related to quantum game theory. For example, grade 4 includes rule 30 = 00011110, which is the first rule to include 16, 8, 4, and 2, and is the first rule with triangular chaotic behavior. Grade 4 is also related to the Spinors and Primitive Idempotents of Cl(0,8).

Here is a numerical (no pictures) list of all 256, with grade indicated:

```
Grade: 0          1          2          3          4          5          6          7          8

000 00000000
001           00000001
002           00000010
```

003		00000011			
004	00000100				
005		00000101			
006		00000110			
007			00000111		
008	00001000				
009		00001001			
010			00001010		
011			00001011		
012		00001100			
013			00001101		
014			00001110		
015				00001111	
016	00010000				
017		00010001			
018		00010010			
019			00010011		
020		00010100			
021			00010101		
022			00010110		
023				00010111	
024		00011000			
025			00011001		
026			00011010		
027				00011011	
028			00011100		
029				00011101	
030				00011110	
031					00011111
032	00100000				
033		00100001			
034		00100010			
035			00100011		
036		00100100			
037			00100101		
038			00100110		
039				00100111	
040		00101000			
041			00101001		
042			00101010		
043				00101011	
044			00101100		
045				00101101	
046				00101110	
047					00101111
048		00110000			
049			00110001		
050			00110010		
051				00110011	
052			00110100		
053				00110101	
054				00110110	
055					00110111
056			00111000		
057				00111001	
058				00111010	
059					00111011
060				00111100	
061					00111101
062					00111110

063						00111111
064	01000000					
065		01000001				
066		01000010				
067			01000011			
068		01000100				
069			01000101			
070			01000110			
071				01000111		
072		01001000				
073			01001001			
074		01001010				
075				01001011		
076			01001100			
077				01001101		
078				01001110		
079					01001111	
080		01010000				
081			01010001			
082			01010010			
083				01010011		
084			01010100			
085				01010101		
086				01010110		
087					01010111	
088			01011000			
089				01011001		
090				01011010		
091					01011011	
092				01011100		
093					01011101	
094					01011110	
095						01011111
096		01100000				
097			01100001			
098			01100010			
099				01100011		
100			01100100			
101				01100101		
102				01100110		
103					01100111	
104			01101000			
105				01101001		
106				01101010		
107					01101011	
108				01101100		
109					01101101	
110					01101110	
111						01101111
112			01110000			
113				01110001		
114				01110010		
115					01110011	
116				01110100		
117					01110101	
118					01110110	
119						01110111
120				01111000		
121					01111001	
122					01111010	

123							01111011		
124						01111100			
125							01111101		
126							01111110		
127								01111111	
128		10000000							
129			10000001						
130			10000010						
131				10000011					
132			10000100						
133				10000101					
134				10000110					
135					10000111				
136			10001000						
137				10001001					
138				10001010					
139					10001011				
140				10001100					
141					10001101				
142					10001110				
143						10001111			
144			10010000						
145				10010001					
146				10010010					
147					10010011				
148				10010100					
149					10010101				
150					10010110				
151						10010111			
152				10011000					
153					10011001				
154					10011010				
155						10011011			
156					10011100				
157						10011101			
158						10011110			
159							10011111		
160			10100000						
161				10100001					
162				10100010					
163					10100011				
164				10100100					
165					10100101				
166					10100110				
167						10100111			
168				10101000					
169					10101001				
170					10101010				
171						10101011			
172					10101100				
173						10101101			
174						10101110			
175							10101111		
176				10110000					
177					10110001				
178					10110010				
179						10110011			
180					10110100				
181						10110101			
182						10110110			

183							10110111		
184					10111000				
185						10111001			
186						10111010			
187							10111011		
188						10111100			
189							10111101		
190							10111110		
191								10111111	
192			11000000						
193				11000001					
194				11000010					
195					11000011				
196				11000100					
197					11000101				
198					11000110				
199						11000111			
200				11001000					
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215							11010111		
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222							11011110		
223								11011111	
224				11100000					
225					11100001				
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233						11101001			
234						11101010			
235							11101011		
236						11101100			
237							11101101		
238							11101110		
239								11101111	
240					11110000				
241						11110001			
242						11110010			

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243                                                              11110011
244                                                    11110100
245                                                              11110101
246                                                              11110110
247                                                                        11110111
248                                                    11111000
249                                                              11111001
250                                                              11111010
251                                                                        11111011
252                                                              11111100
253                                                                        11111101
254                                                                        11111110
255                                                                                  11111111
```

Frank D. (Tony) Smith, Jr. - May 2004 (June 2004 correction to SU(3) diagram suggested by Michael Gibbs)

Tony Smith's Home Page - Here is some more about Cellular Automata.

......

Tony Smith's Home Page

Primitive Idempotents for Cl(8) Clifford Algebra

Ian Porteous, in Lecture 2: Mathematical Structure of Clifford Algebras, presented at "Lecture Series on Clifford Algebras and their Applications", May 18 and 19, 2002, as part of the 6th International Conference on Clifford Algebras and their Applications in Mathematical Physics, Cookeville, TN, May 20-25, 2002, said:

> "... the Clifford algebra ... Cl(p,q) ...[is]... the real algebra of endomorphisms of a right A-linear space of the form A^m, where A = R, C, H, 2^R or 2^H. This space is called the (real) **spinor** space or space of (real) spinors of the orthogonal space R(p,q). It is identifiable with a minimal left ideal of the algebra, namely the space of matrices with ever column except the first non-zero. However as a minimal left ideal it is non-unique. ...
>
> **Minimal left ideals of a matrix algebra are generated by primitive idempotents**. An idempotent of an algebra is an element y such that y^2 = y. It is primitive if it cannot be expressed as the sum of two idempotents, whose product is zero. The simplest example in a matrix algebra is **the matrix consisting entirely of zeros, except for a single entry of 1 somewhere in the main diagonal**. The minimal ideal generated by such an idempotent then consists of matrices all of whose columns are zero except one consist of zeros. The easiest idempotents to construct are of the form (1/2)(1 + x) where x^2 = 1, but not x^2 = › 1. Then of course (1/2)(1 - x) is also an idempotent, so that spinor spaces constructed in this way come naturally in pairs. However these are not necessarily primitive. They are where the matix algebra consists of 2x2 matrices over R, C or H, but in the case of 4x4 matrix algebras the primitive idempotents are products of commuting pairs of such idempotents.
>
> Though as minimal left ideals of matrix algebras any two spinor spaces are equivalent, they may lie differently when the Clifford algebra structure of the matrix algebra is taken into account ...".

Bilge, Dereli, and Kocak, in their paper "The geometry of self-dual two-forms", J. Math. Phys. 38 (1997) 4804-4814, say in their abstract:

> "... We show that self-dual two-forms in 2n-dimensional spaces determine a n^2 &endash;

n + 1 -dimensional manifold S_2n and the dimension of the maximal linear subspaces of S_2n is equal to

the (Radon&endash;Hurwitz) number of linearly independent vector fields on the sphere S^(2n &endash; 1).

We provide a direct proof that for n odd S_2n has only one-dimensional linear submanifolds. We exhibit 2^c &endash; 1-dimensional subspaces in dimensions which are multiples of 2^c, for c=1,2,3. In particular, we demonstrate that **the seven-dimensional linear subspaces of S_8 also include among many other interesting classes of self-dual two-forms**, the self-dual two-forms of Corrigan, Devchand, Fairlie, and Nuyts [Nucl. Phys. B 214, 452 (1983)] and a representation of Cl_7 given by octonionic multiplication. We discuss the relation of the linear subspaces with the representations of Clifford algebras. ...".

Pertti Lounesto, in his book Clifford Algebras and Spinors (Second Edition, LMS 286, Cambridge 2001) says at pages 226-227 and 29:

"... **Primitive idempotents and minimal left ideals**

An orthonormal basis of of R(p,q) induces a basis of Cl(p,q), called the standard basis. Take a non-scalar element e_T, e_T^2 = 1, from the standard basis of Cl(p,q). Set e = (1/2)(1 + e_T) and f = (1/2)(1 - e_T), then e + f = 1 and ef = fe = 0. So Cl(p,q) decomposes into a sum of two left ideals

Cl(p,q) =Cl(p,q) e + Cl(p,q) f ,

where dim Cl(p,q) e = dim Cl(p,q) f = [dim] (1/2) Cl(p,q) = 2^(n-1) [for n = p + q]. Furthermore, if { e_T_1 , e_T_2 , ... , e_T_k } is a set of non-scalar basis elements such that e_T_i^2 = 1 and e_T_i e_T_j = e_T_j e_T_i , then **letting the signs vary independently in the product**

(1/2)(1 +/- e_T _1) (1/2)(1 +/- e_T_2) ... (1/2)(1 +/- e_T_k) ,

one obtains 2^k idempotents which are mutually annihilating and sum up to 1. The Clifford algebra Cl(p,q) is thus decomposed into a direct sum of 2^k left ideals, and by construction, **each left ideal has dimension 2^(n - k)** . In this way one obtains a minimal left ideal by forming a maximal product of non-annilating and commuting idempotents.

The Radon-Hurwitz number r_i for i in Z is given by

```
i     0  1  2  3  4  5  6  7
r_i   0  1  2  2  3  3  3  3
```

and the recursion formula r_(i + 8) = r_ i + 4 . For the negative values of i one may observe that r_(-1) = -1 and r_(-i) = 1 - i + r_(i + 2) for i > 1 .

Theorem. In the standard basis of Cl(p,q) there are always k = q - r_(q - p) non-scalar elements e_T_i , e_T_i^2 = 1 , which commute, e_T_i e_T_j = e_T_j e_T_i , and generate a group of order 2^k . The product of the corresponding mutually non-annihilating idempotents,

f = (1/2)(1 +/- e_T _1) (1/2)(1 +/- e_T_2) ... (1/2)(1 +/- e_T_k) ,

is primitive in Cl(p,q). Thus, the left ideal S = Cl(p,q) f is minimal in Cl(p,q).

Example ... In the case of R(0,7) we have k = 7 - r_7 = 4. Therefore the idempotent

f = (1/2)(1 + e_124) (1/2)(1 + e_235) (1/2)(1 + e_346) (1/2)(1 + e_457)

is primitive to Cl(0,7) = 2^Mat(8,R). ...

... If e and f are commuting idempotents of a ring R, then e f and e + f - e f are also idempotents of R. The idempotents e f and e + f - e f are a greatest lower bound and a least upper bound relative to the partial ordering given by

e ≤ f if and only if ef = fe = e

A set of commuting idempotents induces a lattice of idempotents. ...

...

... The Clifford algebra ... has three involutions similar to complex conjugation in C. ... The grade involution is an automorphism ... while the reversion and the Clifford-conjugation are anti-automorphisms ...".

Pertti Lounesto, in his book Spinor Valued Regular Functions in Hypercomplex Analysis (Report-HTKK-MAT-A154 (1979) Helsinki University of Technology) says [in the quote below I have changed his notation for a Clifford algebra from R_(p,q) to Cl(p,q)] at pages 40-42:

"... To fix a minimal left ideal V of Cl(p,q) we can choose a primitive idempotent f of Cl(p,q) so that V = Cl(p,q) f . By means of an orthonormal basis { e_1 , e_2 , ... , e_n } for [the grade-1 vector part of Cl(p,q)] Cl^1(p,q) we can construct a primitive idempotent f as follows: Recall that the 2^n elements

e_A = e_a_1 e_a_2 ... e_a_k , 1 ≤ a_1 < a_2 < ... < s_k ≤ n

constitute a basis for Cl(p,q). ... dim_R V = 2^X , where X = h or X = h + 1 according as p › q = 0, 1, 2 mod 8 or p - q = 3, 4, 5, 6, 7 mod 8 and h = [n / 2] . Select n - X elements e_A, e_A^2 = 1 , so they are pairwise commuting and generate a group of order 2^(n - X) . then the idempotent ...

f = (1/2)(1 + e_A_1) (1/2)(1 + e_A_2) ... (1/2)(1 + e_A_(n - X))

is primitive ... To prove this note that the dimension of (1/2)(1 + e_A) Cl(p,q) is (2^n) / 2 and so the dimension of Cl(p,q) f is (2^n) / (2^(n - X)) = 2^X . Hence, if there exists such an idempotent f , then f is primitive. To porove that such an idempotent f exists in every Clifford algebra Cl(p,q) we may first check the lower dimensional cases and then proceed by making use of the isomorphism Cl(p,q) x Cl(0,8) = Cl(p, q + 8) and the fact that **Cl(0,8) has a primitive idempotent**

f = (1/2)(1 + e_1248) (1/2)(1 + e_2358) (1/2)(1 + e_3468) (1/2)(1 + e_4578) =

=(1/16)(1 + e_1248 + e_2358 + e_3468 + e_4578 + e_5618 + e_6728 + e_7138 - e_3567 › e_4671 - e_5712 - e_6123 - e_7234 - e_1345 - e_2456 + e_J)

with four factors [and where J = 12345678] ...

The division ring F = f Cl(p,q) f = { PSI in V | PSI f = f PSI } is isomorphic to R, C, or H according as p - q = 0, 1, 2, mod 8, p - q = 3 mod 4, or p - q = 4, 5, 6 mod 8. The map ...

V x F -> V , (PSI, /\ ) -> PSI /\

defines a right F-linear structure on V. Provided with this right F-linear structure the minimal left ideal V of Cl(p,q) will be called the pinor module. Similarly, beginning with a minimal left ideal of the even subalgebra Cl(p,q)^(0) we obtain the **spinor** module. ...

... take a left ideal W = V or W = V + V' , where V' = { PSI' | PSI in V } , according as Cl(p,q) is simple or a direct sum of two simple ideals (1/2) (1 +/- e_J) Cl(p,q) . Take an idempotent e = f or e = f + f' , respectively.

The ring E = e Cl(p,q) e = { PSI in W | PSI e = e PSI } is E = F or E = F + F', according as Cl(p,q) is simple or a direct sum of two simple ideals (1/2) (1 +/- e_J) Cl(p,q) . The ring E is isomorphic to R, C, H, 2^H, or 2^R . The map ...

W x E -> W , (PSI, /\ ) -> PSI /\

defines a right E-linear structure on W. Provided with this right E-linear structure the left ideal W of Cl(p,q) will be called the binor module.

Let B be either of the anti-involutions B+ or B- of Cl(p,q) . The real linear spaces

P+ = { PSI in V | B(PSI) = +PSI }

P- = { PSI in V | B(PSI) = -PSI }

have dimensions 0, 1, 2, or 3 and

P = P+ + P- = { PSI in V | B(PSI) in V }

has dimension 0, 1, 2, 3, or 4 no matter how large is the dimension of V. To prove this we may use the facts that Cl(p,q) x Cl(0,8) = Cl(p, q + 8) and for Cl(0,8) the real dimension of P = P+ is 1. The real linear space B = { PSI in W | B(PSI) in W } has dimension 1, 2, 4, or 8. ...".

To paraphrase Pertti Lounesto:

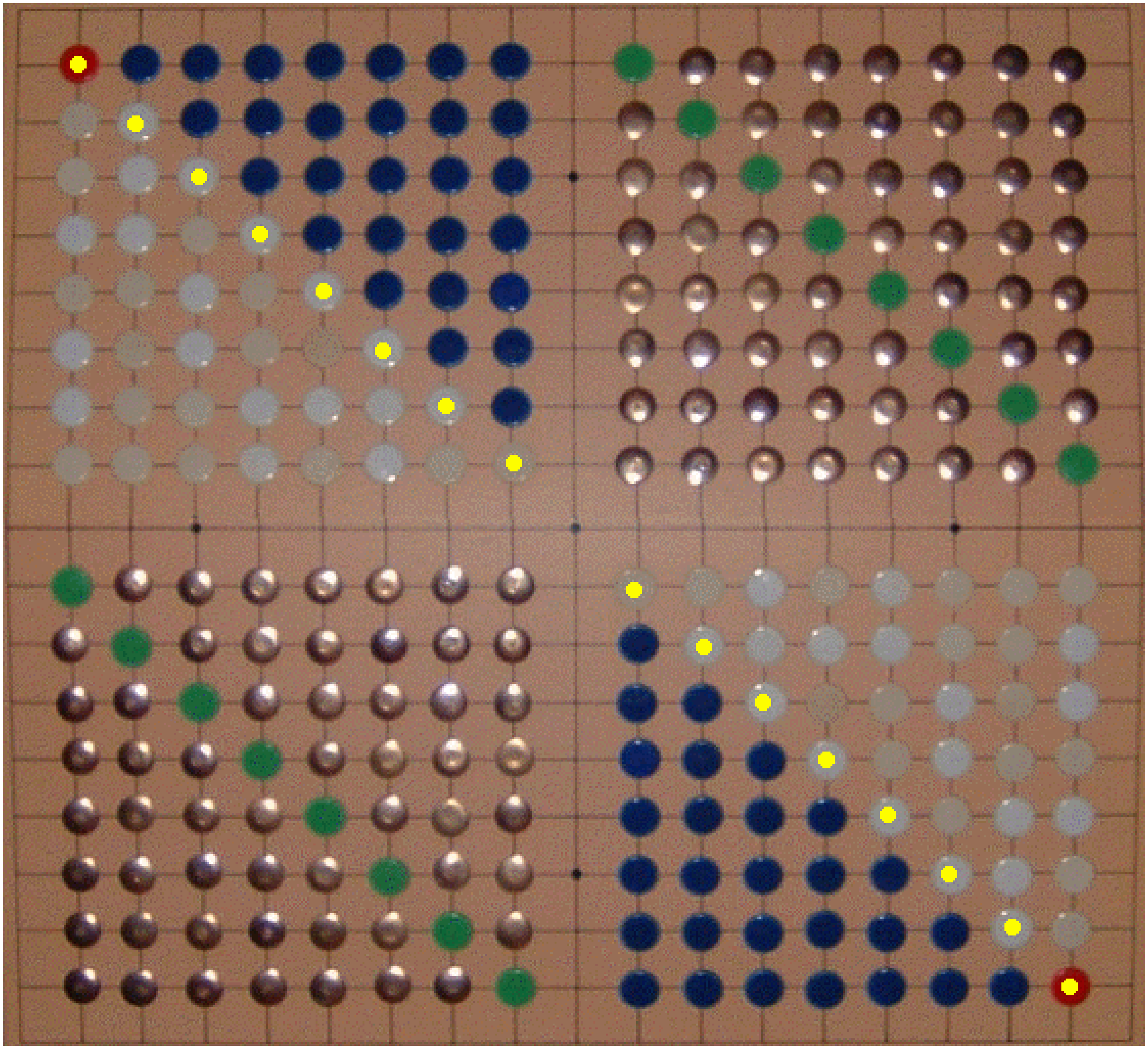
In the case of Cl(0,8) we have k = 8 - r_8 = 8 - 4 = 4. Therefore **Cl(0,8) has a primitive idempotent**

f = (1/2)(1 + e_1248) (1/2)(1 + e_2358) (1/2)(1 + e_3468) (1/2)(1 + e_4578)

By letting the signs vary independently in the product we get a set of 2^4 = 16 idempotents.

Consider the graded structure of the 256 elements of Cl(0,8) = Cl(1,7). In the image below, there are:

- 1 + 1 = 2 red scalar and its dual;
- 8 + 8 = 16 green vectors and their duals;
- 28 + 28 = 56 blue bivectors and their duals;
- 56+56 = 112 gold trivectors and their duals; and
- 35 + 35 = 70 white middle-grade 4-vectors, the set of which is self-dual.

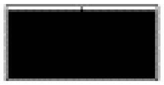


The 1 + 7 + 7 + 1 = 16 diagonal elements (marked in yellow - 2 scalars and 14 4-vectors) correspond to the 16 terms in the primitive idempotent

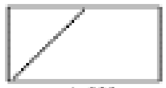
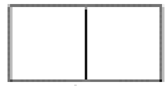
f = (1/2)(1 + e_1248) (1/2)(1 + e_2358) (1/2)(1 + e_3468) (1/2)(1 + e_4578) =

=(1/16)(1 + e_1248 + e_2358 + e_3468 + e_4578 + e_5618 + e_6728 + e_7138 - e_3567 ‐ e_4671 - e_5712 - e_6123 - e_7234 - e_1345 - e_2456 + e_J)

Note that the 16 terms in the primitive idempotent correspond to 16 of [Wolfram’s 256 Cellular Automata](#):


rule 255

- + e_12345678 11111111


rule 226

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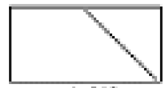
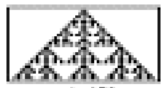

rule 216

- + e_6728 + e_3468 + e_4578 to 11100010 10101100 11011000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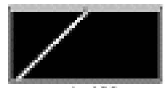
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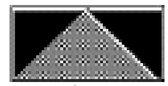
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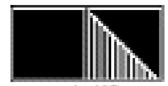
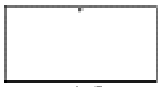
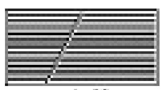
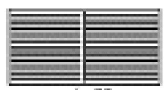
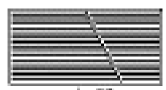

rule 197

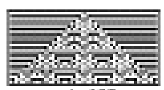
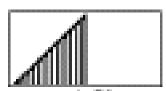
- + e_2358 + e_1248 + e_5618 + e_7138 10010110 10001011 10110001 11000101


rule 0

- + 1 to 00000000


rule 83

rule 29

rule 39

- - e_5712 - e_1345 - e_6123 01010011 00011101 00100111


rule 105

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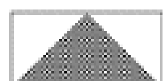
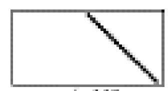
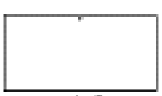

rule 58

rule 116

- - e_4671 - e_7234 - e_2456 - e_3567 01101001 01001110 00111010 01110100

Note the Cl(0,8) = Cl(1,7) triality correspondences among:

- the 8 [+half-spinors](#)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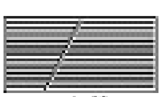
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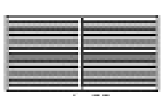
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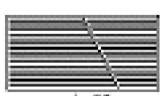
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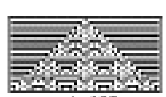
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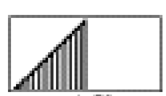
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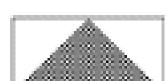
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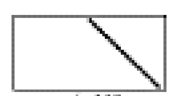
rule 116
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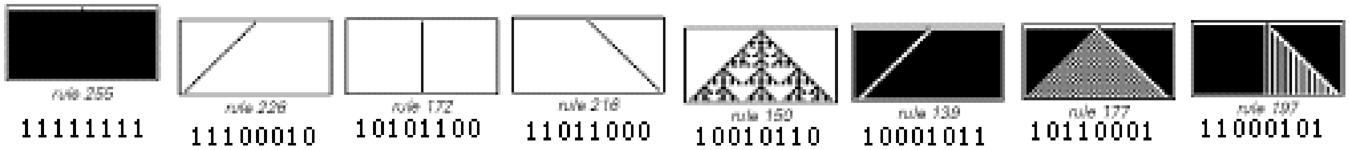
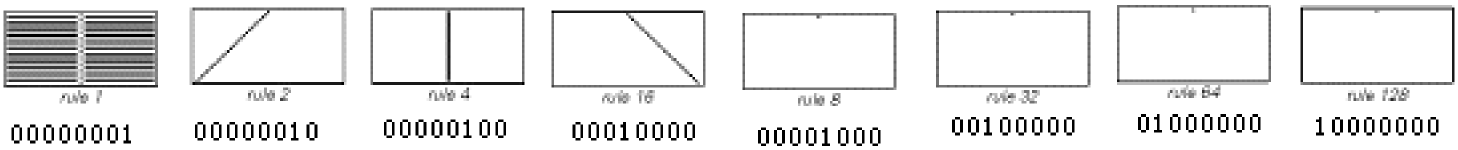
- the 8 [-half-spinors](#)



- the 8 vectors



With respect to Cellular Automata:

Michael Gibbs has been working on using Cellular Automata as neural network nodes, and Robert de Marrais has written a Box-Kites III paper (at math/0403113), leading me to think of some questions:

- Could 16x16 structures such as switching yards of Box-Kites III have structures corresponding to the graded structure o the Clifford algebra Cl(8) that is the 16x16 real matrix algebra?
- Since the vectors of the Cl(8) Clifford algebra are 8-dimensional and correspond to the octonions, if you take the correspondences between the 256 Wolfram CA and the Cl(8) basis elements described here, there is a correspondence:

CA Rule No.	Octonion Basis Element
1	1
2	i
4	j
16	k
8	E
32	I
64	J
128	K

- Could such a correspondence be used to construct such things as "Box-Kites" whose vertices might be regared, not just as octonions etc, but also as Cellular Automata?
- Could Box-Kite type structures give useful computational structures if the vertices were considered as CA and the edge-flow-orinetations were considered as information flow in a computing system?
- If such a computing system can be set up for 2^n-ionic structures for large n, then, since for 16› ions and larger you have interesting zero-divisor "sleeper-cell" substructures, could they be useful

with respect to computational systems, perhaps doing things like forming loops that might let the computational system to "adjust itself" and/or "teach itself"?

Robert de Marrais commented on some of those questions, saying in part:

"... I'm finding two directions to go with box-kites next, and yes, cellular automata clearly are part of it. I did a poster session at Wolfram's [2004 NKS] conference, had a long talk with him and another fellow, one Rodrigo Obando ... My poster session is currently being written up for incorporation in the conference proceedings, after which it goes out to arXiv.org -- and will have (or so I hope!) some nifty graphics for higher-dimensional cases. ... But now to the two directions, which relate to your suggestions:

(1) Boolean monotone and antitone function-pairings can be used, per Rodrigo Obando, to generate exactly all and only the complex cellular automata for a given n and r . . . and, given that for n=4 that means Dedekind's number of 168 mono- and iso- tone functions each, connections to box-kites immediately suggest themselves ... He tells me his work is leading him not merely to isolate and catalog the "complex" CA's for high n and r, but that he's finding -- when he generalizes to the n => infinity situation, that he gets violations of the continuum hypothesis ...

(2): spin networks. The key revelation (which I telescoped on the last couple pages of "Box Kites III") concerns what I call the "trip-sync property." As it turns out, this is incredibly easy to prove, for all box-kites in all dimensions. ... what is truly interesting is this: zero-divisor systems are, ironically, PRESERVERS of associative order! Specifically, each of the four "sails" on a box-kite can be represented (on an isomorphic box-kite diagram, in fact!) as a system of four interconnected Quaternion copies: write each vertex as a pairing of one uppercase and one lowercase letter (with the 'generator' of the given 2^n-ions being the divider of the two: e.g., with the Sedenions, g = the index-8 imaginary, and the pure Sedenions of index > 8 are "uppercase," with the Octonions thereby being written with "lowercase" letters). Using the standard notation in my "strut tables," the "triple-zigzag sail" has vertices (A + a), (B + b), (C + c). Since it's a triple zigzag, this means all the edge-signs are negative: hence, if one takes the diagonal "/" in the (A, a) plane, it will zero-divide the diagonal slanting like "\" in either the (B, b) or (C, c) planes. Now consider that there are 4 associative triplets here: (a, b, c); (a, B, C); (A, b, C); and, (A, B, c). Now, allow for "slippage" of the following sort: orbitings among (a, b, c) can be imagined to "slip" into one of the other 3 by keeping one of the lowercases unchanged, but allowing the other two to form "resonances" with the generator (the XOR of two uppercase is, of course, a lowercase). The trip-sync property says this: IF the "sail" is the triple zigzag, all such slippage can occur without any "flips" in orientation; however, IF the "sail" is one of the other three "trefoil" sails, then ONLY slippage with the lowercase being one of the triple zigzag's trio will preserve orientation. Importantly, this gives a way to envision "observable" and "unobservable" in a quantum mechanical manner: orientation REVERSAL will be observable, and the isomorphism of quaternion algebra to SU2 gives you (recall my graphics toward the end of the first Box-Kite paper vis a vis Catastrophe Theory?) two orthogonal circles whose centers are the "units" of two lines of diagonal idempotents (which, like the diagonals in the boxkite vertex-planes, are ALSO zero-dividers -- but only with each other!!). That is, the 4 axes in the SU2 representation are reals, the usual imaginaries, Pauli spin-matrix "mirror numbers" which square to +1, and a "commutative i" which commutes between these latter two. (This is both Cl(2) in Clifford algebra lingo, and Muses' simplest epsilon-number space.) But then, the centers of the two orthogonal circles are just the projection operators -- 1/2(1 +/- m), m the Pauli "mirror axis" unit. As systems of box-kites get very entangled in higher dimensions (in 32-D, you have systems of 7 of them forming what I call Pleiades, with some fascinating synergetic properties), spin-foams with self-organizing potential suggest themselves . . .

Now, (1) and (2) are BOTH related to my ultimate objective, which is not physics per se, but rather Levi-Strauss's canonical law of myths, and the creation of an infinite-dimensional "collage space" that can accommodate his systems of mythopoetic sign-shunting in a manner roughly reminiscent of Fourier series' infinite-dimensional backdrop for generalized harmonics. So that means I'll be busy with my hobbyhorse at least through "Box-Kites VI"!

The key notion here is that each sail can be seen as an ensemble of 5 Quaternion copies (the 4 associative triplets each are completed by the real unit, and the "sterile" zero-divisor› free triplet of generator, strut constant, and their XOR makes 5). Viewing things in closest-packing-pattern style, we have 5 interacting "unit quaternion" algebras -- with the interactions entailing (1, u), where 'u' is the shared non-real unit. Interestingly, this gives a nice way to think about the Tibetan Book of the Dead's "58 angry demons and 42 happy Buddhas," 100 in all = 5 * 16 + 2*10 = 100 distinct units in the interlinked 5-fold "unit quaternion" ensemble. So one first sees the "42 Assessors," then zooms in one one of the 7 isomorphic box-kites (which, as with all isomorphies, can be seen as identical at some higher level); then, one zooms in further on the "second box-kite" which has its struts defined by upper vs. lower case letters, and the triple zigzag analog being the "all lowercase" sail. ... I've also just purchased a domain name -- "TheoryOfZero.com" -- where I'll start building a site as soon as time permits. ... All these threads are getting ever more entangled and intriguing, aren't they? ...".

Tony Smith's Home Page

......

Tony Smith's Home Page

Clifford Tensor Product Universe

- Ulam Spiral
- Moore and Hilbert Curves
- Gray Codes
- von Neumann algebras

The beginning of our physical universe may be described by a D4-D5-E6-E7-E8 VoDou Physics model generalization (related to loopoids) of the **von Neumann hyperfinite II1** Clifford tensor product

... x Cl x Cl x Cl x Cl x Cl x Cl x Cl x ...

where Cl = Mat2(C) to a similar structure with Cl = Mat16(R).

- Begin by considering the Clifford tensor product as a linear chain of Cl's.
- Consider each Cl in the linear chain as a node in a linear pregeometry.
- Let the linear pregeometry, like a long line of yarn, "fold" or "weave" it into a higher-dimensional "array" or "tapestry" of Cl's.
- Prior to the folding/weaving, each Cl node in the linear pregeometry would have 2 nearest neighbors in the chain

  ... Cl--Cl--Cl--Cl--Cl--Cl--Cl ...

  that corresponds to the 1-dim lattice of Natural Numbers.

- After the folding/weaving, each Cl pregeometry node in the tapestry could have more nearest neighbors. For an oversimpified visualization, consider each Cl pregeometry node as having 4 "arms" or "hooks" corresponding to { -x, +x, -t, +t } (i.e., this oversimplification is sort of like Cl(2,R) for which the 4 arms/hooks of each Cl would correspond to + and - in the Cl(2,R) 2-dimensional vector space), so, for the purpose of this visualization, denote each Cl pregeometry node by the 4-armed symbol + to get the linear chain

  ```
  ... +--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+--+-- ...
  ```

  which might be folded/woven roughly as follows:

```
... +--+--+--+--+--+--+--+--+
                            |
                            +--+--+--+--+--+--+--+--+--+--  ...
```

```
... +--+--+--+--+--+--+--+--+--+
                               |
... +--+--+--+--+--+--+--+--+  +
                            |  |
                            +--+
```

```
                      +--+--+--+
                      |        |
                      +  +--+  +
                      |  |  |  |
                      +  +  +--+
                      |  |
                      +  +--+--+--+--+--+--+--+--+--+--+--  ...
                      |
                      +--+--+--+--+--+--+--+--+--+--+--+--  ...
```

- After formation of natural nearest-neighbor-connections among the folded/woven pregeometry nodes, then you might get:

```
... +--+--+--+--+--+--+--+--+
                            |
                            +--+--+--+--+--+--+--+--+--+--  ...
```

```
... +--+--+--+--+--+--+--+--+--+
    |  |  |  |  |  |  |  |  |  |
... +--+--+--+--+--+--+--+--+--+
                            |  |
                            +--+
```

+--+--+--+

```
|  |  |  |
+--+--+--+
|  |  |  |
+--+--+--+
|  |  |  |
+--+--+--+--+--+--+--+--+--+--+--+--  ...
|  |  |  |  |  |  |  |  |  |  |  |
+--+--+--+--+--+--+--+--+--+--+--+--  ...
```

> If you continue that pattern of folding/weaving indefinitely in a natural way, you might end up with a 2-dim square lattice that could be taken to be an Ising model, or, equivalently, a Feynman checkerboard for the 2-dim Dirac equation. (That equivalence has been shown by Hal Gersch (Int. J. Theor. Phys. 20 (1981) 491).)

Note that in the case of the example show above where each vertex neighborhood + looks in the continuum limit like a unit disk of the complex plane, all the vertex neighborhoods are the same, and the total 2-dim lattice space looks in the continuum limit like a big complex plane with its unique differential structure,

while in the case of each vertex neighborhood + looking like an E8 lattice (in the continuum limit like the 8-dimensional vector space of the Cl(8,R) = Mat16(R)) there can be 7 different kinds of vertex neighborhoods, corresponding to the 7 different E8 latttices. Further, if in the continuum limit the boundary of each vertex neighborhood looks like a 7-sphere S7, then, since each S7 can have 28 different differential structures, the total 8-dim space can have a very complicated structure, whether viewed as a lattice (with varying types of E8 neighborhoods) or in the continuum limit (as a manifold with complicated Riemannian structure).

It is interesting that the 2-dimensional weave structure looks a lot like a Ulam spiral.

According to an Abarim web page:

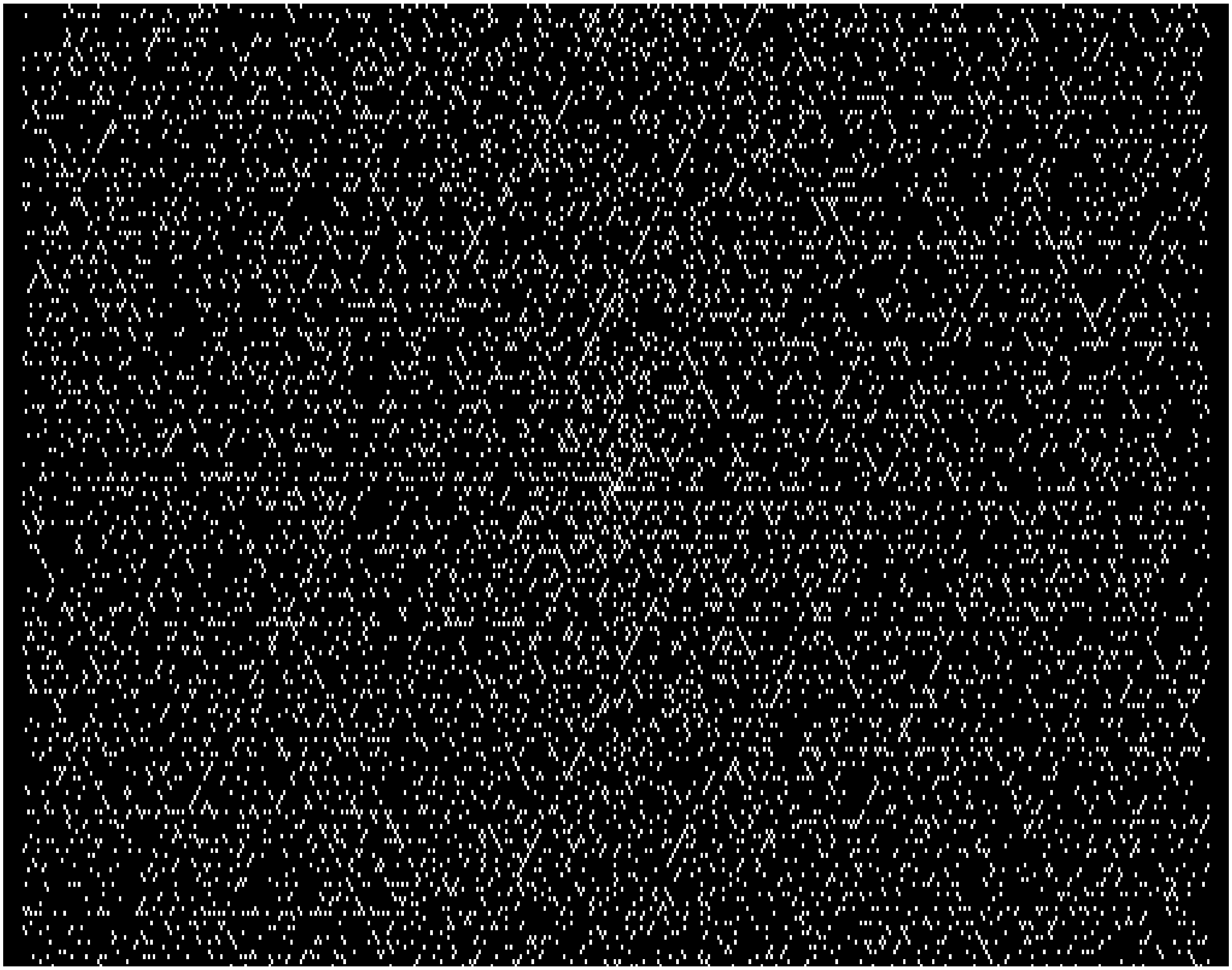
> "... Stanislaw Ulam was attending some boring meeting, and to divert himself somewhat he began to scribble on a piece of paper. ... He put down the number 1 as the bright shining center of a universe of numbers that Big Banged outwardly in a spiral:

73	74	75	76	77	78	79	80	81
72	43	44	45	46	47	48	49	50
71	42	21	22	23	24	25	26	51
70	41	20	7	8	9	10	27	52
69	40	19	6	1	2	11	28	53
68	39	18	5	4	3	12	29	54
67	38	17	16	15	14	13	30	55
66	37	36	35	34	33	32	31	56
65	64	63	62	61	60	59	58	57

> Much to his amazement the prime numbers appeared to gravitate towards diagonal lines emanating from the central 1. ... Most of them sat on or in the vicinity of a diagonal, but

> some obviously didn't. ...".

According to a Prime Number Spiral web page:

> "... Consider a rectangular grid. We start with the central point and arrange the positive integers in a spiral fashion (anticlockwise) as at right. The prime numbers are then marked ... There is a tendency for the prime numbers to form diagonal lines. This can be seen more clearly in the image below,
>
> 
>
> which shows a window onto a square array of 640 x 640 numbers, with the primes marked by white pixels. ...".

According to a M. Watkins web page:

> "... There is currently no explanation for the distinct diagonal lines which appear when the primes are marked out along a particular 'square spiral' path. ...".

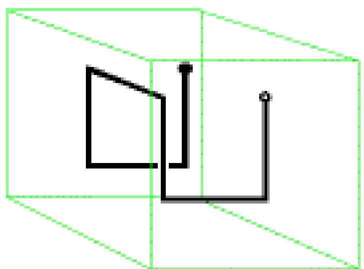
Physically, if the 2-dim weave corresponds to 2-dim spacetime, the diagonal lines would correspond to light-cone correlations of points of spacetime.

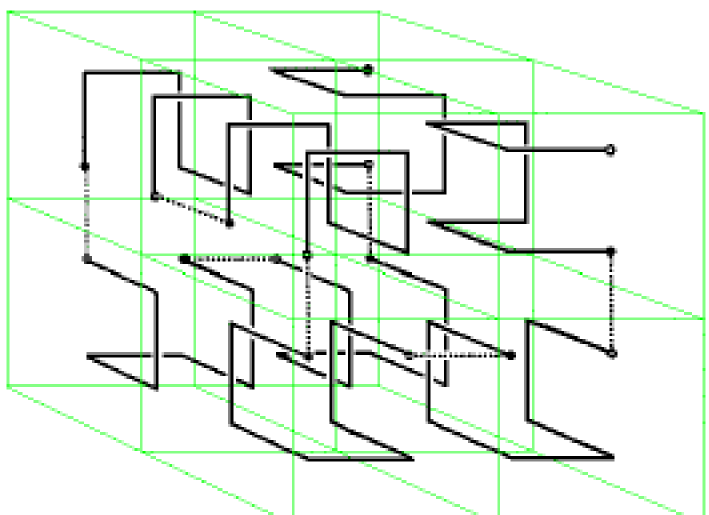
In dimensions greater than 2, the weaving should produce something like a Moore space-filling curve. Acccording to a web page of V. B. Balayoghan:

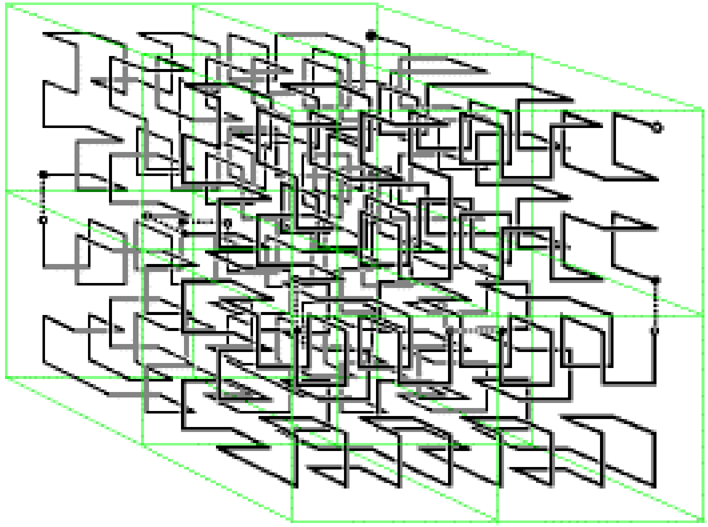
> "... The Hilbert and Moore curves use square cells -- the level n curve has 4^n cells (and hence 4^n - 1 lines). The Moore curve has the same recursive structure as the Hilbert curve, but ends one cell away from where it started. The Hilbert curve starts and ends at opposite ends of a side of the unit square. ...".

According to a web page by William Gilbert:

> "... We exhibit a direct generalization of Hilbert's curve that fills a cube. The first three iterates of this curve are shown.







> In constructing one iterate from the previous one, note that the direction of the curve determines the orientation of the smaller cubes inside the larger one.
>
> The initial stage of this three dimensional curve can be considered as coming from the 3-bit reflected Gray code which traverses the 3-digit binary strings in such a way that each string differs from its predecessor in a single position by the addition or subtraction of 1. The kth iterate could be considered a a generalized Gray code on the Cartesian product set {0,1,2,...,2^k-1}^3.
>
> The n-bit reflected binary Gray code will describe a path on the edges of an n-dimensional cube that can be used as the initial stage of a Hilbert curve that will fill an n-dimensional cube. ...".

According to Numerical Recipes in C, by Press, Teukolsky, Vettering, and Flannery (2nd ed, Cambridge 1992):

> "... A Gray code is a function G(i) of the integers i, that for each integer N $\geq$ 0 is one-to-one for 0 $\leq$ i $\leq$ 2^N -1, and that has the following remarkable property: The binary representation of G(i)and G(i+1) differ in exactly one bit. an example of a Gray code ... is the sequence ...[

```
0000 ( 0=0000), 0001 ( 1=0001), 0011 ( 2=0010), 0010 ( 3=0011),

0110 ( 4=0100), 0111 ( 5=0101), 0101 ( 6=0110), 0100 ( 7=0111),

1100 ( 8=1000), 1101 ( 9=1001), 1111 (10=1010), 1110 (11=1011),

1010 (12=1100), 1011 (13=1101), 1001 (14=1110), 1000 (15=1111)
```

]... for i = 0, ... 15. The algorithm for generating this code is simply to form ... XOR of i with 1/2 (integer part). ... G(i) and G(1+1) differ in the bit position of the rightmosst zero bit of i ... Gray codes can be useful when you need to do some task that depends intimatelyu on the bits of i, looping over many values of i. Then, if there are economies in repeating the task for values differing only by one bit, it makes sense to do things in Gray code order rather than consecutive order. ...".

According to some MathWorld web pages:

> "... The binary reflected Gray code is closely related to the solutions of the towers of Hanoi and baguenaudier, as well as to Hamiltonian circuits of hypercube graphs ...[A Hamiltonian Circuit is]... A graph cycle (i.e., closed loop) through a graph that visits each node exactly once ... The number of Hamiltonian circuits on an n-hypercube is 2, 8, 96, 43008, ...".

If you look at a 2-dimensional slice of the n-dimensional Moore curve including the time axis and one spatial axis, you see something like a Ulam Spiral and also like a 2-dimensional Feynman checkerboard.

The Ising model (shown by Hal Gersch (Int. J. Theor. Phys. 20 (1981) 491) to be equivalent to a Feynman checkerboard for the 2-dim Dirac equation) is related to von Neumann algebras:

- Adrian Ocneanu, in his article Quantized Groups, String Algebras and Galois Theory for Algebras, at pages 119-172 in Operator Algebras and Applications, Volume 2, edited by David E. Evans and Masamichi Takesaki (Cambridge 1988), said:
  - "... We introduce a Galois type invariant for the position of s subalgebra inside an algebra, called a paragroup, which has a group-like structure. Paragroups are the natural quantization of (finite) groups. ... harmonic analysis for the paragroup corresponding to the group Z2 is done in the Ising model ...".

  D. B. Abraham, in his article Some Recent Results for the Planar Ising Model, at pages 1-22 in Operator Algebras and Applications, Volume 2, edited by David E. Evans and Masamichi Takesaki (Cambridge 1988), said:

  - "... The planar Ising model has become one of the most important statistical mechanical systems for the study of phase transitions and critical phenomena. ...It is ... the purpose of this article ... to discuss two ... mathematical aspects ... The first ... is the Yang-Baxter system of equations for the planar Ising model in zero field with transfer in the (1,1) direction. This work shows that the Clifford-algebraic structure of the exact solution is a natural consequence of the star-triangle equations. The second item is a Fredholm system which turns out to be of crucial importance in unerstanding surface and interface problems, as well as the pair correlation function. ...".
- There are many possible different ways of folding/weaving, and they might be related to each

other in ways that can be described mathematically by braids. As to braids:

Vaughan F. R. Jones, in his review of the book Quantum symmetries on operator algebras, by D. Evans and Y. Kawahigashi, Oxford Univ. Press, New York, 1998, Bull. (N.S.) Am. Math. Soc., Volume 38, Number 3, Pages 369-377, said:

- "... The "algebraic quantum field theory" of Haag, Kastler and others ... is an attempt to approach quantum field theory by seeing what constraints are imposed on the underlying operator algebras by general physical principles such as relativistic invariance and positivity of the energy. A von Neumann algebra of "localised observables" is postulated for each bounded region of space-time. Causality implies that these von Neumann algebras commute with each other if no physical signal can travel between the regions in which they are localised. The algebras act simultaneously on some Hilbert space which carries a unitary representation of the Poincare (=Lorentz plus 4-d translations) group. The amount of structure that can be deduced from this data is quite remarkable. ... Just as remarkably, more than one type II1 factor (up to isomorphism) was constructed ... and ... uncountably many were shown to exist and the classification of factors is not at all straightforward. That is the bad news.

  Now the good news. A von Neumannn algebra is called hyperfinite if it contains an increasing dense sequence of finite dimensional *-subalgebras ... it was shown that there is **a unique hyperfinite II1 factor**. (It **can be realised as U(G) where G is the group of all finite permutations of [the natural numbers] N** .) ...

  ...The ideal result would be that to each standard invariant there is a unique subfactor of the hyperfinite II1 factor. This is partly true. There is an amenability condition for a subfactor defined in terms of the random walk on the principal graph. For amenable subfactors (in particular finite depth ones) and standard invariants Popa has shown that the ideal result holds true. This is a deep theorem and implies among other things the Connes-Ocneanu classification of actions of discrete amenable groups on the hyperfinite II1 factor ... Outside the amenable world things go wrong in both directions. Using actions of free groups it is easy to construct families of subfactors with the same standard invariant, and an unpublished result of Popa implies that even the simplest case (the "Temperley-Lieb" algebra in planar algebra terminology) is not always obtainable from a hyperfinite subfactor. ...

  ... **Ocneanu has shown that subfactors (of finite index and depth) are equivalent to Topological Quantum Field Theories and so give a wealth of unitary representations of mapping class groups and braid groups**. ...".

The group G of all finite permutations of the natural numbers N can interchange any pregeometry node Cl = Mat16(R) = Cl(8,R) Clifford algebra with any other node on the pregeometry line parameterized by the natural numbers.

Frank Wilczek, in his paper Projective Statistics and Spinors in Hilbert Space, hep-th/9806228, said:

- "... In quantum mechanics, symmetry groups can be realized by projective, as well as by ordinary unitary, representations. **For the permutation symmetry relevant to quantum statistics of N indistinguishable particles, the simplest properly projective representation is highly non-trivial, of dimension 2^{(N-1)/2)$, and is most easily realized starting with spinor geometry**. Quasiparticles in the Pfaffian quantum Hall state realize this representation. Projective statistics is a consistent theoretical possibility in any dimension. ...[A]... very **basic** quantum mechanical **symmetry concerns the interchange, or permutation, of indistinguishable particles**. It is natural to ask whether the permutation symmetry is realized projectively in Nature. The mathematical theory of projective representations of the group SN of permutations of N elementary particles was developed in classic papers by I. Schur ...[in 1907 and 1911]... , prior to the discovery of either modern quantum mechanics or spinors. **The simplest (irreducible) non-trivial projective representations of SN are already surprisingly intricate and have dimensions which grow exponentially with N. They are intimately related to spinor representations of SO(N)** ... For even N = 2p one can construct an irreducible representation of the G [my substitution for capital gamma] matrices of dimension 2^p iteratively ... This is not irreducible for SO(2p) ... By projecting onto the eigenvalues of k = G1 G2 ... G2p we get irreducible spinor representations. k, of course, does not commute with the representatives of the permutation group. But k' = k(G1 - G2 + G3 - G4 ...) does. By projecting onto its eigenvalues, we obtain irreducible (projective) representations of S2p. ... Schur demonstrated that all the non-trivial, irreducible projective representations of SN realize the modified algebra ...[and]... may be classified using Young diagrams, but with the additional restriction that row lengths must be strictly decreasing. In this construction, the spinorial representation constructed above corresponds to a single row, analogous to bosons. ... In recent work on the Pfaffian nu = 1/2 quantum Hall state, it was shown that 2n quasiparticles at fixed positions span a 2^(n-1) dimensional Hilbert space, and that braiding such quasiparticles around one another generated operations closely analogous to spinor representations ... (In addition, there are exp(2 pi i / 8) "anyonic" phase factors.) The concepts explained above allow one to formulate the results in a different way: the exchange of these quasiparticles realizes the simplest projective representation of the symmetric group.

Another perspective on the projective statistics arises from realizing the Clifford algebra in terms of fermion creation and annihilation operators ... we find for the interchange of an odd [2j-1] index particle with the following even [2j] index particle ... is ... simply the operation of changing the occupation of the j th mode. This makes contact with an alternative description of the nu = 1/2 quasiparticles using antisymmetric polynomial wave-functions, which can be considered to label occupation numbers of fermionic states ... Thus projecting to eigenvalues of k amounts to restricting attention to either even or odd mode occupations. This is adequate to get irreducible representations of the rotation group or of the even permutations. If we want to get an irreducible representation of all permutations we must allow both even and odd occupations, with a peculiar global relation between them. **Since the definition of projective statistics refers to interchanges of particles, as opposed to braiding, this concept is not in principle tied to 2+1 dimensional theories**. Also, no violation of the discrete symmetries P, T is implied. ...".

By taking the limit as n goes to infinity of the real-Clifford-periodicity tensor factorization of order 8

Cl(8n,R) = Cl(8,R) x ...(n times tensor)... x Cl(8,R)

the full hyperfinite II1 von Neumann algebra R can be denoted as the real Clifford algebra Cl(infinity,R) whose half-spinors are sqrt(2^(infinity))-dimensional. In other words, since the halfspinors of Cl(2n,R) are 2^(n-1)-dimensional, the dimension of the full spinors grows exponentially with the dimension of the vector space of the Clifford algebra.

Note that, unlike vectors of a Clifford algebra (which define a vector space on which actions take place) and bivectors of a Clifford algebra (which define a Lie algebra of rotations on that vector space),

spinors of a Clifford algebra encode information from all parts of the Clifford algebra (such as the orientation/entanglement relations of spin 1/2 fermions with respect to physical vector spacetime), so that Projective Permutation symmetry of the entire Clifford algebra Cl(infinity,R) of pregeometry nodes Cl(8,R) can be represented by the half-spinors of Cl(infinity, R) which in turn can be represented by the infinite tensor product of 8-dimensional half-spinors of Cl(8,R) = Mat16(R).

- The special dimensions 1,2,4,8 in which there exist real division algebras may contain special folding/weaving configurations that are likely to emerge from pregeometry to physical spacetime geometry, perhaps based on lattices such as:
  - 1-dim linear lattice of Natural Numbers;
  - 2-dim complex Gaussian integer square lattice and/or Eisenstein triangular lattice;
  - 4-dim quaternion "integral" lattice with each vertex having 24 nearest neighbors, combining the symmetries of square and triangular; and
  - 8-dim octonion "integral" E8 lattice, with 7 slightly different versions. Since this is the highest dimension in which a real division algebra lattice can occur, and since its dimensionality coincides with the dimensionality of the vector space of the Mat16(R) = Cl(8,R) Clifford algebra that describes each node in the pregeometry, it is my opinion that 8-dim octonion "integral" E8 lattice is the most likely beginning of our physical universe and that it is described by the D4-D5-E6-E7-E8 VoDou Physics model.

Tony Smith's Home Page

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T-Quark Mass and

Hyperfinite II1 von Neumann factor

Frank D. (Tony) Smith, Jr., Cartersville - July-August 2002, August-October 2003

Abstract:

My theoretical model (which I call the D4-D5-E6-E7-E8 VoDou Physics Model , because it is based on the Lie algebras D4,D5,E6,E7,E8 and on Clifford algebra periodicity related to IFA =VoDou) **meets Einstein's Criterion**:

"... a theorem which at present can not be based upon anything more than upon a faith in the simplicity, i.e., intelligibility, of nature: **there are no arbitrary constants** ... that is to say, nature is so constituted that it is possible logically to lay down such strongly determined laws that within these laws **only rationally completely determined constants occur (not constants, therefore, whose numerical value could be changed without destroying the theory)**. ...".

According to the model, geometry of the Hermitian Symmetric Spaces D5 / D4xU(1) and E6 / D5xU(1) and related Shilov Boundaries, along with combinatorial relations, allows the calculation of ratios of particle masses:

- Me-neutrino = Mmu-neutrino = Mtau-neutrino = 0 (tree-level)
- Me = 0.5110 MeV
- Md = Mu = 312.8 MeV (constituent quark mass)
- Mmu = 104.8 MeV
- Ms = 625 MeV (constituent quark mass)
- Mc = 2.09 GeV (constituent quark mass)
- Mtau = 1.88 GeV
- Mb = 5.63 GeV (constituent quark mass)
- **Mt = 130 GeV (constituent Truth Quark mass)**

and

- W+ mass = W- mass = 80.326 GeV
- Z0 mass = 91.862 GeV
- Higgs mass = 145.8 GeV
- weak force - Higgs VEV = 252.5 GeV (assumed, since ratios are calculated)

as well as ratios of force strength constants:

- Gravitational G = (Ggravity)(Mproton)^2 = 5 x 10^(-39) (assumed, since ratios are calculated)
- **electromagnetic fine structure constant = 1/137.03608**
- Gfermi = (Gweak)(Mproton)^2 = 1.02 x 10^(-5)
- color force strength = 0.6286 (at 0.245 GeV) - perturbative QCD running gives
  - color force strength = 0.167 (at 5.3 GeV)
  - color force strength = 0.121 (at 34 GeV)
  - color force strength = 0.106 (at 91 GeV)
- If Nonperturbative QCD and other things are taken into account, then the color force strength = 0.123 (at 91 GeV)

The theoretical calculated electromagnetic fine structure constant = 1/137.03608 solves **Feynman's mystery** (QED, Princeton 1985, 1988, at page 129): "... **the inverse of ... about 137**.03597 ... [the] square [of] ... the amplitude for a real electron to emit or absorb a real photon ... **has been a mystery** ever since it was discovered more than fifty years ago, and **all good theoretical physicists put this number up on their wall and worry about it**. ...".

The Truth Quark constituent mass (tree-level) calculation of about 130 GeV had been made by February 1984.

About 10 years later, in April 1994, Fermilab officially announced observation of the Truth Quark.

Fermilab's analysis of the events gives a T-quark mass of about 170 GeV.

My independent analysis of the same Fermilab events gives a Truth Quark mass of about 130 GeV, consistent with the theoretical tree-level calculation.

The local Lagrangian of the theoretical model is based on the structure of the real Cl(1,7) Clifford algebra which, through 8-fold periodicity, might be used to construct a Generalized Hyperfinite II1 von Neumann Algebra factor.

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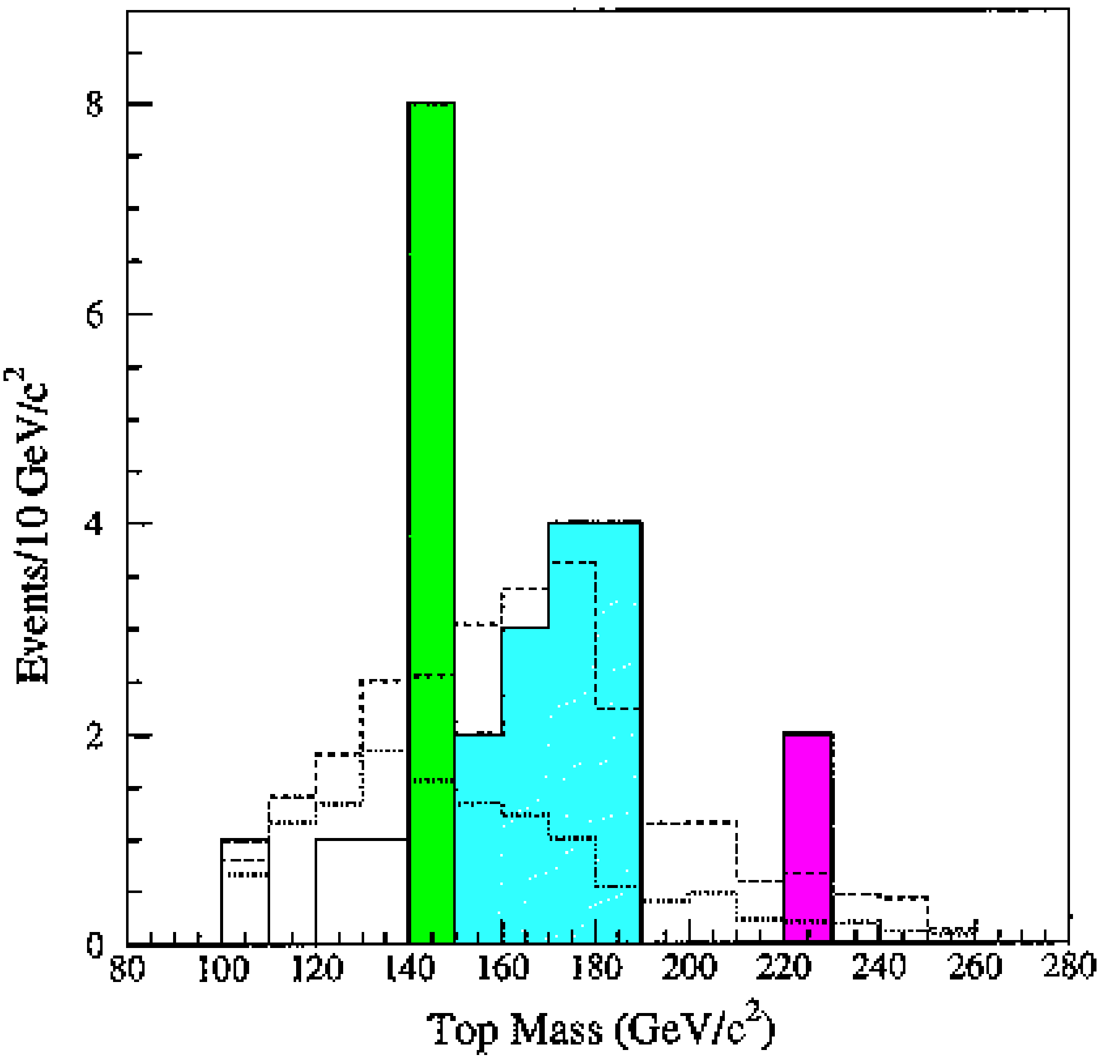
Truth Quark Experimental Results.



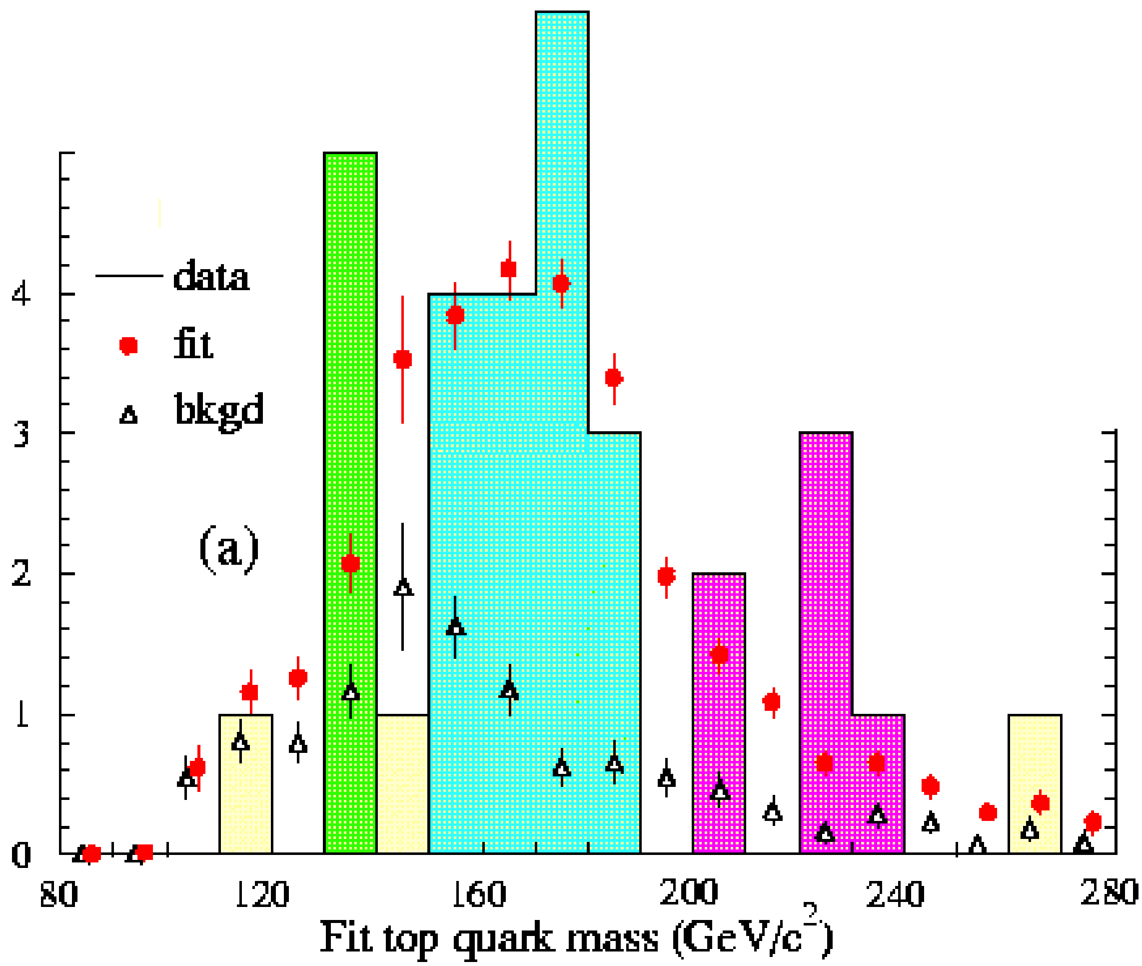
In April 1994, CDF at Fermilab (in FERMILAB-PUB-94/097-E) reported a T-quark mass of 174 (+/› 10)(+13/-12) GeV. The data analyzed by CDF included a 26-event histogram for Semileptonic events with

W + (3 or more) jets, without b-tags, which is Figure 65 of the report. In the histogram, the green bars are in the 140-150 GeV bin, close to the 130 GeV range that is deemed insignificant by Fermilab's analysts, but considered by me to represent the Truth quark; the cyan-blue bars represent bins in the 173 GeV range containing Semileptonic events interpreted by Fermilab as Truth Quarks; and the magenta bars represent bins in the 225 GeV range containing Semileptonic events not considered by Fermilab's analysts or by me as corresponding to either 130 GeV or 173 GeV Truth Quarks.

The peak of 8 events in the 140-150 GeV bin, shown in green, were excluded from the analysis by CDF on the grounds that (see page 140 of the report) "... the bin with masses between 140 and 150 GeV/c^2 has eight events.

We assume the mass combinations in the 140 to 150 GeV/c^2 bin represent a statistical fluctuation since their width is narrower than expected for a top signal. ...".

If the 140-150 GeV peak were only a statistical fluctuation seen by the CDF detector, one would not expect to find such a peak repeated in the data seen by the D0 detector at Fermilab. However, in March 1997, D0 (in hep-ex/9703008) reported a T-quark mass of 173.3 GeV (+/- 5.6 stat +/- 6.2 syst), based on data including a histogram similar to Figure 65 of the April 1994 CDF report which is Figure 3 of the D0 report, to which I have added colors as described above:

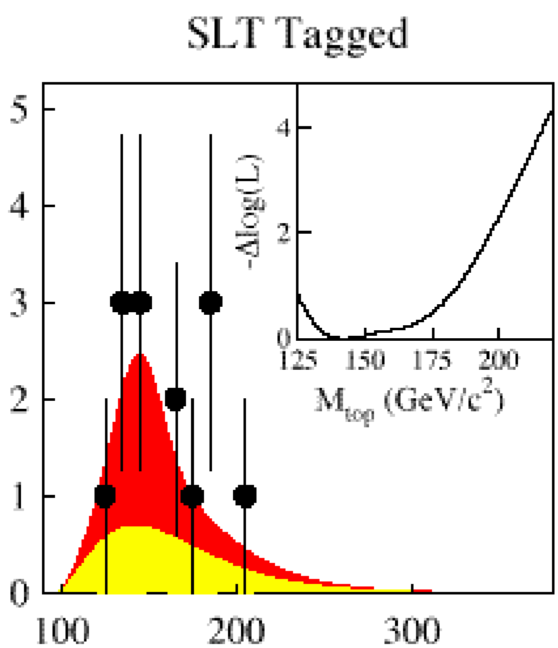


Some of the D0 histogram events, shown in cyan-blue, are are in the 150-190 GeV range and do support the CDF analysis. However, similar to the 140-150 GeV bin peak seen and thrown out by CDF, there is a peak of 5 events in the 130-140 GeV bin, shown in green, that were excluded from the analysis by D0. I did not see in the D0 report an explicit discussion of the 5-event peak in the 130-140 GeV bin.

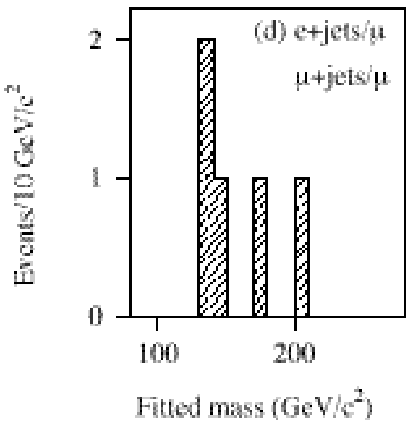
Those 130-150 GeV peaks are from untagged semileptonic events.

Tagged semileptonic events may be a more reliable measure of T-quark mass, although there are fewer of them, so that statistics are not as good.

CDF (in hep-ex/9801014, dated 30 September 1997) reported a T-quark mass of 175.9 +/- 4.8(stat.) +/› 4.9(syst.) GeV based on events that were either SVX tagged, SVX double tagged, or untagged. However, CDF analysis of tagged semileptonic events (14 of them) gave a T-quark Mass of 142 GeV (+33, -14), as shown in their Figure 2, which is a plot of events/10 GeV bin vs. Reconstructed Mass in GeV:



D0 (in hep-ex/9801025) also analyzed tagged semileptonic events, with the result shown in their figure 25:



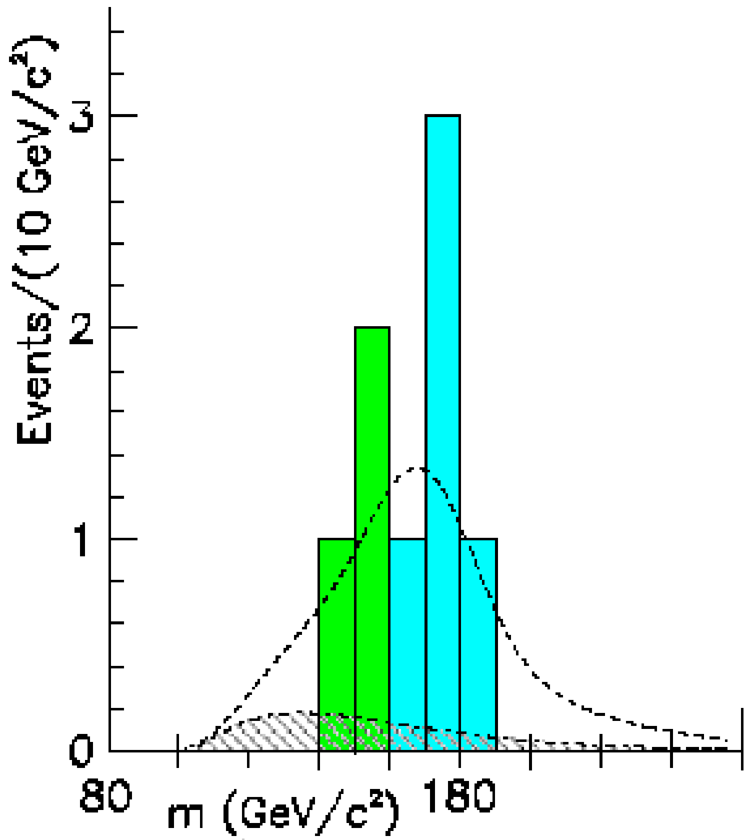
The figure shows 3 events in the 130-150 GeV range, one event in the 170-180 GeV bin, and one event in the 200-210 GeV bin. According to footnote 10 of hep-ex/9801025,

One event which would have otherwise passed the cuts, event (95653; 10822), was removed by D0 from its analysis because it was selected by the dilepton mass analysis. If this event is treated as a l + jets candidate,

it has a fit Chi-squared of 0.92 and fitted Truth Quark mass of 138.7 GeV.

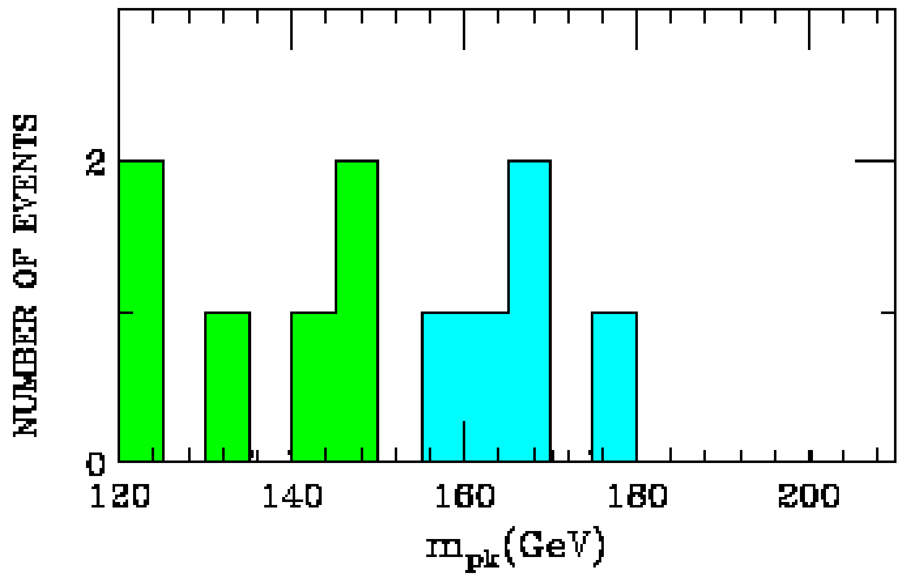
Dilepton events may be the most reliable measure of T-quark mass, although they are the least numerous type of event, so that statistics are not so good.

In October 1998 (in hep-ex/9810029) CDF analyzed 8 dilepton events and reported a T-quark mass of 167.4 +/- 10.3(stat) +/- 4.8(syst) GeV. Figure 2 of the report shows the 8 events:



I have colored green the events with T-quark mass less than 160 GeV, and blue the events with T-quark mass greater than 160 GeV. The hep-ex/9810029 CDF report stated that it "... supersedes our previously reported result in the dilepton channel ...".

The superseded previous CDF dilepton report (hep-ex/9802017) analyzed 9 events out of a total of 11 events, which 11 events are shown on the following histogram:



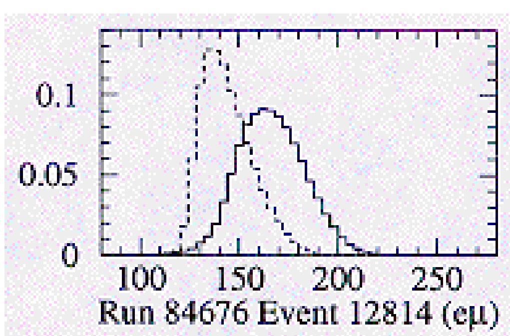
The distribution of m_{pk} values determined from 11 CDF dilepton events available empirically.

I have colored green the events with T-quark mass less than 150 GeV, and blue the events with T-quark mass greater than 150 GeV.

Note first, that in the earlier 11-event histogram 5 events are shown as greater than 150 GeV, but only 4 events are shown as greater than 160 GeV, while in the 8-event revised histogram 5 events are shown as greater than 160 GeV. This indicates to me that some changes in the analysis have shifted the event mass assignments upward by about 10 GeV.

Note second, that the earlier 11-event histogram contains 3 events from 120-140 GeV that are omitted from the 8-event revised histogram.

D0 (in hep-ex/9706014 and hep-ex/9808029) has analyzed 6 dilepton events, reporting a T-quark mass of about 168.4 GeV. The 1997 UC Berkeley PhD thesis of Erich Ward Varnes which can be found on the web at http://wwwd0.fnal.gov/publications_talks/thesis/thesis.html contains details of the events and the D0 analyses. Each of the 6 events has its own characteristics. In this letter I will only discuss one of them, Run 84676 Event 12814, an electron-muon dilepton event. This figure



from page 159 of the Varnes thesis, shows a T-quark mass likelihood plot calculated by the neutrino weighting algorithm.

In this event there were 3 jets instead of the 2 jets you would normally expect in a Dilepton event.

The solid line is the plot if all 3 jets are included, and the dashed line is the plot if only 2 of the jets are included by excluding the third (lowest transverse energy) jet.

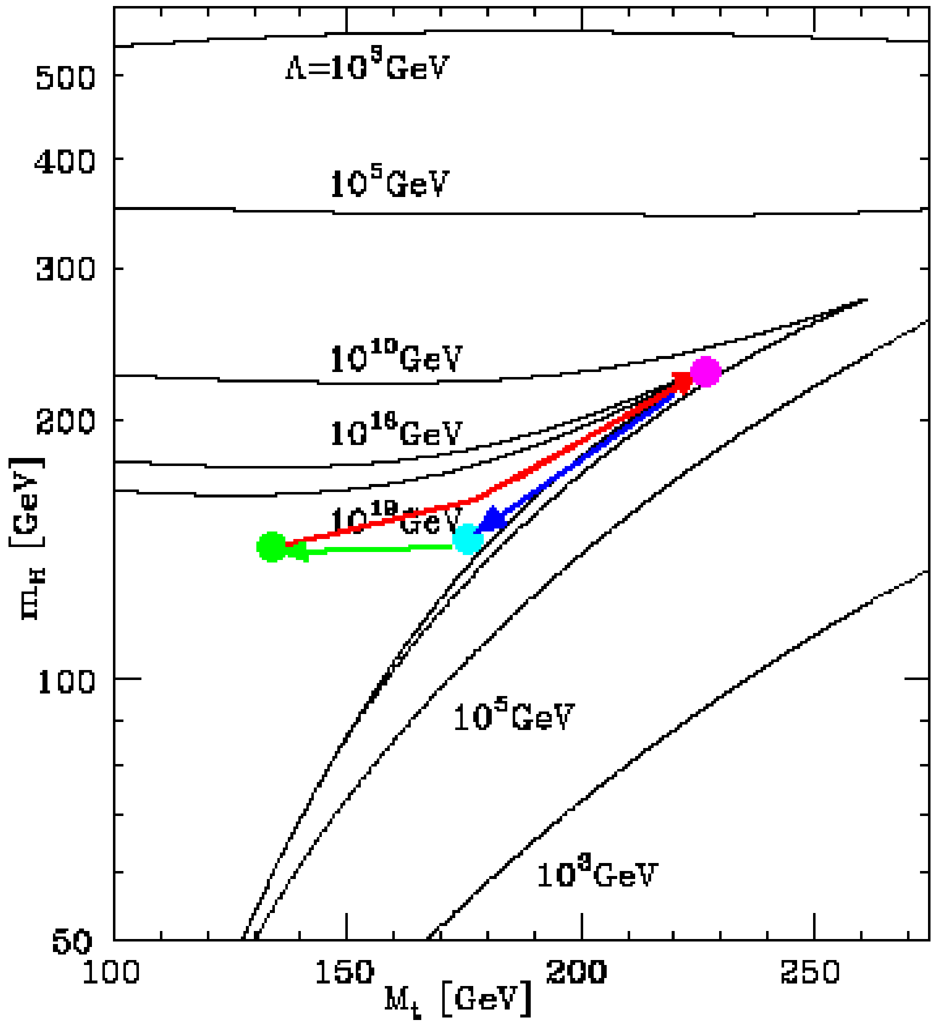
The 3-jet interpretation supports the 170 GeV mass favored by the Fermilab consensus, while

the 2-jet interpretation supports a 130-140 GeV mass analysis that favors my calculated mass of about 130 Gev.

If the ground state of the Truth Quark is at 130 GeV, then what might the peaks at 173 GeV and 225 GeV represent? Could they be

Excited States from interactions among Truth Quark - Higgs - Vacua ?

Consider the Higgs mass - Truth Quark mass plane, based on Fig. 3 of Froggatt's paper hep-ph/0307138:



The green dot corresponds to a 130 GeV Truth Quark low-energy Standard Model one-vacuum (< phi_vac1 > = 252 GeV) ground state that is well within the Stability Region below the Triviality Bound and above the Vacuum Stability bound for a Standard Model with a high-energy cut-off that goes all the way to the Planck energy 10^19 GeV.

If accelerator-event collisions deposit up to 95 GeV of extra energy into a Truth Quark, it will be pumped up along the red curve within the Stability Region until it hits the Standard Model Critical Point at the magenta dot, where it will be a Standard Model Truth Quark excited state with mass-energy 225 GeV.

Since **the 225 GeV Standard Model Truth Quark excited state is at a Critical Point, which is by definition on the Vacuum Stability curve**, the one low-energy Standard Model vacuum (< phi_vac1 > = 252 GeV) is no longer stable, and **a new vacuum phi_vac2 forms**.

In the theoretical model, the new vacuum phi_vac2 appears at the Planck energy, where the low-energy Standard Model, Higgs, and Gravity with 4-dimensional Physical Spacetime makes a transition to a more unified structure with a Spin(1,7) gauge boson Lie algebra, fermion spinors from a Cl(1,7) Clifford algebra, an 8-dimensional Spacetime, and a corresponding high-energy vacuum with **< phi_vac2 > = 10^19 GeV = Planck energy**.

When the second vacuum phi_vac2 appears, the structure of the Standard Model is altered (as explained by Froggatt) so that the new Critical Point is at a 173 GeV Truth Quark mass, so the magenta dot 225 GeV excited Truth Quark state decays, moving along the blue curve along the Vacuum Stability bound to an intermediate excited state at the cyan dot at a Truth Quark mass of 173 GeV.

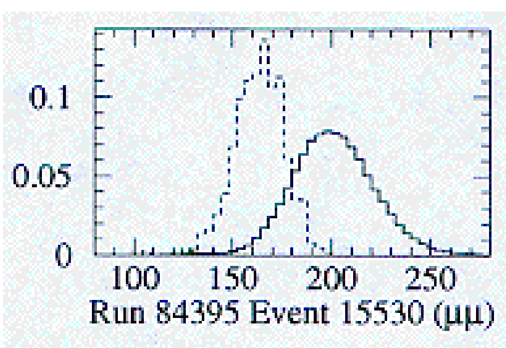
If the region around the Truth Quark does not have enough energy-density to maintain the second Planck energy phi_vac2 vacuum (as is the case with present-day colliders that can do Truth Quark experiments) then the cyan dot 173 GeV intermediate excited Truth Quark state decays along the green curve to the more stable Truth Quark low-energy Standard Model one-vacuum ground state at constituent mass of 130 GeV, the green dot.

As a result:

The Truth Quark may provide a Window on the 8th Dimension.

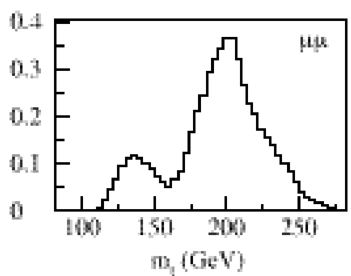
There are some actual Fermilab events that seem to me to show that process in action. They are dilepton events, for which I would normally expect to see 2 jets in addition to the 2 leptons. However, some of the 6 D0 dilepton events described in the 1997 UC Berkeley PhD thesis of Erich Ward Varnes and in hep-ex/9808029 have 3 jets, and I will here discuss the kinematics of two of those events to illustrate the above-described Truth Quark - Higgs - Vacua process. The kinematics of those two events are given in Appendix B.2 of the 1997 UC Berkeley PhD thesis of Erich Ward Varnes. (Similar kinematic data are presented in D0 August 1998, hep-ex/9808029.) In the Varnes Kinematics tables, there are two numbers for each jet: one is energy after CAFIX corrections; and the second (in parentheses) is energy after post-CAFIX corrections.

The first dilepton event, Run 84395, Event 15530 (mu mu), as analyzed using the neutrino weighting algorithm,



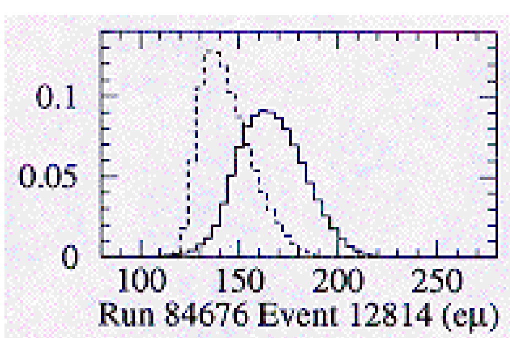
Run 84395 Event 15530					z vertex: 5.9 cm		
Object	E	E_x	E_y	E_z	E_T	η	ϕ
Muon 1	68.6	-63.9	12.7	-21.4	65.1	-0.32	2.94
Muon 2	34.9	-16.0	31.0	1.9	34.9	0.05	2.05
$\not{E}_T$	–	71.2	53.2	–	88.9	–	0.64
Jet 1	146.1	32.1	-98.2	-102.4	103.3	-0.88	5.03
	(153.5)	(33.8)	(-103.1)	(-107.6)	(108.5)		
Jet 2	35.1	-8.6	21.4	26.2	23.1	0.97	1.95
	(37.2)	(-9.1)	(22.7)	(27.7)	(24.5)		
Jet 3	47.1	-7.6	-16.8	43.0	18.4	1.58	4.29
	(52.3)	(-8.4)	(-18.6)	(47.8)	(20.5)		

has, if all 3 jets are included (the solid line in the graph), energy around 200 GeV, corresponding to the Standard Model Critical Point Truth Quark excited state at the magenta dot. If only the 2 highest energy jets are included (the dashed line in the graph), it has energy around 170 GeV, corresponding to the 2› vacuum intermediate excited Truth Quark state at the cyan dot, and the energy of the third jet would correspond to the decay down the blue curve along the Vacuum Stability bound. This same event, if analyzed usingthe matrix-element weighting algorithm that, according to hep-ex/9808029, "... is an extension of the weight proposed in [R.H. Dalitz and G.R. Goldstein, Phys. Rev. D45, 1531 (1992)] ...",



indicates the eventual decay into the Truth Quark low-energy Standard Model one-vacuum ground state at constituent mass of 130 GeV at the green dot.

The other dilepton event that I will discuss is Run 84676, Event 12814 (e mu), as analyzed using the neutrino weighting algorithm:



Run 84676 Event 12814					z vertex: -6.17 cm		
Object	E	E_x	E_y	E_z	E_T	η	ϕ
Electron	81.3	-75.4	-1.1	-30.2	74.5	-0.39	3.16
Muon	30.2	-25.2	10.6	-12.8	27.4	-0.45	2.75
$\not{E}_T$	–	62.0	5.2	–	62.3	–	0.08
Jet 1	93.8	38.0	-83.7	-15.6	91.9	-0.17	5.14
	(95.9)	(38.9)	(-85.6)	(-16.0)	(94.0)		
Jet 2	37.8	13.9	32.3	-11.2	35.2	-0.31	1.17
	(38.8)	(14.2)	(33.1)	(-11.4)	(36.0)		
Jet 3	31.4	-1.6	28.6	11.6	28.7	0.39	1.63
	(32.2)	(-1.6)	(29.3)	(11.9)	(29.4)		

It has, if all 3 jets are included (the solid line in the graph), energy around 170 GeV, corresponding to the 2-vacuum intermediate excited Truth Quark state at the cyan dot. If only the 2 highest energy jets are included (the dashed line in the graph), it has energy around 130 GeV, corresponding to the Truth Quark low-energy Standard Model one-vacuum ground state at constituent mass of 130 GeV at the green dot, and the energy of the third jet would correspond to the decay down the green curve.

Cl(1,7) Clifford Algebra, 8-Periodicity, and a Real Hyperfinite von Neumann Algebra factor.

Complex Clifford Periodicity

Cl(2N;C) = Cl(2;C) x ...(N times tensor product)... x Cl(2;C)

Cl(2;C) = M2(C) = 2x2 complex matrices

spinor representation = 1x2 complex column spinors

Hyperfinite II1 von Neumann Algebra factor is the completion of the union of all the tensor products

Cl(2;C) x ...(N times tensor product)... x Cl(2;C)

By looking at the spinor representation, you see that "the hyperfinite II1 factor is the smallest von Neumann algebra containing the creation and annihilation operators on a fermionic Fock space of countably infinite dimension."

In other words, Complex Clifford Periodicity leads to the complex hyperfinite II1 factor which represents Dirac's electron-positron fermionic Fock space.

Now, generalize this to get a representation of ALL the particles and fields of physics.

Use Real Clifford Periodicity to construct a Real Hyperfinite II1 factor as the completion of the union of all the tensor products

Cl(1,7;R) x ...(N times tensor product)... x Cl(1,7;R)

where the Real Clifford Periodicity is

Cl(N,7N;R) = Cl(1,7;R) x ...(N times tensor product)... x Cl(1,7;R)

The components of the Real Hyperfinite II1 factor are each

Cl(1,7;R)

[my convention is (1,7) = (-+++++++)]

Cl(1,7) is 2^8 = 16x16 = 256-dimensional, and has graded structure

1 8 28 56 70 56 28 8 1

D4-D5-E6 Lagrangian Structure.

Construct the Standard Model plus Gravity Lagrangian of the theoretical model based on the structure of the Cl(1,7) Clifford Algebra. Cl(1,7) is 2^8 = 16x16 = 256-dimensional, and has graded structure

1 8 28 56 70 56 28 8 1

What are the physical interpretations of its representations?

There are two mirror image half-spinors, each of the form of a real (1,7) column vector with octonionic structure.

The 1 represents:

the neutrino.

The 7 represent:

the electron;

the red, blue, and green up quarks;

the red, blue, and green down quarks.

One half-spinor represents first-geneneration fermion particles, and its mirror image represents first-generation fermion antiparticles.

Second and third generation fermions come from dimensional reduction of spacetime, so that

- first generation - octonions
- second generation - pairs of octonions

- third generation - triples of octonions

There is a (1,7)-dimensional vector representation that corresponds to an 8› dimensional high-energy spacetime with octonionic structure

that reduces at lower energies to quaternionic structures that are

- a (1,3)-dimensional physical spacetime [my convention is (1,3)=(-+++)]
- a (0,4)-dimensional internal symmetry space

There is a 28-dimensonal bivector representation that corresponds to the gauge symmetry Lie algebra Spin(1,7)

that reduces at lower energies to:

- a 16-dimensional U(2,2) = U(1)xSU(2,2) = U(1)xSpin(2,4) whose conformal Lie algebra / Lie group structure leads to gravity by a mechanism similar to the MacDowell-Mansouri mechanism;
- a 12-dimensional SU(3)xSU(2)xU(1) Standard Model symmetry group that is represented on the internal symmetry space by the structure SU(3) / SU(2)xU(1) = CP2.

There is a 1-dimensional scalar representation for the Higgs mechanism.

The Cl(1,7) Clifford Algebra structures

1 8 28 56 70 56 28 8 1 = (8+8)x(8+8)

fit together to form a Lagrangian in 8-dimensional SpaceTime that can be written, prior to dimensional reduction, as

the Integral over 8-dim SpaceTime of

dd P' /\ * dd P + F /\ *F + S' D S + GF + GG

where d is the 8-dim covariant derivative

P is the scalar field

F is the Spin(8) curvature

S' and S are half-spinor fermion spaces

D is the 8-dim Dirac operator

GF is the gauge-fixing term

GG is the ghost term

As shown in chapter 4 of Gockeler and Schucker,

the scalar part of the Lagrangian dd P' /\ * dd P becomes Fh8 /\ *Fh8

where Fh8 is an 8-dimensional Higgs curvature term.

After dimensional reduction to 4-dim SpaceTime, the scalar Fh8 /\ *Fh8 term becomes the Integral over 4-dim Spacetime of

(Fh44 + Fh4I + FhII) /\ *(Fh44 + Fh4I + FhII) =

= Fh44 /\ *Fh44 + Fh4I /\ *Fh4I + FhII /\ *FhII

where cross-terms are eliminated by antisymmetry of the wedge /\ product

and 4 denotes 4-dim SpaceTime

and I denotes 4-dim Internal Symmetry Space

The Internal Symmetry Space terms should be integrated over the 4-dimensional Internal Symmetry Space, to get **3 terms.**

The first term is the integral over 4-dim SpaceTime of

Fh44 /\ *Fh44

Since they are both SU(2) gauge group terms, this term merges into the SU(2) weak force term that is the integral over 4-dim SpaceTime of Fw /\ *Fw (where w denotes Weak Force).

The third term is the integral over 4-dim SpaceTime of the integral over 4-dim Internal Symmetry Space of

FhII /\ *FhII

The third term after integration over the 4-dim Internal Symmetry Space, produces, by a process similar to the Mayer Mechanism developed by Meinhard Mayer, terms of the form

L (PP)^2 - 2 M^2 PP

where L is the Lambda term, P is the Phi scalar complex doublet term, and M is the Mu term in the wrong-sign Lamba Phi^4 theory potential term, which describes the Higgs Mechanism. The M and L are written above in the notation used by Kane and Barger and Phillips. Ni, and Ni, Lou, Lu, and Yang, use a different notation

- (1 / 2) Sigma Pn Pn + (1 / 4!) Ln (PnPn)^2

so that the L that I use (following Kane and Barger and Phillips) is different from the Ln of Ni, and Ni, Lou, Lu, and Yang, and the P that I use is different from Pn, and the 2 M^2 that I use is (1 / 2) Sigma.

Proposition 11.4 of chapter II of volume 1 of Kobayashi and Nomizu states that

$$2FhII(X,Y) = [P(X),P(Y)] - P([X,Y])$$

where P takes values in the SU(2) Lie algebra. If the action of the Hodge dual * on P is such that *P = -P and *[P,P] = [P,P], then

$$FhII(X,Y) \wedge *FhII(X,Y) = (1/4) ([P(X) , P(Y)]^2 - P([X,Y])^2)$$

If integration of P over the Internal Symmetry Space gives P = (P+, P0), where P+ and P0 are the two components of the complex doublet scalar field, then

$$(1/4) ([P(X) , P(Y)]^2 - P([X,Y])^2) = (1/4) (L (PP)^2 - M^2 PP)$$

which is the Higgs Mechanism potential term.

In my notation (and that of Kane and Barger and Phillips), 2 M^2 is the square Mh^2 of the tree-level Higgs scalar particle mass.

In my notation (and that of Kane and Barger and Phillips), P is the Higgs scalar field, and its tree-level vacuum expectation value is given by

$$v^2 / 2 = P^2 = M^2 / 2 L \text{ or } M^2 = L v^2.$$

The value of the fundamental mass scale vacuum expectation value v of the Higgs scalar field is set in this model as the sum of the physical masses of the weak bosons, W+, W-, and Z0, whose tree-level masses will be 80.326 GeV, 80.326 GeV, and 91.862 GeV, respectively, and so that the electron mass will be 0.5110 MeV.

The resulting equations, in my notation (and that of Kane and Barger and Phillips), are:

$$Mh^2 = 2 M^2 \text{ and } M^2 = L v^2 \text{ and } Mh^2 / v^2 = 2 L$$

In their notation, Ni, Lou, Lu, and Yang have 2M^2 = (1/2) Sigma and P^2 = 6 Sigma / Ln, and for the tree-level value of the Higgs scalar particle mass Mh they have Mh^2 / Pn^2 = Ln / 3.

By combining the non-perturbative Gaussian Effective Potential (GEP) approach with their Regularization-Renormalization (R-R) method, Ni, Lou, Lu, and Yang find that:

Mh and Pn are the two fundamental mass scales of the Higgs mechanism, and

the fundamental Higgs scalar field mass scale Pn of Ni, Lou, Lu, and Yang is equivalent to the vacuum expectation value v of the Higgs scalar field in my notation and that of Kane and Barger and Phillips, and

Ln (and the corresponding L) can not only be interpreted as the Higgs scalar field self-coupling constant, but also can be interpreted as determining the invariant ratio between the mass squares of the Higgs mechanism fundamental mass scales, Mh^2 and Pn^2 = v^2. Since the tree-level value of Ln is Ln = 1, and since Ln / 3 = Mh^2 / Pn^2 = Mh^2 / v^2 = 2 L, the tree-level value of L is L = Ln / 6 = 1 / 6, so that, at tree-level

$$Mh^2 / Pn^2 = Mh^2 / v^2 = 2 / 6 = 1 / 3.$$

In the theoretical model, the fundamental mass scale vacuum expectation value v of the Higgs scalar field is the fundamental mass parameter that is to be set to define all other masses by the mass ratio formulas of the model.

v is set to be 252.514 GeV

so that it is equal to the sum of the physical masses of the weak bosons, W+, W-, and Z0, whose tree-level masses will be 80.326 GeV, 80.326 GeV, and 91.862 GeV, respectively, and

so that the electron mass will be 0.5110 MeV.

Then, the tree-level mass Mh of the Higgs scalar particle is given by

$$Mh = v / \mathrm{sqrt}(3) = 145.789 \text{ GeV}$$

The Higgs scalar field P is a Complex Doublet that can be expressed in terms of a vacuum expectation value v and a real Higgs field H.

The Complex Doublet P = (P+, P0) = (1/sqrt(2)) (P1 + iP2, P3 + iP4) = (1/sqrt(2)) (0, v + H), so that

$$P3 = (1/\mathrm{sqrt}(2)) (v + H)$$

where v is the vacuum expectation value and H is the real surviving Higgs field.

The value of the fundamental mass scale vacuum expectation value v of the Higgs scalar field is in the theoretical model set to be 252.514 GeV so that the electron mass will turn out to be 0.5110 MeV.

Now, to interpret the term

$$(1/4) ([P(X) , P(Y)]^2 - P([X,Y])^2) = (1/4) (L (PP)^2 - M^2 PP)$$

in terms of v and H, note that $L = M^2 / v^2$ and that $P = (1/\mathrm{sqrt}(2)) (v + H)$, so that

$$FhII(X,Y) \wedge *FhII(X,Y) = (1/4) (L (PP)^2 - M^2 PP) =$$

$$= (1/16) ((M^2 / v^2) (v + H)^4 - (1/8) M^2 (v + H)^2 =$$

$$= (1/4) M^2 H^2 - (1/16) M^2 v^2 (1 - 4 H^3 / v^3 - H^4 / v^4)$$

Disregarding some terms in v and H,

$$FhII(X,Y) \wedge *FhII(X,Y) = (1/4) M^2 H^2 - (1/16) M^2 v^2$$

The second term is the integral over 4-dim SpaceTime of the integral over 4-dim Internal Symmetry Space of

$$Fh4I \wedge *Fh4I$$

The second term after integration over the 4-dim Internal Symmetry Space, produces, by a process similar to the Mayer Mechanism, terms of the form

$$dP\ dP$$

where P is the Phi scalar complex doublet term and d is the covariant derivative.

Proposition 11.4 of chapter II of volume 1 of Kobayashi and Nomizu states that

$$2Fh4I(X,Y) = [P(X),P(Y)] - P([X,Y])$$

where P(X) takes values in the SU(2) Lie algebra. If the X component of Fh4I(X,Y) is in the surviving 4› dim SpaceTime and the Y component of Fh4I(X,Y) is in the 4-dim Internal Symmetry Space, then the Lie bracket product [X,Y] = 0 so that P([X,Y]) = 0 and therefore

$$Fh4I(X,Y) = (1/2) [P(X),P(Y)] = (1/2) dx P(Y)$$

Integration over Internal Symmetry Space of (1/2) dx P(Y) gives (1/2) dx P, where now P denotes the scalar Higgs field and dx denotes covariant derivative in the X direction.

Taking into account the Complex Doublet structure of P, the second term is the Integral over 4-dim SpaceTime of

$$Fh4I \wedge *Fh4I = (1/2)\ d\ P \wedge *(1/2)\ d\ P = (1/4)\ d\ P \wedge *d\ P =$$

$$= (1/4)\ (1/2)\ d\ (\ v + H\ ) \wedge *d\ (\ v + H\ ) = (1/8)\ dH\ dH + \text{(some terms in v and H)}$$

Disregarding some terms in v and H,

$$Fh4I \wedge *Fh4I = (1/8)\ dH\ dH$$

Combining the second and third terms, since the first term is merged into the weak force part of the Lagrangian:

$$Fh4I \wedge *Fh4I + FhII(X,Y) \wedge *FhII(X,Y) =$$

$$= (1/8)\ dH\ dH + (1/4)\ M^2\ H^2 - (1/16)\ M^2\ v^2 =$$

$$= (1/8)\ (\ dH\ dH + 2\ M^2\ H^2 - (1/2)\ M^2\ v^2\ )$$

This is the form of the Higgs Lagrangian in Barger and Phillips for a Higgs scalar particle of mass

$$Mh = M\ sqrt(2) = v\ /\ sqrt(3)= 145.789\ GeV$$

To calculate Charge = Amplitude to Emit Gauge Boson and its probability-square, Force Strength:

```
Three factors determine the probability for emission of
a gauge boson from an origin spacetime vertex to a target vertex:

the part of the Internal Symmetry Space
of the target spacetime vertex that is available for the gauge boson
to go to from the origin vertex;

the volume of the spacetime link that is available for the gauge
boson to go through from the origin vertex to the target vertex; and

an effective mass factor for forces
(such as the Weak force and Gravity)
that, in the low-energy ranges of our experiments,
are carried effectively by gauge bosons that are not
massless high-energy.

In this physics model, force strength probabilities are calculated
in terms of relative volumes of bounded complex homogeneous domains and
their Shilov boundaries.

The bounded complex homogeneous domains correspond to
harmonic functions of generalized Laplacians
that determine heat equations, or diffusion equations;

while the amplitude to emit gauge bosons in the
HyperDiamond Feynman Checkerboard is a process that
is similar to diffusion, and
therefore also corresponds to a generalized Laplacian.


In this theoretical  model, all force strengths are
represented as ratios with respect to the geometric force
strength of Gravity (that is, the force strength of Gravity
without using the Effective Mass factor).
```

Therefore, the only free charge, or force strength, parameter is the charge of the Spin(5) gravitons in the MacDowell-Mansouri formalism of Gravity. Note that these Spin(5) gravitons are NOT the ordinary spin-2 gravitons of the low-energy region in which we live.
The charge of the Spin(5) gravitons is taken to be unity, 1, so that its force strength is also unity, 1.
All other force strengths are determined as ratios with respect to the Spin(5) gravitons and each other.

The force strength probability for a gauge boson to be emitted from an origin spacetime HyperDiamond vertex and go to a target vertex is the product of three things:

the volume Vol(MISforce) of the target Internal Symmetry Space, that is, the part of the Internal Symmetry Space of the target spacetime vertex that is available for the gauge boson to go to from the origin vertex;

the volume Vol(Qforce) / Vol(Dforce)^(1 / mforce) of the spacetime link to the target spacetime vertex from the origin vertex; and

an effective mass factor 1 / Mforce^2 for forces (such as the Weak force and Gravity) that, in the low-energy ranges of our experiments, are carried effectively by gauge bosons that are not massless high-energy SU(2) or Spin(5) gauge bosons, but are either massive Weak bosons due to the Higgs mechanism or effective spin-2 gravitons. For other forces, the effective mass factor is taken to be unity, 1.

Therefore, the force strength of a given force is

```
alphaforce = (1 / Mforce^2 \)
             ( Vol(MISforce))
             ( Vol(Qforce) / Vol(Dforce)^( 1 / mforce ))
```

where:

alphaforce represents the force strength;

Mforce represents the effective mass;

MISforce represents the part of the target
Internal Symmetry Space that is available for the gauge
boson to go to;

Vol(MISforce) stands for volume of MISforce,
and is sometimes also denoted by the shorter notation Vol(M);

Qforce represents the link from the origin
to the target that is available for the gauge
boson to go through;

Vol(Qforce) stands for volume of Qforce;

Dforce represents the complex bounded homogeneous domain
of which Qforce is the Shilov boundary;

mforce is the dimensionality of Qforce,
which is 4 for Gravity and the Color force,
2 for the Weak force (which therefore is considered to
have two copies of QW for each spacetime HyperDiamond link),
and 1 for Electromagnetism (which therefore is considered to
have four copies of QE for each spacetime HyperDiamond link)

Vol(Dforce)^(1 / mforce) stands for
a dimensional normalization factor (to reconcile the dimensionality
of the Internal Symmetry Space of the target vertex
with the dimensionality of the link from the origin to the
target vertex).

The Qforce, Hermitian symmetric space,
and Dforce manifolds for the four forces are:

Gauge Group	Hermitian Symmetric Space	Type of Dforce	mforce	Qforce
Spin(5)	Spin(7) / Spin(5)xU(1)	IV5	4	RP^1xS^4
SU(3)	SU(4) / SU(3)xU(1)	B^6(ball)	4	S^5
SU(2)	Spin(5) / SU(2)xU(1)	IV3	2	RP^1xS^2

U(1)	-	-	1	-

The geometric volumes needed for the calculations, mostly taken from Hua, are

Force	M	Vol(M)	Q	Vol(Q)	D	Vol(D)
gravity	S^4	8pi^2/3	RP^1xS^4	8pi^3/3	IV5	pi^5/2^4 5!
color	CP^2	8pi^2/3	S^5	4pi^3	B^6(ball)	pi^3/6
weak	S^2xS^2	2x4pi	RP^1xS^2	4pi^2	IV3	pi^3/24
e-mag	T^4	4x2pi	-	-	-	›

Using these numbers, the results of the calculations are the relative force strengths at the characteristic energy level of the generalized Bohr radius of each force:

Gauge Group	Force	Characteristic Energy	Geometric Force Strength	Total Force Strength
Spin(5)	gravity	approx 10^19 GeV	1	GGmproton^2 approx 5 x 10^-39
SU(3)	color	approx 245 MeV	0.6286	0.6286
SU(2)	weak	approx 100 GeV	0.2535	GWmproton^2 approx 1.05 x 10^-5
U(1)	e-mag	approx 4 KeV	1/137.03608	1/137.03608

The force strengths are given at the characteristic energy levels of their forces, because the force strengths run with changing energy levels.

The effect is particularly pronounced with the color force.

The color force strength was calculated using a simple perturbative QCD renormalization group equation at various energies, with the following results:

Energy Level	Color Force Strength
245 MeV	0.6286
5.3 GeV	0.166
34 GeV	0.121
91 GeV	0.106

Taking other effects, such as Nonperturbative QCD, into account, should give
a Color Force Strength of about 0.125 at about 91 GeV

To calculate Weak Boson Masses and Weinberg Angle:

Denote the 3 SU(2) high-energy weak bosons (massless at energies higher than the electroweak unification) by W+, W-, and W0, corresponding to the massive physical weak bosons W+, W-, and Z0.

The triplet { W+, W-, W0 } couples directly with the T - Tbar quark-antiquark pair, so that the total mass of the triplet { W+, W-, W0 } at the electroweak unification is equal to the total mass of a T - Tbar pair, 259.031 GeV.

The triplet { W+, W-, Z0 }
couples directly with the Higgs scalar,
which carries the Higgs mechanism by
which the W0 becomes the physical Z0,
so that the total mass of the triplet { W+, W-, Z0 }
is equal to the vacuum expectation value v of
the Higgs scalar field, v = 252.514 GeV.

What are individual masses of members
of the triplet { W+, W-, Z0 } ?

First, look at the triplet { W+, W-, W0 }
which can be represented by the 3-sphere S^3.

The Hopf fibration of S^3 as
S^1 --} S^3 --} S^2
gives a decomposition of the W bosons
into the neutral W0 corresponding to S^1 and
the charged pair W+ and W- corresponding
to S^2.

The mass ratio of the sum of the masses of
W+ and W- to
the mass of W0
should be the volume ratio of
the S^2 in S^3 to
the S^1 in S3.

The unit sphere S^3 in R^4 is
normalized by 1 / 2.

The unit sphere S^2 in R^3 is
normalized by 1 / sqrt3.

The unit sphere S^1 in R^2 is
normalized by 1 / sqrt2.

The ratio of the sum of the W+ and W- masses to

the W0 mass should then be
(2 / sqrt3) V(S^2) / (2 / sqrt2) V(S^1) = 1.632993.

Since the total mass of the triplet { W+, W-, W0 }
is 259.031 GeV, the total mass of a T - Tbar pair,
and the charged weak bosons have equal mass,
we have

mW+ = mW- = 80.326 GeV,

and mW0 = 98.379 GeV.

Parity Violation, Effective Masses, and Weinberg Angle:

The charged W+/- neutrino-electron interchange

must be symmetric with the electron-neutrino interchange,

so that the absence of right-handed neutrino particles requires

that the charged W+/- SU(2)
weak bosons act only on left-handed electrons.

Each gauge boson must act consistently
on the entire Dirac fermion particle sector,
so that the charged W+/- SU(2) weak bosons
act only on left-handed fermions of all types.

The neutral W0 weak boson does not interchange Weyl
neutrinos with Dirac fermions, and so is not restricted
to left-handed fermions,
but also has a component that acts on both types of fermions,
both left-handed and right-handed, conserving parity.

However, the neutral W0 weak bosons are related to
the charged W+/- weak bosons by custodial SU(2)
symmetry, so that the left-handed component of the
neutral W0 must be equal to the left-handed (entire)
component of the charged W+/-.

Since the mass of the W0 is greater than the mass
of the W+/-, there remains for the W0 a component
acting on both types of fermions.

Therefore the full W0 neutral weak boson interaction
is proportional to
(mW+/-^2 / mW0^2) acting on left-handed fermions
and

(1 - (mW+/-^2 / mW0^2)) acting
on both types of fermions.

If (1 - (mW+/-2 / mW0^2)) is defined to be
sin(thetaw)^2 and denoted by K, and

if the strength of the W+/- charged weak force
(and of the custodial SU(2) symmetry) is denoted by T,

then the W0 neutral weak interaction can be written as:

W0L = T + K and W0LR = K.

Since the W0 acts as W0L with respect to the
parity violating SU(2) weak force and

as W0LR with respect to the parity conserving U(1)
electromagnetic force of the U(1) subgroup of SU(2),

the W0 mass mW0 has two components:

the parity violating SU(2) part mW0L that is
equal to mW+/- ; and

the parity conserving part mW0LR that acts like a
heavy photon.

As mW0 = 98.379 GeV = mW0L + mW0LR, and

as mW0L = mW+/- = 80.326 GeV,

we have mW0LR = 18.053 GeV.

Denote by *alphaE = *e^2 the force
strength of the weak parity conserving U(1)
electromagnetic type force that acts through the
U(1) subgroup of SU(2).

The electromagnetic force strength
alphaE = e^2 = 1 / 137.03608 was calculated
in Chapter 8 using
the volume V(S^1) of an S^1 in R^2,
normalized by 1 / \qrt2.

The *alphaE force is part of the SU(2) weak
force whose strength alphaW = w^2 was calculated
in Chapter 8 using the volume V(S^2) of an S^2 \subset R^3,
normalized by 1 / sqrt3.

Also, the electromagnetic force strength alphaE = e^2
was calculated in Chapter 8 using a
4-dimensional spacetime with global structure of
the 4-torus T^4 made up of four S^1 1-spheres,

while the SU(2) weak force strength
alphaW = w^2 was calculated in Chapter 8
using two 2-spheres S^2 x S^2,
each of which contains one 1-sphere of
the *alphaE force.

Therefore
*alphaE = alphaE (sqrt2 / sqrt3)(2 / 4) = alphaE / sqrt6,

*e = e / (4th root of 6) = e / 1.565 , and

the mass mW0LR must be reduced to an effective value

mW0LReff = mW0LR / 1.565 = 18.053/1.565 = 11.536 GeV

for the *alphaE force to act like
an electromagnetic force in the 4-dimensional
spacetime HyperDiamond Feynman Checkerboard model:

*e mW0LR = e (1/5.65) mW0LR = e mZ0,

where the physical effective neutral weak boson is
denoted by Z0.

Therefore, the correct HyperDiamond Feynman Checkerboard values for
weak boson masses and the Weinberg angle thetaW are:

mW+ = mW- = 80.326 GeV;

mZ0 = 80.326 + 11.536 = 91.862 GeV;

Sin(thetaW)^2 = 1 - (mW+/- / mZ0)^2 =

= 1 - (6452.2663 / 8438.6270) = 0.235.

Radiative corrections are not taken into account here,
and may change these tree-level values somewhat.

To calculate Fermion Masses:

Constituent Quark Masses:

To do calculations in theories such as
Perturbative QCD and Chiral Perturbation Theory,
you need to use effective quark masses that
are called current masses. Current quark masses are different

```
from the Pre-Quantum constituent quark masses of our model.
The current mass of a quark is defined in this model as
the difference between
the constituent mass of the quark
and
the density of the lowest-energy sea of virtual gluons,
quarks, and antiquarks, or 312.75 MeV.
```

The fundamental correctness of the Constituent Quark Mass and the effectiveness of the NonRelativistic Quark Model of hadrons can be explained by Bohm's quantum theory applied to a fermion confined in a box, in which the fermion is at rest because its kinetic energy is transformed into PSI-field potential energy. Since that aspect of Bohm's quantum theory is not a property of most other formulations of quantum theory, the effectiveness of the NonRelativistic Quark Model confirms Bohm's quantum theory as opposed to those others.

Fermion Mass Calculations:

```
First generation fermion particles are also represented
by octonions as follows:
```

Octonion Basis Element	Fermion Particle
1	e-neutrino
i	red up quark
j	green up quark
k	blue up quark
E	electron
I	red down quark
J	green down quark
K	blue down quark

```
First generation fermion antiparticles are represented
```

by octonions in a similiar way.

Second generation fermion particles and antiparticles
are represented by pairs of octonions.

Third generation fermion particles and antiparticles
are represented by triples of octonions.

There are no higher generations of fermions than the Third.

This can be seen geometrically as a consequence of the fact
that
if you reduce the original 8-dimensional spacetime
into associative 4-dimensional physical spacetime
and coassociative 4-dimensional Internal Symmetry Space
then
if you look in the original 8-dimensional spacetime
at a fermion (First-generation represented by a single octonion)
propagating from one vertex to another
there are only 4 possibilities for the same propagation
after dimensional reduction:

1 - the origin o and target x vertices are both
in the associative 4-dimensional physical spacetime

```
4-dim Internal Symmetry Space   --------------


4-dim Physical SpaceTime        ---o------x---
```

in which case the propagation is unchanged, and the
fermion remains a FIRST generation fermion represented
by a single octonion o

2 - the origin vertex o is in the associative spacetime
and the target vertex * in in the Internal Symmetry Space

```
4-dim Internal Symmetry Space   ----------*---


4-dim Physical SpaceTime        ---o----------
```

in which case there must be a new link from
the original target vertex * in the Internal Symmetry Space

to a new target vertex x in the associative spacetime

```
4-dim Internal Symmetry Space   ----------*---


4-dim Physical SpaceTime        ---o------x---
```

and a second octonion can be introduced at the original target vertex in connection with the new link so that the fermion can be regarded after dimensional reduction as a pair of octonions o and * and therefore as a SECOND generation fermion

3 - the target vertex x is in the associative spacetime and the origin vertex o in in the Internal Symmetry Space

```
4-dim Internal Symmetry Space   ---o----------


4-dim Physical SpaceTime        ----------x---
```

in which case there must be a new link to the original origin vertex o in the Internal Symmetry Space from a new origin vertex * in the associative spacetime

```
4-dim Internal Symmetry Space   ---o----------


4-dim Physical SpaceTime        ---O------x---
```

so that a second octonion can be introduced at the new origin vertex O in connection with the new link so that the fermion can be regarded after dimensional reduction as a pair of octonions O and o and therefore as a SECOND generation fermion

and

4 - both the origin vertex o and the target vertex * are in the Internal Symmetry Space,

```
4-dim Internal Symmetry Space   ---o------*---
```

```
4-dim Physical SpaceTime        ------------›
```

in which case there must be a new link to
the original origin vertex o in the Internal Symmetry Space
from a new origin vertex O in the associative spacetime,
and a second new link from the original target vertex *
in the Internal Symmetry Space to a new target vertex x
in the associative spacetime

```
4-dim Internal Symmetry Space   ---o------*---


4-dim Physical SpaceTime        ---O------x---
```

so that a second octonion can be introduced at the new
origin vertex O in connection with the first new link,
and a third octonion can be introduced at the original
target vertex * in connection with the second new link,
so that the fermion can be regarded after dimensional reduction
as a triple of octonions O and o and *
and therefore as a THIRD generation fermion.

As there are no more possibilities, there are no more generations,
and we have:

The first generation fermions
correspond to octonions O

and second generation fermions
correspond to pairs of octonions O x O

and third generation fermions
correspond to triples of octonions O x O x O

To calculate the fermion masses in the model,
the volume of a compact manifold representing the
spinor fermions S8+ is used.
It is the parallelizable manifold S^7 x RP^1.

Also, since gravitation is coupled to mass,
the infinitesimal generators of the MacDowell-Mansouri

gravitation group, Spin(0,5), are relevant.

The calculated quark masses are constituent masses,
not current masses.

Fermion masses are calculated as a product of four factors:

V(Qfermion) x N(Graviton) x N(octonion) x Sym

V(Qfermion) is the volume of the part of
the half-spinor fermion particle manifold S^7 x RP^1
that is related to the fermion particle
by photon, weak boson, and gluon interactions.

N(Graviton) is the number of types of Spin(0,5) graviton
related to the fermion.
The 10 gravitons correspond to
the 10 infinitesimal generators of Spin(0,5) = Sp(2).

2 of them are in the Cartan subalgebra.

6 of them carry color charge,
and may therefore be considered as corresponding to quarks.

The remaining 2 carry no color charge,
but may carry electric charge
and so may be considered as corresponding to electrons.

One graviton takes the electron into itself,
and the other can only take the first-generation electron
into the massless electron neutrino.

Therefore only one graviton should correspond to the mass
of the first-generation electron.

The graviton number ratio of the down quark to the first-generation electron is therefore 6/1 = 6.

N(octonion) is an octonion number factor relating up-type quark masses to down-type quark masses in each generation.

Sym is an internal symmetry factor, relating 2nd and 3rd generation massive leptons to first generation fermions. It is not used in first-generation calculations.

The ratio of the down quark constituent mass to the electron mass is then calculated as follows:

Consider the electron, e.

By photon, weak boson, and gluon interactions,
e can only be taken into 1, the massless neutrino.

The electron and neutrino, or their antiparticles,
cannot be combined to produce any of the
massive up or down quarks.

The neutrino, being massless at tree level,
does not add anything to the mass formula for the electron.

Since the electron cannot be related to any other massive Dirac fermion, its volume V(Qelectron) is taken to be 1.

Next consider a red down quark I.

By gluon interactions,
I can be taken into J and K,
the blue and green down quarks.

By also using weak boson interactions,
it can be taken into i, j, and k,
the red, blue, and green up quarks.

Given the up and down quarks,
pions can be formed from quark-antiquark pairs,
and the pions can decay

to produce electrons and neutrinos.

Therefore the red down quark (similarly, any down quark)
is related to any part of S^7 x RP^1,
the compact manifold corresponding to

{ 1, i, j, k, I, J, K, E }

and therefore a down quark should have a spinor manifold
volume factor V(Qdown quark) of the volume of
S^7 x RP^1.

The ratio of the down quark spinor manifold volume factor to
the electron spinor manifold volume factor is just

V(Qdown quark) / V(Qelectron) = V(S^7x RP^1)/1 = pi^5 / 3.

Since the first generation graviton factor is 6,

md/me = 6V(S^7 x RP^1) = 2 pi^5 = 612.03937

As the up quarks correspond to i, j, and k,
which are
the octonion transforms under E of I, J, and K
of the down quarks,
the up quarks and down quarks
have the same constituent mass mu = md.

Antiparticles have the same mass as the corresponding
particles.

Since the model only gives ratios of massses,
the mass scale is fixed so that the electron mass

me = 0.5110 MeV.

Then, the constituent mass of the down quark is

md = 312.75 MeV, and

the constituent mass for the up quark is

mu = 312.75 MeV.

These results when added up give a total mass of
first generation fermion particles:

Sigmaf1 = 1.877 GeV

As the proton mass is taken to be the sum of the constituent masses of its constituent quarks

mproton = mu + mu + md = 938.25 MeV

The theoretical calculation is close to
the experimental value of 938.27 MeV.

The third generation fermion particles correspond to triples of octonions. There are 8^3 = 512 such triples.

The triple { 1,1,1 } corresponds to the tau-neutrino.

The other 7 triples involving only 1 and E correspond
to the tauon:
{ E, E, E }
{ E, E, 1 }
{ E, 1, E }
{ 1, E, E }
{ 1, 1, E }
{ 1, E, 1 }
{ E, 1, 1 }

The symmetry of the 7 tauon triples is the same
as the symmetry of
the 3 down quarks, the 3 up quarks, and the electron,
so the tauon mass should be

the same as
the sum of the masses of
the first generation massive fermion particles.

Therefore the tauon mass is 1.877 GeV.

The calculated Tauon mass of 1.88 GeV is a sum of first generation fermion masses, all of which are valid at the energy level of about 1 GeV.

However, as the Tauon mass is about 2 GeV, the effective Tauon mass should be renormalized from the energy level of 1 GeV (where the mass is 1.88 GeV) to the energy level of 2 GeV. Such a renormalization should reduce the mass. If the renormalization reduction were about 5 percent, the effective Tauon mass at 2 GeV would be about 1.78 GeV.

The 1996 Particle Data Group Review of Particle Physics gives a Tauon mass of 1.777 GeV.

Note that all triples corresponding to the tau and the tau-neutrino are colorless.

The beauty quark corresponds to 21 triples.

They are triples of the same form as the 7 tauon triples, but for 1 and I, 1 and J, and 1 and K, which correspond to the red, green, and blue beauty quarks, respectively.

The seven triples of the red beauty quark correspond to the seven triples of the tauon, except that the beauty quark interacts with 6 Spin(0,5) gravitons while the tauon interacts with only two.

The beauty quark constituent mass should be the tauon mass times the third generation graviton factor 6/2 = 3, so the B-quark mass is

$$mb = 5.63111 \text{ GeV}.$$

The calculated Beauty Quark mass of 5.63 GeV is a consitituent mass, that is,
it corresponds to the conventional pole mass plus 312.8 MeV.

Therefore, the calculated Beauty Quark mass of 5.63 GeV corresponds to a conventional pole mass of 5.32 GeV.

The 1996 Particle Data Group Review of Particle Physics gives a lattice gauge theory Beauty Quark pole mass as 5.0 GeV.

The pole mass can be converted to an MSbar mass
if the color force strength constant alpha_s is known.
The conventional value of alpha_s at about 5 GeV is about 0.22.
Using alpha_s (5 GeV) = 0.22,
a pole mass of 5.0 GeV gives an MSbar 1-loop mass of 4.6 GeV,
and an MSbar 1,2-loop mass of 4.3, evaluated at about 5 GeV.

If the MSbar mass is run from 5 GeV up to 90 GeV,
the MSbar mass decreases by about 1.3 GeV,
giving an expected MSbar mass of about 3.0 GeV at 90 GeV.
DELPHI at LEP has observed the Beauty Quark
and found a 90 GeV MSbar mass of about 2.67 GeV,
with error bars +/- 0.25 (stat) +/- 0.34 (frag) +/- 0.27 (theo).

Note that the theoretical model calculated mass of 5.63 GeV
corresponds to a pole mass of 5.32 GeV,
which is somewhat higher than the conventional value of 5.0 GeV.
However,
the theoretical model calculated value of
the color force strength constant alpha_s at
about 5 GeV is about 0.166,
while
the conventional value of
the color force strength constant alpha_s at

about 5 GeV is about 0.216,
and
the theoretical model calculated value of
the color force strength constant alpha_s at
about 90 GeV is about 0.106,
while
the conventional value of
the color force strength constant alpha_s at
about 90 GeV is about 0.118.

The theoretical model calculations gives
a Beauty Quark pole mass (5.3 GeV)
that is about 6 percent higher
than the conventional Beauty Quark pole mass (5.0 GeV),
and
a color force strength alpha_s at 5 GeV (0.166) such that
1 + alpha_s = 1.166 is about 4 percent lower
than the conventional value of 1 + alpha_s = 1.216 at 5 GeV.

Note particularly that triples of the type { 1, I, J },
{ I, J, K }, etc.,
do not correspond to the beauty quark, but to the truth quark.

The truth quark corresponds to the remaining 483 triples, so the
constituent mass of the red truth quark is 161/7 = 23 times the
red beauty quark mass, and the red T-quark mass is

$$mt = 129.5155 \text{ GeV}$$

The blue and green truth quarks are defined similarly.

All other masses than the electron mass
(which is the basis of the assumption of the value of the
Higgs scalar field vacuum expectation value v = 252.514 GeV),
including the Higgs scalar mass and Truth quark mass,
are calculated (not assumed) masses in the HyperDiamond Feynman
Checkerboard model.

The tree level T-quark constituent mass rounds off to 130 GeV.

These results when added up give a total mass of
third generation fermion particles:

Sigmaf3 = 1,629 GeV

The second generation fermion calculations are:

The second generation fermion particles correspond
to pairs of octonions.

There are 8^2 = 64 such pairs.

The pair { 1,1 } corresponds to the mu-neutrino.

the pairs { 1, E }, { E, 1 }, and
{ E, E } correspond to the muon.

Compare the symmetries of the muon pairs to the symmetries
of the first generation fermion particles.

The pair { E, E } should correspond
to the E electron.

The other two muon pairs have a symmetry group S2,
which is 1/3 the size of the color symmetry group S3
which gives the up and down quarks their mass of 312.75 MeV.

Therefore the mass of the muon should be the sum of
the { E, E } electron mass and
the { 1, E }, { E, 1 } symmetry mass,
which is 1/3 of the up or down quark mass.

Therefore, mmu = 104.76 MeV.

According to the 1998 Review of Particle Physics of the Particle Data Group, the experimental muon mass is about 105.66 MeV.

```
Note that all pairs corresponding to
the muon and the mu-neutrino are colorless.



The red, blue and green strange quark each corresponds
to the 3 pairs involving 1 and I, J, or K.


The red strange quark is defined as the thrge pairs
1 and I, because I is the red down quark.

Its mass should be the sum of two parts:
the { I, I } red down quark mass, 312.75 MeV, and
the product of the symmetry part of the muon mass, 104.25 MeV,
times the graviton factor.


Unlike the first generation situation,
massive second and third generation leptons can be taken,
by both of the colorless gravitons that
may carry electric charge, into massive particles.


Therefore the graviton factor for the second and

third generations is 6/2 = 3.


Therefore the symmetry part of the muon mass times
the graviton factor 3 is 312.75 MeV,
and
the red strange quark constituent mass
is
```

$$ms = 312.75 \text{ MeV} + 312.75 \text{ MeV} = 625.5 \text{ MeV}$$

```
The blue strange quarks correspond to the
three pairs involving J,
the green strange quarks correspond to the
```

three pairs involving K,
and their masses are determined similarly.

The charm quark corresponds to the other 51 pairs.
Therefore, the mass of the red charm quark should
be the sum of two parts:

the { i, i }, red up quark mass, 312.75 MeV; and

the product of the symmetry part of the strange quark
mass, 312.75 MeV, and

the charm to strange octonion number factor 51/9,
which product is 1,772.25 MeV.

Therefore the red charm quark constituent mass
is

$$mc = 312.75 \text{ MeV} + 1{,}772.25 \text{ MeV} = 2.085 \text{ GeV}$$

The blue and green charm quarks are defined similarly,
and their masses are calculated similarly.

The calculated Charm Quark mass of 2.09 GeV is a
consitituent mass, that is,
it corresponds to the conventional pole mass plus 312.8 MeV.

Therefore, the calculated Charm Quark mass of 2.09 GeV
corresponds to a conventional pole mass of 1.78 GeV.

The 1996 Particle Data Group Review of Particle Physics gives
a range for the Charm Quark pole mass from 1.2 to 1.9 GeV.

The pole mass can be converted to an MSbar mass
if the color force strength constant alpha_s is known.
The conventional value of alpha_s at about 2 GeV is about 0.39,

which is somewhat lower than the teoretical model value.
Using alpha_s (2 GeV) = 0.39,
a pole mass of 1.9 GeV gives an MSbar 1-loop mass of 1.6 GeV,
evaluated at about 2 GeV.

These results when added up give a total mass of
second generation fermion particles:

Sigmaf2 = 32.9 GeV

To calculate Kobayashi-Maskawa Parameters:

The Kobayashi-Maskawa parameters are determined in terms of
the sum of the masses of the 30 first-generation
fermion particles and antiparticles, denoted by Smf1 = 7.508 GeV,
and
the similar sums for second-generation and third-generation fermions,
denoted by Smf2 = 32.94504 GeV and Smf3 = 1,629.2675 GeV.

The reason for using sums of all fermion masses
(rather than sums of quark masses only) is that
all fermions are in the same spinor representation of Spin(8),
and the Spin(8) representations are considered to be fundamental.

The following formulas use the above masses to
calculate Kobayashi-Maskawa parameters:

phase angle d13 = 1 radian (unit length on a phase circumference)

sin(alpha) = s12 =
= [me+3md+3mu]/sqrt([me^2+3md^2+3mu^2]+[mmu^2+3ms^2+3mc^2]) =
           = 0.222198

sin(beta) = s13 =

```
= [me+3md+3mu]/sqrt([me^2+3md^2+3mu^2]+[mtau^2+3mb^2+3mt^2])=
          = 0.004608

sin(*gamma) =
= [mmu+3ms+3mc]/sqrt([mtau^2+3mb^2+3mt^2]+[mmu^2+3ms^2+3mc^2])

sin(gamma) = s23 = sin(*gamma) sqrt( Sigmaf2 / Sigmaf1 ) =
           = 0.04234886

The factor sqrt( Smf2 /Smf1 ) appears in s23 because
an s23 transition is to the second generation and
not all the way to the first generation,
so that the end product of an s23 transition has a
greater available energy than s12 or s13 transitions
by a factor of Smf2 / Smf1 .
Since the width of a transition is proportional to
the square of the modulus of the relevant KM entry and
the width of an s23 transition has greater available energy
than the s12 or s13 transitions by a factor of Smf2 / Smf1
the effective magnitude of the s23 terms in the KM entries
is increased by the factor sqrt( Smf2 /Smf1 ) .
```

The Chau-Keung parameterization is used,

```
as it allows the K-M matrix to be represented as
the product of the following three 3x3 matrices:
```

```
           1               0                 0

           0           cos(gamma)        sin(gamma)

           0          -sin(gamma)        cos(gamma)
```

```
       cos(beta)           0        sin(beta)exp(-i d13)

           0               1                 0

 -sin(beta)exp(i d13)  0             cos(beta)
```

---

cos(alpha)	sin(alpha)	0
-sin(alpha)	cos(alpha)	0
0	0	1

The resulting Kobayashi-Maskawa parameters
for W+ and W- charged weak boson processes, are:

	d	s	b
u	0.975	0.222	0.00249 -0.00388i
c	-0.222 -0.000161i	0.974 -0.0000365i	0.0423
t	0.00698 -0.00378i	-0.0418 -0.00086i	0.999

The matrix is labelled by either
(u c t) input and (d s b) output,
or, as above,
(d s b) input and (u c t) output.

For Z0 neutral weak boson processes, which are suppressed
by the GIM mechanism of cancellation of virtual subprocesses,
the matrix is labelled by either
(u c t) input and (u’c’t’) output,
or, as below,
(d s b) input and (d’s’b’) output:

	d	s	b
d’	0.975	0.222	0.00249 -0.00388i
s’	-0.222 -0.000161i	0.974 -0.0000365i	0.0423
b’	0.00698 -0.00378i	-0.0418 -0.00086i	0.999

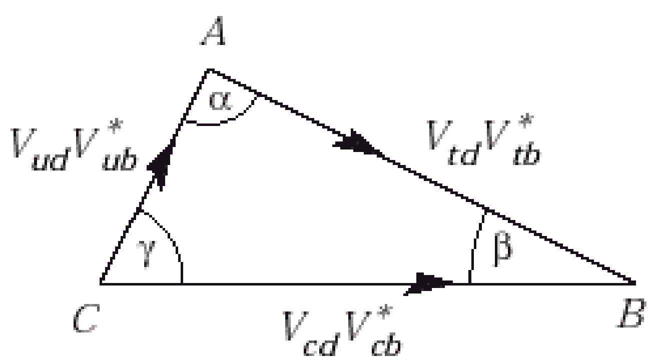
```
Since neutrinos of all three generations are massless at tree level,
the lepton sector has no tree-level K-M mixing.
```

According to a Review on the KM mixing matrix by Gilman, Kleinknecht, and Renk in the 2002 Review of Particle Physics:

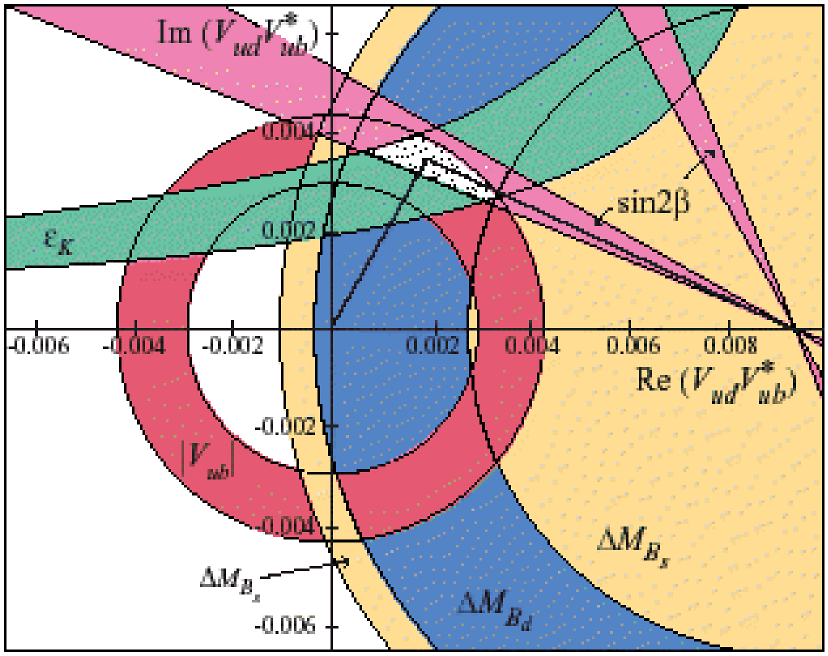
"... Using the eight tree-level constraints discussed below together with unitarity, and assuming only three generations, the 90% confidence limits on the magnitude of the elements of the complete matrix are

	d	s	b
u	0.9741 to 0.9756	0.219 to 0.226	0.00425 to 0.0048
c	0.219 to 0.226	0.9732 to 0.9748	0.038 to 0.044
t	0.004 to 0.014	0.037 to 0.044	0.9990 to 0.9993

... The constraints of unitarity connect different elements, so choosing a specific value for one element restricts the range of others. ... The phase d13 lies in the range 0 < d13 < 2 pi, with non-zero values generally breaking CP invariance for the weak interactions. ... Using tree-level processes as constraints only, the matrix elements ...[of the 90% confidence limit shown above]... correspond to values of the sines of the angles of s12 = 0.2229 +/- 0.0022, s23 = 0.0412 +/- 0.0020, and s13 = 0.0036 +/- 0.0007. If we use the loop-level processes discussed below as additional constraints, the sines of the angles remain unaffected, and the CKM phase, sometimes referred to as the angle gamma = phi3 of the unitarity triangle ...



... is restricted to d13 = (1.02 +/- 0.22) radians = 59 +/- 13 degrees. ... CP-violating amplitudes or differences of rates are all proportional to the product of CKM factors ... s12 s13 s23 c12 c13^2 c23 sind13. This is just twice the area of the unitarity triangle. ... All processes can be quantitatively understood by one value of the CKM phase d13 = 59 +/- 13 degrees. The value of beta = 24 +/- 4 degrees from the overall fit is consistent with the value from the CP-asymmetry measurements of 26 +/- 4 degrees. The invariant measure of CP violation is J = (3.0 +/- 0.3) x 10^(-5). ... From a combined fit using the direct measurements, B mixing, epsilon, and sin2beta, we obtain: Re Vtd = 0.0071 +/- 0.0008 , Im Vtd = -0.0032 +/- 0.0004 ... Constraints... on the position of the apex of the unitarity triangle following from | Vub | , B mixing, epsilon, and sin2beta. ...



... A possible unitarity triangle is shown with the apex in the preferred region. ...".

In hep-ph/0208080, Yosef Nir says: "... Within the Standard Model, the only source of CP violation is the Kobayashi-Maskawa (KM) phase ... The study of CP violation is, at last, experiment driven. ... The CKM matrix provides a consistent picture of all the measured flavor and CP violating processes. ... There is no signal of new flavor physics. ... Very likely, the KM mechanism is the dominant source of CP violation in flavor changing processes. ... The result is consistent with the SM predictions. ...".

Proton-Neutron Mass Difference:

```
According to the 1986 CODATA Bulletin No. 63,
the experimental value of the neutron mass is 939.56563(28) Mev,
```

and the experimental value of the proton is 938.27231(28) Mev.

The neutron-proton mass difference 1.3 Mev is due to
the fact that the proton consists of two up quarks and one down quark,
while the neutron consists of one up quark and two down quarks.

The magnitude of the electromagnetic energy difference
mN - mP is about 1 Mev,
but the sign is wrong: mN - mP = -1 Mev,
and
the proton's electromagnetic mass is greater than the neutron's.

The difference in energy between the bound states, neutron and proton,
is not due to a difference between
the Pre-Quantum constituent masses of the up quark and the down quark,
calculated in the theory to be equal.

It is due to the difference between the Quantum color force
interactions of the up and down constituent valence quarks
with the gluons and virtual sea quarks in the neutron and the proton.

An up valence quark, constituent mass 313 Mev,
does not often swap places with a 2.09 Gev charm sea quark,
but a 313 Mev down valence quark can more often swap places
with a 625 Mev strange sea quark.

Therefore the Quantum color force constituent mass
of the down valence quark is heavier by about

(ms - md) (md/ms)^2 a(w) |Vds| =

= 312 x 0.25 x 0.253 x 0.22 Mev = 4.3 Mev,

(where
a(w) = 0.253 is the geometric part of the weak force strength
and
|Vds| = 0.22 is the magnitude of the K-M parameter
mixing first generation down and second generation strange)

so that **the Quantum color force constituent mass Qmd**
of the down quark is

Qmd = 312.75 + 4.3 = 317.05 MeV.

Similarly,
the up quark Quantum color force mass increase is about

(mc - mu) (mu/mc)^2 a(w) |V(uc)| =

= 1777 x 0.022 x 0.253 x 0.22 Mev = 2.2 Mev,

(where
|Vuc| = 0.22 is the magnitude of the K-M parameter
mixing first generation up and second generation charm)

so that **the Quantum color force constituent mass Qmu of the up quark is**

Qmu = 312.75 + 2.2 = 314.95 MeV.

The Quantum color force Neutron-Proton mass difference is

mN - mP = Qmd - Qmu = 317.05 Mev - 314.95 Mev = 2.1 Mev.

Since the electromagnetic Neutron-Proton mass difference is

roughly mN - mP = -1 MeV

the total theoretical Neutron-Proton mass difference is

mN - mP = 2.1 Mev - 1 Mev = 1.1 Mev,

an estimate that is fairly close
to the experimental value of 1.3 Mev.

Note that in the equation

(ms - md) (md/ms)^2 a(w) |Vds| = 4.3 Mev

Vds is a mixing of down and strange by a neutral Z0,
compared to the more conventional Vus mixing by charged W.
Although real neutral Z0 processes are suppressed
by the GIM mechanism,
which is a cancellation of virtual processes,
the process of the equation is strictly a virtual process.

```
Note also that the K-M mixing parameter |Vds| is linear.
Mixing (such as between a down quark and a strange quark)
is a two-step process,
that goes approximately as the square of |Vds|:
First
the down quark changes to a virtual strange quark,
producing one factor of |Vds|.
Then, second,
the virtual strange quark changes back to a down quark,
producing a second factor of |Vsd|, which is approximately
equal to |Vds|.

Only the first step (one factor of |Vds|) appears in the
Quantum mass formula used to determine the neutron mass.
If you measure the mass of a neutron,
that measurement includes a sum over a lot of histories
of the valence quarks inside the neutron.
In some of those histories, in my view,
you will "see" some of the two valence down quarks
in a virtual transition state that is at a time
after the first action, or change from down to strange,
and
before the second action, or change back.
Therefore, you should take into account
those histories in the sum in which you see a strange valence quark,
and you get the linear factor |Vds| in the above equation.


Note also that
if there were no second generation fermions,
or
if the second generation quarks had equal masses,
then
the proton would be heavier than the neutron
(due to the electromagnetic difference)
and
the hydrogen atom would decay into a neutron,
and
there would be no stable atoms in our world.
```

In this model, protons decay by virtual Black Holes over 10^64 years, according to by Hawking and his students who have studied the physical consequences of creation of virtual pairs of Planck-energy Black Holes.

UCC - DCC Baryon Mass Difference:

According to a 14 June 20002 article by Kurt Riesselmann in Fermi News: "... The four [first and second generation] flavors - up, down, strange, charm - allow for twenty different ways of putting quarks together to form baryons ... Protons, for example, consist of two up quarks and one down quark (u-u-d), and neutrons have a u-d-d quark content. Some combinations exist in two different spin configurations, and the SELEX collaboration believes it has identified both spin levels of the u-c-c baryon. ... Physicists expect the mass difference between u-c-c and d-c-c baryons to be comparable to the difference in proton (u-u-d) and neutron (u-d-d) mass, since this particle pair is also related by the replacement of an up by a down quark. **The proton-neutron mass splitting**, however, **is sixty times smaller than the mass difference between the Xi_cc candidates** observed by the SELEX collaboration. ...

... Other questions, however, remain as well. The SELEX collaboration is puzzled by the high rate of doubly charmed baryons seen in their experiment. As a matter of fact, most scientists believed that the SELEX collaboration wouldn't see any of these particles. ...".

```
An up valence quark, constituent mass 313 Mev,
can swap places with a 2.09 Gev charm sea quark.
Therefore the Quantum color force constituent mass
of the down valence quark is heavier by about

  (mc - mu)    a(w)    |Vds|         =

=   1,777  x  0.253  x  0.22   Mev   =   98.9 Mev,

(where
a(w) = 0.253 is the geometric part of the weak force strength
and
|Vuc| = 0.22 is the magnitude of the K-M parameter
        mixing first generation up and second generation charm)

so that the Quantum color force constituent mass Qmu
of the up quark is
```

```
                       Qmu = 312.75 + 98.9 = 411.65 MeV.


A 313 Mev down valence quark can swap places
with a 625 Mev strange sea quark.
Therefore the Quantum color force constituent mass
of the down valence quark is heavier by about

  (ms - md)  a(w)    |Vds|        =

=   312  x  0.253  x  0.22   Mev   =   17.37 Mev,

(where
a(w) = 0.253 is the geometric part of the weak force strength
and
|Vds| = 0.22 is the magnitude of the K-M parameter
        mixing first generation down and second generation strange)

so that the Quantum color force constituent mass Qmd
of the down quark is
                       Qmd = 312.75 + 17.37 = 330.12 MeV.
```

Note that at the energy levels at which ucc and dcc live, the ambient sea of quark-antiquark pairs has at least enough energy to produce a charm quark, so that in the above equations there is no mass-ratio-squared suppression factor such as (mu/mc)^2 or (md/ms)^2, unlike the case of the calculation of the neutron-proton mass difference for which the ambient sea of quark-antiquark pairs has very little energy since the proton is almost stable and the neutron-proton mass difference is, according to experiment, only about 1.3 MeV.

Note also that these rough calculations ignore the electromagnetic force mass differentials, as they are only on the order of 1 MeV or so, which for ucc - dcc mass difference is small, unlike the case for the calculation of the neutron-proton mass difference.

```
The Quantum color force ucc - dcc mass difference is
```

mucc - mdcc = Qmu - Qmd = 411.65 MeV - 330.12 MeV = 81.53 MeV

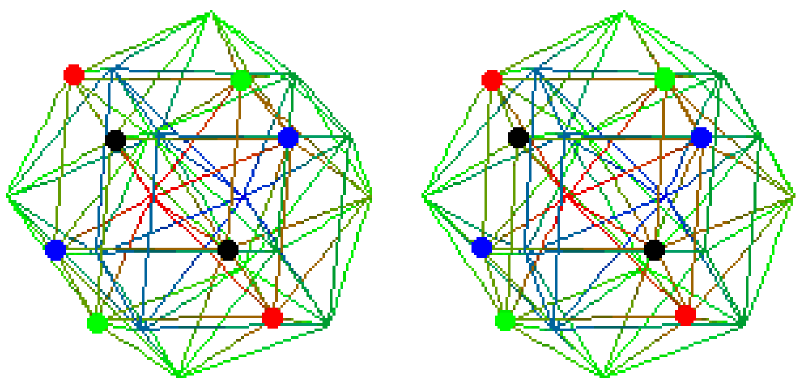
Since the experimental value of the neutron-proton mass difference is about 1.3 MeV, the theoretically calculated

ucc - dcc mass difference is about 81.53 / 1.3 = 62.7 times the experimental value of the neutron-proton mass difference,

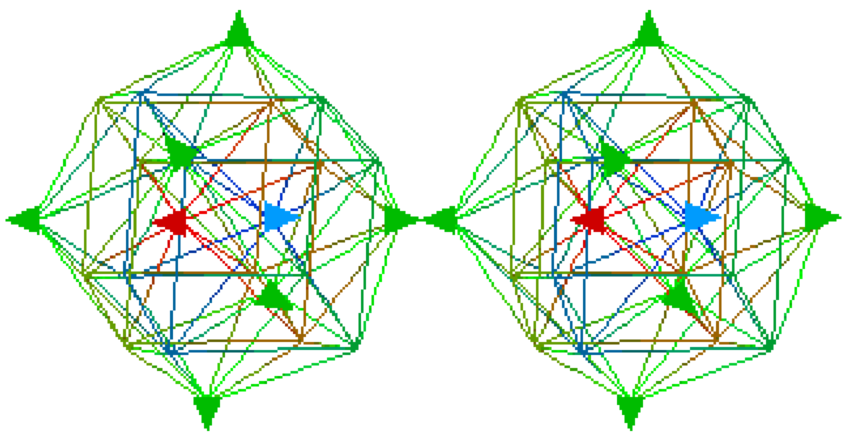
which is consistent with the SELEX 2002 experimental result that: "... The proton-neutron mass splitting ... is sixty times smaller than the mass difference between the Xi_cc candidates ...".

Root Vector Geometry of Fermions, Spacetime, Gauge Bosons, and D4-D5-E6-E7›E8.

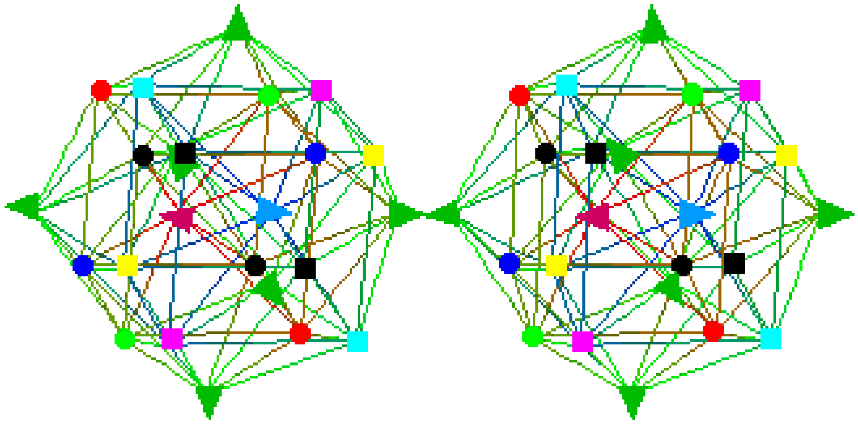
The 8 first-generation fermion particles can be represented as 8 vertices of a 24-cell



The 8 dimensions of unreduced spacetime (which reduces to 4-dimensional physical spacetime plus 4› dimensional internal Symmetry Space) can be represented as another 8 vertices of the 24-cell



The third set of 8 vertices of the 24-cell then represents the 8 first-generation fermion particles, so that the entire 24-cell representation looks like

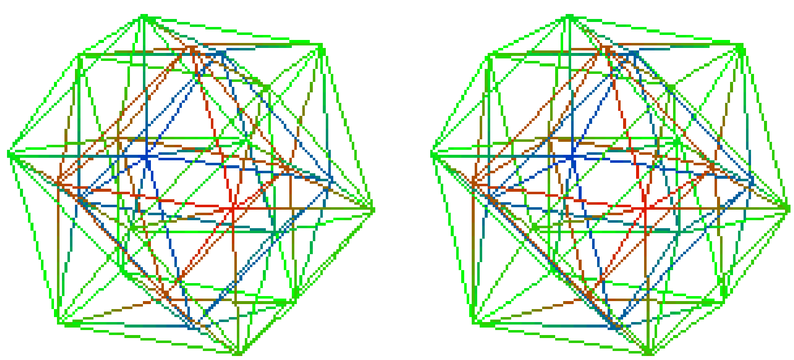


Note that the three sets of 8 vertices correspond to the two half-spinor and the vector representations of the D4 Lie Algebra are related by triality.

These relationships can also be viewed from the perspective of the Cl(1,7) Clifford Algebra structures

1 8 28 56 70 56 28 8 1 = (8+8)x(8+8)

As to the 28-dimensional adjoint representation, 24 of the 28 gauge boson D4 generators can be represented by the vertices of a dual 24-cell:



Note that the 24 + 24 = 48 vertices of the two dual 24-cells are 48 of the 72 root vector vertices of the E6 Lie algebra, and correspond to the 48 root vector vertices of the F4 subalgebra of E6:

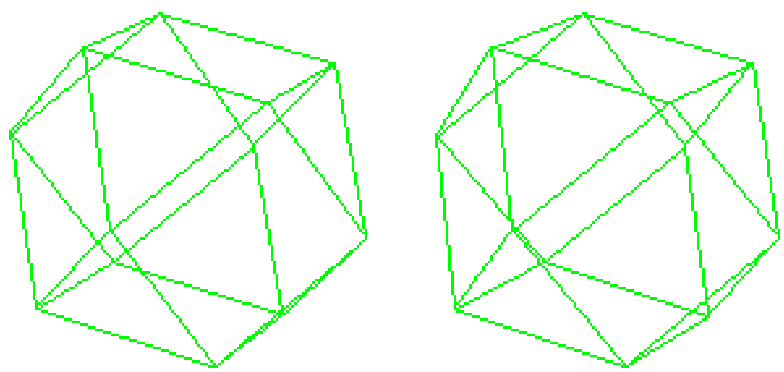
> The 24 adjoint gauge boson vertices correspond to the 24 root vector vertices of the D4 subalgebra of E6;

When the 8 vector spacetime vertices are added, you get the 32 root vector vertices of the B4 subalgebra of E6;

When the 8+8 = 16 spinor vertices are added, you get the 48 root vector vertices of the F4 subalgebra of E6.

Here is how the 24 adjoint gauge boson vertices break down after dimensional reduction to form U(2,2) for gravity plus SU(3)xSU(2)xU(1) for the Standard Model:

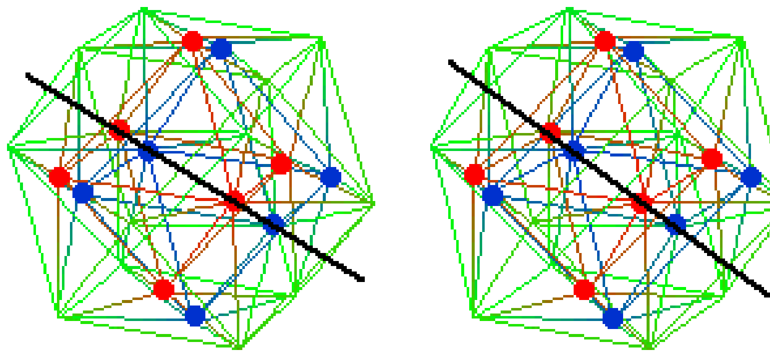
12 of the 24 vertices correspond to the 12 vertices of the cuboctahedron



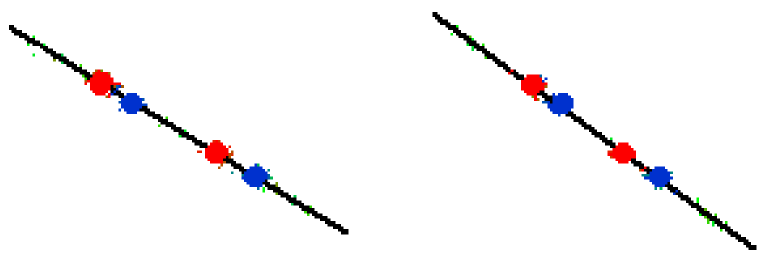
that is the root vector polytope of the A3 = D3 Lie Algebra SU(2,2) = Spin(2,4) of the 4-dimensional Conformal Group. Then add the 4 D4 Cartan subalgebra generators to get the 12+4 = 16-dimensional Lie Algebra SU(2,2)xU(1) = Spin(2,4)xU(1) = U(2,2) that, by a generalization of the MacDowell-Mansouri mechanism, produces Gravity and the Higgs mechanism, and

12 vertices of the 24 adjoint gauge boson vertices, plus the 4 D4 Cartan Subalgebra generators, represent the 16-dimensional U(2,2) for construction of Gravity plus Higgs.

That leaves 24-12 = 12 remaining vertices

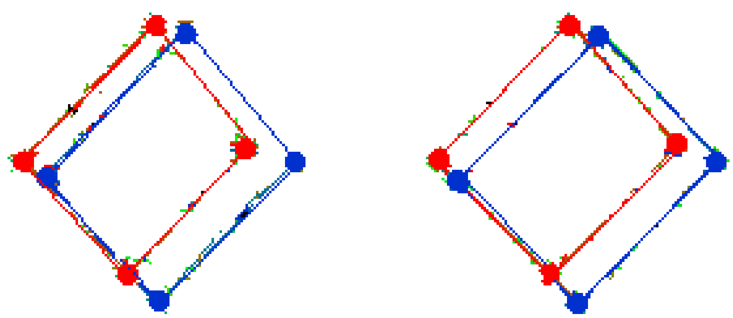


4 of which lie on a common line



and represent the generators of the 4-dimensional Lie Algebra U(2) = SU(2)xU(1).

The remaining 8 vertices



form a cube that can be labelled

```
    tb----xb
     |\    | \
   | zb----yb
    |  |   |   |
  yr-|--zr  |
     \|     \|
```

```
xr----tr
```

Now look at the cube along its tb-tr diagonal axis, and project all 8 vertices onto a plane perpendicular to the tb-tr axis, giving the diagram

```
          yb

xb                zb

        tb tr

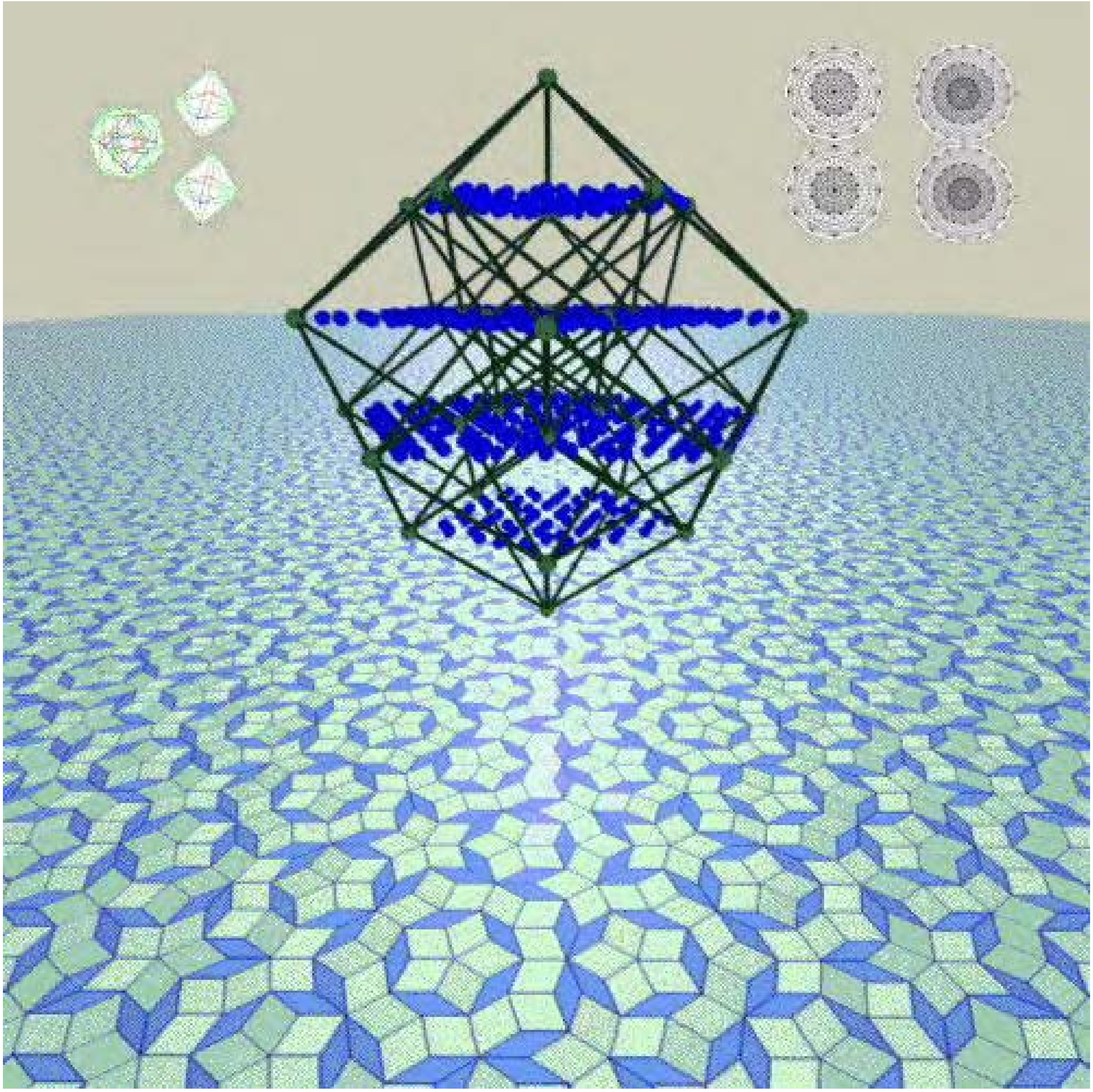
zr                xr

          yr
```

with two central points surrounded by two interpenetrating triangles, which is the root vector diagram of SU(3), Therefore:

the 12 remaining vertices of the 24 adjoint gauge boson vertices represent the Standard Model Gauge Group SU(3xSU(2xU(1),

There is a nice geometric way to see the structures of D4-D5-E6-E7-E8 Lie Algebras:



Floating above the Penrose-tiled plane in the above image (adapted from Quasitiler) are, going from left to right:

- 4-dimensional 24-cell, whose **24 vertices are the root vectors of the 24+4 = 28-dimensional D4 Lie algebra**;
- two 4-dimensional HyperOctahedra, lying (in a 5th dimension) above and below the 24-cell, whose **8+8 = 16 vertices add to the 24 D4 root vectors to make up the 40 root vectors of the 40+5 = 45-dimensional D5 Lie algebra**;
- 5-dimensional HyperCube, half of whose 32 vertices are lying (in a 6th dimension) above and half below the 40 D5 root vectors, whose **16+16 = 32 vertices add to the 40 D5 root vectors to make up the 72 root vectors of the 72+6 = 78-dimensional E6 Lie algebra**;
- two 27-dimensional 6-dimensional figures, lying (in a 7th dimension) above and below the the 72

E6 root vectors, whose 27+27 = 54 vertices add to the 72 E6 root vectors to make up the 126 root vectors of the 126+7 = 133-dimensional E7 Lie algebra; and

- two 56-dimensional 7-dimensional figures, lying (in an 8th dimension) above and below the the 126 E7 root vectors, and two polar points also lying above and below the 126 E7 root vectors, whose56+56+1+1 = 114 vertices add to the 126 E7 root vectors to make up the 240 root vectors of the 240+8 = 248-dimensional E8 Lie algebra.

E6 is an exceptional simple graded Lie algebra of the second kind:

E6 = g = g-2 + g-1 + g0 + g1 + g2

g0 = so(1,7) + R + iR

dim g-1 = 16

dim g-2 = 8

This gives real Shilov boundary geometry of S1xS7 for (1,7)-dimensional high-energy spacetime representation and for the first generation half-spinor fermion representations, which is the local structure needed for a local Lagrangian and calculation of ratios of particle masses and force strengths.

Geometric Structure of NonLocal Quantum Theory is given by E6, E7, and E8:

- **26-dim String Theory** with Jordan Algebra structure **J3(O)o** and Lie Algebra structure **E6 / F4** describes Generalized Bohm Quantum Theory with NonLinear Back-Reaction.
- **27-dim M-theory** with Jordan Algebra structures **J3(O) and J4(Q)o** and Lie Algebra structure **E7 / E6xU(1)** describes Timelike Branes in the MacroSpace of Many-Worlds.
- **28-dim F-theory** with Jordan Algebra structure **J4(Q)** and Lie Algebra structure **E8 / E7xSU(2)** describes Spacelike Branes in the MacroSpace of Many-Worlds.

References:

The theoretical physics model described in this paper is not only based on the Lie Algebras D4, D5, E6, E7, and E8, but also on the 256-dimensional Clifford Algebra Cl(1,7), whose 256 dimensions correspond to the 256 Odu of IFA, also known as Vodou. Therefore, the name that I prefer for this theoretical physics model is

the D4-D5-E6-E7-E8 VoDou Physics Model.

Many details and references can be found on my home page on the web at URL

http://www.innerx.net/personal/tsmith/TShome.html

and on pages linked therefrom.

A few specific outside references are:

Weinberg, The Quantum Theory of Fields (2 Vols.), Cambridge 1995,1996.

Barger and Phillips, Collider Physics, updated edition, Addison Wesley 1997.

Gockeler and Schucker, Differential Geometry, Gauge Theories, and Gravity , Cambridge 1987.

Kane, Modern Elementary Particle Physics, updated edition, Addison Wesley 1993.

Kobayashi and Nomizu, Foundations of Differential Geometry, vol. 1, John Wiley 1963.

Kobayashi and Nomizu, Foundations of Differential Geometry, vol. 2, John Wiley 1969.

Mayer, Hadronic Journal 4 (1981) 108-152, and also articles in New Developments in Mathematical Physics, 20th Universitatswochen fur Kernphysik in Schladming in February 1981 (ed. by Mitter and Pittner), Springer-Verlag 1981, which articles are:

- A Brief Introduction to the Geometry of Gauge Fields (written with Trautman);
- The Geometry of Symmetry Breaking in Gauge Theories;
- Geometric Aspects of Quantized Gauge Theories.

Ni, To Enjoy the Morning Flower in the Evening - What does the Appearance of Infinity in Physics Imply?, quant-ph/9806009.

Ni, Lou, Lu, and Yang, hep-ph/9801264.

Particle Properties from the Particle Data Group at LBL

Quasitiler - The Penrose Tiling and 5-dim HyperCube in the image at the top of this page is from a web page of Alex Feingold. Unfortunately, the link to Quasitiler at the Geometry Center of the University of Minnesota is no longer good, because not only was the URL http://freeabel.geom.umn.edu/ changed to http://www.geom.umn.edu/ some time ago, but now the Geometry Center has gone away (NSF funds were cut off). Some of its pages live on in google cache, such as http://www.google.com/search?q=cache:s_WVB9Mv-4MC:www.geom.umn.edu/closed.html+&hl=en , but I don't know how to access all of them, and I feel that the loss of the Geometry Center is a loss to all of us who use the web.

Encyclopedic Dictionary of Mathematics, second edition, MIT Press 1993; Hua, Harmonic Analysis of Functions of Several Complex Variables in the Classical Domains, Am. Math. Soc. 1979; Helgason, Differential Geometry, Lie Groups, and Symmetric Spaces, Academic 1978; Helgason, Groups and Geometric Analysis, Academic 1984; Besse, Einstein Manifolds, Springer-Verlag 1987; Rosenfeld, Geometry of Lie Groups, Kluwer 1997; Gilmore, Lie Groups, Lie Algebras, and Some of Their Applications, John Wiley 1974; Edward Dunne's web site; Coquereaux and Jadczyk, Conformal Theories, Curved Phase Spaces Relativistic Wavelets and the Geometry of Complex Domains, Reviews in Mathematical Physics, Volume 2, No 1 (1990) 1-44, which can be downloaded from the web as a 1.98 MB pdf file.

Tony's Home

...

Wireframes, Surfaceframes, Volumes, etc.

Geometric volumes needed for calculation of force strengths include:

```
Force        M      Vol(M)

gravity     S^4    8pi^2/3 - S^4 is a 4-dim solid


color       CP^2   8pi^2/3 - CP^2 is a 4-dim solid


weak   S^2 x S^2  2 x 4pi - S^2 is a 2-dim boundary of 3-dim ball
                                4-dim S^2 x S^2 =
                           = topological boundary of 6-dim 2-polyball
                   Shilov Boundary of 6-dim 2-polyball = S^2 + S^2 =
                           = 2-dim surface frame of 4-dim S^2 x S^2

e-mag       T^4    4 x 2pi - S^1 is 1-dim boundary of 2-dim disk
                             4-dim T^4 = S^1 x S^1 x S^1 x S^1 =
                           = topological boundary of 8-dim 4-polydisk
                   Shilov Boundary of 8-dim 4-polydisk =
                           = S^1 + S^1 + S^1 + S^1 =
                           = 1-dim wire frame of 4-dim T^4
```

Also note that:

For U(1) electromagnetism, whose photon carries no charge, the factors Vol(Q) and Vol(D) do not apply and are set equal to 1.

From another point of view, the link manifold to the target vertex is trivial for the abelian neutral U(1) photons of Electromagnetism, so we take QE and DE to be equal to unity.

Tony's Home Page

Some Phenomena that can be understood in terms of the D4-D5-E6-E7-E8 VoDou Physics Model

- Atmospheric and Solar Neutrino Observations
- Ken Shoulders's EVOs and Ball Lightning

Atmospheric and Solar Neutrino Observations

```
Consider the three generations of neutrinos:
nu_e (electron neutrino); nu_m (muon neutrino); nu_t
and three neutrino mass states: nu_1 ; nu_2 : nu_3
and
the division of 8-dimensional spacetime into
4-dimensional physical Minkowski spacetime
plus
4-dimensional CP2 internal symmetry space.

The lightest mass state nu_1 corresponds to a neutrino
whose propagation begins and ends in physical Minkowski spacetime,
lying entirely therein. According to the D4-D5-E6-E7-E8 VoDou
Physics Model the mass of nu_1 is zero at tree-level
and it picks up no first-order correction while propagating
entirely through physical Minkowski spacetime,
so
the first-order corrected mass of nu_1 is zero.

Since only two of the three neutrinos have first-order mass,
and since in the D4-D5-E6-E7-E8 VoDou Physics Model the
neutrinos are not Majorana particles,
there is no neutrino CP-violation or phase at first order.

Consider the neutrino mixing matrix
```

	nu_1	nu_2	nu_3
nu_e	Ue1	Ue2	Ue3
nu_m	Um1	Um2	Um3
nu_t	Ut1	Ut2	Ut3

Assume the simplest mixing scheme with a massless nu_1
and
nu_3 has no nu_e component so that Ue3 = 0 or, in conventional
notation, mixing angle theta_13 = 0 = sin(theta_13)
and cos(theta_13) = 1.
Then we have (as described in the 2004 Particle Data Book):

	nu_1	nu_2	nu_3
nu_e	cos(theta_12)	sin(theta_12)	0
nu_m	-sin(theta_12)cos(theta_23)	cos(theta_12)cos(theta_23)	sin(theta_23)
nu_t	sin(theta_12)sin(theta_23)	-cos(theta_12)sin(theta_23)	cos(theta_23)

Assume that nu_3 has equal components of nu_m and nu_t so
that Um3 = Ut3 = 1/sqrt(2) or, in conventional
notation, mixing angle theta_23 = pi/4.
Then we have:

	nu_1	nu_2	nu_3
nu_e	cos(theta_12)	sin(theta_12)	0
nu_m	-sin(theta_12)/sqrt(2)	cos(theta_12)/sqrt(2)	1/sqrt(2)
nu_t	sin(theta_12)/sqrt(2)	-cos(theta_12)/sqrt(2)	1/sqrt(2)

The heaviest mass state nu_3 corresponds to a neutrino
whose propagation begins and ends in CP2 internal symmetry space,
lying entirely therein. According to the D4-D5-E6-E7-E8 VoDou Physics Model the mass of nu_3 is zero at tree-level
but it picks up a first-order correction propagating
entirely through internal symmetry space by
merging with an electron through the weak and electromagnetic forces,
effectively acting not merely as a point
but
as a point plus an electron loop at both beginning and ending points
so
the first-order corrected mass of nu_3 is given by
M_nu_3 x (1/sqrt(2)) = M_e x GW(mproton^2) x alpha_E
where the factor (1/sqrt(2)) comes from the Ut3 component
of the neutrino mixing matrix

so that
M_nu_3 = sqrt(2) x M_e x GW(mproton^2) x alpha_E =
= 1.4 x 5 x 10^5 x 1.05 x 10^(-5) x (1/137) eV =
= 7.35 / 137 = **5.4 x 10^(-2) eV**.
Note that the neutrino-plus-electron loop can be anchored
by weak force action through any of the 6 first-generation quarks
at each of the beginning and ending points, and that the
anchor quark at the beginning point can be different from
the anchor quark at the ending point,
so that there are 6x6 = 36 different possible anchorings.

The intermediate mass state nu_2 corresponds to a neutrino
whose propagation begins or ends in CP2 internal symmetry space
and ends or begins in physical Minkowski spacetime,
thus having only one point (either beginning or ending) lying
in CP2 internal symmetry space where it can act not merely
as a point but as a point plus an electron loop.
According to the D4-D5-E6-E7-E8 VoDou Physics Model the mass
of nu_2 is zero at tree-level
but it picks up a first-order correction at only one (but not both)
of the beginning or ending points
so that so that there are 6 different possible anchorings
for nu_2 first-order corrections, as opposed to the 36 different
possible anchorings for nu_3 first-order corrections,
so that
the first-order corrected mass of nu_2 is less than
the first-order corrected mass of nu_3 by a factor of 6,
so
the first-order corrected mass of nu_2 is
M_nu_2 = M_nu_3 / Vol(CP2) = 5.4 x 10^(-2) / 6
= 9 x 10^(-3)eV.

Therefore:

the mass-squared difference D(M23^2) = M_nu_3^2 - M_nu_2^2 =
= (2916 - 81) x 10^(-6) eV^2 =
= 2.8 x 10^(-3) eV^2

and

the mass-squared difference D(M12^2) = M_nu_2^2 - M_nu_1^2 =
= (81 - 0) x 10^(-6) eV^2 =
= 8.1 x 10^(-5) eV^2

```
Set theta_12 = pi/6 so that cos(theta_12) = 0.866 = sqrt(3)/2
and sin(theta_12) = 0.5 = 1/2 = Ue2 = fraction of nu_2 begin/end
points that are in the physical spacetime where massless nu_e lives.
Then we have for the neutrino mixing matrix:
```

	nu_1	nu_2	nu_3
nu_e	0.87	0.50	0
nu_m	-0.35	0.61	0.71
nu_t	0.35	-0.61	0.71

The above model is substantially consistent with experimental results as described in the 2004 Particle Data Book and in the presentation by deGouvea at the 2004 APS DPF meeting at UC Riverside, and it provides an intuitive physical understanding of those results.

Ken Shoulders's EVOs and Ball Lightning

```
For reference, here are values of some useful physical quantities:

The effective G* induced by the zero point energy core needed
to stabilize a single spatially extended electron is ~ 10^40 G.

G* m / r = e / r   G* m = e    G* = e/m = 10^42

e        Electron charge        [Q]           1.381 E-34 cm

m_e      Electron mass          [M]           9.1095 E-28 gm
                                                   6.764 E-56 cm

r_e      Electron radius        [L]           2.81794 E-13 cm
              classical (= alpha(h-bar/(m_e c))

r_es     Electron Schwarzschild radius  [L]   1.35264 E-55 cm
              (= 2G_0 m_e/c^2)
              22 orders of magnitude *smaller* than the Planck length

a_0      Bohr radius            [L]           0.529177 E-08 cm
              ( = h-bar^2/(m_e e^2) )
```

Ken Shoulders and Steve Shoulders said in 1996: "... Highly organized, **micron-sized clusters of electrons** having soliton behavior ... have been investigated by K. Shoulders since 1980 ... a short Latin acronym has been adopted and the structure is called an EV, for strong electron. Their organizational properties have been theoretically studied and reported by P. Beckmann [... Petr Beckmann, "Electron Clusters," Galilean Electrodynamics, Sept./Oct., Vol. 1, No. 5, pp. 55-58, 1990 ...] and R. Ziolkowski [... Richard W. Ziolkowski and Michael K. Tippett, "Collective effect in an electron plasma system catalyzed by a localized electromagnetic wave," Physical Review A, vol. 43, no.6, pp. 3066-3072, 15 mar., 1991 ...] ... What is seen in the laboratory is an extremely energetic entity ... Measurements ... measuring the charge-to-mass ratio of the structure ...[by]... time-of-flight ... have been made showing there are no included ions to a limit of at least one ion per million electrons. **The total number of electrons in a one micrometer diameter EV is 10^11**. ...". In 1999 they said: "... Throughout much of this work on EV energetics it has been obvious that we get more energy out of certain experiments than we put in. ...".

In August 2004 e-mail messages about Shoulders's EVOs, Jack Sarfatti said:

> "... picture is of a self-assembled spherical shell or maybe a kind of Buckyball of N close-packed electrons each of effective surface area ~ (h/mc)^2. This forms a closed cavity › with some leakage perhaps, but the leakage rate decreases as N increases. Obviously there

will be a cavity boundary condition Casimir effect but I am pretty sure it is usually negligible in comparison with my strong gravity effect from Einstein's general relativity. ...

... The KEY IDEA is as follows:

1. The repulsive electro-static self energy per unit electron mass for the N poly-electron cluster is V(Coulomb Self-Energy) ~ N^2e^2/mr > 0 where the N electrons are arranged in a mono-layer thin spherical shell of thickness h/mc ~ 10^-11 cm

i.e. Euclidean area of the shell is A = 4pir^2 = N(h/mc)^2 r ~ N^1/2(h/mc) = Schwarzschild radial coordinate if large space warp ... from G* ~ 10^40G at short-range.

That is, N on-mass-shell bare electrons each of radius e^2/mc^2 ~ 10^-13 cm in a soup of virtual plasma of virtual photons and virtual electron-positron pairs - the latter partially condensed as a vacuum condensate!

... a Casimir force ... plays a minor secondary role. The Casimir potential energy per unit electron mass will be of the form V(Casimir) ~ C(hc/mr)N(h/mcr)^2 Where C is a dimensionless coefficient that can be positive or negative ... Note that V(Casimir) scales only as N because it depends on the surface area of the N poly-electron thin shell. This is a boundary effect!

Ignoring rotational and vibrational modes - to be added later. All we have next is the GR correction term ... V(Dark Energy) = c^2/\zpfr^2 a 3D Harmonic Oscillator Potential like a ball in a tunnel through center of Earth

Note that /\zpf > 0 i.e. an anti-gravity repulsive "dark energy" exotic vacuum core that COUNTER-INTUITIVELY BINDS the N electrons into a metastable BOUNDARY WALL THIN POLY-ELECTRON SHELL making the QED Casimir force in the first place ... Adding all three potential energies Coulomb, Casimir & General Relativity with PW Anderson's "More is Different"

V(total) = BN^2(e^2/mr) + CN(hc/mr)(h/mcr)^2 + c^2/\zpfr^2

B is also a dimensionless coefficient The critical point for dynamical equilibrium is dV(total)/dr = 0 i.e. the total acceleration must vanish in metastable equilibrium where r --> r* -BN^2(e^2/mr*^2) - 3CN(hc/mr*^2)(h/mcr*)^2 + 2c^2/\zpfr* = 0

So I do not care about Casimir force, which when N >> 1 is obviously a small perturbation!

We now have a more accurate formula for r*, or rather, if you want to keep r* = N^1/2(h/mc) then you can compute /\zpf.

> We also have the stability constraint: d^V(total)/dr^2 > 0
>
> When this constraint is violated WE HAVE WHAT IS BEGINNING TO SUGGEST A BOMB! ...
>
> ... you must explain why the boundary forms! You cannot impose it by fiat. The boundary is the thin shell of charge itself of radius a ~ N^1/2(h/mc). If N ~ 10^12 that gives a ~ 10^-5 cm. ... I don't think it works well for 2 electrons. You need, in simplest model, N >> 1 electrons close-packed to form a sphere ...".

My model for EVOs also makes a spherical shell, but it is a two-layer shell, motivated by the formation of a blastocyst two-layer shell in embryology, and it also explains how the door to the high-energy vacuum is opened.

```
Here is an 8-step description of my model:

1 - A bunch of electrons are zapped in Ken Shoulders's apparatus
with a complicated electromagnetic field.

2 - One of the electrons finds another with opposite spin
and they form a Cooper pair of two electrons
in a dumbbell configuration.

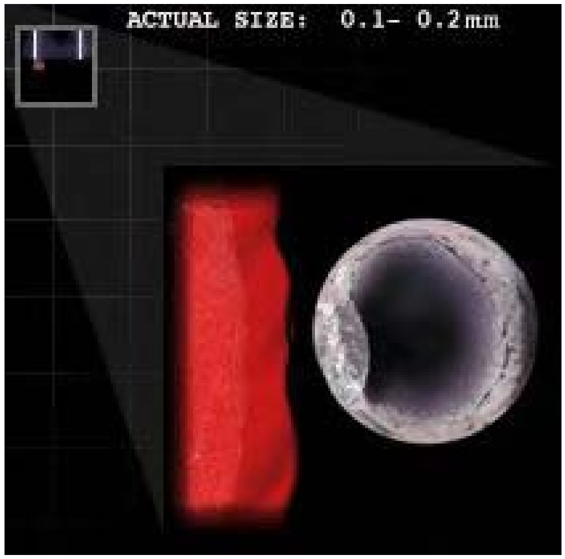
3 - They find another Cooper pair, and the 4 of them form
a double-dumbbell tetrahedral configuration.

4 - The tetrahedron finds (or catalyzes the formation of)
another opposite-oriented tetrahedron, and the 8 of them
form a cube.

5 - Each of the 8 vertices of the cube finds from the cloud
an opposite-spin electron, and the 16 of them look like
Cooper pairs at each of the 8 cube vertices
with the long axis of each pair on a diagonal of the cube.
```

FORMATION OF THE 16 CONFIGURATION IS LIKE THE MORULA / BLASTOCYST TRANSITION

(At age 4 days, a human embryo consists of a solid ball of 16 cells, called the morula. At the next stage of cell division, the blasocyst forms. Here is a blastocyst image



from http://www.visembryo.com/baby/stage3.html which states: "... Cell division continues, and a cavity known as a blastocele forms in the center of the morula. Cells flatten and compact on the inside of the cavity ... the appearance of the cavity in the center the entire structure is now called a blastocyst. ... two cell types are forming: the embryoblast (inner cell mass on the inside of the blastocele), and the trophoblast (the cells on the outside of the blastocele). ...".)

```
THE CENTER OF THE CUBE IS A HOLLOW INTERIOR,
with a 2-layer boundary of 8 inner electrons of each Cooper pair
and 8 outer electrons of each Cooper pair.
The 8 inner electrons can be thought of as being bounded by
the 8 outer electrons.

6 - Any energy (kinetic or repulsive electromagnetic) of
the 8 inner electrons confined by the boundary of the 8 outer electrons
is transferred to the Bohm Quantum Potential by the process
described in Bohm's Hidden Variable Paper II, section 5,
(reprinted at page 387 of Quantum Theory and Measurement,
edited by Wheeler and Zurek (Princeton 1983))
in which Bohm says:
   "... the PSI-field is able to bring the particle to rest
   and to transform the entire kinetic energy into potential energy
   of interaction with the PSI-field. ...".
Bohm discusses specifically the situation of
   "... a "free" particle contained between two impenetrable and
   perfectly reflecting walls, separated by a distance L. ...",
but
perhaps a similar analysis might apply to a spherical cluster.
Bohm goes on to say:
   "... at first sight, it may seem puzzling
   that a particle having a high energy should be at rest
   in the empty space between two walls.
```

```
   Let us recall, however, that the space is not really empty,
   but contains
   an objectively real PSI-field that can act on the particle. ...".

7 - The increased energy of the Bohm Quantum Potential is
now enough to open the door to the high-energy vacuum,
which effectively gives the electron configuration
access to conformal degrees of freedom of of vacuum dark energy etc.

8 - The electron double-layer with central vacuum energy configuration,
which is the EVO, then begins to collect the other electrons in
the cloud, making them into Cooper pairs and sticking them into
the sort-of-spherical double-layer.
The outer layer of electrons acts as a protective boundary for
the EVO, because if a hostile electron/positive ion system
attacks the EVO, an outer boundary EVO electron neutralizes
the positive ion and the EVO captures the remaining electron
to replace the boundary electron.
The entire EVO system continues to grow until the electrons
of the cloud are all assimilated into it (about 10^12 electrons
in the case of EVOs manufactured by Ken Shoulders).
```

Ball lightning can be a lot larger than the size of the Ken Shoulders manufactured EVO because lightning can be more energetic than his machines.

```
A typical Ball Lightning has r ~ 10 cm, N = 10^21.

Use the hydrogen atom as the basis of comparison
where r ~ 10^-8 cm and N = 1
with self-electrical force ~ 10^+16
compared to
the Ball Lightning self-electrical force 10^42 x 10^-2 = 10^40
in these relative dimensionless units.

That is,
the self-electrical force at the
surface of the Ball Lightning assumed to be in a spherical thin shell
is ~ 10^24 stronger than the electrical force on
the atomic electron in the ground state of the hydrogen atom.

Next consider a single electron as a shell of charge e
at the classical electron radius 10^-13cm.
The relative self-electric force is then 10^+26.
```

```
Therefore,
the electrical force of the Ball Lightning is
about 10^14 larger than that on a single electron.

The effective G* induced by the zero point energy core needed
to stabilize a single spatially extended electron is ~ 10^40 G.

That is
the effective Planck length Lp* in
the interior of a single electron is ~ 10^-13 cm.

The effective Planck length in the interior of the Ball Lightning
is therefore ~ 10^-6 cm since G* ~ Lp^*2.
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Tony Smith's Home Page

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Cosmology, Gravity, and the WMAP ratio 0.73 : 0.23 : 0.04

Frank D. (Tony) Smith, Jr., Cartersville, Georgia USA

[Note - shortly after arXiv removed this paper, in response to some comments mde by others, I added the material set off by [ ] .]

Abstract

WMAP results indicate that our universe is now made up of 73% dark energy (DE), 23% dark matter (DM), and 4% ordinary matter (OM), the DE possibly being in the form of a cosmological constant (itself a misnomer, as a "cosmological constant" can be variable). A model of gravity based on the conformal group Spin(2,4) = SU(2,2), motivated by work of I. E. Segal, can be used to estimate the present-day DE : DM : OM ratio. If DM obeys the ordinary matter equation of state, then the model gives the ratio 0.753 : 0.202 : 0.045, which is quite close to the WMAP observation of 0.73 : 0.23 : 0.04.

WMAP results indicate that our universe is now made up of 73% dark energy (DE), 23% dark matter (DM), and 4% ordinary matter (OM), the DE possibly being in the form of a cosmological constant (itself a misnomer, as a "cosmological constant" can be variable).

In the D4-D5-E6-E7-E8 VoDou Physics model, Gravity and the Cosmological Constant come from the MacDowell-Mansouri Mechanism and the 15-dimensional Spin(2,4) = SU(2,2) Conformal Group, which is the group used by Irving Ezra Segal in his work on gravity and cosmology.

The 15 generators of the Conformal Group SU(2,2) = Spin(2,4) correspond to:

- 3 Rotations;
- 3 Boosts;
- 4 Translations;
- 4 Special Conformal transformations; and
- 1 Dilatation.

The main purpose of this paper is to use the structure of the Conformal group to estimate the present-day ratio

DE : DM : OM

which, according to WMAP results, is

.73 : .23 : .04

The basis of the estimation is the following correspondence:

- DE (dark energy, cosmological constant) - the 10 Rotations, Boosts, and Special Conformal generators
- DM (dark matter) - the 4 Translations
- OM (ordinary matter) - the 1 Dilatation

  [Here is some motivation for the above correspondence:

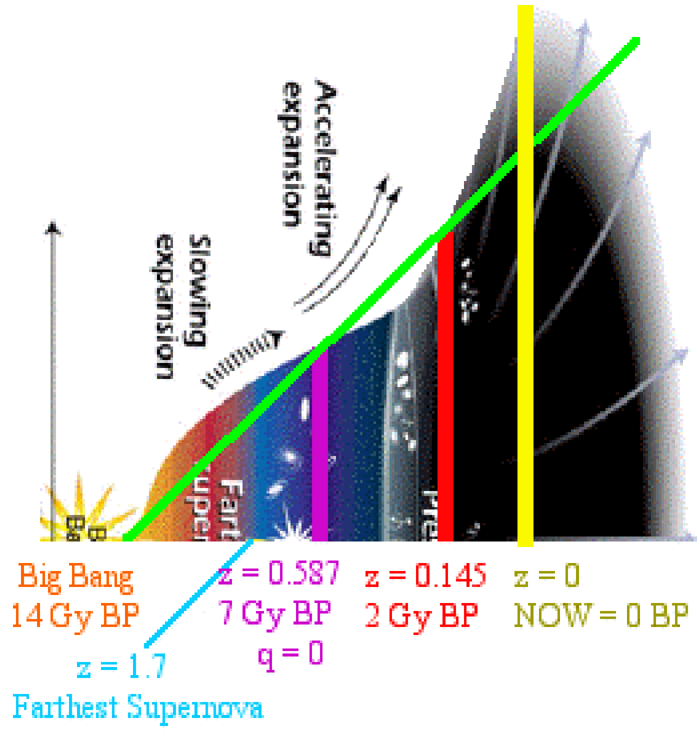
  - DE is the NORMAL state of stuff in our universe (it is now, according to WMAP, about 73% of it). It looks more like deSitter spacetime than Minkowski spacetime. In Segal's model and as Aldrovandi and Peireira show in some mathematical detail in their paper at gr-qc/9809061 the DE spacetime structure comes from "... the group Q, formed by a semi-direct product between Lorentz and special conformal transformation groups ...". Those are the 10 Rotations, Boosts and Special Conformal generators that correspond to DE.
  - DM is a lesser part (it is now, according to WMAP, about 23% of it) of our universe, and differs from the dominant DE by being based on the 4 Translations that are the basis for Einstein's description of spacetime curvature, which in turn describes effective mass (such as the mass of such DM candidates as primordial black holes). Those 4 Translations therefore correspond to DM.
  - OM (the stuff of which we and Earth are made) is sort of weird and exceptional (it is now, according to WMAP, only about 4% of it). For us to call it ordinary is quite provincial, because it is only ordinary in the context of our physical bodies and the planet on which we live. What characterizes all OM is that its mass comes from the Higgs mechanism. The Dilatation gives the spin 0 Higgs field, and therefore all the mass of OM, so the 1 Dilatation therefore corresponds to OM.

  In terms of I. E. Segal's book Mathematical Cosmology and Extragalactic Astronomy (Academic Press 1976), you might say that DE and DM are respectively related to Unispace and Minkowski space, and that OM is something like a little frothy foam on/in the DE/DM system.]

As a first-order calculation, the correspondence gives the ratio

DE : DM : OM = 10/15 : 4/15 : 1/15 = **.67 : .27 : .06**

However, the various components of DE, DM, and OM vary differently with time (or, equivalently, with the radius of our expanding universe), so the ratio 0.67 : 0.27 : 0.06 is valid only for a particular time, or scale factor, of our Universe, so it is necessary to ask at what stage of the expansion of the universe should the first-order ratio 0.67 : 0.27 : 0.06 be valid. In order to answer that question, we should try to see **what are the Special Times in the History of our Universe ?**



There seem to be four Special Times in the history of our Universe:

- the **Big Bang Beginning of Inflation** (about 13.7 Gy BP);
- the **End of Inflation** = Beginning of Decelerating Expansion (beginning of green line also about 13.7 Gy BP);
- the **End of Deceleration** (q=0) = Inflection Point = Beginning of Accelerating Expansion (purple vertical line at about z = 0.587 and about 7 Gy BP). According to a hubble site web page credited to Ann Feild, the above diagram "... reveals changes in the rate of expansion since the universe's birth 15 billion years ago. ... **The curve changes noticeably about 7.5 billion years ago**, when objects in the universe began flying apart as a faster rate. ...". According to a CERN Courier web page: "... Saul Perlmutter, who is head of the Supernova Cosmology Project ... and his team have studied altogether some 80 high red-shift type Ia supernovae. Their results imply that **the universe was decelerating for the first half of its existence, and then began accelerating approximately 7 billion years ago**. ...". According to astro-ph/0106051 by Michael S. Turner and Adam G. Riess: "... **current supernova data ... favor deceleration at z > 0.5** ... **SN 1997ff at z = 1.7** provides direct evidence for an early phase of slowing expansion if the dark energy is a cosmological constant ...".
- the **Last Intersection** of the Accelerating Expansion of our Universe with Linear Expansion

(green line) from End of Inflation (first interesection) through Inflection Point (second intersection, at purple vertical line at about z = 0.587 and about 7 Gy BP) to the Third Intersection (at red vertical line at z = 0.145 and about 2 Gy BP), which is also around the times of the beginning of the Proterozoic Era and Eukaryotic Life, Fe2O3 Hematite ferric iron Red Bed formations, a Snowball Earth, and the start of the Oklo fission reactor.

After the Last Intersection at the end of the Early Part of the Accelerating Expansion of our Universe, expansion of our Universe continues to accelerate with the Late Part of its Accelerating Expansion.

Those four Special Times define four Special Epochs:

- The **Inflation Epoch**, beginning with the Big Bang and ending with the End of Inflation. The Inflation Epoch is described by Zizzi Quantum Inflation, ending with Self-Decoherence of our Universe.
- The **Decelerating Expansion Epoch**, beginning with the End of Inflation. During the Decelerating Expansion Epoch, the Radiation Era is succeeded by the Matter Era, and the Matter Components (Dark and Ordinary) remain more prominent than they would be under the "standard norm" conditions of Linear Expansion.
- The **Early Accelerating Expansion Epoch**, beginning with the End of Deceleration and ending with the Last Intersection of Accelerating Expansion with Linear Expansion. During Accelerating Expansion, the prominence of Matter Components (Dark and Ordinary) declines, reaching the "standard norm" condition of Linear Expansion at the end of the Early Accelerating Expansion Epoch at the Last Intersection with the Line of Linear Expansion.
- The **Late Accelerating Expansion Epoch**, beginning with the Last Intersection and continuing into the far future. During the Late Accelerating Expansion Epoch, DE dark energy is more prominent than it would be under the "standard norm" conditions of Linear Expansion.

In making my estimation of the ratio DE : DM : OM, **the time of the first approximation ratio 0.67 : 0.27 : 0.06** is taken to be the time of the Last Intersection, which **is about 2 billion years ago**.

To see how the ratio DE : DM : OM evolved during the 2 billion years from the Last Intersection to the present time, you must know the value of w in equation of state

density =proportional= 1 / R^3(1+w)

for DE, DM, and OM in our universe at a time when its scale factor is R.

- For DE (dark energy cosmological constant), w = -1
- For DM(dark matter) that obeys the ordinary matter equation of state, w = 0
- For OM, w = 0

About 2 billion years ago, the redshift z = 0.145 , or 1+z = 1.145, or (1+z)^3 = 1.5, so that from then to now:

- DM density would decline by the1 / R^3 factor as Ordinary Matter, from .27 to .27 / 1.5 = .18.
- OM density would decline by the1 / R^3 factor as Ordinary Matter, from .06 to .06 / 1.5 = .04
- DE density would remain constant at .67.

Therefore, the ratio as of now would be DE : DM : OM = .67 : .18 : .04 = .753 : 202 : 0.45 or **75.3% : 20.2% : 4.5%**

which is quite close to the WMAP observation of **73% : 23% : 4%.**

If Cold Dark Matter = PBH + MOND:

(Note that the equation of state for MOND might be similar to that for gravitational interactions from other Worlds of the Many-Worlds, so, in these calculations, MOND dark matter might be taken to include gravitational interactions from other Worlds of the Many-Worlds.)

The above calculation of 2 Gy BP for the ratio 0.67 : 0.27 : 0.06 is based only on the decline in the Ordinary Matter component with expansion of Space, so it is only a rough estimate, in that it ignores such things as decay of Ordinary Matter protons by GUT (10^31 year lifetime) or by Black Hole processes (10^64 year lifetime), which would be less important during the relevant time periods near NOW than in the Black Hole and Dark Eras of the distant future. As to how the Dark Energy /\ and Cold Dark Matter terms have evolved during the past 2 Gy, a rough estimate analysis would be, if Cold Dark Matter = (1/2) PBH + (1/2) MOND:

- /\ and CDM would be effectively created during expansion in their natural ratio 67 : 27 = 2.48 = 5 / 2, each having proportionate fraction 5 / 7 and 2 / 7, respectively;
- CDM Black Hole decay would be ignored;
- pre-existing CDM MOND density (1/2)(0.27) = 0.14 would not decline; and
- pre-existing CDM Black Hole density would decline by the same 1 / R^3 factor as Ordinary Matter, from (1/2)(0.27) = 0.13 to (0.13 / 1.5) = 0.09.

The Ordinary Matter excess 0.06 - 0.04 = 0.02 plus the first-order CDM excess 0.13 = 0.09 = 0.04 should be summed to get a total first-order excess of 0.06, which in turn should be distributed to the /\ and CDM factors in their natural ratio 67 : 27, producing, for NOW after 2 Gy of expansion:

- /\ factor = 0.67 + 0.06 x 5/7 = 0.67 + 0.04 = 0.71; and
- CDM Black Hole factor = 0.23 + 0.06 x 2/7 = 0.23 + 0.02 = 0.25

for a total calculated ratio for NOW of **0.71 : 0.25 : 0.04** so that the present ratio of 0.73 : 0.23 : 0.04 observed by WMAP seems to me to be quite consistent with the cosmology of the D4-D5-E6-E7-E8 VoDou Physics model **if Cold Dark Matter = PBH + MOND**.

[July 2004 note by Frank D. (Tony) Smith, Jr., on

Josephson Junctions and Dark Energy

Consider the experimental results mentioned in the Beck and Mackey paper at http://xxx.lanl.gov/abs/astro-ph/0406504 in which they say:

"... the zero-point term has proved important in

- explaining X-ray scattering in solids ... ;
- understanding of the Lamb shift ... in hydrogen ... ;
- predicting the Casimir effect ... ;
- understanding the origin of Van der Waals forces ... ;
- interpretation of the Aharonov-Bohm effect ... ;
- explaining Compton scattering ... ; and
- predicting the spectrum of noise in electrical circuits ... .

It is this latter effect that concerns us here. ... We predict that the measured spectrum in Josephson junction experiments must exhibit a cutoff at the critical frequency nu_c ... [corresponding to the currently observed Dark Energy density 0.73 x critical density = 0.73 x 5.3 GeV/m^3 = 3.9 GeV/m^3]... If not, the corresponding vacuum energy density would exceed the currently measured dark energy density of the universe. ... The energy associated with the computed cutoff frequency nu_c ...[about 1.7 x 10^12 Hz]...

E_c = h nu_c = (7.00 – 0.17) x 10^(-3) eV ...

coincides with current experimental estimates of neutrino masses. .. It is likely that the Josephson junction experiment only measures the photonic part of the vacuum fluctuations, since this experiment is purely based on electromagnetic interaction. ...

If it is possible to increase the maximum frequency by a factor of about 3, then this experiment could provide valuable information on the nature of dark energy. ...

If the frequency cutoff is observed, it could be used to determine the fraction ... of dark energy density that is produced by electromagnetic processes ...

Finally, we conjecture that it will be interesting to re-analyze experimentally observed 1/f noise in electrical circuits under the hypothesis that it could be a possible manifestation of suppressed zero-point fluctuations. ... Our simple theoretical considerations show that 1/f noise arises naturally if bosonic vacuum fluctuations are suppressed by fermionic ones. ...".

AS TO THE ISSUE OF LORENTZ INVARIANCE OF A CUTOFF
at higher energies than have yet been observed
in Josephson Junction fluctuations,
my view is that you need to have ALL the forces
(gravity, color, weak, and QED) to get cancellations
that give a cosmological constant near zero,
and when you get energetic enough to introduce neutrinos,
you are effectively bringing in the weak force
that is felt by the neutrinos so that you begin to change
the equation (or introduce a cut-off) at that energy.
Since the cut-off is due to introduction of weak force effects
(and probably NOT a simple hard-line energy/frequency cut-off,
which could violate Lorentz symmetry)
it probably is a cut-off regulated by the gauge symmetry
of the weak force. As Lubos Motl said in an spr post :
"... cutoffs ...[can be]... Lorentz invariant ... the gauge
symmetries: the regulators must be of specific kind to preserve
these kinds of symmetry - but they almost always preserve
Lorentz symmetry. ...",
so the cut-off due to the phasing in of the weak force probably
does not violate Lorentz symmetry.
As you go to higher and higher energies,
you introduce more and more forces, etc,
and in the high-energy limit of D4-D5-E6-E7-E8 VoDou Physics
there are cancellations due to subtle supersymmetry.

AS TO EXPERIMENTAL RESULTS, Beck and Mackey say:

1 - the critical density in our universe now is about 5 GeV/m^3

2 - it is made up of Dark Energy : Dark Matter : Ordinary Matter
    in a ratio DE : DM : OM = 73 : 23 : 4

3 - the density of the various types of stuff in our universe now is
    DE = about 4 GeV/m^3
    DM = about 1 GeV/m^3
    OM = about 0.2 GeV/m^3

4 - the density of vacuum fluctuations already observed
    in Josephson Junctions is about 0.062 GeV/m^3
    which is for frequencies up to about 6 x 10^11 Hz

5 - the radiation density (for photons) varies with frequency
    as the 4th power of the frequency, i.e., as (pi h / c^3) nu^4

6 - if Josephson Junction frequencies were to be experimentally
    realized up to 2 x 10^12 Hz, then, if the photon vacuum fluctuation
    energy density formula were to continue to hold,
    the vacuum energy density would be seen to be 0.062 x (20/6)^4 =
    = about 7 GeV/m^3 which exceeds the total critical density
    of our universe now

7 - to avoid such a divergence being physically realized,
neutrinos should appear in the vacuum at frequencies high
enough that E = h nu exceeds their mass of about 8 x 10^(-3) eV,
or at frequencies over about 1.7 x 10^12 Hz

8 - if Josephson Junctions could be developed to see vacuum
fluctuation frequencies up to 10^12 Hz, and if the
photon equation were to hold there, then the obseved vacuum
fluctuation density would be about 0.5 GeV/m^3
which is well over the 0.2 GeV/m^3 Ordinary Matter energy density
which means that
DE and/or DM COMPONENTS WOULD BE SEEN IN VACUUM FLUCTUATIONS
IN JOSEPHSON JUNCTIONS THAT GO UP TO 10^12 HZ FREQUENCY

As to the experimental question:

HOW TO DESIGN A 10^12 HZ JOSEPHSON JUNCTION ?

A PhysicsWeb article by Belle Dume at
http://physicsweb.org/article/news/8/6/17
describes the Beck and Mackey paper, saying
"... In 1982, Roger Koch and colleagues,
then at the University of California at Berkeley
and the Lawrence Berkeley Laboratory,
performed an experiment in which they measured
the frequency spectrum of current fluctuations in Josephson junctions.
Their system was cooled to millikelvin temperatures
so that thermal vibrations were reduced to a minimum,
leaving only zero-point quantum fluctuations. ...".

So, our junction must be cooled to a few millikelvin,
which was done back in 1982,
which means that the next question is how to find a junction
sensitive to terahertz fluctuations.
Here are a couple of relevant references:

According to a paper by at
http://www.iop.org/EJ/abstract/0953-2048/15/12/309
Terahertz frequency metrology based on high-Tc Josephson junctions
J Chen1, H Horiguchi1, H B Wang1, K Nakajima1, T Yamashita2 and P H Wu3
1 Research Institute of Electrical Communication,
Tohoku University, 2-1-1 Katahira, Aoba-ku, Sendai 980-8577, Japan
2 New Industry Creation Hatchery Center, Tohoku University,
04 Aza-aoba, Aramaki, Aoba-ku, Sendai 980-8579, Japan
3 Department of Electronic Science and Engineering,
University of Nanjing, Nanjing 210093, People’s Republic of China
Received 1 July 2002
Published 22 November 2002:
"... Using YBa2Cu3O7/MgO bicrystal Josephson junctions

operating between 6-77 K,
we have studied their responses
to monochromatic electromagnetic radiation from 50 GHz to 4.25 THz.
We have obtained direct detections for radiation
at 70 K from 50 GHz to 760 GHz
and
at 40 K from 300 GHz to 3.1 THz. ...".

Some details of how to make such things were outlined at
http://fy.chalmers.se/~tarasov/e1109m_draft.htm
by E. Stepantsov a,b, M. Tarasov a,c, A.Kalabukhov a,d,
T. Lindströoem a, Z. Ivanov a, T. Claeson a
a MINA, Chalmers University of Technology and Göteborg University,
GothenburgGöteborg, SE-41296, Sweden
b Institute of Crystallography, Leninsky Prosp 59, Moscow 117333, Russia
c Institute of Radio Engineering and Electronics, Mokhovaya 11,
Moscow 101999, Russia
d Department of Physics, Moscow State University, 119899 Moscow, Russia
dated August 2001
"... Submicron YBCO bicrystal Josephson junctions
and devices for high frequency applications were designed, fabricated
and experimentally studied.
The key elements of these devices are bicrystal sapphire substrates.
... A technological process based on deep ultraviolet photolithography
using a hard carbon mask was developed for the fabrication of 0.4-0.6 mm
wide Josephson junctions. ...
These junctions were used as Josephson detectors and spectrometers
at frequencies up to 1.5 THz ...".

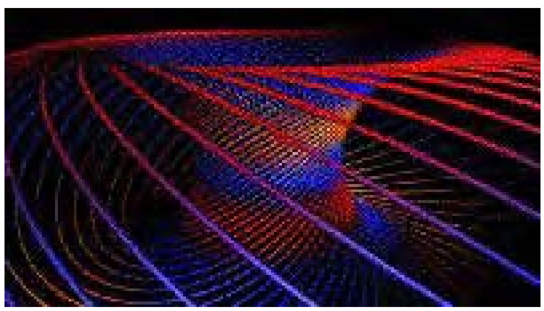
As to the possibility of using arrays of Josephson junctions,
here is a relevant article:

A paper entitled
Averaged Equations for Distributed Josephson Junction Arrays
at
http://www.physics.gatech.edu/mbennett/dist2003.pdf
by Matthew Bennett and Kurt Wiesenfeld says:
"... The Kirchhoff limit is valid provided the size of the system
is small compared to the wavelength of the electromagnetic radiation.
As it happens, the twin technological goals of generating higher
operating frequencies ...
and larger output powers (and thus more junctions)
both work against this limit. ...
To take an example,
an array operating at 300 GHz - not a particularly high frequency
for Josephson junctions - corresponds to a wavelength of 0.4 millimeters
when the index of refraction is 2.5;
for a typical spacing of 10 micrometers,
this is about the same size as an array of about 40 junctions - not a
particularly large number for Josephson arrays ...

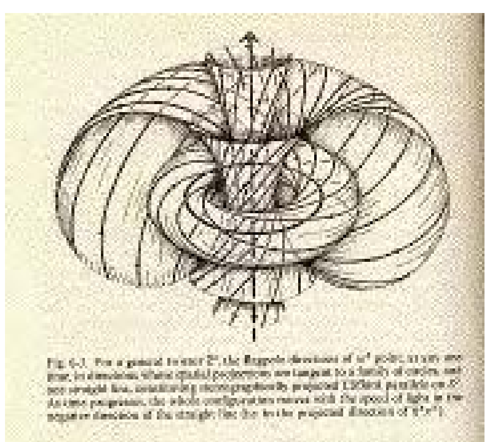
at higher frequencies
the current in the wire is not necessarily spatially uniform,
so the wire becomes a significant dynamical entity which couples
the junctions along its length. ... we model the wire as a lossless
transmission line ...
...
The resonant case is especially revealing, and leads to significant
physical insight into achieving attracting synchronized dynamics.
The tighter the clusters,
the more likely it is that phase locked solutions appear. ...
There are also hints
that distributed arrays exhibit fundamentally different phenomena
than their lumped counterparts.
In one case, experiments on distributed Josephson arrays
reported evidence of super-radiance ...".

Here is picture that I have in my mind for building
a Josepson Junction device for exploring vacuum fluctuations:

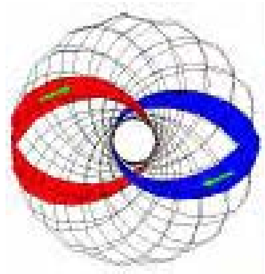
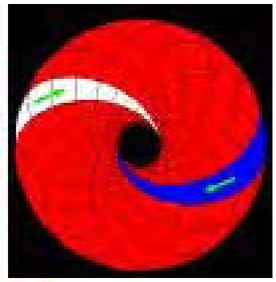
Consider the nested tori and linked circles of a Clifford-Hopf
3-sphere fibration. This picture

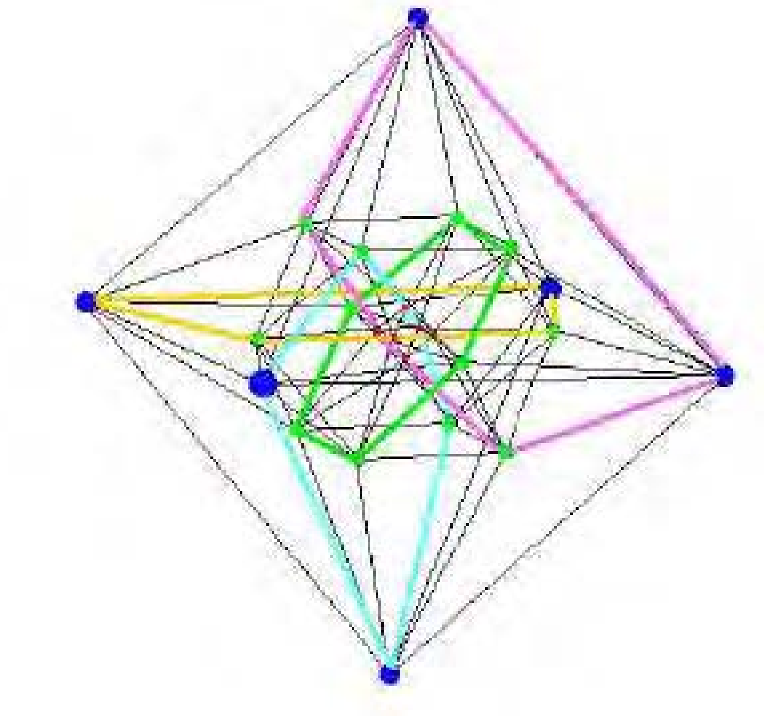


shows one torus,
so imagine a lot of tori nested as in this picture



These pictures

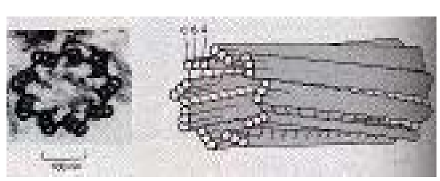
 



show that for any given torus in the nesting
the circles are interlinked similarly to 24-cell paths.

Let each circle be a superconducting wire carrying some current,
and
let all the circles be embedded in an insulator so that the
whole thing has characteristics of a lot of Josephson Junctions
and
then play with various magnetic field configurations
and
then watch what happens.

In order to get up to the terahertz energy level you might
have to fabricate the thing on sub-millmeter scales,
which should be fun. When you get down to micron - nanometer
scales, you get to scales of subcellular biological structures
such as microtubules and centrioles (this picture



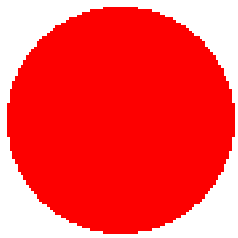
shows centriole structure), so maybe evolution has already
built some related stuff into our cells,
and maybe this stuff is on the borderline between
conventional semiconductor/superconductor fabrication
and biological growth of structures.

]

Universe, Unispace, Pioneer and Uranus

In his book Mathematical Cosmology and Extragalactic Astronomy (Academic Press 1976) (page 68), Segal says: "... We use the term **unispace** (short for universal covering space) for the universal space ... unispace is conformally an infinite-sheeted covering of Minkowski space augmented by a light cone at infinity. Similarly, **unitime** refers to the natural time T in this space. ...".

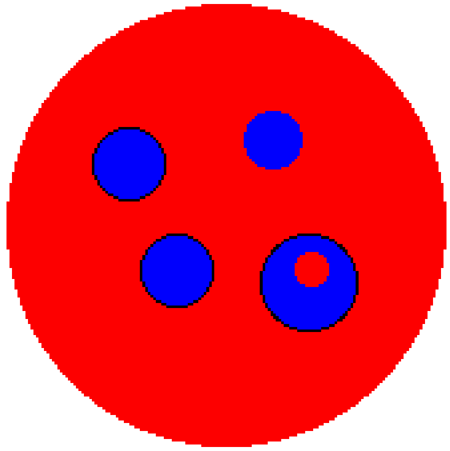
In the D4-D5-E6-E7-E8 VoDou Physics model, our 4-dimensional Physical SpaceTime Universe begins as a relatively small spatial volume that is entirely high-energy unispace, in which all 15 generators of Conformal Spin(2,4) Unispace, including the 4 Conformal GraviPhoton generators, are effective.



After some expansion, some regions of our Universe become Gravitationally Bound Domains (such as, for example, Galaxies) in which the 4 Conformal GraviPhoton generators are frozen out, forming domains within our Universe like IceBergs in an Ocean of Water.

Note that Gravitationally Bound Domains are defined by their gravitational accelerations, not by their size - there is no correlation with system size.

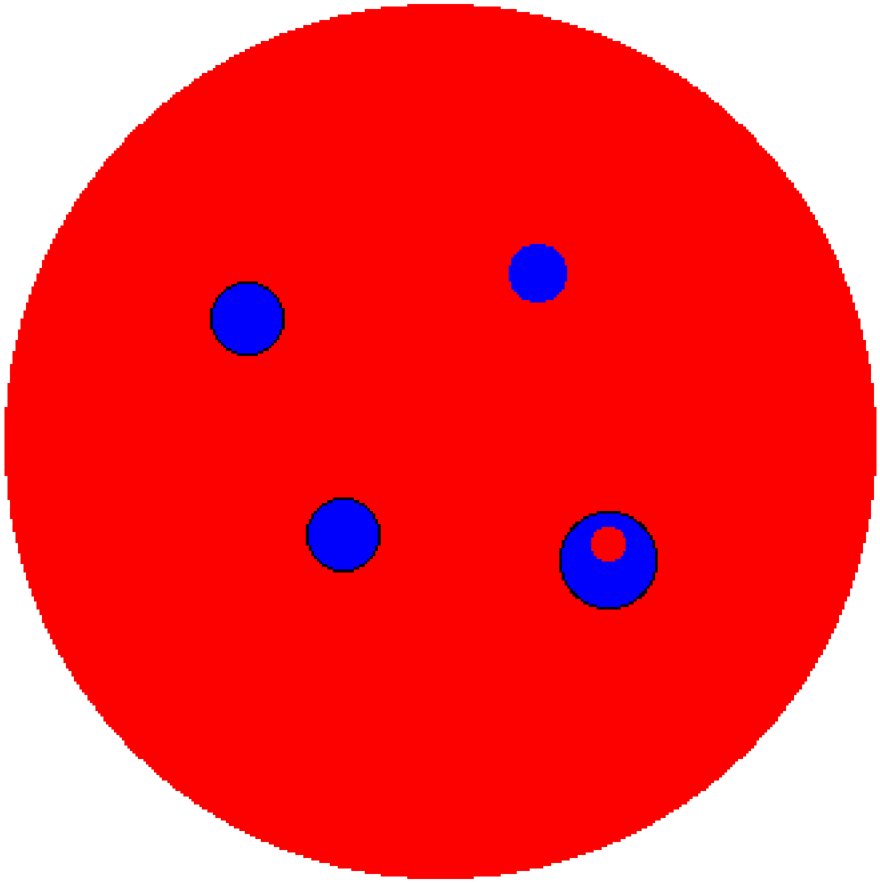
The process of formation of Gravitationally Bound Domains releases (like latent heat of fusion when Ice freezes from Water) the excess of the Conformal Unienergy of Unispace over the Poincare Energy of Minkowski space.



Note that, within the Gravitationally Bound Domains there can exist Islands of Unispace in which all 15 generators of Conformal Spin(2,4) remain effective (such as, for example, Protostar Clouds of Dust and Gas - like Puddles of Water on an IceBerg floating in an Ocean of Water ›

> When a Protostar Clouds of Dust and Gas condense to form the Gravitationally Bound Domain of a Star and its Planets, the process releases (like latent heat of fusion when Ice freezes from Water) the excess of the Conformal Unienergy of Unispace over the Poincare Energy of Minkowski space).

During and after more expansion of our Universe as a whole, the Gravitationally Bound Domains do not expand within themselves, but are carried apart from each other as in the familiar example of inflating a Balloon with Coins glued to its surface.



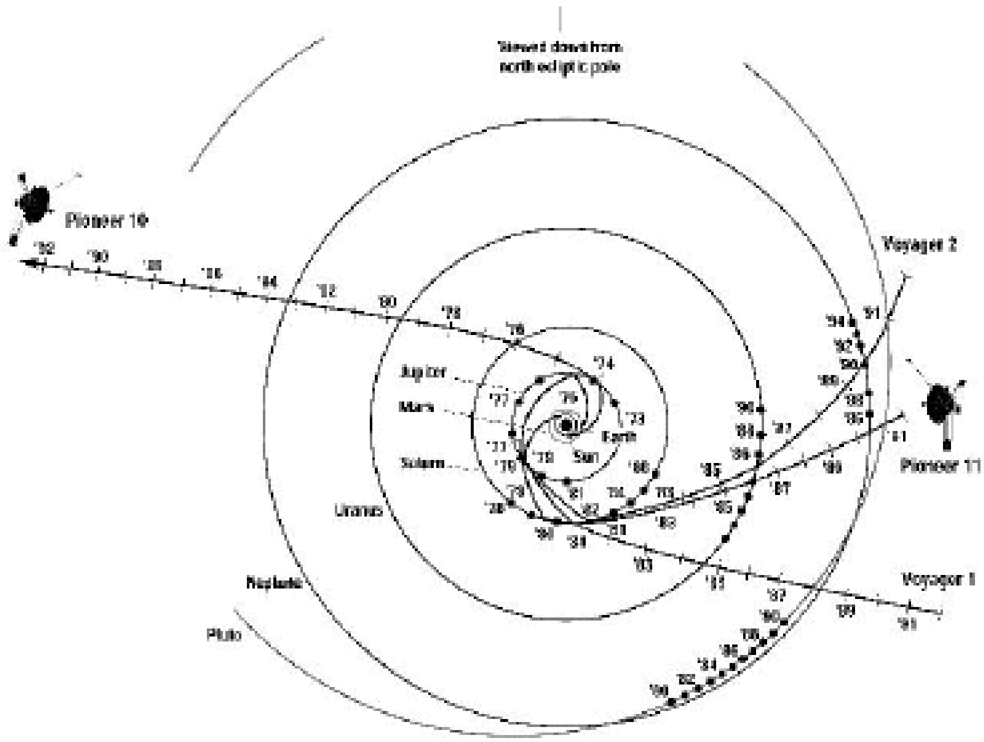
Since our laboratories on our Earth are Gravitationally Bound Domains, our conventional experiments on Earth only see the Poincare Energy of Minkowski space.

However:

Since the Pioneer spacecraft are not bound to our Solar System,

the Pioneer Spacecraft are experiments beyond the Gravitationally Bound Domain of our Earth-Sun Solar System.

In their Study of the anomalous acceleration of Pioneer 10 and 11, gr-qc/0104064, John D. Anderson, Philip A. Laing, Eunice L. Lau, Anthony S. Liu, Michael Martin Nieto, and Slava G. Turyshev say: "... The latest successful precession maneuver to point ...[Pioneer 10]... to Earth was accomplished on 11 February 2000, when Pioneer 10 was at a distance from the Sun of 75 AU. [The distance from the Earth was [about] 76 AU with a corresponding round-trip light time of about 21 hour.] ... The next attempt at a maneuver, on 8 July 2000, was unsuccessful ... conditions will again be favorable for an attempt around July, 2001. ... At a now nearly constant velocity relative to the Sun of 12.24 km/s, Pioneer 10 will continue its motion into interstellar space, heading generally for the red star Aldebaran ... about 68 light years away ... it should take Pioneer 10 over 2 million years to reach its neighborhood....



Ecliptic pole view of Pioneer 10, Pioneer 11, and Voyager trajectories. Digital artwork by T. Esposito. NASA ARC Image # AC97-0036-3.

... on 1 October 1990 ... Pioneer 11 ... was [about] 30 AU away from the Sun ... The last communication from Pioneer 11 was received in November 1995, when the spacecraft was at distance of [about] 40 AU from the Sun. ... Pioneer 11 should pass close to the nearest star in the constellation Aquila in about 4 million years ...

... Calculations of the motion of a spacecraft are made on the basis of the range time-delay and/or the Doppler shift in the signals. This type of data was used to determine the positions, the velocities, and the magnitudes of the orientation maneuvers for the Pioneer, Galileo, and Ulysses spacecraft considered in this study. ... The Pioneer spacecraft only have two- and three-way S-band Doppler. ... analyses of radio Doppler ... data ... indicated that an apparent anomalous acceleration is acting on **Pioneer 10 and 11** ... The data implied **an anomalous, constant acceleration with a magnitude a_P = 8 x 10^(-8) cm / s^2 , directed towards the Sun** ...

... The anomalous acceleration is too large to have gone undetected in planetary orbits, particularly for Earth and Mars. ... For Earth and Mars, delta_r is about -21 km and -76 km. However, the Viking data determines the difference between the Mars and Earth orbital radii to about a 100 m accuracy, and their sum to an accuracy of about 150 m. The Pioneer effect is not seen. Further, a perturbation in r produces a perturbation to the orbital angular velocity ... The determination of the synodic angular velocity ... is accurate to 7 parts in 10^11 , or to about 5 ms accuracy in synodic period. The only parameter that could possibly mask the spacecraft-determined a_R is (G M_sun). But a large error here would cause inconsistencies with the overall planetary ephemeris ... Also, there would be a problem with the advance of the perihelion of Icarus ... We conclude that the Viking ranging data limit any unmodeled radial acceleration acting on Earth and Mars to no more than 0.1 x 10^(-8) cm / s^2 . ... the size of the anomalous acceleration is of the order c H, where H is the Hubble constant ...

... The Aerospace Corporation’s Compact High Accuracy Satellite Motion Program (CHASMP) ... analysis of Pioneer 10 data ... showed an unmodeled acceleration in a direction along the radial toward the Sun ... The value is (8.65 +/- 0.03) x 10^(-8) cm / s^2 ... agreeing with JPL’s result ...

... Without using the apparent acceleration, CHASMP shows a steady frequency drift of about -6 x 10^(›9) Hz / s, or 1.5 Hz over 8 years (one-way only). ...

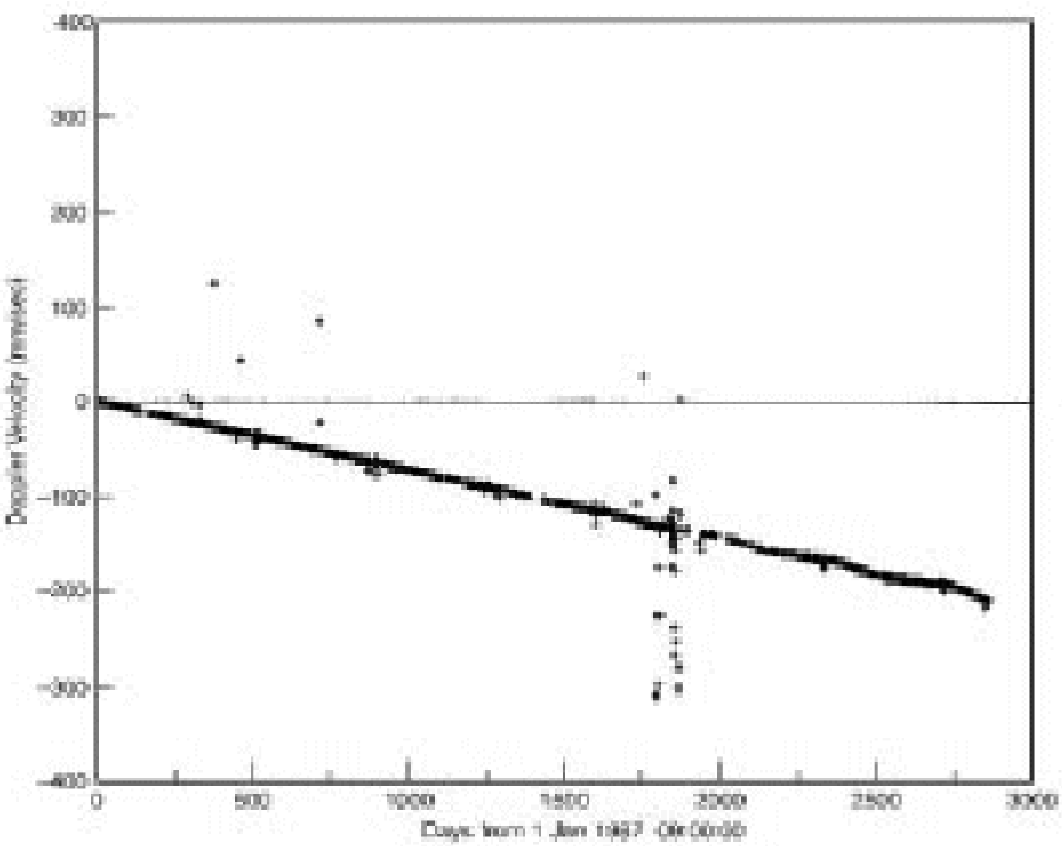


Figure 8: CHASMP two-way Doppler residuals (observed Doppler velocity minus model Doppler velocity) for Pioneer 10 vs. time. 1 Hz is equal to 65 mm/s range change per second. The model is fully-relativistic. The solar system's gravitational field is represented by the Sun and its planetary systems [47].

... This equates to a clock acceleration, -a_t, of -2.8 x 10^(-18) s / s^2 . The identity with the apparent Pioneer acceleration is a_P = a_t c. ...

... Having noted the relationships

$$a_P = c\, a_t$$

and that of ...

$$a_H = c H \rightarrow 8 \times 10^{-8} \text{ cm} / s^2$$

if H = 82 km / s / Mpc ...

we were motivated to try to think of any ... "time" distortions that might ... fit the CHASMP Pioneer results ... In other words ...

Is there any evidence that some kind of "time acceleration" is being seen?

... In particular we considered ... **Quadratic Time Augmentation**. This model **adds a quadratic-in-time augmentation to the** TAI-ET (International Atomic Time - Ephemeris Time) **time transformation**, as follows

$$ET \rightarrow ET + (1/2)\, a_{ET}\, ET^2$$

The model fits Doppler fairly well ...

... There was one [other] model of the ...[time acceleration]... type that was especially fascinating. This model adds a quadratic in time term to the light time as seen by the DSN station:

$$delta\_TAI = TAI\_received - TAI\_sent \rightarrow$$

$$\rightarrow delta\_TAI + (1/2)\, a_{quad}\, (TAI\_received^2 - TAI\_sent^2)$$

It mimics a line of sight acceleration of the spacecraft, and could be thought of as an expanding space model. Note that a_quad affects only the data. This is in contrast to the a_t ... that affects both the data and the trajectory. ... This model fit both Doppler and range very well. Pioneers 10 and 11 ... the numerical relationship between the Hubble constant and a_P ... remains an interesting conjecture. ...".

In his book Mathematical Cosmology and Extragalactic Astronomy (Academic Press 1976) (pages 61-62 and 72), Segal says:

"... Temporal evolution in ... Minkowski space ... is

$$H \to H + s I$$

... unispace temporal evolution ... is ...

$$H \to (H + 2 \tan(a/2)) / (1 - (1/2) H \tan(a/2)) = H + a I + (1/4) a H^2 + O(s^2)$$

...".

Therefore,

the Pioneer Doppler anomalous acceleration is an experimental observation of a system that is not gravitationally bound in the Earth-Sun Solar System, and its results are consistent with Segal's Conformal Theory.

Rosales and Sanchez-Gomez say, at gr-qc/9810085 :

> "... the recently reported anomalous acceleration acting on the Pioneers spacecrafts should be a consequence of the existence of some local curvature in light geodesics when using the coordinate speed of light in an expanding spacetime. This suggests that the Pioneer effect is nothing else but the detection of cosmological expansion in the solar system. ... the ... problem of the detected misfit between the calculated and the measured position in the spacecrafts ... this quantity differs from the expected ... just in a systematic "bias" consisting on an effective residual acceleration directed toward the center of coordinates; its constant value is ... H c ... This is the acceleration observed in Pioneer 10/11 spacecrafts. ... a periodic orbit does not experience the systematic bias but only a very small correction ... which is not detectable ... in the old Foucault pendulum experiment ... the motion of the pendulum experiences the effect of the Earth based reference system being not an inertial frame relatively to the "distant stars". ... Pioneer effect is a kind of a new cosmological Foucault experiment, the solar system based coordinates, being not the true inertial frame with respect to the expansion of the universe, mimics the role that the rotating Earth plays in Foucault's experiment ...".

The Rosales and Sanchez-Gomez idea of a 2-phase system in which objects bound to the solar system (in a "periodic orbit") are in one phase (non-expanding pennies-on-a-balloon) while unbound (escape velocity) objects are in another phase (expanding balloon) that "feels" expansion of our universe is very similar to my view of such things as described on this page. The Rosales and Sanchez-Gomez paper very nicely unites:

- the physical 2-phase (bounded and unbounded orbits) view;
- the Foucault pendulum idea; and
- the cosmological value H c.

My view, which is consistent with that of Rosales and Sanchez-Gomez, can be summarized as a 2-phase model based on Segal's work which has two phases with different metrics:

- a metric for outside the inner solar system, a dark energy phase in which gravity is described in which all 15 generators of the conformal group are effective, some of which are related to the dark energy by which our universe expands; and
- a metric for where we are, in regions dominated by ordinary matter, in which the 4 special conformal and 1 dilation degrees of freedom of the conformal group are suppressed and the remaining 10 generators (antideSitter or Poincare, etc) are effective, thus describing ordinary matter phenomena.

If you look closely at the difference between the metrics in those two regions, you see that the full conformal dark energy region gives an "extra acceleration" that acts as a "quadratic in time term" that has been considered as an explanation of the Pioneer effect by John D. Anderson, Philip A. Laing, Eunice L. Lau, Anthony S. Liu, Michael Martin Nieto, and Slava G. Turyshev in their paper at gr-qc/0104064 .

Jack Sarfatti has a 2-phase dark energy / dark matter model that can give a similar anomalous acceleration in regions where c^2 /\ dark energy / dark matter is effectively present. If there is a phase transition (around Uranus at 20 AU) whereby ordinary matter dominates inside that distance from the sun and exotic dark energy / dark matter appears at greater distances, then Jack's model could also explain the Pioneer anomaly and it may be that Jack's model with ordinary and exotic phases and my model with deSitter/Poincare and Conformal phases may be two ways of looking at the same thing. As to what might be the physical mechanism of the phase transition, Jack says

> "... Rest masses of [ordinary matter] particles ... require the smooth non-random Higgs Ocean ... which soaks up the choppy random troublesome zero point energy ...".

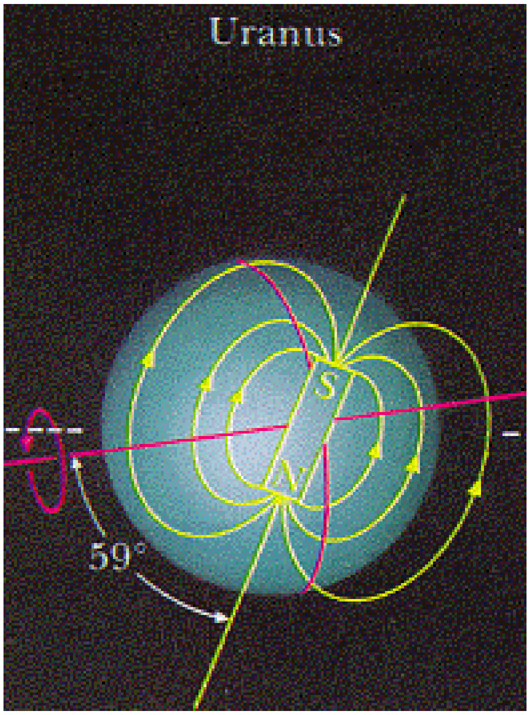
In other words in a region in which ordinary matter is dominant, such as the Sun and our solar system, the mass-giving action of the Higgs mechanism "soaks up" the Dark Energy zero point conformal degrees of freedom that are dominant in low-ordinary mass regions of our universe (which are roughly the intergalactic voids that occupy most of the volume of our universe). That physical interpretation is consistent with my view.

It may be that the observation of the Pioneer phase transition at Uranus from ordinary to anomalous acceleration is an experimental result that gives us a first look at dark energy / dark matter phenomena that could lead to energy sources that could be even more important than the nuclear energy discovered during the past century.

In gr-qc/0104064, Anderson et al say:

> "... Beginning in 1980 ... at a distance of 20 astronomical units (AU) from the Sun ... we found that the largest systematic error in the acceleration residuals was a constant bias, aP, directed toward the Sun. Such anomalous data have been continuously received ever since. ...",

so that the transition from inner solar system Minkowski acceleration to outer Segal Conformal acceleration occurs at about 20 AU, which is about the radius of the orbit of Uranus. That phase transition may account for the unique rotational axis of Uranus,



which lies almost in its orbital plane.

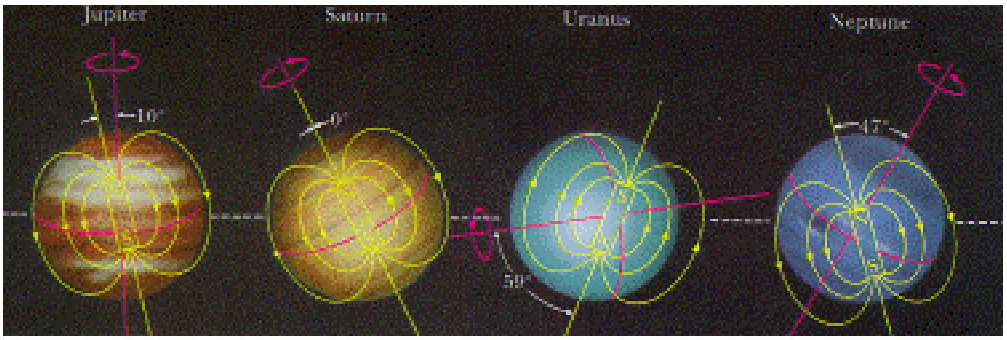
The most stable state of Uranus may be with its rotational axis pointed toward the Sun, so that the Solar hemisphere would be entirely in the inner solar system Minkowski acceleration phase and the anti-Solar hemisphere would be in entirely in the outer Segal Conformal acceleration phase.

Then the rotation of Uranus would not take any material from one phase to the other, and there would be no drag on the rotation due to material going from phase to phase.

Of course, as Uranus orbits the Sun, it will only be in that most stable configuration twice in each orbit, but an orbit in the ecliptic containing that most stable configuration twice (such as its present orbit) would be in the set of the most stable ground states, although such an effect would be very small now.

However, such an effect may have been been more significant on the large gas/dust cloud that was condensing into Uranus and therefore it may have caused Uranus to form initially with its rotational axis pointed toward the Sun.

In the pre-Uranus gas/dust cloud, any component of rotation that carried material from one phase to another would be suppressed by the drag of undergoing phase transition, so that, after Uranus condensed out of the gas/dust cloud, the only remaining component of Uranus rotation would be on an axis pointing close to the Sun, which is what we now observe.



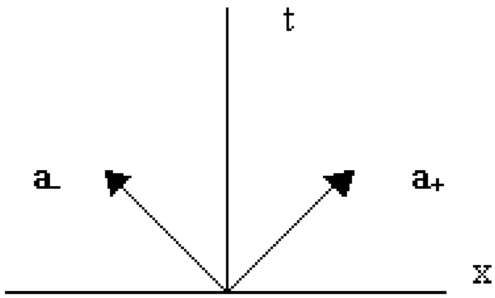
Much of the perpendicular (to Uranus orbital plane) angular momentum from the original gas/dust cloud may have been transferred (via particles "bouncing" off the phase boundary) to the clouds forming Saturn (inside the phase boundary) or Neptune (outside the phase boundary, thus accounting for the substantial (relative to Jupiter) deviation of their rotation axes from exact perpendicularity (see above image from Universe, 4th ed, by William Kaufmann, Freeman 1994).

According to Utilizing Minor Planets to Assess the Gravitational Field in the Outer Solar System, astro-ph/0504367, by Gary L. Page, David S. Dixon, and John F. Wallin:
"... the great distances of the outer planets from the Sun and the nearly circular orbits of Uranus and Neptune makes it very difficult to use them to detect the Pioneer Effect. ... The ratio of the Pioneer acceleration to that produced by the Sun at a distance equal to the semimajor axis of the planets is 0.005, 0.013, and 0.023 percent for Uranus, Neptune, and Pluto, respectively. ... Uranus' period shortens by 5.8 days and Neptune's by 24.1, while Pluto's period drops by 79.7 days. ... an equivalent change in aphelion distance of 3.8 x 10^10, 1.2 x 10^11, and 4.3 x 10^11 cm for Uranus, Neptune, and Pluto. In the first two cases, this is less than the accepted uncertainty in range of 2 x 10^6 km [or 2 x 10^11 cm] (Seidelmann 1992). ... Pluto['s] ... orbit is even less well-determined ... than the other outer planets. ...
.... [C]omets ... suffer ... from outgassing ... [and their nuclei are hard to locate precisely] ...".

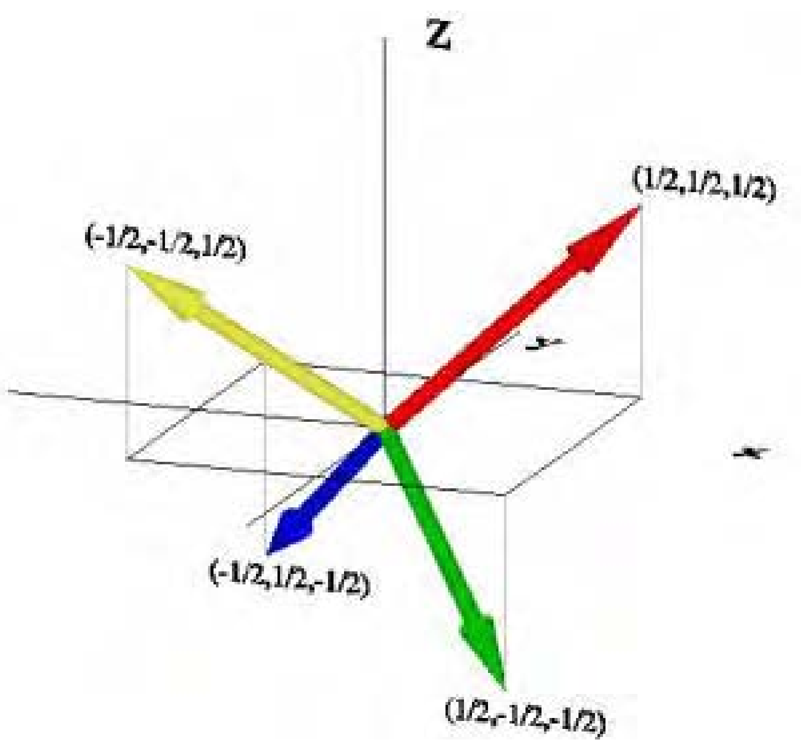
According to a google cache of an Independent UK 23 September 2002 article by Marcus Chown:
"... The Pioneers are "spin-stabilised", making them a particularly simple platform to understand. Later probes ... such as the Voyagers and the Cassini probe ... were stabilised about three axes by intermittent rocket boosts. The unpredictable accelerations caused by these are at least 10 times bigger than a small effect like the Pioneer acceleration, so they completely cloak it. ...".

The HyperDiamond Feynman Checkerboard in 1+3 dimensions reproduces the correct Dirac equation.

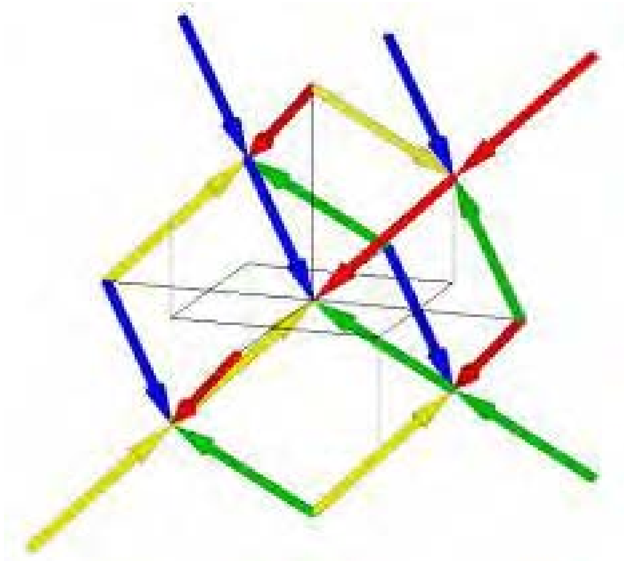
Urs Schreiber has done the work necessary for the proof, after reading the work of George Raetz presented on his web site. A very nice feature of the George Raetz web site is its illustrations, which include an image of a vertex of a 1+1 dimensional Feynman Checkerboard



and an image of a projection into three dimensions of a vertex of a 1+3 dimensional Feynman Checkerboard



and an image of flow contributions to a vertex in a HyperDiamond Random Walk from the four nearest neighbors in its past



Urs Schreiber wrote on the subject: Re: Physically understanding the Dirac equation and 4D in the newsgroup sci.physics.research on 2002-04-03 19:44:31 PST (including an appended forwarded copy of an earlier post) and again on 2002-04-10 19:03:09 PST as found on the web page http://www-stud.uni-essen.de/~sb0264/spinors-Dirac-checkerboard.html and the following are excerpts from those posts:

> "... I know ... http://www.innerx.net/personal/tsmith/FynCkb.html ... and the corresponding lanl paper ...[http://xxx.lanl.gov/abs/quant-ph/9503015]... and I know that Tony Smith does give a generalization of Feynman's summing prescription from 1+1 to 1+3 dimensions.
>
> But I have to say that I fail to see that this generalization reproduces the Dirac propagator in 1+3 dimensions, and that I did not find any proof that it does. Actually, I seem to have convinced myself that it does not, but I may of course be quite wrong. I therefore take this opportunity to state my understanding of these matters.
>
> First, I very briefly summarize (my understanding of) Tony Smith's construction:
>
> The starting point is the observation that the left |-> and right |+> going states of the 1+1 dim checkerboard model can be labeled by complex numbers
>
> |-> ---> (1 + i)
>
> |+> ---> (1 - i)
>
> (up to a factor) so that multiplication by the negative imaginary unit swaps components:

(-i) (1 + i)/2 = (1 - i)/2

(-i) (1 - i)/2 = (1 + i)/2 .

Since the path-sum of the 1+1 dim model reads

phi = sum over all possible paths of (-i eps m)^(number of bends of path) = sum over all possible paths of product over all steps of one path of -i eps m (if change of direction after this step generated by i) 1 (otherwise)

this makes it look very natural to identify the imaginary unit appearing in the sum over paths with the "generator" of kinks in the path. To generalize this to higher dimensions, more square roots of -1 are added, which gives the quaternion algebra in 1+3 dimensions. The two states |+> and |-> from above, which were identified with complex numbers, are now generalized to four states identified with the following quaternions (which can be identified with vectors in M^4 indicating the direction in which a given path is heading at one instant of time):

(1 + i + j + k)

(1 + i - j - k)

(1 - i + j - k)

(1 - i - j + k) ,

which again constitute a (minimal) left ideal of the algebra (meaning that applying i,j, or k from the left on any linear combination of these four states gives another linear combination of these four states). Hence, now i,j,k are considered as "generators" of kinks in three spatial dimensions and the above summing prescription naturally generalizes to

phi = sum over all possible paths of product over all steps of one path of

-i eps m (if change of direction after this step generated by i)

-j eps m (if change of direction after this step generated by j)

-k eps m (if change of direction after this step generated by k)

1 (otherwise)

The physical amplitude is taken to be

A * e^(i alpha)

where A is the norm of phi and alpha the angle it makes with the x0 axis.

As I said, this is merely my paraphrase of Tony Smith's proposal as I understand it.

I fully appreciate that the above construction is a nice (very "natural") generalization of the summing prescription of the 1+1 dim checkerboard model. But if it is to describe real fermions propagating in physical spacetime, this generalized path-sum has to reproduce the propagator obtained from the Dirac equation in 1+3 dimensions, which we know to correctly describe these fermions. Does it do that?

...

Hence I have taken a look at the material [that] ... George Raetz ... present[s] ... titled "The HyperDiamond Random Walk", found at http://www.pcisys.net/~bestwork.1/QRW/the_flow_quaternions.htm , which is mostly new to me.... I am posting this in order to make a suggestion for a more radical modification ...

[The]... equation ... DQ = (iE)Q ... is not covariant. That is because of that quaternion E sitting on the left of the spinor Q in the rhs of [the] equation ... . The Dirac operator D is covariant, but the unit quaternion E on the rhs refers to a specific frame. Under a Lorentz transformation L one finds

L DQ = iE LQ = L E' Q <=> DQ = E'Q

now with E' = L~ E L instead of E. This problem disappears when the unit quaternion E is brought to the *right* of the spinor Q. What we would want is an equation of the form

DQ = Q(iE) .

In fact, demanding that the spinor Q be an element of the minimal left ideal generated by the primitive projector

P = (1+y0)(1+E)/4 ,

so that

Q = Q' P ,

one sees that

DQ = Q(iE)

almost looks like the the *Dirac-Lanczos equation*. (See hep-ph/0112317, equation (5) or ... equation (9.36) [of]... W. Baylis, Clifford (Geometric) Algebras, Birkhaeuser (1996) ...). To be equivalent to the Dirac-Lanczos equation, and hence to be correct, we need to require that

D = y0 @0 + y1 @1 + y2 @2 + y3 @3

instead of

... = @0 + e1 @1 + e2 @2 + e3 @3 .

All this amounts to sorting out in which particluar representation we are actually working here.

In an attempt to address these issues, I now redo the steps presented on http://www.pcisys.net/~bestwork.1/QRW/the_flow_quaternions.htm with some suitable modifications to arrive at the correct Dirac-Lanczos equation (this is supposed to be a suggestion subjected to discussion):

So consider a lattice in Minkoswki space generated by a unit cell spanned by the four (Clifford) vectors

r = (y0 + y1 + y2 + y3)/2

g = (y0 + y1 - y2 - y3)/2

b = (y0 - y1 + y2 - y3)/2

y = (y0 - y1 - y2 + y3)/2 .

(yi are the generators of the Dirac algebra {yi,yj} = diag(+1,-1,-1,-1)_ij.) This is Tony Smith’s "hyper diamond". (Note that I use Clifford vectors instead of quaternions.) Now consider a "Clifford algebra-weighted" random walk along the edges of this lattice, which is described by four Clifford valued "amplitudes":

Kr, Kg, Kb, Ky

and such that

@r Kr = k (Kg y2 y3 + Kb y3 y1 + Ky y1 y2)

@b Kb = k (Ky y2 y3 + Kr y3 y1 + Kg y1 y2)

@g Kg = k (Kr y2 y3 + Ky y3 y1 + Kb y1 y2)

@y Ky = k (Kb y2 y3 + Kg y3 y1 + Kr y1 y2) .

(This is geometrically motivated. The generators on the rhs are those that rotate the unit vectors corresponding to the amplitudes into each other. "k" is some constant.) Note that I multiply the amplitudes from the *right* by the generators of rotation, instead of multiplying them from the left.

Next, assume that this coupled system of differential equations is solved by a spinor Q

Q = Q' (1+y0)(1+iE)/4

E = (y2 y3 + y3 y1 + y1 y2)/sqrt(3)

with

Kr = r Q

Kg = g Q

Kb = b Q

Ky = y Q .

This ansatz for solving the above system by means of a single spinor Q is, as I understand it, the central idea. But note that I have here modified it on the technical side: Q is explicitly an algebraic Clifford spinor in a definite minial left ideal, E squares to -1, not to +1, and the Ki are obtained from Q by premultiplying with the Clifford basis vectors defined above.

Substituting this ansatz into the above coupled system of differential equations one can form one covariant expression by summing up all four equations:

(r @r + g @g + b @b + y @y) Q = k sqrt(3) Q E

The left hand side is immediate. To see that the right hand side comes out as indicated simply note that r + g + b + y = y0 and that Q y0 = Q by construction.

The above equation is the Dirac-Lanczos-Hestenes-Guersey equation, the algebraic version of the equation describing the free relativistic electron. The left hand side is the flat Dirac operator r @r + g @g + b @b + y @y = ym @m and the right hand side, with k = mc / (hbar sqrt(3)) , is equal to the mass term i mc / hbar Q.

As usual, there are a multitude of ways to rewrite this. If one wants to emphasize biquaternions then premultiplying everything with y0 and splitting off the projector P on the right of Q to express everything in terms of the, then also biquaternionic, Q' (compare the definitions given above) gives Lanczos' version (also used by Baylis and others).

I think this presentation improves a little on that given on George Raetz's web site: The factor E on the right hand side of the equation is no longer a nuisance but a necessity. Everything is manifestly covariant (if one recalls that algebraic spinors are manifestly covariant when nothing non-covariand stands on their *left* side). The role of the quaternionic structure is clarified, the construction itself does not depend on it. Also, it is obvious how to generalize to arbitrary dimensions. In fact, one may easily check that for 1+1 dimensions the above scheme reproduces the Feynman model.

While I enjoy this, there is still some scepticism in order as long as a central questions remains to be clarified: How much of the Ansatz K(r,g,b,y) = (r,g,b,y) Q is whishful thinking?

For sure, **every Q that solves the system of coupled differential equations that describe the amplitude of the random walk on the hyper diamond lattice also solves the Dirac equation**.

But what about the other way round?

Does every Q that solves the Dirac equation also describe such a random walk. ...".

My proposal to answer the question raised by Urs Schreiber

Does every solution of the Dirac equation also describe a HyperDiamond Feynman Checkerboard random walk?

uses symmetry.

The hyperdiamond random walk transformations include the transformations of the Conformal Group:

- rotations and boosts (to the accuracy of lattice spacing);
- translations (to the accuracy of lattice spacing);
- scale dilatations (to the accuracy of lattice spacing): and
- special conformal transformations (to the accuracy of lattice spacing).

Therefore, to the accuracy of lattice spacing, the hyperdiamond random walks give you all the conformal group Dirac solutions, and since the full symmetry group of the Dirac equation is the conformal group, the answer to the question is "Yes". Thanks to the work of Urs Schreiber:

The HyperDiamond Feynman Checkerboard in 1+3 dimensions does reproduce the correct Dirac equation.

Here are some references to the conformal symmetry of the Dirac equation:

R. S. Krausshar and John Ryan in their paper Some Conformally Flat Spin Manifolds, Dirac Operators and Automorphic Forms at math.AP/0212086 say:

> "... In this paper we study Clifford and harmonic analysis on some conformal flat spin manifolds. ... manifolds treated here include RPn and S1 x S(n-1). Special kinds of Clifford-analytic automorphic forms associated to the different choices of are used to construct Cauchy kernels, Cauchy Integral formulas, Green's kernels and formulas together with Hardy spaces and Plemelj projection operators for Lp spaces of hypersurfaces lying in these manifolds. ... **Solutions to the Dirac equation** are called Clifford holomorphic functions or monogenic functions. Such functions **are covariant under ... conformal or .... Mobius transformations acting over Rn u {oo}**. ...".

Barut and Raczka, in their book Theory of Group Representations and Applications (World 1986), say, in section 21.3.E, at pages 616-617:

> "... E. The Dynamical Group Interpretation of Wave Equations.
>
> ... Example 1. **Let G = O(4,2)**. Take U to be the 4-dimensional non-unitary representation in which the generators of G are given in terms of the 16 elements of the algebra of Dirac

> matrices as in exercise 13.6.4.1. Because (1/2)L_56 = gamma_0 has eigenvalues n = +/-1, taking the simplest mass relation mn = K, we can write
>
> (m gamma_0 - K) PSI(dotp) = 0, where K is a fixed constant.
>
> **Transforming this equation** with the Lorentz transformation of parameter E
>
> PSI(p) = exp(i E N) PSI(p)
>
> N = (1/2) gamma_0 gamma
>
> **gives**
>
> (gamma^u p_u - K) PSI(p) = 0
>
> which is **the Dirac equation** ...".

P. A. M. Dirac, in his paper Wave Equations in Conformal Space, Ann. Math. 37 (1936) 429-442, reprinted in The Collected Works of P. A. M. Dirac: Volume 1: 1924-1948, by P. A. M. Dirac (author), Richard Henry Dalitz (editor), Cambridge University Press (1995), at pages 823-836, said:

> "... by passing to a four-dimensional conformal space ... a ... greater symmetry of ... equations of physics ... is shown up, and their invariance under a wider group is demonstrated. ... The spin wave equation ... seems to be the only simple conformally invariant wave equation involving the spin matrices. ... This equation is equivalent to the usual wave equation for the electron, except ...[that it is multiplied by]... the factor (1 + alpha_5) , which introduces a degeneracy. ...".

Tony's Home

This paper is also at CERN-CDS-EXT-2004-030.

E6, Strings, Branes, and the Standard Model

- E6 String Structure
- Standard Model String Theory

In his paper hep-th/0112261 entitled **Algebraic Dreams**, Pierre Ramond says:

> "... **Nature shows that space-time symmetries with dynamics associated with gravity, and internal symmetries with their dynamics described by Yang-Mills theories, can coexist peacefully. How does She do it?** ... **there remain important unanswered questions**. ...".

According to a superstring theory web site:

> "... For bosonic strings ...[you]... can ... do quantum mechanics sensibly only if the spacetime dimensions number 26. For superstrings we can whittle it down to 10. ...

A Brief Table of String Theories		
Type	**Spacetime Dimensions**	**Details**
Bosonic	26	Only bosons, no fermions means only forces, no matter, with both open and closed strings. Major flaw: a particle with imaginary mass, called the **tachyon**
I	10	Supersymmetry between forces and matter, with both open and closed strings, no tachyon, group symmetry is **SO(32)**
IIA	10	Supersymmetry between forces and matter, with closed strings only, no tachyon, massless fermions spin both ways (nonchiral)
IIB	10	Supersymmetry between forces and matter, with closed strings only, no tachyon, massless fermions only spin one way (chiral)

HO	10	Supersymmetry between forces and matter, with closed strings only, no tachyon, heterotic, meaning right moving and left moving strings differ, group symmetry is **SO(32)**
HE	10	Supersymmetry between forces and matter, with closed strings only, no tachyon, heterotic, meaning right moving and left moving strings differ, group symmetry is $\mathbf{E_8 \times E_8}$

... There are higher dimensional objects in string theory with dimensions from zero (points) to nine, called p-branes. In terms of branes, what we usually call a membrane would be a two› brane, a string is called a one-brane and a point is called a zero-brane. ... A special class of p› branes in string theory are called D branes. Roughly speaking, a D brane is a p-brane where the ends of open strings are localized on the brane. A D brane is like a collective excitation of strings. ...

... the five superstring theories are connected to one another as if they are each a special case of some more fundamental theory ...

... an eleven dimensional theory of supergravity, which is supersymmetry combined with gravity ... didn't work as a unified theory of particle physics, because it doesn't have a sensible quantum limit as a point particle theory. But this eleven dimensional theory ... came back to life in the strong coupling limit of superstring theory in ten dimensions ... M theory is is the unknown eleven-dimensional theory whose low energy limit is the supergravity theory in eleven dimensions ... many people have taken to also using M theory to label the unknown theory believed to be the fundamental theory from which the known superstring theories emerge as special limits ...

... **We still don't know the fundamental M theory** ...".

The purpose of this paper is to give an example of

Algebraic Reality:

A String Theory with E6 Structure that accurately represents Gravity and the Standard Model.

The E6 exceptional Lie algebra string theory is a counterexample to Pierre Ramond's statement:

> "... M-theory and Superstring theories ... are the only examples of theories where ... union ...[of]... gravity ... and internal symmetries ... appears possible ...",

but is consistent with Pierre Ramond's statement:

> "... **Nature relishes unique mathematical structures**. ... **The Exceptional Algebras are most unique and beautiful among Lie Algebras**, and no one should be surprised if Nature uses them. ...".

Although Raymond sees the tensor-spinor relationships of exceptional groups as an obstacle, saying

> "... The use of exceptional groups to describe space-time symmetries has not been as fruitful [as the use of classical groups] ... One obstacle has been that exceptional algebras relate tensor and spinor representations of their orthogonal subgroups, while Spin_Statistics requires them to be treated differently. ...",

I see the exceptional tensor-spinor relationships of E6 as a way to introduce fermions into String Theory without naive 1-1 fermion-boson supersymmetry.

Ramond accurately describes E6 in these terms:

> "... **The traceless Jordan matrices [J3(O)o] ... (3x3) traceless octonionic hermitian matrices, each labelled by 26 real parameters ... span the 26 representation of [the 52› dimensional exceptional Lie algebra F4**]. One can **supplement the F4 transformations by an additional 26 parameters ... leading to a group with 78 parameters**. These extra transformations are non-compact, and close on the F4 transformations, **leading to the exceptional group E6(-26)**. The subscript in parenthesis denotes the number of non-compact minus the number of compact generators. ...".

The following is my proposal to use the exceptional Lie algebra E6(-26), which I will for the rest of this message write as E6, to introduce fermions into string theory in a new way, based on the exceptional E6 relations between bosonic vectors/bivectors and fermionic spinors, in which 16 of the 26 dimensions are seen as orbifolds whose 8 + 8 singularities represent first-generation fermion particles and antiparticles.

This structure allows string theory to be physically interpreted as a theory of interaction among world-lines in the Many-Worlds.

According to Soji Kaneyuki, in Graded Lie Algebras, Related Geometric Structures, and Pseudo-hermitian Symmetric Spaces, Analysis and Geometry on Complex Homogeneous Domains, by Jacques Faraut, Soji Kaneyuki, Adam Koranyi, Qi-keng Lu, and Guy Roos (Birkhauser 2000), E6 as a Graded Lie Algebra with 5 grades:

g = E6 = g(-2) + g(-1) + g(0) + g(1) + g(2)

such that

- g(0) = so(8) + R + R
- dimR g(-1) = dimR g(1) = 16 = 8 + 8
- dimR g(-2) = dimR g(2) = 8

Here, step-by-step, is a description of the E6 structure:

Step 1:

```
g(0) = so(8)                                28 gauge bosons

                                      _
             + R + R                   |
                                       |
dimR g(-1) = dimR g(1) = 16 = 8 + 8    |>   26-dim string spacetime
                                       |      with J3(O)o structure
dimR g(-2) = dimR g(2) = 8            _|
```

Step 2:

The E6 GLA has an Even Subalgebra gE (Bosonic) and an Odd Part gO (Fermionic):

```
BOSONIC      gE = g(-2) + g(0) + g(2)

FERMIONIC    gO = g(-1) + g(1)
```

Step 3:

```
BOSONIC

g(0) = so(8)                                28 gauge bosons
```

```
                                                          _
                   + R + R                                 |
dimR g(-2) = dimR g(2) = 8                                 |›    10-dim spacetime
                                                          _|
```

```
FERMIONIC

dimR g(-1) = dimR g(1) = 16 = 8                                8-dim orbifold
                                +
                                  8                            8-dim orbifold
```

Giving the Fermionic sector orbifold structure gives each point of the string/world-line a discrete value corresponding to one of the 8+8 = 16 fundamental first-generation fermion particles or antiparticles.

Step 4:

```
BOSONIC

g(0) = so(8)                                                  28 gauge bosons

                                                          _
                   + R + R                                 |
dimR g(-2) = dimR g(2) = 8                                 |›    10-dim spacetime
                                                          _|
FERMIONIC

dimR g(-1) = dimR g(1) = 16 = 8                                8 fermions
                                +
                                  8                            8 antifermions
```

Step 5:

```
BOSONIC
                                                               16-dim conformal U(2,2)
g(0) = so(8)                                                         +
                                                               12-dim SU(3)xSU(2)xU(1)

                                                          _
                   + R + R                                 |
dimR g(-2) = dimR g(2) = 4                                 |-     6-dim conformal spacetime
```

```
                                        _|
                             +
                               4              4-dim internal symmetry space


FERMIONIC

dimR g(-1) = dimR g(1) = 16 = 8               8 fermions (3 gen)

                                  + 8         8 antifermions (3 gen)
```

Dimensional reduction of spacetime breaks so(8) to U(2,2) and SU(3)xSU(2)xU(1) and also introduces 3 generations of fermion particles and antiparticles.

Step 6:

```
BOSONIC

                                             16-dim conformal U(2,2)
g(0) = so(8)                                       +
                                             12-dim SU(3)xSU(2)xU(1)


             + R + R                          2 spacetime conformal dim

dimR g(-2) = dimR g(2) = 4                    4-dim physical spacetime
                             +
                               4              4-dim internal symmetry space


FERMIONIC

dimR g(-1) = dimR g(1) = 16 = 8               8 fermions (3 gen)

                                  + 8         8 antifermions (3 gen)
```

The 2 spacetime conformal dimensions R+R are related to complex structure of

- spacetime g(-2) + g(2) and
- fermionic g(-1) + g(1).

Physical spacetime and internal symmetry space, and fermionic representation spaces, are related to Shilov boundaries of the corresponding complex domains.

The E6 String Structure described above allows construction of a Realistic String Theory:

This construction was motivated by a March 2004 sci.physics.research thread Re: photons from strings? in which John Baez asked:

"... has anyone figured out a way to ... start with string theory ... to get just photons on Minkowski spacetime ..." ?

Lubos Motl noted "... **string theory always contains gravity** ... Gravity is always contained as a vibration of a closed string, and closed strings can always be created from open strings....".

Urs Schreiber said "... the low energy effective worldsheet theory of a single flat **D3 brane of the bosonic string** is, to lowest nontrivial order, just U(1) gauge theory in 4D ...".

Aaron Bergman noted "... there are a bunch of scalars describing the transverse fluctuations of the brane ...".

Urs Schreiber said "... I guess that's why you have to **put the brane at the singularity of an orbifold if you want to get rid of the scalars** ... if the number of dimensions is not an issue the simplest thing probably would be to consider the single space-filling D25 brane of the bosonic string. This one does not have any transverse fluctuations and there is indeed only the U(1) gauge field ...".

Aaron Bergman replied "... Unfortunately, there's a tadpole in that configuration. You need 8192 D25 branes to cancel it. ...".

Lubos Motl pointed out the existence of brane structures other than massless vectors, saying "... A D-brane contains other massless states, e.g. the **transverse scalars** (and their **fermionic superpartners**). It also contains an **infinite tower of excited massive states**. Finally, a D› brane in the full string theory is coupled to **the bulk which inevitably contains gravity as well as other fields and particles**. ... N coincident D-branes carry a U(N) gauge symmetry (and contain the appropriate gauge N^2 bosons, as you explained). Moreover, if this stack of N D-branes approaches **an orientifold**, they meet their mirror images and U(N) is extended to O(2N) or USp(2N). The brane intersections also carry **new types of matter - made of the open strings stretched from one type of brane to the other** - but these new fields are *not* gauge fields, and they don't lead to new gauge symmetries. For example, there are **scalars whose condensation is able to join two intersecting D2-branes into a smooth, connected,**

> **hyperbolically shaped objects (D2-branes)**. ... **the number of D-branes can be determined or bounded by anomaly cancellation and similar requirements**. For example, the spacetime filling D9-branes in type I theory must generate the SO(32) gauge group, otherwise the theory is anomalous. (There are other arguments for this choice of 16+16 branes, too.)...".

What follows on this page is my construction of

a specific example of a String Theory with E6 structure containing gravity and the U(1)xSU(2)xSU(3) Standard Model.

As to how my simple model is affected by some of the complications mentioned by Lubos Motl:

- Transverse scalars are taken care of by Orbifolding as suggested by Urs Schreiber.
- Fermionic superpartners are taken care of by not using naive 1-1 fermion-boson supersymmetry.
- The infinite tower of excited massive states is related to Regge trajectories which in turn are related to interactions among strings considered as world-lines in the Many-Worlds.
- Bulk gravity is included.
- There are no orientifolds.
- Open strings from one brane to another, as vacuum loops, look like exchange of closed loops and are related to gravity among branes and the Bohm-type quantum potential.
- Scalar condensates are related to Dilatons which in turn are related to interactions among strings considered as world-lines in the Many-Worlds.
- I have not fully investigated all potential anomaly problems.

Further, string theory Tachyons are related to interactions among strings considered as world-lines in the Many-Worlds.

In short,

> the complications are either taken care of in the construction of the model or are useful in describing the Bohm-type quantum potential interactions among strings considered as world-lines in the Many-Worlds.

Here is some further background, from Joseph Polchinski's book String Theory vol. 1 (Cambridge 1998), in Chapter 8 and the Glossary:

> "... a ... D-brane ...[is]... a dynamical object ... a flat hyperplane ...[for which]... a certain open string state corresponds to fluctuation of its shape ...

... A D25-brane fills space, so the string endpoint can be anywhere ...

... When no D-branes coincide there is just one massless vector on each, giving the gauge group U(1)^n in all.

If r D-branes coincide, there are new massless states because string that are stretched between these branes can have vanishing length: ... Thus, there are r^2 vectors, forming the adjoint of a U(r) gauge group. ... there will also be r^2 massless scalars from the components normal to the D-brane. ...

... The massless fields on the world-volume of a Dp-brane are a U(1) vector plus 25 - p world› brane scalars describing the fluctuations. ... The fields on the brane are the embedding X^u(x) and the gauge field A_a(x) ...

... For n separated D-branes, the action is n copies of the action for a single D-brane. ... when the D-branes are coincident there are n^2 rather than n massless vectors and scalars on the brane ...

... The fields X^u(x) and A_a(x) will now be nxn matrices ...

... the gauge field ... becomes a non-Abelian U(n) gauge field ...

... the collectives coordinates ... X^u ... for the embedding of n D-branes in spacetime are now enlarged to nxn matrices. This ’noncommutative geometry’ ...[may be]... an important hint about the nature of spacetime. ...

...[an]... orbifold ...(*noun*)...[is]... a coset space M/H, where H is a group of discrete symmetries of a manifold M. The coset is singular at the fixed points of H ...(*verb*)...[is]... to produce such a ... string theory by gauging H ...

... To determine the actual value of the D-brane tension ... Consider two parallel Dp-branes ...[They]... can feel each other’s presence by exchanging closed strings ...[which is equivalent to]... a vacuum loop of an open string with one end on each D-brane ... The ... analogous ... field theory graph ... is the exchange of a single graviton or dilaton between the D-branes....".

Here, step-by-step, is the String/Brane construction:

Step 1:

Consider the 26 Dimensions of String Theory as the 26-dimensional traceless part J3(O)o

a	O+	Ov
O+*	b	O-
Ov*	O-*	-a-b

(where Ov, O+, and O- are in Octonion space with basis {1,i,j,k,E,I,J,K} and a and b are real numbers with basis {1})

of the 27-dimensional Jordan algebra J3(O) of 3x3 Hermitian Octonion matrices.

Step 2:

Take Urs Schreiber's **D3 brane to correspond to the Imaginary Quaternionic associative subspace spanned by {i,j,k} in the 8-dimenisonal Octonionic Ov space**.

Step 3:

Compactify the 4-dimensional co-associative subspace spanned by {E,I,J,K} in the Octonionic Ov space as a CP2 = SU(3)/U(2), with its 4 world-brane scalars corresponding to the 4 covariant components of a Higgs scalar.

Add this subspace to D3, to get D7.

Step 4:

Orbifold the 1-dimensional Real subspace spanned by {1} in the Octonionic Ov space by the discrete multiplicative group Z2 = {-1,+1}, with its fixed points {-1,+1} corresponding to past and future time. This discretizes time steps and gets rid of the world-brane scalar corresponding to the subspace spanned by {1} in Ov. It also gives our brane a 2-level timelike structure, so that its past can connect to the future of a preceding brane and its future can connect to the past of a succeeding brane.

Add this subspace to D7, to get D8.

D8, our basic Brane, looks like two layers (past and future) of D7s.

Beyond D8 our String Theory has 26 - 8 = 18 dimensions, of which 25 - 8 have corresponding world-brane scalars:

- 8 world-brane scalars for Octonionic O+ space;
- 8 world-brane scalars for Octonionic O- space;
- 1 world-brane scalars for real a space; and
- 1 dimension, for real b space, in which the D8 branes containing spacelike D3s are stacked in timelike order.

Step 5:

To use Urs Schreiber's idea to get rid of the world-brane scalars corresponding to the Octonionic O+ space, orbifold it by the 16-element discrete multiplicative group Oct16 = {+/-1,+/-i,+/-j,+/-k,+/-E,+/-I,+/-J,+/-K} to reduce O+ to 16 singular points {-1,-i,-j,-k,-E,-I,-J,-K,+1,+i,+j,+k,+E,+I,+J,+K}.

- Let the 8 O+ singular points {-1,-i,-j,-k,-E,-I,-J,-K} correspond to the fundamental fermion particles {neutrino, red up quark, green up quark, blue up quark, electron, red down quark, green down quark, blue down quark} located on the past D7 layer of D8.
- Let the 8 O+ singular points {+1,+i,+j,+k,+E,+I,+J,+K} correspond to the fundamental fermion particles {neutrino, red up quark, green up quark, blue up quark, electron, red down quark, green down quark, blue down quark} located on the future D7 layer of D8.

This gets rid of the 8 world-brane scalars corresponding to O+, and leaves:

- 8 world-brane scalars for Octonionic O- space;
- 1 world-brane scalars for real a space; and
- 1 dimension, for real b space, in which the D8 branes containing spacelike D3s are stacked in timelike order.

Step 6:

To use Urs Schreiber's idea to get rid of the world-brane scalars corresponding to the Octonionic O- space, orbifold it by the 16-element discrete multiplicative group Oct16 = {+/-1,+/-i,+/-j,+/-k,+/-E,+/-I,+/-J,+/-K} to reduce O- to 16 singular points {-1,-i,-j,-k,-E,-I,-J,-K,+1,+i,+j,+k,+E,+I,+J,+K}.

- Let the 8 O- singular points {-1,-i,-j,-k,-E,-I,-J,-K} correspond to the fundamental fermion anti› particles {anti-neutrino, red up anti-quark, green up anti-quark, blue up anti-quark, positron, red down anti-quark, green down anti-quark, blue down anti-quark} located on the past D7 layer of D8.
- Let the 8 O- singular points {+1,+i,+j,+k,+E,+I,+J,+K} correspond to the fundamental fermion anti› particles {anti-neutrino, red up anti-quark, green up anti-quark, blue up anti-quark, positron, red down anti-quark, green down anti-quark, blue down anti-quark} located on the future D7 layer of D8.

This gets rid of the 8 world-brane scalars corresponding to O-, and leaves:

- 1 world-brane scalars for real a space; and
- 1 dimension, for real b space, in which the D8 branes containing spacelike D3s are stacked in timelike order.

Here is some discussion of some symmetries of fermion particles and antiparticles.

Step 7:

Let the 1 world-brane scalar for real a space correspond to a Bohm-type Quantum Potential

acting on strings in the **stack of D8 branes**.

Interpret strings as world-lines in the Many-Worlds, short strings representing virtual particles and loops.

Step 8:

Fundamentally, physics is described on HyperDiamond Lattice structures.

There are 7 independent E8 lattices, each corresponding to one of the 7 imaginary octionions. They can be described as iE8, jE8, kE8, EE8, IE8, JE8, and KE8.

Further, an 8th naturally related, but dependent, E8 lattice corresponds to the real octonions and can be described as 1E8.

Give each D8 brane structure based on Planck-scale E8 lattices so that **each D8 brane is a superposition/intersection/coincidence of the eight E8 lattices**.

Step 9:

Since Polchinski says "... If r D-branes coincide ... there are r^2 vectors, forming the adjoint of a U(r) gauge group ...", make the following assignments:

- a gauge boson emanating from D8 only from its 1E8 lattice is a U(1) photon;
- a gauge boson emanating from D8 only from its 1E8 and EE8 lattices is a U(2) weak boson;
- a gauge boson emanating from D8 only from its IE8, JE8, and KE8 lattices is a U(3) gluon.

Note that I do not consider it problematic to have U(2) and U(3) instead of SU(2) and SU(3) for the weak and color forces, respectively. Here is some further discussion of the global Standard Model group structure. Here is some discussion of the root vector structures of the Standard Model groups.

Step 10:

Since Polchinski says "... there will also be r^2 massless scalars from the components normal to the D-brane. ... the collectives coordinates ... X^u ... for the embedding of n D-branes in spacetime are now enlarged to nxn matrices. This 'noncummutative geometry' ...[may be]... an important hint about the nature of spacetime. ...", make the following assignment:

> The 8x8 matrices for the collective coordinates linking a D8 brane to the next D8 brane in the stack are needed to connect
>
> > the eight E8 lattices of the D8 brane
> >
> > to the eight E8 lattices of the next D8 brane in the stack.

We have now accounted for all the scalars, and, since, as Lubos Motl noted, "... string theory always contains gravity ...",

> we have here at Step 10 **a specific example of a String Theory containing gravity and the U(1)xSU(2)xSU(3) Standard Model**.

Step 11:

We can go a bit further by noting that we have not described gauge bosons emanating from D8 from its iE8, jE8, or kE8 lattices. Therefore, make the following assignment:

- a gauge boson emanating from D8 only from its 1E8, iE8, jE8, and kE8 lattices is a U(2,2) conformal gauge boson.

We have here at Step 10 a String Theory containing the Standard Model plus two forms of gravity:

- closed-string gravity and
- conformal U(2,2) = Spin(2,4)xU(1) gravity plus conformal structures, based on a generalized MacDowell-Mansouri mechanism.

I conjecture that those two forms of gravity are not only consistent, but that the structures of each will shed light on the structures of the other, and that the conformal structures are related to the conformal gravity ideas of I. E. Segal.

Step 12:

Going a bit further leads to consideration of the exceptional E-series of Lie algebras, as follows:

a gauge boson emanating from D8 only from its 1E8, iE8, jE8, kE8, and EE8 lattices is a U(5) gauge boson related to Spin(10) and Complex E6.

a gauge boson emanating from D8 only from its 1E8, iE8, jE8, kE8, EE8, and IE8 lattices is a U(6) gauge boson related to Spin(12) and Quaternionic E7.

a gauge boson emanating from D8 only from its 1E8, iE8, jE8, kE8, EE8, IE8, and JE8 lattices is a U(7) gauge boson related to Spin(14) and possibly to Sextonionic E(7+(1/2)).

a gauge boson emanating from D8 only from its 1E8, iE8, jE8, kE8, EE8, IE8, JE8, and KE8 lattices is a U(8) gauge boson related to Spin(16) and Octonionic E8.

These correspondences are based on the natural inclusion of U(N) in Spin(2N) and on Magic Square constructions of the E series of Lie algebras, roughly described as follows:

- 78-dim E6 = 45-dim Adjoint of Spin(10) + 32-dim Spinor of Spin(10) + Imaginary of C;
- 133-dim E7 = 66-dim Adjoint of Spin(12) + 64-dim Spinor of Spin(12) + Imaginaries of Q;
- 248-dim E8 = 120-dim Adjoint of Spin(16) + 128-dim half-Spinor of Spin(16)

Physically,

- E6 corresponds to 26-dim String Theory, related to traceless J3(O)o and the symmetric space E6 / F4.
- E7 corresponds to 27-dim M-Theory, related to the Jordan algebra J3(O) and the symmetric space E7

/ E6 x U(1).
- E8 corresponds to 28-dim F-Theory, related to the Jordan algebra J4(Q) and the symmetric space E8 / E7 x SU(2).

Note on Sextonions:

I am not yet clear about how the Sextonionic E(7+(1/2)) works. It was only recently developed by J. M. Landsberg and Laurent Manivel in their paper "The sextonions and $E_{7\frac 12}$" at math.RT/0402157. Of course, the Sextonion algebra is not a real division algebra, but it does have interesting structure. In their paper, Landsberg and Manivel say:

> "... We fill in the "hole" in the exceptional series of Lie algebras that was observed by Cvitanovic, Deligne, Cohen and deMan. More precisely, we show that the intermediate Lie algebra between E_7 and E_8 satisfies some of the decomposition and dimension formulas of the exceptional simple Lie algebras. A key role is played by the sextonions, a six dimensional algebra between the quaternions and octonions. Using the sextonions, we show simliar results hold for the rows of an expanded Freudenthal magic chart. We also obtain new interpretations of the adjoint variety of the exceptional group G_2. ...
>
> ... the orthogonal space to a null-plane U, being equal to the kernel of a rank-two derivation, is a six-dimensional subalgebra of O. ...
>
> ... The decomposition ... into the direct sum of two null-planes, is unique. ...[this]... provides an interesting way to parametrize the set of quaternionic subalgebras of O. ...".

Some possibly related facts of which I am aware include:

- The set of Quaternionic subalgebras of Octonions = SU(3) = G2 / Spin(4).
- G2 / SU(3) = S6 is almost complex but not complex and is not Kaehler. Its almost complex structure is not integrable. See chapter V of Curvature and Homology, rev. ed., by Samuel I. Goldberg (Dover 1998).
- It may be that the sextonions and S6 are related to Spin(4) as the 6-dim conformal vector space of SU(2,2) = Spin(2,4) is related to 4-dim Minkowski space.

Note on the Monster:

The 26 dimensions of String Theory might be related to the 26 Sporadic Finite Simple Groups, the largest of which, the Monster, has about 8 x 10^53 elements. If you use positronium (electron-positron bound state of the two lowest-nonzero-mass Dirac fermions) as a unit of mass Mep = 1 MeV, then it is interesting that the product of the squares of the Planck mass Mpl = 1.2 x 10^22 MeV and W-boson mass Mw = 80,000 MeV gives ((Mpl/Mep)(Mw/Mep))^2 = 9 x 10^53 which is roughly the Monster order. Maybe the Monster shows how, in the world of particle physics, "big" things like Planck mass and W-bosons are related to "little" (but not zero-mass) things like electrons and positrons, thus giving you some persepective on the world of fundamental particles.

July 2004 note by Frank D. (Tony) Smith, Jr., on

Sporadic Finite Groups

The 26 Sporadic Finite Groups correspond to the 26 dimensions of J3(O)o, the traceless 3x3 Hermitian Octonionic matrices,

```
 a      Os+     Ov

Os+*     b      Os-

Ov*     Os-*   -a-b
```

as follows:

The 8 red groups correspond to the 8-dim octonionic Os+, the 8 green groups correspond to the 8-dim octonionic Os-, the 4+4=8 blue groups correspond to the 4+4=8-dim octonionic Ov, and the 2 black groups correspond to a and b.

The 8 + 8 + 4 = 20 groups above the dashed --- line correspond to the Monster Family, as they are all part of the Monster Group F1.

Here are 3 tables:

- Involvements among the Sporadic Finite Simple Groups, from A Brief Introduction to the Finite Simple Groups, by Robert L. Griess, Jr., in Vertex Operators in Mathematics and Physics - Proceedings of a Conference November 10-17, 1983 (Springer-Verlag 1984), and from Sporadic Groups, by Michael Aschbacher (Cambridge 1994);
- Orders of the Sporadic Finite Simple Groups, from The Classification of the Finite Simple Groups, by Daniel Gorenstein, Richard Lyons, and Ronald Solomon, (AMS 1994); and
- a combined table of both Involvements and Orders.

See also the Atlas of Sporadic Groups at http://web.mat.bham.ac.uk/atlas/v2.0/spor/ on the web.

```
F1
F2   in F1
F3   in F1   F2
F5   in F1   F2
F7   in F1   Fi24

Fi24 in F1
Fi23 in F1   F2   Fi24
Fi22 in F1   F2   Fi24 Fi23


Co1  in F1
Co2  in F1   F2   Co1
Co3  in F1   Co1
```

```
M24  in F1   Fi24 Co1  J4        ?in  F2 ?
M23  in F1   F2   Fi24 Fi23 Co1  Co2  Co3  M24  J4
M22  in F1   F2   F5   Fi24 Fi23 Fi22 Co1  Co2  Co3  M24  M23  Mc   HS   J4   Ly
M12  in F1   F2   F5   Fi24 Fi23 Fi22 Co1  Co3  M24  Suz  J4
M11  in F1   F2   F5   Fi24 Fi23 Fi22 Co1  Co2  Co3  M24  M23  M12  Suz  Mc   HS   ON
J4   Ly


Suz  in F1   Co1
J2   in F1   Co1  Suz       ?in  F2   Fi24  Fi23 ?
Mc   in F1   F2   Co1  Co2  Co3  Ly
HS   in F1   F2   F5   Co1  Co2  Co3
-----------------------------------------------------
ON
J1   in ON        ?in  F1   F2 ?          also in G2(11)
J3                                        also in E6(4)
Ru                                        also in E7(5)


J4
Ly
```

Primes below 72 not used in sporadic finite groups: 53 61

F1	2^46	3^20	5^9	7^6	11^2	13^3	17	19	23	29	31	41	47	59	71
F2	2^41	3^13	5^6	7^2	11	13	17	19	23		31		47		
F3	2^15	3^10	5^3	7^2		13		19			31				
F5	2^14	3^6	5^6	7	11			19							
F7	2^10	3^3	5^2	7^3			17								
Fi24	2^21	3^16	5^2	7^3	11	13	17		23	29					
Fi23	2^18	3^13	5^2	7	11	13	17		23						
Fi22	2^17	3^9	5^2	7	11	13									
Co1	2^21	3^9	5^4	7^2	11	13			23						
Co2	2^18	3^6	5^3	7	11				23						
Co3	2^10	3^7	5^3	7	11				23						
M24	2^10	3^3	5	7	11				23						
M23	2^7	3^2	5	7	11				23						
M22	2^7	3^2	5	7	11										
M12	2^6	3^3	5		11										
M11	2^4	3^2	5		11										
Suz	2^13	3^7	5^2	7	11	13									
J2	2^7	3^3	5^2	7											
Mc	2^7	3^6	5^3	7	11										
HS	2^9	3^2	5^3	7	11										

```
ON    2^9  3^4  5   7^3 11           19       31
J1    2^3  3    5   7   11           19
J3    2^7  3^5  5                 17 19
Ru    2^14 3^3  5^3 7       13            29


J4    2^21 3^3  5   7   11^3            23 29 31 37 41 43 47    59       71
Ly    2^8  3^7  5^6 7   11                    31 37                   67
```

```
Primes below 72 not used in sporadic finite groups:    53    61


F1
2^46 3^20 5^9 7^6 11^2 13^3 17 19 23 29 31    41    47    59       71

F2   in F1
2^41 3^13 5^6 7^2 11   13   17 19 23    31          47

F3   in F1   F2
2^15 3^10 5^3 7^2      13      19       31

F5   in F1   F2
2^14 3^6  5^6 7   11           19

F7   in F1   Fi24
2^10 3^3  5^2 7^3           17


Fi24 in F1
2^21 3^16 5^2 7^3 11   13   17    23 29

Fi23 in F1   F2   Fi24
2^18 3^13 5^2 7   11   13   17    23

Fi22 in F1   F2   Fi24 Fi23
2^17 3^9  5^2 7   11   13



Co1  in F1
2^21 3^9  5^4 7^2 11   13         23

Co2  in F1   F2   Co1
2^18 3^6  5^3 7   11              23

Co3  in F1   Co1
2^10 3^7  5^3 7   11              23



M24  in F1   Fi24 Co1  J4        ?in  F2 ?
2^10 3^3  5   7   11              23
```

```
M23  in F1   F2   Fi24 Fi23 Co1  Co2  Co3  M24  J4
2^7  3^2  5   7   11              23

M22  in F1   F2   F5   Fi24 Fi23 Fi22 Co1  Co2  Co3  M24  M23  Mc   HS   J4   Ly
2^7  3^2  5   7   11

M12  in F1   F2   F5   Fi24 Fi23 Fi22 Co1  Co3  M24  Suz  J4
2^6  3^3  5       11

M11  in F1   F2   F5   Fi24 Fi23 Fi22 Co1  Co2  Co3  M24  M23  M12  Suz  Mc   HS   ON
J4   Ly
2^4  3^2  5       11



Suz  in F1   Co1
2^13 3^7  5^2 7   11   13

J2   in F1   Co1  Suz       ?in  F2   Fi24  Fi23 ?
2^7  3^3  5^2 7

Mc   in F1   F2   Co1  Co2  Co3  Ly
2^7  3^6  5^3 7   11

HS   in F1   F2   F5   Co1  Co2  Co3
2^9  3^2  5^3 7   11
-----------------------------------------------------
ON
2^9  3^4  5   7^3 11          19       31

J1   in ON        ?in  F1   F2 ?          also in G2(11)
2^3  3    5   7   11          19

J3                                        also in E6(4)
2^7  3^5  5                17 19

Ru                                        also in E7(5)
2^14 3^3  5^3 7        13            29



J4
2^21 3^3  5   7   11^3            23 29 31 37 41 43 47    59       71

Ly
2^8  3^7  5^6 7   11                    31 37                   67
```

Orbifolding E6 String Theory

In CERN-CDS-EXT-2004-031, E6, Strings, Branes, and the Standard Model, the 5-graded Graded Lie Algebra of the 78-dimensional exceptional Lie algebra

E6 = g(-2) + g(-1) + g(0) + g(1) + g(2) =

= 8-dim + 16-dim + (Spin(8) + R + R) + 16-dim + 8-dim =

= 8-complex-dim + 16-complex-dim + (Spin(8) + R + R)

provides a physical interpretation of the 26 dimensions of String Theory.

Of the 26 dimensions of String Theory, 2 correspond to complex structure of E6, 8 correspond to 4›dimensional SpaceTime and 4-dimensional Internal Symmetry Space, and 16 = 8+8 represent 8 first-generation fermion particles and 8 first-generation antiparticles.

Although the 8 SpaceTime and Internal Symmetry Space dimensions can be thought of as, at least approximately at scales much larger than the Planck length, being continuous,

the 16 = 8+8 fermion particles and antiparticles are clearly 16 = 8+8 discrete things, and their representation as such requires discretization of the corresponding 16 dimensions of 26-dimensional String Theory, which is accomplished by Orbifolding. The purpose of this paper is to describe the geometry of such Orbifolding.

Begin by looking at the root vector structure of E6:

the 6-dimensional polytope formed by the root vectors of the Lie algebra E6 has 72 vertices. A 2›dimensional projection, by Peter McMullen,

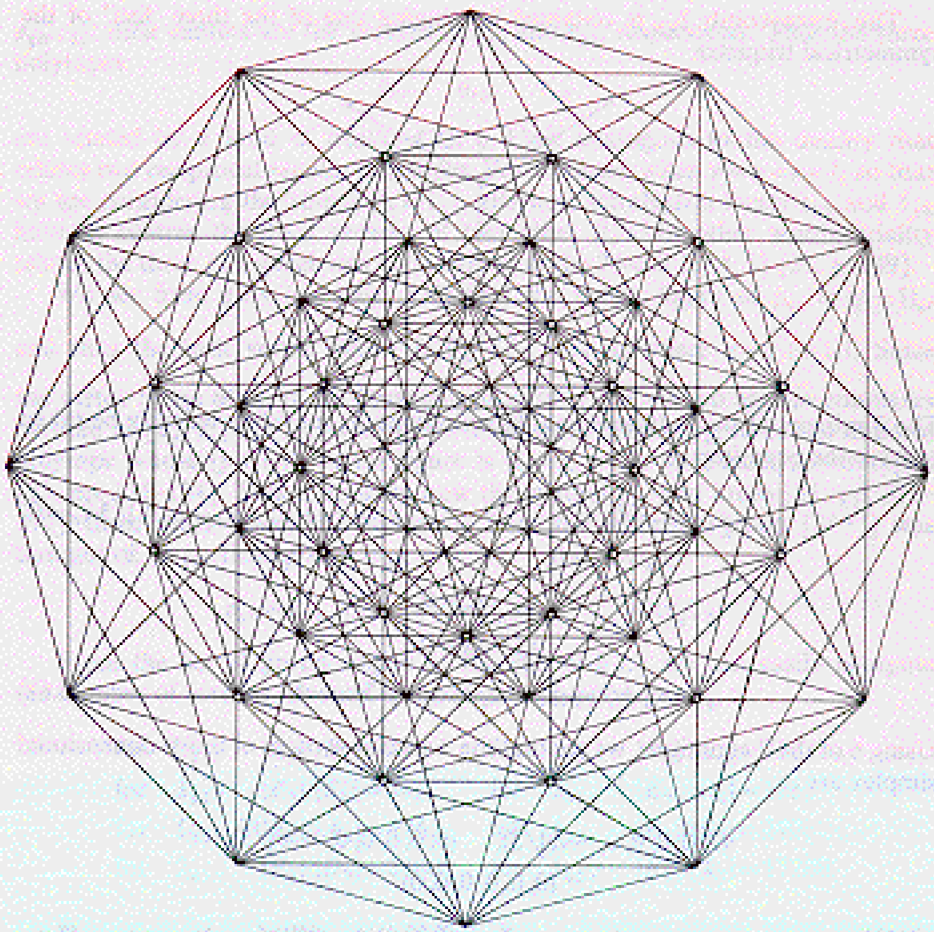
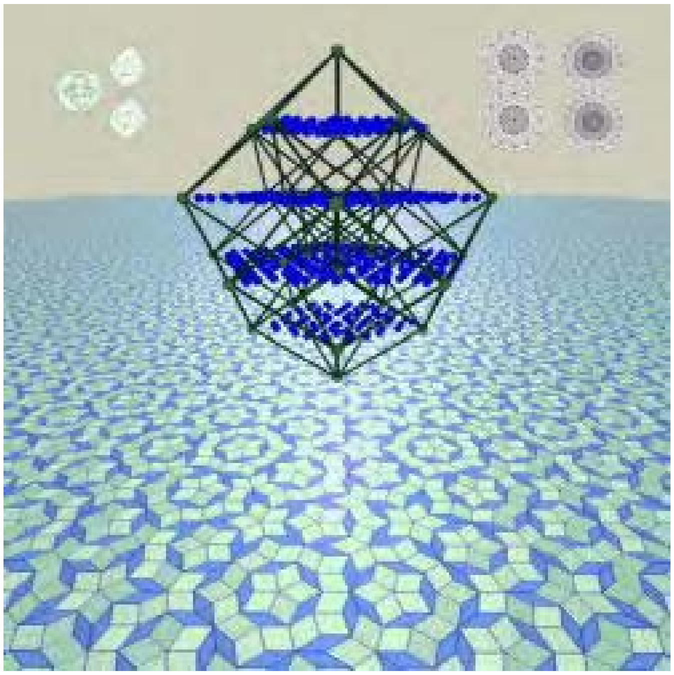


Fig. 3.6a. The six-dimensional polytope 1_{22}

has 72 vertices in sets of 12 on 4 concentric circles, 2 of which (white centers) are double (one vertex behind another). The 6-dimensional 72-vertex Root Vector Diagram of E6 can be constructed from the 4-dimensional 24-vertex 24-cell Root Vector Diagram of D4 by adding to it the following:

- a 5th dimension, with an 8-vertex 4-dim hyperoctahedron cross polytope above in the 5th dimension, and another 8-vertex 4-dim hyperoctahedron cross polytope below in the 5th dimension, to get a 40-vertex Root Vector Diagram of D5; and
- a 6th dimension, with, instead of adding to it hyperoctahedra cross polytopes, adding to it a 16-vertex 5-dim hemi-hypercube (half of the 2^5 = 32 vertices of a 5-dim hypercube) above in the 6th dimension, and a 16-vertex 5-dim hemi-hypercube (the other half of the 2^5 = 32 vertices of a 5-dim hypercube) below in the 6th dimension.

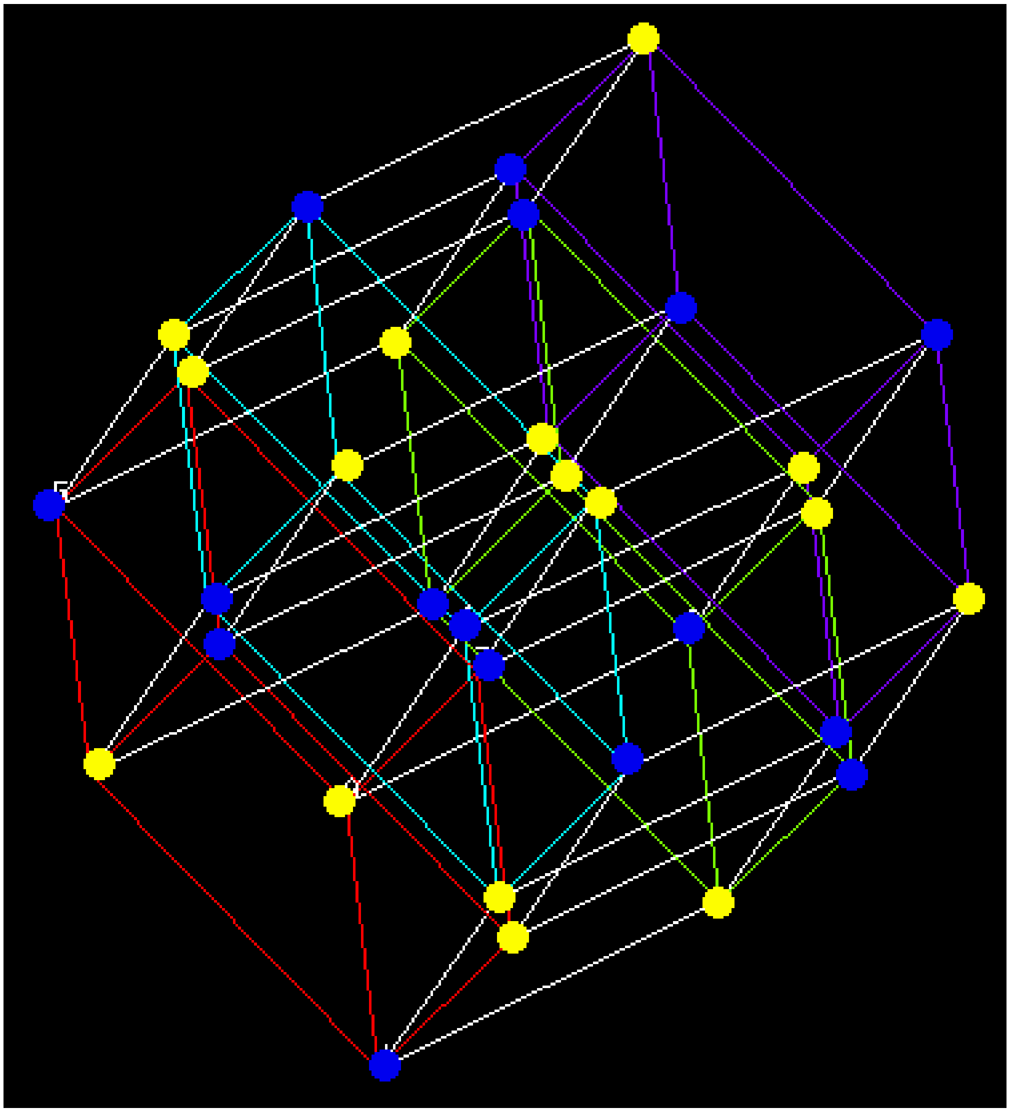
This construction is the first three stages of the 5-stage construction of the E8 Root Vector Diagram,



that is, proceeding from the left in the above image, the D4 24-cell, the two D5 hyperoctahedra cross polytopes, and the 5-dim hypercube.

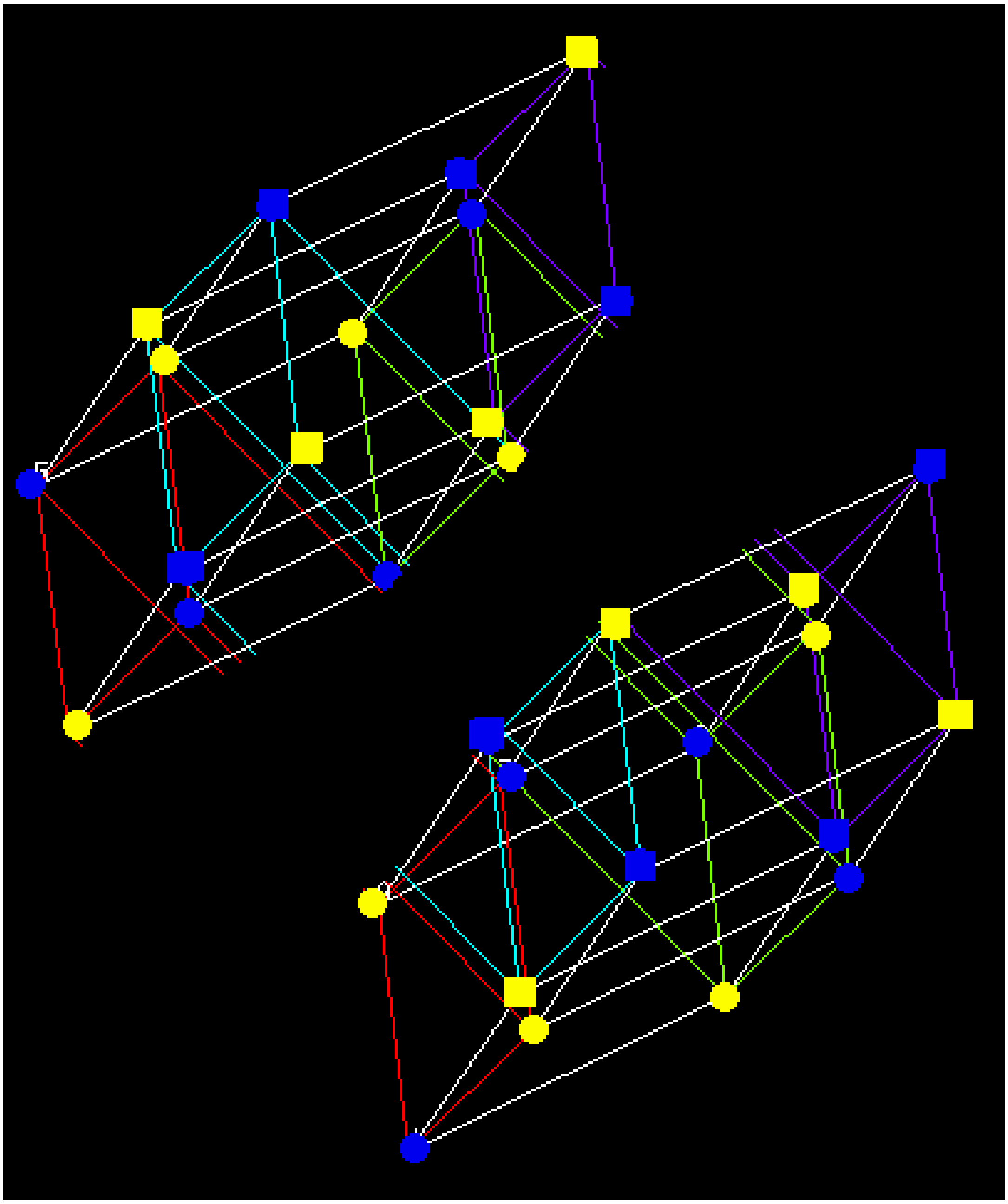
The 32 vertices of the 5-dim hypercube correspond to the 16 complex (32 real) dimensions of the symmetric space E6 / D5xU(1), corresponding to a bounded complex domain whose Shilov boundary is an 8 complex (16 real) dimensional non-tube-type domain.

Here (adapated from an image on a johnh web page) is an image of a 5-dim hypercube



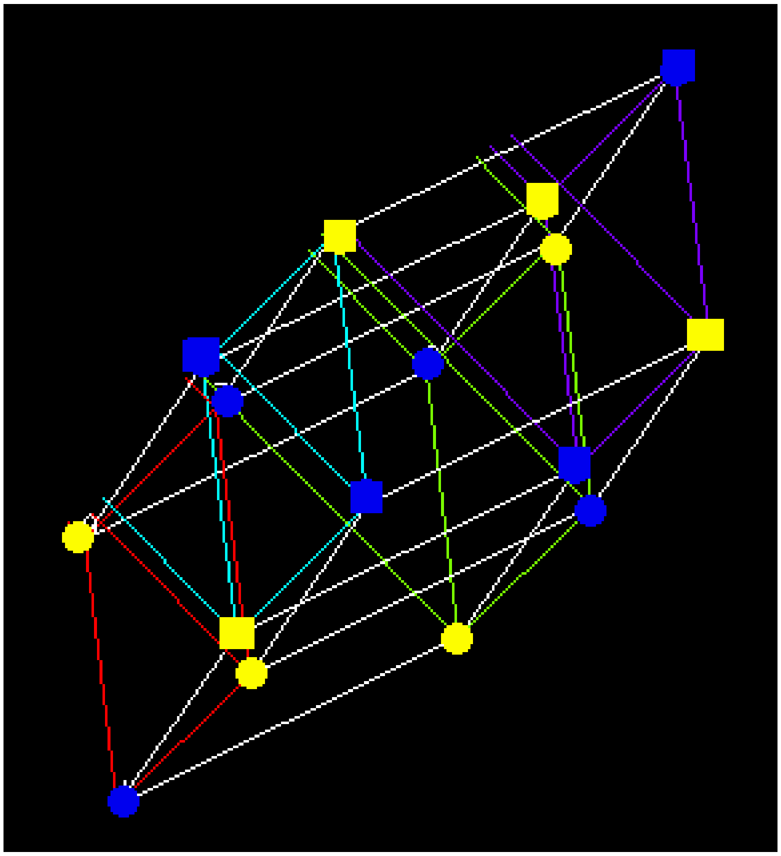
in which you can see the graded structure of its vertices - 1 (top yellow), 5 (blue), 10 (yellow), 10 (blue), 5 (yellow), and 1 (bottom blue).

Divide the 32 vertices into two sets of 16



each of which corresponds to a 16-vertex 4-dimensional hypercube, whose vertices have graded structure 1, 4, 6, 4, 1.

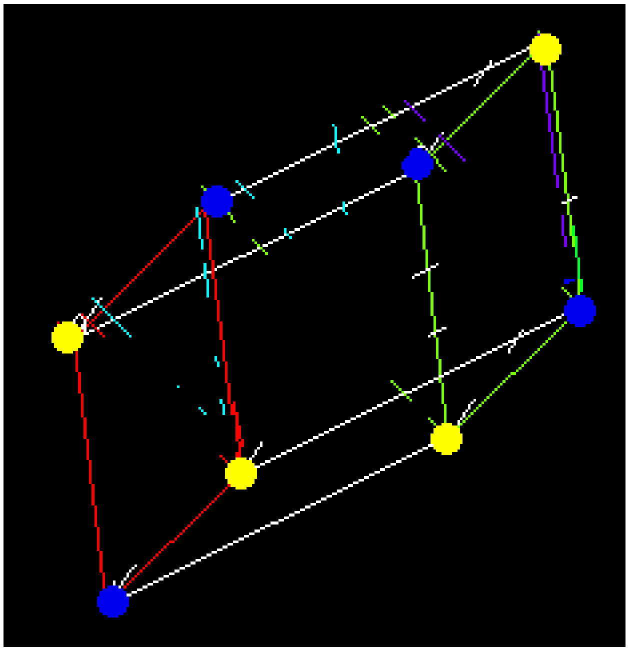
Now look at one of the 4-dimensional hypercubes (call it the +hypercube)



and notice that it is made up of two 3-dimensional cubes (one shown with circle vertices, the other shown with square vertices.

In CERN-CDS-EXT-2004-031, E6, Strings, Branes, and the Standard Model, orbifolding to discretize fermion particles and antiparticles corresponding to the 16-vertex +hypercube is done this way:

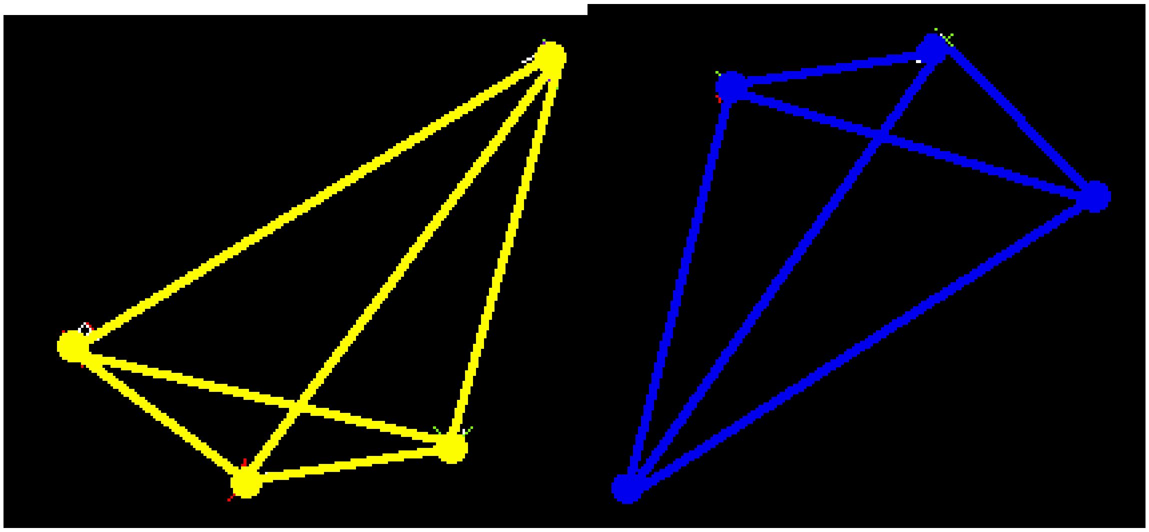
> "... To use Urs Schreiber's idea to get rid of the world-brane scalars corresponding to the Octonionic O+ space, orbifold it by the 16-element discrete multiplicative group Oct16 = {+/-1,+/-i,+/-j,+/-k,+/-E,+/-I,+/-J,+/-K} to reduce O+ to 16 singular points {-1,-i,-j,-k,-E,-I,› J,-K,+1,+i,+j,+k,+E,+I,+J,+K}.
>
> Let the 8 O+ singular points {-1,-i,-j,-k,-E,-I,-J,-K} correspond to the fundamental fermion particles {neutrino, red up quark, green up quark, blue up quark, electron, red down quark, green down quark, blue down quark} located on the past D7 layer of D8. [These 8 can be taken to be the cube



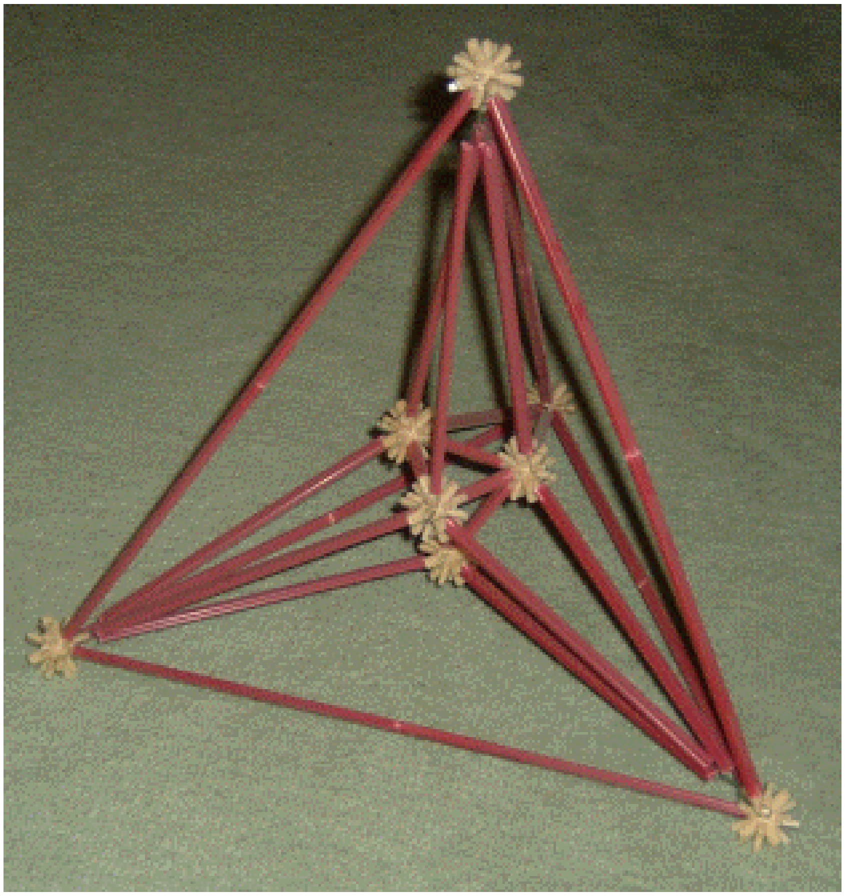
with 8 circle vertices.]

Let the 8 O+ singular points {+1,+i,+j,+k,+E,+I,+J,+K} correspond to the fundamental fermion particles {neutrino, red up quark, green up quark, blue up quark, electron, red down quark, green down quark, blue down quark} located on the future D7 layer of D8. [These 8 can be taken to be the cube with 8 circle vertices.] ...".

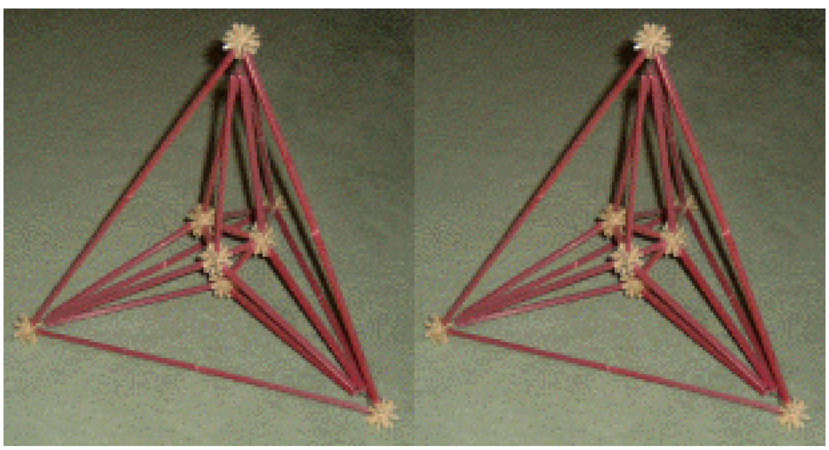
A geometrical picture of the Orbifolded **8-dimensional fermionic first-generation particle representation space** as 8 of the 26 dimensions of String Theory comes from looking at the **organization of the 16 vertices of the 4-dimensional +hypercube**. Each of its two 8-vertex 3› dimensional cubes can be seen as two 3-dimensional octahedron cross-polytopes



or also as one 4-dimensional hyperoctahedron cross-polytope



Therefore, the **16 vertices of the 4-dimensional +hypercube,** made up of the two 8-vertex 3›dimensional cubes taken together, can be seen as a 4-dimensional hyperoctahedron cross-polytope in one 4-dimensional space plus a second 4-dimensional hyperoctahedron cross-polytope in a second 4›dimensional space,



or also as **one 16-vertex 8-dimensional hyperoctahedron cross-polytope**.

Therefore:

Orbifolding 8-dimensional O+ Octonionic space by the 16-element discrete multiplicative group Oct16 = {+/-1,+/-i,+/-j,+/-k,+/-E,+/-I,+/-J,+/-K} produces an orbifold that looks like an 8› dimensional cross polytope with 16 vertices/corners.

The geometry related to the other 16 vertices of the 5-dimensional 32-vertex hypercube, the 4› dimensional -hypercube, and the first-generation fermion antiparticles, is similar.

Note that:

in the Octonionic orbifold {+/-1,+/-i,+/-j,+/-k,+/-E,+/-I,+/-J,+/-K} 8-dimensional cross polytope with 16 corners (vertices)

each + vertex (say, +i) is the singularity representative of the segment [0,+i]

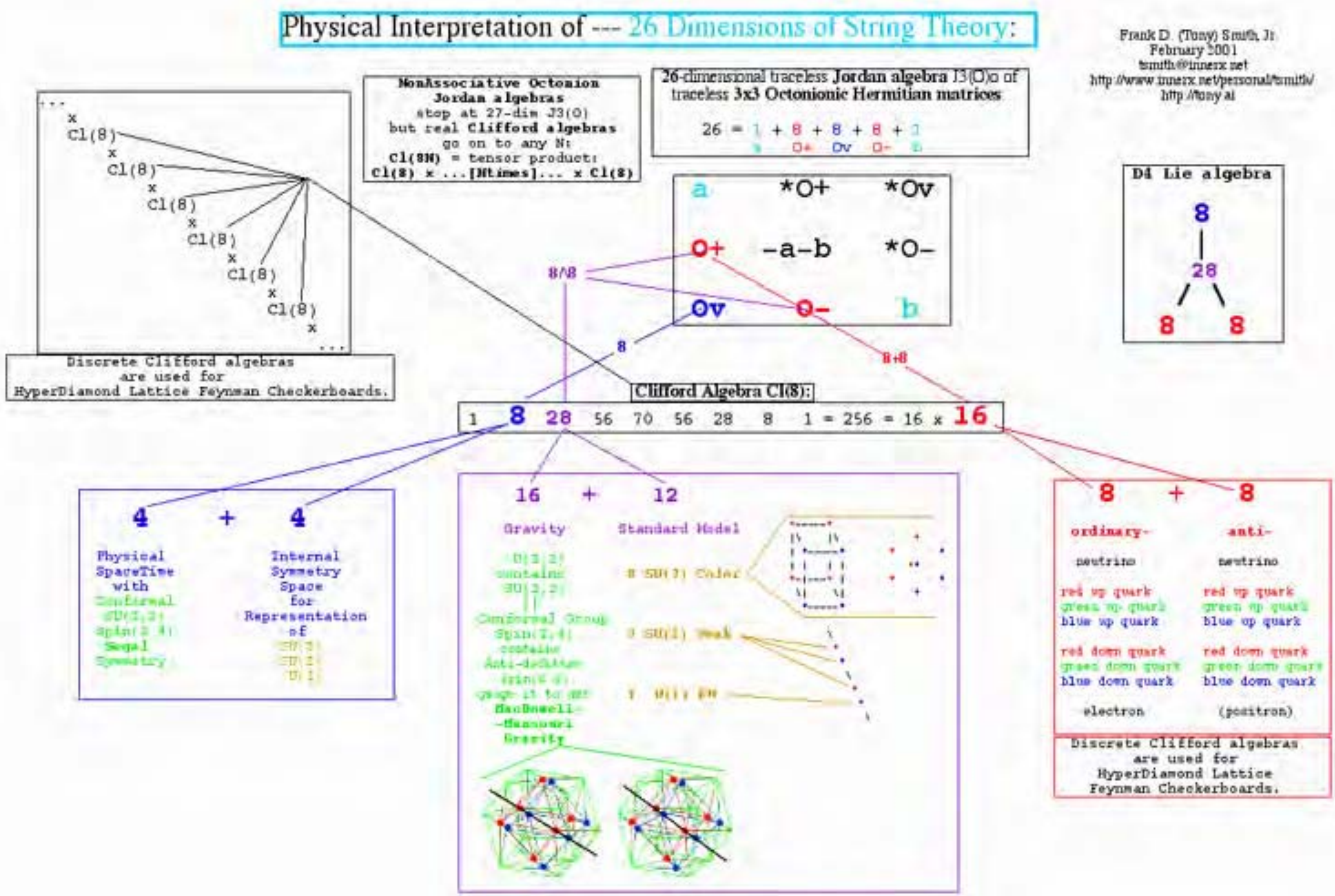
which in turn represents the +i component part of all of the orbifold with nonzero +i coordinate

which in turn by extension to the full line (-oo, -i, 0, +i, oo) and by triality automorphism among the three octonionic spaces O+ representing first-generation fermion particles, O- representing first-generation fermion antiparticles, and Ov 8-dimensional spacetime, has a global connection with all of 8-dimensional spacetime

which is consistent with the fact that

Fermions - quaternions - have a Dirac belt trick type connection with global spacetime.

Tony's Home Page



Physical Interpretation of --- 26 Dimensions of String Theory:
Frank D. (Tony) Smith, Jr.
February 2001
tsmith@innerx.net
http://www.innerx.net/personal/tsmith/
http://tony.ai
NonAssociative Octonion Jordan algebras stop at 27-dim J3(O) but real Clifford algebras go on to any N: Cl(8N) = tensor product: Cl(8) x ...[Ntimes]... x Cl(8)
26-dimensional traceless Jordan algebra J3(O)o of traceless 3x3 Octonionic Hermitian matrices
26 = 1 + 8 + 8 + 8 + 1
a O+ Ov O- b
D4 Lie algebra
8
28
8 8
a *O+ *Ov
O+ -a-b *O-
Ov O- b
8/8
8
8+8
Cl(8) x Cl(8) x Cl(8) x Cl(8) x Cl(8) x Cl(8) x
Discrete Clifford algebras are used for HyperDiamond Lattice Feynman Checkerboards.
Clifford Algebra Cl(8):
1 8 28 56 70 56 28 8 1 = 256 = 16 x 16
4 + 4
Physical SpaceTime with Conformal SU(2,2) Spin(2,4) Segal Symmetry
Internal Symmetry Space for Representation of SU(3) SU(2) U(1)
16 + 12
Gravity
Standard Model
U(2,2) contains SU(2,2)
Conformal Group Spin(2,4) contains Anti-deSitter Spin(2,3) gauge it to get MacDowell-Mansouri Gravity
8 SU(3) Color
3 SU(2) Weak
1 U(1) EM
8 + 8
ordinary- anti-
neutrino neutrino
red up quark red up quark
green up quark green up quark
blue up quark blue up quark
red down quark red down quark
green down quark green down quark
blue down quark blue down quark
electron (positron)
Discrete Clifford algebras are used for HyperDiamond Lattice Feynman Checkerboards.

Note added 18 July 2005:

Lubos Motl, in his blog entry Tachyons and the Big Bang at http://motls.blogspot.com/ dated 13 July 2005, said:
"... closed string tachyons ... signal an instabilityof the whole spacetime ...
... closed string tachyons ... can be localized ifthey appear in a twisted sector of an orbifold ...
the twisted closed strings describe fields thatare localized at the origin ...
The tachyons condense near the tip which smears out the tip of the cone which makes the tip nice and round. ...".

Closed string tachyons localized at an orbifold may be physically equivalent to what Schroer describes in http://xxx.lanl.gov/abs/hep-th/9908021 as "... any compactly localized operator applied to the vacuum generates clouds of pairs of particle/antiparticles, unless the system is free ..."
and to
Dirac's 1938 Dirac-Lorentz equation model of the electron as described in pages 194-195 of
Dirac: A Scientific Biography,by Helge Kragh (Cambridge 1990):
"... Dirac explained that the strange behavior of electrons in this theory could be understood if
the electron was thought of as an extended particlewith a nonlocal interior.
He suggested that the point electron, embedded in its own radiation field, be interpreted as
a sphere of radius a, where a is the distance within which an incoming pulse must arrive
before the electron accelerates appreciably.
With this interpretation he showed that it was possible for a signal to be propagated faster than light
through the interior of the electron. ... In spite of the appearance of superluminal velocities,
Dirac's theorywas Lorentz-invariant. ...".

In short, if orbifolds are identified with fermion particles,
then their localized tachyons can be physically interpreted as describing the virtual particle-antiparticle clouds that dress the fermion particles.

Penrose-Hameroff Quantum Tubulin Electrons, Chiao Gravity Antennas, and Mead Resonance

Frank D. (Tony) Smith, Jr., Cartersville Georgia USA

Abstract:

Penrose and Hameroff have proposed that consciousness in the human brain may be based on gravitational interactions and quantum superposition states of electrons in tubulin cages in microtubules.

Chiao has proposed experimental construction of a gravity antenna that might be analogous to tubulin caged electrons.

Tegmark has criticized Penrose-Hameroff quantum consciousness, based on thermal decoherence of any such quantum superposition states.

This paper briefly describes some experimental results and theoretical ideas that indicate to me that Tegmark's criticism may be invalid.

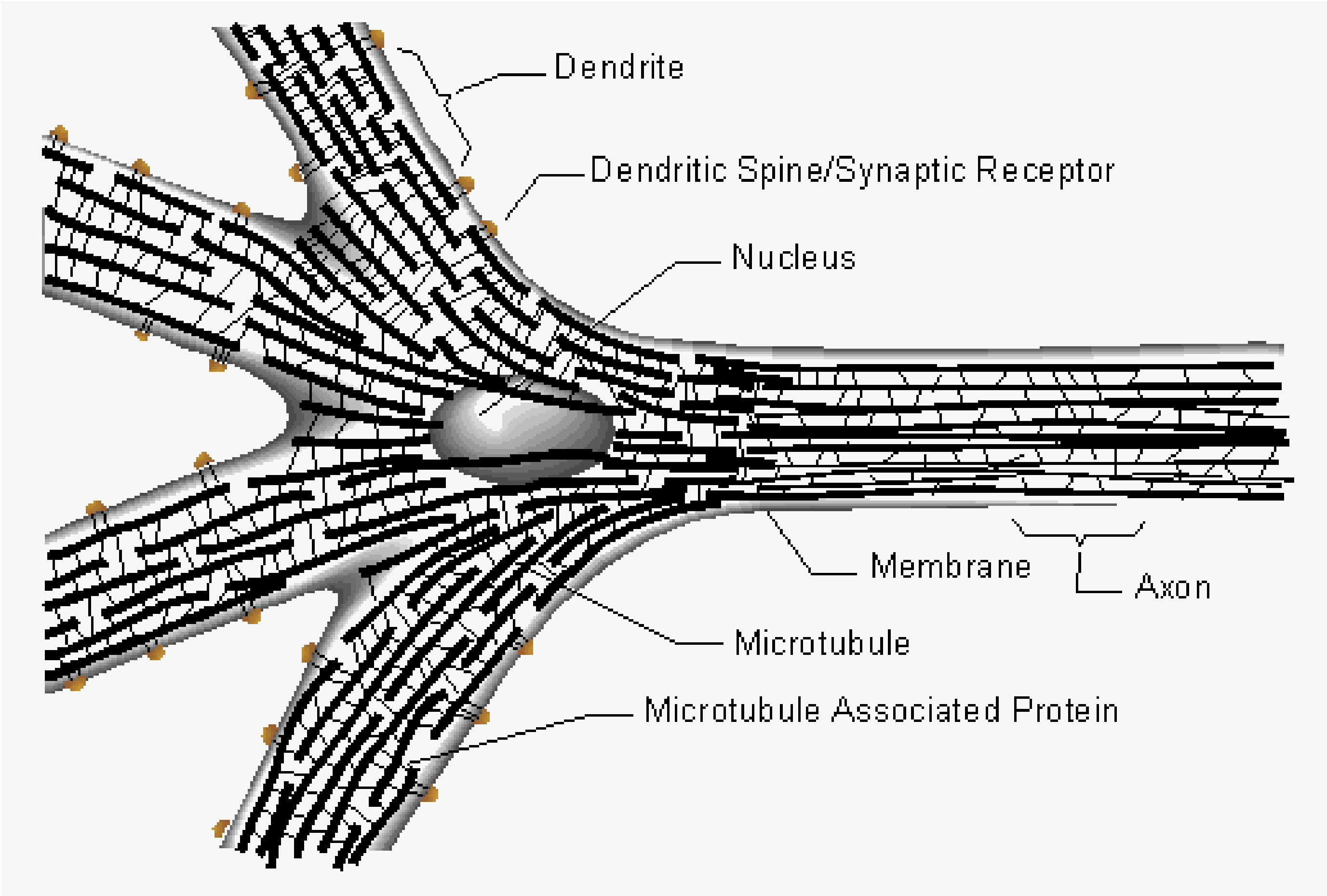
Such theoretical ideas include Mead's quantum physics of resonance.

This paper closes with brief summaries of

- relevant experiments of Grinberg-Zylberbaum,
- the quantum cosmology of Paula Zizzi, and
- 26-dimensional closed unoriented bosonic string theory interpreted as a many-worlds quantum theory in which strings correspond to world lines, with massless spin-2 gravitons in 26-dimensions corresponding to gravitational interaction among tubulin electrons in states with Penrose-Hameroff superposition separation.

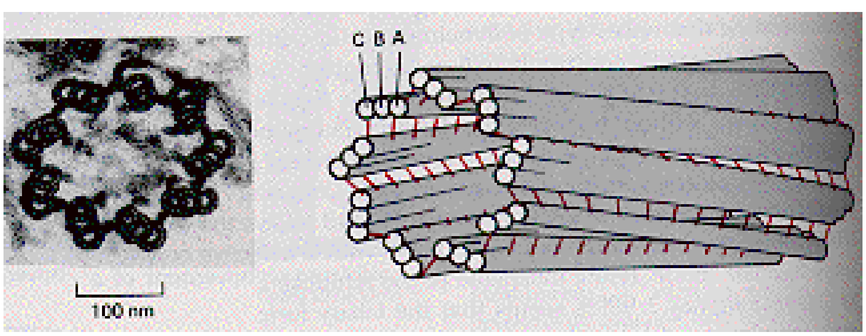
Penrose-Hameroff Quantum Consciousness

Roger Penrose and Stuart Hameroff propose that Consciousness involves a Planck scale Decoherence of Quantum Superpositions that they call Orch OR in their paper entitled Orchestrated Objective Reduction of Quantum Coherence in Brain Microtubules: The "Orch OR" Model for Consciousness. Figure 1



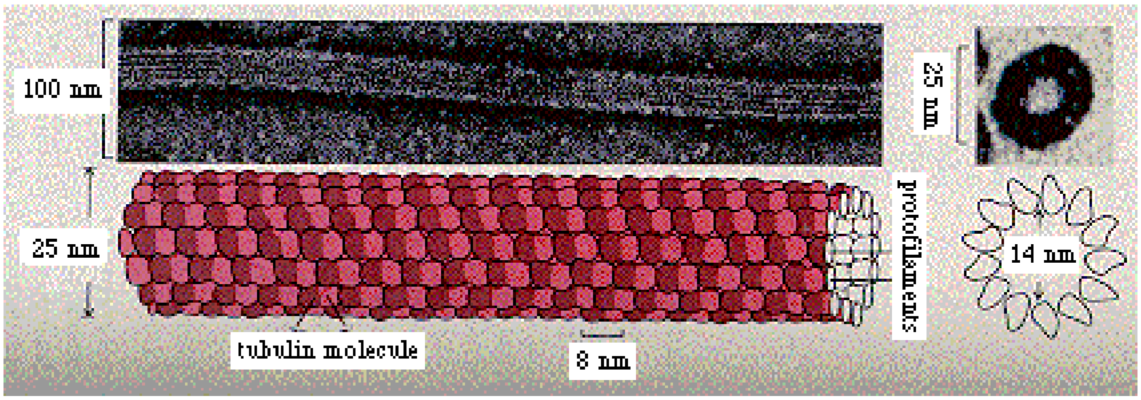
is a "Schematic of central region of neuron (distal axon and dendrites not shown) showing parallel arrayed microtubules interconnected by MAPs [Microtubule Associated Proteins]. Microtubules in axons are lengthy and continuous, whereas in dendrites they are interrupted and of mixed polarity. Linking proteins connect microtubules to membrane proteins including receptors on dendritic spines.".

The Centrosome, in most animal cells, acts as a Microtubule Organizing Center. Most Centrosomes contain a pair of Centrioles arrranged at right angles to each other in an L-shaped configuration. A Centriole



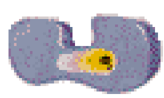
is about 200 nm wide and 400 nm long. Its wall is made up of 9 groups of 3 microtubles. You can regard the A microtubule of a triplet as being a complete microtubule, with the B and C microtubules being incomplete microtubules fused to A and B respectively. Each triplet is tilted in toward the central axis at an angle of about 45 degrees.

Each microtubule is a hollow cylindrical tube with about 25 nm outside diameter and 14 nm inside diameter, made up of 13 columns of Tubulin Dimers.



(The two preceding illustrations are from Molecular Biology of the Cell, 2nd ed, by Alberts, Bray, Lewis, Raff, Roberts, and Watson (Garland 1989))

Each Tubulin Dimer is about 8 nm x 4 nm x 4 nm, consists of two parts, alpha-tubulin and beta-tubulin (each made up of about 450 Amino Acids, each of which contains roughly 20 Atoms), and can exist in (at least) 2 different geometrical configurations, or conformations, involving the position of a single Electron.



Call this Electron the Conformation Electron, because in a single Tubulin Dimer its the position at the junction of the alpha-tubulin and the beta-tubulin determines the 2 different conformations of the Tubulin, which correspond to 2 different states of the dimer’s electric polarization.

There are 10^7 Tubulin Dimers per neuron, with 10% of them, or 10^6, estimated to be involved in the consciousness process, and the remainder doing other things needed to keep the cell alive.

The human brain contains about 10^11 neurons.

Therefore, the human brain contains about 10^18 tubulins, about 10^17 of which are involved in the consciousness process.

The Tubulins in a Microtubule can represent Information, and act as Cellular Automata to process it.

Roger Penrose says, in Shadows of the Mind (Oxford 1994), page 344, "... We can now consider the gravitational self-energy of that mass distribution which is the difference between the mass distributions of the two states that are to be considered in quantum linear superposition. The reciprocal of this self-energy gives ... the reduction timescale ...".

This is the decoherence time T = h / E.

For a given Particle, Stuart Hameroff describes this as a particle being separated from itself, saying that the Superposition Separation a is "... the separation/displacement of a mass separated from its superposed self. ... The picture is spacetime geometry separating from itself, and re-anealing after time T. ...".

If the Superposition consists of States involving one Particle of Mass m, but with Superposition Separation a, then the Superposition Separation Energy Difference is the gravitational energy

E = G m^2 / a

In the Osaka paper (Hameroff, S.R. (1997) Quantum computing in microtubules: an intra-neural correlate of consciousness? Cognitive Studies: Bulletin of the Japanese Cognitive Science Society 4(3):67-92.)), Hameroff says that Penrose describes Superposition Separation as "... shearing off into separate, multiple spacetime universes as described in the Everett "multi&endash;worlds" view of quantum theory. ...".

The superposition energy E_N of N Tubulin Electrons and the corresponding decoherence time T_N can be calculated from the equations E = G m^2 / a and T = h / E.

Therefore for a single Electron (ignoring for simplicity some factors like 2 and pi, etc.):

T = h / (G m^2 / a) = (h / m c) (c^2 / G m) (a / c) =

= (Compton / Schwarzschild) (a / c)

where

2 G m / c^2 = Schwarzschild Radius of a classical black hole of mass m and

h / m c = Compton Radius of an elementary particle of mass m.

The calculation for a single Electron will be used as the basis for a superpositon of N Electrons over the 10-cm scale human brain. If the single Tubulin Electron with mass m_e has a Superposition Displacement a that is of the order of 10^(-7) cm, or one nanometer, then, since Compton = 10^(-11) cm and Schwarzschild = 10^(-55) cm and the speed of light c = 3 x 10^10 cm/sec, and since E_electron = G (m_e)^2 / a, we have for a single Electron and ordinary gravity

T_electron = h / E_electron =

= (Compton / Schwarzschild) (a / c) = 10^26 sec = 10^19 years.

Now consider the case of N Tubulin Electrons in Coherent Superposition, in which ordinary gravity is realistic.

As Jack Sarfatti says, "Since all the [Tubulin] Electrons are nonlocally connected into a coherent whole we do not want to treat them as fluctuating statistically independent of each other ... .", and Stuart Hameroff agrees, saying "True. That's why we consider them coherently linked or entangled.". Jack Sarfatti defines the Superposition Energy E_N of N superposed Tubulin Electrons in N Tubulins as

E_N = G M^2 / L

where L is the mesoscopic quantum phase coherence length for the collective mode of N Tubulin Electrons of total mass M = N m with each electron having mass m and with L = a N^(1/3) where a is the separation of individual electrons and the cube root of N is the linear scale of of the whole collection of N Tubulin Electrons in the N Tubulins.

As Jack Sarfatti says (here I have substituted some of my numerical values for his): "... Note the volume ... is the sum of the volumes of all [10^17 Tubulins involved in the process of consciousness] even though they are separated in physical space from each other over the whole cortex of volume 10^3 cc - they are like one super-particle entangled in configuration space of [about 3 x 10^17 dimensions]! That is, this sentient post-quantum computing "enchanted web" is [10^17 little Tubulin nanoboxes] ... . Each box has a little arrow in Hilbert space and all the arrows are phase-locked over a time of order [0.5 milliseconds]. The actual physical distance between the boxes is irrelevant to this Einstein-Podolsky-Rosen network that is one coherent conscious system. The mesoscopic quantum coherence length L is what you would get if you lined up all these nanoboxes in a row - ... It is really not a metrical property in ordinary space. ...".

Therefore, we have:

E_N = N^2 G m^2 / a N^(1/3) =

= N^(5/3) G m^2 / a=

= N^(5/3) E_electron

To get the decoherence time for the system of N Tubulin Electrons, recall that (approximately) T_electron = h / E_electron = (Compton / Schwarzschild) (a / c) = 10^26 sec = 10^19 years, so that

T_N = h / E_N = h / N^(5/3) E_electron =

= N^(-5/3) T_electron =

= N^(-5/3) 10^26 sec

and

N = (10^26 / (T_N))^(3/5) =

= 4 x 10^15 / (T_N)^(3/5)

From the above formulas get the following rough approximate Decoherence Tim T_N for various Numbers of Tubulin Dimers or Neurons, if 10% of the Tubulins in each Neuron are involved in the process of consciousness:

Time T_N	Number of Tubulins	Number of Neurons
10^(-43) sec (Planck)	2.5 x 10^41	
5 x 10^(-4) sec (2 kHz)	10^17	10^11
10^26 sec = 3 x 10^18 years	1	

The 10^17 tubulin Electron (10^11 Neuron) line of the table corresponds to the number of neurons in the human brain.

Here is a rough outline of what happens during the 0.5 milliseconds of a single conscious thought involving 10^17 Tubulin Electrons:

- Each Tubulin Site Electron sits within its tubulin cage in one of its 2 Quantum States. Each Tubulin Site Electron has one of 2^1 = 2 States, so it contains one qbit of information, representable by the 2^1 = 2-dimensional Cl(1) Clifford Algebra that is isomorphic to the Complex Numbers. The total of N = 10^17 Tubulin Site Electrons are connected and brought into a coherent Superposition of States, which, as was suggested by Robert Neil Boyd, is representable by the 2^N = 2^(10^17)) dimensional Cl(10^17) Clifford Algebra. Cl(10^17) can be represented as the tensor product of about (10^17) / 8 = about 10^16 factors, each being 256-dimensional Cl(8). Further information about that Clifford Algebra structure, and related information theoretical and particle physics structures and models, can be found in material at http://www.innerx.net/personal/tsmith/TShome.html.

- Many of the Quantum States of the Superposition are Closed Timelike Loops, some of which intersect with others. If each Closed Timelike Loop represents an Abstract Idea, then the Intersections among the Closed Timelike Loops represent Interactive Abstract Thought operating on the set of Abstract Ideas.
- During the time of Superposition, new Abstract Thoughts can be derived from the original ones by reorganizing the corresponding Closed Timelike Loops and their Intersections.
- Conscious Thought formation ends when the Decoherence/Collapse time T_N is reached and Decoherence/Collapse occurs. Then, a single Abstract Idea is chosen from the entire Set of States in the Superposition. This is the Execution Process, which involves choosing one Abstract Idea and rejecting/executing the other Ideas of the Superposition.
- The chosen State from the Superposition determines the Positions of all the Gap Junction Electrons of the Quantum Tunnelling connections between Neurons.
- The Positions of the Gap Junction Electrons determine the Conformations of the Micrtubules that are adjacent to the Gap Junctions.
- The Conformations of those Microtubules determine, through MAP connections, the Conformations of other Microtubules in the same Neuron.
- The Conformation of a Microtubule determines the State of its Tubulins.
- The State of a Tubulin determines the State of its Tubulin Site Electron, thus completing the process.

Chaio Gravity Antennas

During that 0.5 milliseconds of the process of a single conscious thought, the 10^17 Tubulin Electrons are linked in a coherent state by gravity.

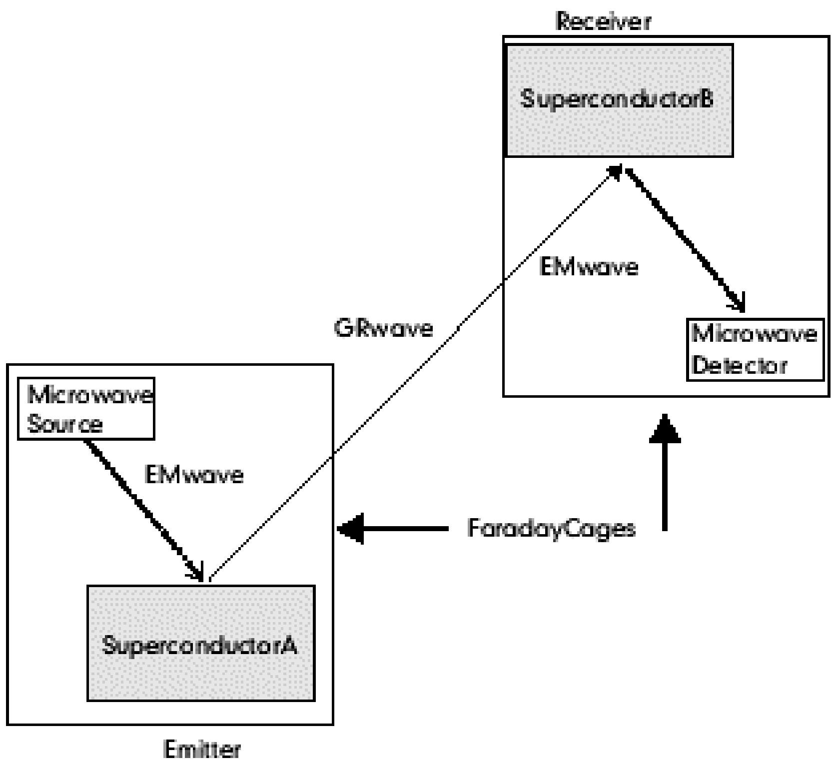
For such a gravity linkage to take place, two things are necessary:

- There must be a gravitational connection among all 10^17 Tubulin Electrons; and
- There superposition must be stable with respect to decoherence during to the 0.5 millisecond duration of the single conscious thought.

First, does there exist a realistic mechanism of gravitational connection between all pairs of the 10^17 Tubulin Electrons?

A positive result in an experiment proposed by Raymond Chiao and described in gr-qc/0204012 [which is an "... abbreviated writeup of ...[his]... March 23, 2002 Wheeler Symposium lecture, and book chapter for Wheeler Festschrift ..." which book chapter is at gr-qc/0208024 and, in its final version, at gr-qc/0303100] might provide an affirmative answer. In that paper, Chiao says:

> "... Superconductors will be considered as macroscopic quantum gravitational antennas and transducers, which can directly convert upon reflection a beam of quadrupolar electromagnetic radiation into gravitational radiation, and vice versa, and thus serve as practical laboratory sources and receivers of microwave and other radio-frequency gravitational waves. ... a superconductor can by itself be a direct transducer from electromagnetic to gravitational radiation upon reflection of the wave from a vacuum superconductor interface, with a surprisingly good conversion efficiency. By reciprocity, this conversion process can be reversed, so that gravitational radiation can also be converted upon reflection into electromagnetic radiation from the same interface, with equal efficiency. ... under certain circumstances involving "natural impedance matching" between quadrupolar EM and GR plane waves upon a mirror-like reflection at the planar surface of extreme type II, dissipationless superconductors, the efficiency of such superconductors used as simultaneous transducers and antennas for gravitational radiation, might in fact become of the order of unity, so that a gravitational analog of Hertz's experiment might then become possible. ... These developments suggest the possibility of a simple, Hertz-like experiment, in which the emission and the reception of gravitational radiation at microwave frequencies can be implemented by means of a pair of superconductors used as transducers. ... The schematic of this experiment is ...



> ... we did not detect any observable signal inside the second Faraday cage, down to a limit of more than 70 dB below the microwave power source of around 10 dBm at 12 GHz. ... Note, however, that since the transition temperature of YBCO is 90 K, there may have been a substantial ohmic dissipation of the microwaves due to the remaining normal

electrons at our operating temperature of 77 K, so that the EM wave was absorbed before it could reach the impedance-matching depth at z0. It may therefore be necessary to cool the superconductor down very low temperatures before the normal electron component freezes out sufficiently to achieve such impedance matching. [see gr-qc/0304026] ... An improved Hertz-like experiment using extreme type II superconductors with extremely low losses, perhaps at millikelvin temperatures, is a much more difficult, but worthwhile, experiment to perform. Such an improved experiment, if successful, would allow us to communicate through the Earth and its oceans, which, like all classical matter, are transparent to GR waves. ... I would especially like to thank my father-in-law, the late Yi-Fan Chiao, for his financial and moral support of this work. This work was partly supported also by the ONR. ...".

Further, in gr-qc/0303089, Walter J. Fitelson and Raymond Chiao say:

"... Measurements of the tunneling time are briefly reviewed. ... using ... a photon-pair emission light source ... The arrival time of the tunneled photon was measured with respect to that of its twin, which had traversed a distance equal to the tunnel barrier thickness, but in the vacuum, by means of the difference in the two "click" times of two Geiger counters. ... when a photon succeeded in tunneling (which is rare), it arrived earlier than its twin which had traversed the vacuum ... as if the tunneling photons had traversed the tunnel barrier superluminally. The effective group velocity of the tunneling single-photon wavepacket was measured to be 1.7 +/- 0.2 times the vacuum speed of light. ...

... Next, time and matter in general relativity and quantum mechanics is examined. In particular, the question arises: How does gravitational radiation interact with a coherent quantum many-body system (a "quantum fluid")? ...

... the ground state of a superconductor, which possesses spontaneous symmetry breaking, and therefore off-diagonal long-range order, is very similar to that of the physical vacuum, which is believed also to possess spontanous symmetry breaking through the Higgs mechanism. In this sense, therefore, the vacuum is "superconducting." The question thus arises: How does such a broken-symmetry ground, or "vacuum," state interact with a dynamically changing spacetime, such as that associated with a GR wave? More generally: How do we embed quantum fields in dynamically curved spacetimes? ... Due to its gyroscopic nature, the spin vector of an electron undergoes parallel transport during the passage of a GR wave. The spin of the electron is constrained to lie inside the space-like submanifold of curved spacetime. ... the spin of the electron must be purely a space-like vector with no time-like component. This imposes an important constraint on the motion of the electron’s spin, such that whenever the space-like submanifold of spacetime is disturbed by the passage of a gravitational wave, the spin must remain at all times perpendicular to the local time axis. If the spin vector is constrained to follow a conical trajectory during the passage of the gravitational wave, the electron picks up a Berry phase proportional to the solid angle subtended by this conical trajectory after one period of the GR wave. In a manner similar to the persistent currents induced by the Berry phase in systems with off-diagonal long-range order. ... such a Berry phase induces an electrical current in the quantum Hall fluid, which is in a macroscopically coherent ground state. ... This current generates an EM wave. Thus a GR wave can be converted into an EM wave. By reciprocity, the time-reversed process of the conversion from an EM wave to a GR wave must also be possible. ... The question immediately arises: EM radiation is fundamentally a spin 1(photon) field, but GR radiation is fundamentally a spin 2 (graviton) field. How is it possible to convert one kind of radiation into the other, and not violate the conservation of angular momentum? The answer: The EM wave converts to the GR wave through a medium. Here specifically, the medium of conversion consists of a strong DC magnetic field applied to a system of electrons. This system possesses an axis of symmetry pointing along the magnetic field direction, and therefore transforms like a spin 1 object. When coupled to a spin 1 (circularly polarized) EM radiation field, the total system can in principle produce a spin 2 (circularly polarized) GR radiation field, by the addition of angular momentum. ... In the case of superconductors, Cooper pairs of electrons possess a macroscopic phase coherence, which can lead to an Aharonov-Bohm-type interference absent in the ionic lattice. Similarly, in the quantum Hall fluid, the electrons will also possess macroscopic phase coherence, ... which can lead to Berry-phase-type interference absent in the lattice. Furthermore, there exist ferromagnetic superfluids with intrinsic spin, ... in which an ionic lattice is completely absent,such in superfluid helium 3. In such ferromagnetic quantum fluids, there exists no ionic lattice ... Thus there may be more than one kind of quantum fluid which can serve as a transducer between EM and GR waves. ... However, it remains an open question as to how strong this interconversion process is between EM and GR radiation. ...

... There exist other situations in which a minimal-coupling rule similar to the one above, arises for scalar quantum fields in curved spacetime. ... Quantum mechanically, there may exist due to the macroscopic quantum phase coherence of the superconductor, collective, many-body enhancements of the above classical conversion efficiency. Most importantly, ...[see Speliotopoulos and Chiao, gr-qc/0302045]... there must exist enhancements due to the fact that the intensive coupling constant sqrt(G) of the Feynman graviton-matter vertex should be replaced by the extensive coupling constant sqrt(G) L, in order to account correctly for the tidal nature of GR waves. ...[L is]... a new characteristic length scale L corresponding to the typical size of the distance ... separating the test particle from the observer ... For example, L can be the typical size of the detection apparatus ... or of the transverse Gaussian wave packet size of the gravitational radiation ...

... How then do we account for the lack of any observable quantum transducer conversion in our experiment? There are several possible reasons, the most important ones probably having to do with the material properties of the YBCO medium. One such possible reason is the earlier observations of unexplained residual microwave and far-infrared losses (of the order of 10^(-5) ohms per square at 10 GHz) in YBCO and other high Tc superconductors,which are independent of temperature and have a frequency-squared dependence, ... which may be due to the fact that YBCO is a D-wave superconductor. ... In D-wave superconductors, there exists a four-fold symmetry of nodal lines along which the BCS gap vanishes, ... where the microwave attenuation may become large. Thus D-wave superconductors are quite unlike the classic, low-temperature S-wave superconductors with respect to their microwave losses. Since one of conditions for a good coupling of a quantum antenna and transducer to the GR wave sector is extremely low dissipative losses, the choice of YBCO as the material medium for the Hertz-type experiment may not have been a good one. ..".

Note that :

> if the negative result of the preliminary experiment were due to failure of the superconductor impedance-matching mechanism for converting EM waves to gravity waves [see gr-qc/0304026];
>
> then the negative result would not indicate failure of the gravity antenna concept, which is the important concept with respect to the Quantum Tubulin Electron model of Quanum Consciousness.

Note also that the Faraday cages of Chiao's schematic correspond to the Tubulin Cages of the Tubulin Electrons in the Quantum Tubulin Electron model of Quantum Consciousness, and that if Chiao's gravity antenna can receive gravity signals by graviton links, then Tubulin Electrons in their cages should be able to receive gravity signals establishing graviton links, as needed for the Penrose-Hameroff model of Quantum Tubulin Electron Quantum Consciousness.

Decoherence, Mead Resonance and Quantum Protectorates

Second, is the superposition state of Tubulin Electrons stable with respect to decoherence during to the 0.5 millisecond duration of the single conscious thought?

Max Tegmark, in quant-ph/9907009, says:

> "... Penrose has ... suggested that the dynamics of such excitations can make a microtubule act like a quantum computer, and that microtubules are the site of of human consciousness ... This idea has been further elaborated ... with the conclusion that quantum superpositions of coherent excitations can persist for as long as a second before being destroyed by decoherence ... This was hailed as a success for the model, the interpretation being that the quantum gravity effect on microtubules was identified with the human though process on this same timescale. This decoherence rate T = 1 s was computed assuming that quantum gravity is the main decoherence source. Since this quantum gravity model is somewhat

controversial ... and its effect has been found to be more than 20 orders of magnitude weaker than other decoherence sources in some cases ... We will now ... evaluate ... decoherence sources for the microtubule case as well, to see whether they are in fact dominant ... we will ignore collisions between polarized tubulin dimers and nearby water molecules, since it has been argued that these may be in some sense ordered and part of the quantum system ... Let us instead apply ... the decoherence timescale

T = (a^3 sqrt(m k t)) / N g q^2 | r' - r |

caused by a single ion a distance a away. ...[where k is Boltzmann's constant and g = 1 4 pi e0 is the Coulomb constant, m is ion mass, N is number of ions, q is ion charge, and t is temperature]... with N = Q / qe = 10^3. The distance to the nearest ion will generally be less than ...[about] ... 26 nm ... Superpositions spanning many tubuline dimers ... therefore decohere on a timescale ...[about]... 10^(-13) s. due to the nearest ion alone. This is quite a conservative estimate, since the other ... 10^3 ions that are merely a small fraction further away will also contribute to the decoherence rate ... ... We neglected screening effects because the decoherence rates were dominated by the particles closest to the system, i.e., the very same particles that are responsible for screening the charge from more distant ones. ... We find that the decoherence timescales ...[about 10^(-13)]... seconds are typically much shorter than the relevant dynamical timescales ...[about 0.001 to 0.1 seconds]... both for regular neuron firing and for kink-like polarization excitations in microtubules. This conclusion disagrees with suggestions by Penrose and others that the brain acts as a quantum computer, and that quantum coherence is related to consciousness in a fundamental way. ...".

I disagree with Tegmark, on both experimental and theoretical grounds. I think that Tegmark has ignored significant phenomena related to maintaining coherence during the 0.5 millisecond duration of a single conscious thought involving 10^17 Tubulin Electrons.

On the experimental side, there are some results that indicate that coherence is maintained much longer than would be expected from analyses such as Tegmark's. For example:

- On page 20 of the 17 July 1999 issue of the New Scientist is an article by Charles Seife (a New Scientist Reporter) that says in part: "... last April [1998], Isaac Chuang of IBM in San Jose, California, and Neil Gershenfeld the Massachusetts Institute of Technology created a quantum computer ... in a forthcoming issue of Physical Review Letters, Carlton Caves ... say they are unsure why quantum computation worked. Gershenfeld and Chuang used magnetic fields to manipulate atoms in liquid chloroform. But the problem, says Caves, is that the choloroform atoms were not in "entangled" states. ... because the chloroform was at room temperature, the atoms could not have been entangled ... The thermal motion of the atoms would have mixed up their quantum states and ruined any entanglement. ... So why did the chloroform comuter work at all? Caves's colleague John Smolin, a physicist at IBM in New York, suspects Chuang's chloroform has simulated a quantum computer, though he doesn't know how. Or maybe the experiment hints there are other ways of doing quantum computation that we don't yet understand. ...".

- A 6 July 2001 New Scientist article by Willis Knight says: "... Molecular transistors that run on single electrons now work at room temperature. Dutch scientists achieved the feat by buckling carbon nanotubes with an atomic force microscope. ... By buckling a metallic carbon nanotube, they formed a small area from which a single electron cannot escape at room temperature unless a current is applied via an electrode. ... pushing a single electron through the transistor caused it to exhibit quantum coherence. This means that the electron maintains some of the quantum state it obtained whilst inside the transistor when it leaves. The effect is not found within normal electronics. ...".
- According to Apoorva Patel in his paper Quantum Algorithms and the Genetic Code, quant-ph/0002037: "... Enzymes are the objects which catalyse biochemical reactions. They are large complicated molecules, much larger than the reactants they help, made of several peptide chains. Their shapes play an important part in catalysis, and often they completely surround the reaction region. They do not bind to either the reactants or the products ... for example, enzymes can suck out the solvent molecules from in between the reactants ... It is proposed that enzymes play a crucial role in maintaining quantum coherence ... Enzymes provide a shielded environment where quantum coherence of the reactants is maintained. ... For instance, diamagnetic electrons do an extraordinarily good job of shielding the nuclear spins from the environment ... the coherence time observed in NMR is O(10) sec, much longer than the thermal environment relaxation time (hbar / kT = O(10^(-14)) sec) and the molecular collision time (O(10^(-11)) sec), and still neighbouring nuclear spins couple through the electron cloud. ... Enzymes are able to create superposed states of chemically distinct molecules. ... Enzymes are known to do cut-and-paste jobs ... (e.g. ... methylation, replacing H by CH3, which converts U to T). Given such transition matrix elements, quantum mechanics automatically produces a superposition state as the lowest energy equilibrium state. ... Delocalisation of electrons and protons over distances of the order of a few angstroms greatly helps in molecular bond formation. It is important to note that these distances are much bigger than the Compton wavelengths of the particles, yet delocalisation is common and maintains quantum coherence. ...".
- According to an article by Bennett Davis in the 23 Feb 2002 edition of The New Scientist: "... In the early 1990s, Guenter Albrecht-Buehler ... at Northwestern ... discovered that some cells can detect and respond to light from others. ... cells ... were using light to signal their orientation. If so, they must have some kind of eye. ... centrioles fill the bill. These cylindrical structures have slanted "blades" which ... Albrecht-Buehler ... believes act as simple blinds. ... microtubules ... could act as optical fibres ... feeding light towards the centrioles from the cell's wall. ... why should cells want to detect light? ... they are talking to each other ... Cells in embryos might signal with photons so that they know how and where they fit into the developing body. ... Albrecht-Buehler ... wants to learn their language. ... In the 1980s Fritz-Albert Popp, then a lecturer at the University of Marburg in Germany, ... who now heads the International Institute of Biophysics in Neuss, Germany, ...[and]... runs a company called Biophotonen that offers its expertise in reading

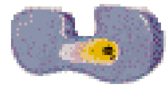
photon emissions to gauge the freshness and purity of food ... became interested in the optical behaviour of cells. In a series of experiments Popp found that two cells separated by an opaque barrier release biophotons in uncoordinated patterns. Remove the barrier and the cells soon begin releasing photons in synchrony. ...".
- Acccording to cond-mat/0007185 and cond-mat/0007287 by Philip W. Anderson: "... **The most striking fact about the high-Tc cuprates is that in none of the relevant regions of the phase diagram is there any evidence of the usual effects of phonon or impurity scattering.** This is strong evidence that **these states are in a "quantum protectorate" ... a state in which the many-body correlations are so strong that the dynamics can no longer be described in terms of individual particles, and therefore perturbations which scatter individual particles are not effective**. ...".

On the theoretical side, there are also some reasons that I disagree with Tegmark. For example:

- Hagan, Hameroff, and Tuszynski, in Physical Review E, Volume 65, 061901, published 10 June 2002, say: "... Tegmark's commentary is not aimed at an existing model in the literature but rather at a hybrid that replaces the superposed protein conformations of the orch. OR theory with a soliton in superposition along the microtubule ... recalculation after correcting for differences between the model on which Tegmark bases his calculations and the orch. OR model (superposition separation, charge vs dipole, dielectric constant) lengthens the decoherence time to 10^(-5) &endash;10^(-4) s ...".
- Mershin, Nanopoulos, and Skoulakis, in quant-ph/0007088, say: "... treat the tubulin molecule as the fundamental computation unit (qubit) in a quantum-computational net work that consists of microtubules (MTs), networks of MTs and ultimately entire neurons and neural networks. ...". They say "... **it has been shown [by D. L. Koruga, D. L. Ann. NY Acad. Sci. 466, 953-955 (1986)] that the particular geometrical arrangement (packing) of the tubulin protofilaments obeys an error-correcting mathematical code known as the K2(13, 2^6, 5) code** ... the existence of a quantum-error correcting code is needed to protect the delicate coherent qubits from decoherence. This has been the major problem of quantum computers until the works of Shor and Steane have independently shown that such a code can be implemented ... We conjecture that the K-code apparent in the packing of the tubulin dimers and protofilaments is partially responsible for keeping coherence among the tubulin dimers. By simulating the brain as a quantum computer it seems we are capable of obtaining a more accurate picture than if we simulate the brain as a classical, digital computer. ...".
- Raymond Chiao in gr-qc/0204012 says: "... quantum entanglement gives rise to EPR correlations at long distance scales within the superconductor. The electrons in a superconductor in its ground BCS state are not only macroscopically entangled, but due to the existence of the BCS gap which separates the BCS ground state energetically from all excited states, they are also protectively entangled, in the sense that this entangled state is protected by the presence of the BCS gap from decoherence arising from the thermal environment, provided that the system temperature is kept

well below the BCS transition temperature. The resulting large quantum rigidity is in contrast to the tiny rigidity of classical matter, such as that of the normal metals used in Weber bars, in their response to gravitational radiation. ...".

- **Mead Resonance:** Resonance among 10^17 Tubulin Electrons of a single conscious thought may be important in achieving and maintaining coherent superposition states among them. Carver Mead, in his book Collective Electrodynamics (MIT 2000), discusses resonance coupling with electromagnetic photons. If Raymond Chiao's gravity antenna idea is correct, then the same resonance phenomena should be applicable for gravity gravitons as for electromagnetic photons. Carver Mead says: "... In our investigation of radiative coupling, we use a superconducting resonator as a model system. ... we can build such a resonator from a superconducting loop and a capacitor ... the coupling of ... two loops is the same, whether retarded or advanced potentials are used. Any loop couples to any other on its light cone, whether past or future. ... The total phase accumulation in a loop is the sum of that due to its own current, and that due to currents in other loops far away. ... normal modes correspond to stationary states of the system. Once the system is oscillating in one of these modes, it will continue to do so forever. To understand energy transfer between the resonators, we can use mixtures of normal modes. ... Any energy leaving one resonator is tranferred to some other resonator, somewhere in the universe. The energy in a single resonator alternates between the kinetic energy of the electrons (inductance), and the potential energy of the electrons (capacitance). With the two resonators coupled, the energy shifts back and forth between the two resonators in such a way that the total energy is constant ... The conservation of energy holds despite an arbitraty separation between the resonators; it is a direct result of the symmetry of the advanced and retarded potentials. There is no energy "in transit" between them. ... the universe contains a truly enormous number of resonators ... [For the 10^17 Tubulin Electrons of a single conscious thought, the resonant frequencies are the same and exchanges of energy among them act to keep them locked in a collective coherent state.] ... How does a single resonator behave in an inhomogeneous universe full of other matter? In the real universe [outside the collective coherent set of tubulin electrons], no two resonators have identical resonant frequencies for long; however, it is a common occurrence that two frequencies will cross, and that energy will be exchanged between the resonators during the crossing. From the point of view of collective electrodynamics, this exchange of energy is the microscopic origin of the thermodynamic behavior of the universe as we observe it. ... In a random universe, any particular phase is equally likely for any given crossing. A particular resonator is therefore equally likely to receive either an increment or a decrement due to a given crossing. ... In a random universe [unlike the collective coherent set of tubulin electrons], there is no first-order effect in which energy flows from the high-amplitude resonator to the low-amplitude resonator; there is, however, a second-order effect in which energy flows, on the average, from the high-amplitude resonator to the low-amplitude resonator. The rate of energy flow is proportional to the difference in energies, and to the inverse square of the distance. ...

  ... The coupling between two loops considered ...[above]... is called magnetic dipole coupling. It is characterized by its proportionality to the second derivative of the current with respect to time. ... A much stronger coupling can be obtained between two straight sections of wire ... We can imagine a resonator configuration for which this type of coupling is realizable: Two parallel capacitor plates [corresponding to the two holes in a tubulin  where the tubulin electron can be stable located] of capacitance C are connected by a straight section of superconducting wire of inductance L between their centers. Such a configuration ... is called an electric dipole. Because there are charges at the two ends of the dipole, we can have a contribution to the electric coupling from the scalar potential ... as well [as] from the magnetic coupling ... from the vector potential ... electric dipole coupling is stronger than magnetic dipole coupling by the square of the ratio of the wavelenght to the size of the element. ... For example, an atom half a nanometer in diameter radiates visible light of 500 nanometer wavelength. In this case, electric dipole coupling is a million times stronger than magnetic dipole coupling. ... we have treated the electron as a wave, continuous in space, carrying a continuous charge density with it. ... Arriving at the correct results required taking into account the interaction of the electron with itself, exactly as we have done in the case of the superconducting loop. The electron wave function depends on the potential; the potential depends of the charge density that is determined by the wave function. Thus, we have an inherently non-linear problem ... The nonlinearity ... poses some computational issues, but no conceptual issues. ... the nonlinear theory gives the correct energy levels for the hydrogen atom ... It is by now a common experimental fact that an atom, if sufficiently isolated from the rest of the universe, can stay in an excited state for an arbitrarily long period. ... The mechanism for initiating an atomic transition is not present in the isolated atom; it is the direct result of coupling with the rest of the universe. ... The electron wave function ... is particularly sensitive to coupling with other electrons; it is coupled either to far-away matter in the universe or to other electrons in a resonant cavity or other local structure. In the initial parts of this monograph, we were able to ignore coupling to far-away matter because we used a collective structure in which there are 10^{23} electrons, arranged in such a way that the collective properties intrinsic to the structure scaled as the square of the number of electrons. ... we ...[made]... a connection between the classical concept of force and the quantum nature of matter through the concept of momentum. ... We would expect the total momentum P of the collective electron system [in a superconducting loop of wire] to be the momentum per charge times the number of charges in the loop. If there are n charges per unit length of wire ... $P = n q L I$ ... $I = n q v$ ... and ... $P = L (nq)^2 v$. The momentum is proportional to the velocity, as it should be. It is also proportional to the size of the loop, as reflected by the inductance L. ... Instead of scaling linearly with the number of charges that take part in the motion, the momentum of a collective system scales as the square of the number of charges! ... In an arrangement where charges are constrained to move in concert, each charge produces phase accumulation, not only for itself but for all the other charges as well. So the inertia of each charge increases linearly with the number of charges moving in concert. The inertia of the ensemble of coupled charges must therefore increase as the square of the number of charges. ...

[To see how Carver Mead's resonance might be applied to the Penrose-Hameroff tubulin electron model of consciousness, consider the maximal case of N tubulin electrons with $N = 10^{18}$, each electron having thermal energy $E = kT$, where $k = 10^{-23}$ Joules Kelvin^{-1} and $T = 300$ Kelvin, so that Total Thermal

Energy = N^2 kT = 10^(36-23) x 300 = 3 x 10^15 Joules. (Due to the nonlinear square-scaling, it would take less if the collapse took place gradually, a few electrons at a time.) Note that decoherence by external thermal energy, with square-scaling, is different from the self-decoherence of the superposition state, based on the energy-time uncertainty principle Energy x Time = h, by which a conscious thought quantum state decoheres to form a completed thought. If N tubulin electrons are in a collective superpostion state of conscious thought, then the total energy needed to decohere them by external thermal energy (decoherence due to the heat of the brain) is much greater than the classical kinetic heat energy in the brain, so that Quantum Consciousness in the brain is stable against thermal decoherence due to the heat of the brain.]

> ... an N-turn closely coupled coil has an inductance L = N^2 Lo. Once again, we see the collective interaction scaling as the square of the number of interacting charges. ... When two classical massive bodies ... are bolted together, the inertia of the resuting composite body is simply the sum of the two individual inertias. The inertia of a collective system, however, is a manifestation of the interaction, and cannot be assigned to the elements separately. ... Thus, it is clear that collective quantum systems do not have a classical correspondence limit. ... It is instructive to work out the magnitude of the electron inertia in a concrete case. A small superconducting magnet has 10^4 turns of NbTi wire approximately 0.1 mm in diameter. The magent is 7 cm long, and just under 5 cm in diameter, and produces a peak field of 7 tesla at a currrent of 40 amperes. The magnet weighs 0.5 kilograms, and has a measured inductance of approximately 0.5 henry. There are of the order of 10^28 electrons per cubic meter in the wire, or 10^20 electrons per meter length of wire, corresponding to approximately 10 coulombs of electronic charge per meter of wire. At 40 amperes, these electrons move at a velcoity v = 4 m / sec. the total length l of wire is about 10^3 meters, so the total electronic charge in the magnet is about 10^4 coulombs. Using these values, A = PHI / l = L I / l = 0.02 V sec / meter. The electromagnetic momentum p of an electron is just this vector potential multiplied by the electronic charge; from this, we can infer an electromagnetic mass m for each electron: q A = 3.2 x 10^(-21) coulomb V sec / meter = m v m = 10^(-21) kg For comparison, the mass of a free electron is approximately 10^(-30) kg, and the rest mass of a proton is a factor 1800 larger than that of an electron. The electromagnetic mass of an electron in our magnet is thus a factor of 10^9 larger than the rest mass of a free electron. ...[The electromagnetic mass of all the electrons in the magnet is 10^20 electrons / meter x 10^3 meters x 10^(-21) kg / electron = 100 kg]... The total inertia of the electron system in the magnet is much larger than the actual mass of all the atoms making up the magnet [0.5 kg]. ...".

[The above material from Carver Mead is directly applicable to the superposition state of tubulin electrons [[and is related to the idea of a **Quantum Protectorate**]]. The following material shows how the same viewpoint applies to understanding quantum state transitions.]

> ... We have developed a detailed description of the energy-transfer process between macroscopic quantum resonators ... We are now in a position to understand the radiative transfer between two identical atomic systems. ... The two atoms act like two small dipole

resonators, and energy is radiatively transferred ... Once the coupled mixed state starts to develop, it becomes self-reinforcing. ... This self-reinforcing behavior gives the transition its initial exponential character. Once the transition is fully under way, the two states are nearly equally represented in the superposition, and the coupled system closely resembles the coupled resonators ... Once the transition has run its course, each atom settles into its final eigenstate. ...

... there are quantum jumps, but they are not discontinuities. They may look discontinuous because of the nonlinear, self-reinforcing nature of a quantum transition; but at the fundamental level, everything can be followed in a smooth and continuous way .... to arrive at this picture, we had to give up the one-way direction of time, and allow coupling to everything on the light cone ... the Green's function for collective systems is totally free of singularities, and cannot, by its very nature, generate infinities ... There is no action of an elementary charge [which is fundamentally an amplitude to transmit or absorb energy by radiative transfer] upon itself ...".

- [[According to cond-mat/0007287 and cond-mat/0007185 by Philip W. Anderson: "... Laughlin and Pines have introduced the term "**Quantum protectorate**" as a general descriptor of the fact that certain states of quantum many-body systems exhibit properties which are unaffected by imperfections, impurities and thermal fluctuations. They instance the quantum Hall effect, which can be measured to 10^(-9) accuracy on samples with mean free paths comparable to the electron wavelength, and flux quantization in superconductors, equivalent to the Josephson frequency relation which again has mensuration accuracy and is independent of imperfections and scattering. An even simpler example is the rigidity and dimensional stability of crystalline solids evinced by the STM. ... **the source of quantum protection is a collective state of the quantum field involved such that the individual particles are sufficiently tightly coupled that elementary excitations no longer involve a few particles but are collective excitations of the whole system** ... **and therefore perturbations which scatter individual particles are not effective**. ... The purpose of this paper is, first, to present the overwhelming experimental evidence that **the metallic states of the high Tc cuprate superconductors are a quantum protectorate**; and second, to propose that this particular collective state involves the phenomenon of charge-spin separation, and to give indications as to why such a state should act like a quantum protectorate. ... Spin-charge separation is a very natural phenomenon in interacting Fermi systems from a symmetry point of view ... The Fermi liquid has an additional symmetry which is not contained in the underlying Hamiltonian, in that the two quasiparticles of opposite spins are exactly degenerate and have the same velocity at all points of the Fermi surface. This is symmetry SO(4) for the conserved currents at each Fermi surface point since we have 4 degenerate real Majorana Fermions. But the interaction terms do not have full SO(4) symmetry, since they change sign for improper rotations, so the true symmetry of the interacting Hamiltonian is SO4 / Z2 = SU2 x SU2, i.e., charge times spin. A finite kinetic energy supplies a field along the " direction of the charge SU(2) and reduces it to U(1), the conventional gauge symmetry of charged particles. ...". Also, according to cond-mat/0301077 by M.Ya. Amusia, A.Z. Msezane, and V.R. Shaginyan: "... the fermion condensation ... can be compared to the Bose-Einstein condensation. ... the appearance of ... fermion condensate (FC) ... is a quantum phase transition ... that separates the regions of normal and strongly correlated liquids. Beyond the fermion condensation point the quasiparticle system is divided into two subsystems, one containing normal quasiparticles, the other being occupied by fermion condensate localized at the Fermi level. ... fermion systems with ... fermion condensate (FC) ... have features of a "quantum protectorate" ... This behavior ... takes place in both three dimensional and two dimensional strongly correlated systems ... The only difference between 2D electron systems and 3D ones is that in the latter ... fermion condensation quantum phase transition (FCQPT) ... occurs at densities which are well below those corresponding to 2D systems. For bulk 3He, FCQPT cannot probably take place since it is absorbed by the first order solidification ... an infinitely extended system composed of Fermi particles, or atoms, interacting by an artificially constructed potential with the desirable scattering length a ... may be viewed as trapped Fermi gases ... We conclude that FCQPT can be observed in traps by measuring the density of states at the Fermi level ... It seems quite probable that the neutron-neutron scattering length (a = 20 fm) is sufficiently large to be the dominant parameter and to permit the neutron matter to have an equilibrium energy, density, and the singular point ... at which the compressibility vanishes. Therefore, we can expect that FCQPT takes place in a low density neutron matter leading to stabilization of the matter by lowering its ground state energy. ... fermion condensate (FC) ... "quantum protectorate" ... behavior ... demonstrates the possibility to control the essence of strongly correlated electron liquids by weak magnetic fields. ... We have demonstrated that strongly correlated many-electron systems with FC, which exhibit strong deviations from the Landau Fermi liquid behavior, can be driven into the Landau Fermi liquid by applying a small magnetic field B at low temperatures. A re-entrance into the strongly correlated regime is observed if the magnetic field B decreases to zero, while the effective mass M* diverges as M* proportional to 1 / sqrt(B). The regime is restored at some temperature T* proportional to sqrt(B). This behavior is of a general form and takes place **in both three dimensional and two dimensional strongly correlated systems**, and **demonstrates the possibility to control the essence of strongly correlated electron liquids by weak magnetic fields**. ...".]]

I close this paper with brief summaries of relevant experiments of Grinberg-Zylberbaum, the quantum cosmology of Paula Zizzi, and 26-dimensional closed unoriented bosonic string theory interpreted as a many-worlds quantum theory in which strings correspond to world lines, with massless spin-2 gravitons in 26-dimensions corresponding to gravitational interaction among tubulin electrons in states with Penrose-Hameroff superposition separation.

- The whereabouts of Grinberg-Zylberbaum (as far as I know) is unknown, and he may even be deceased.
- Paola Zizzi was scheduled to describe her work at Quantum Mind 2003 - Consciousness, Quantum

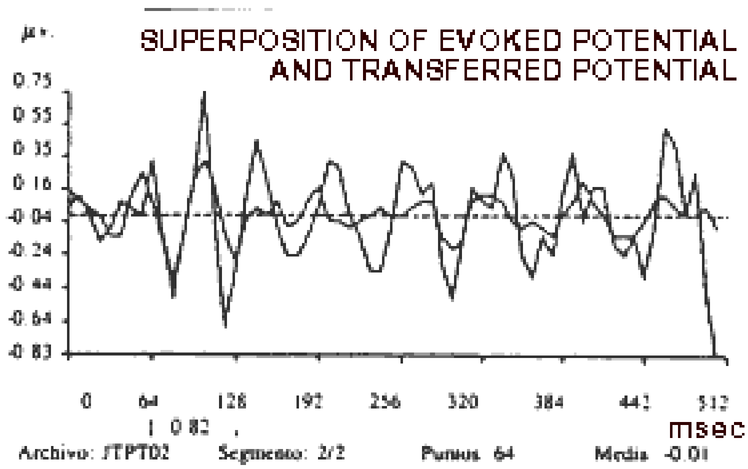
Physics and the Brain,March 15-19, 2003, University of Arizona, Tucson, Arizona.
Some of her recent papers are: The Early Universe as a Quantum Growing Network, Ultimate Internets, and Spacetime at the Planck Scale: The Quantum Computer View.

- The interpretation of 26-dimensional closed unoriented bosonic string theory interpreted as a many-worlds quantum theory in which strings correspond to world lines is based on my D4-D5-E6-E7-E8 VoDou Physics Model.

Grinberg-Zylberbaum Experiments

Some interesting experimental results relevant to Chiao gravity antennas and to Mead resonant coupling were obtained by neurophysiologist Grinberg-Zylberbaum. According a 1997 Science Within Consciousness web article by Henry Swift:

> "... The experiment conducted by neurophysiologist Grinberg-Zylberbaum ... The Einstein-Podolsky-Rosen Paradox in the Brain; The Transferred Potential, Physics Essays 7,(4), 1994. ... demonstrate[s] the existence of a macroscopic quantum system in the human brain through the demonstration of ... non-local correlation between brains ... In this experiment two subjects ... meditated together for twenty minutes. A total of seven pairs of subjects of both sexes, with ages from 20-44 years participated in the study. After meditation and while maintaining their "direct communication" (without speech), they were placed in semi-silent, electro-magnetically shielded chambers separated by 45 feet. ... Both subjects were connected to EEG instruments and 100 random flashes of light were presented to subject A, while both remained reclined with semi-closed eyes. Subject B was not told when the light was flashed for subject A, and control correlation checks were also made at random times with no light flashes. The results indicated that, "after a meditative interaction between two people who were instructed to maintain direct communication (i.e. to feel each other’s presence even at a distance), in about one out of four cases when one of the subjects was stimulated in such a way that his/her brain responded clearly (with a distinct evoked potential), the brain of the nonstimulated subject also reacted and showed a transferred potential of a similar morphology....



... The striking similarity of the transferred and evoked potentials and the total absence of transferred potentials in the control experiments leave no room for doubt about the existence of an unusual phenomenon, namely, propagation of influence without local signals. ... It is also extremely significant that the occurrence of transferred potential is always associated with the participants' feeling that their interaction is successfully completed (in contrast to the lack of transferred potential, when there is no such feeling). The interaction that correlates the subjects under study is entirely an interaction via non-local consciousness. ... none of the subjects B ever reported realizing any type of conscious experience related to the appearance of the transferred potential ...". According to a 1996 DynaPsych article by Ervin Laszlo: "... A particularly poignant example was furnished by a young couple, deeply in love. Their EEG patterns remained closely synchronized throughout the experiment, testifying to their report of feeling a deep oneness. ... In a limited way, Grinberg-Zylberbaum could also replicate his results. When a subject exhibited the transferred potentials in one experiment, he or she usually exhibited them in subsequent experiments as well. ...".

What has Grinberg-Zylberbaum done since 1994? That is unknown. According to an article by Sam Quinones, in the July/August 1997 New Age Journal, as shown on a Sustained Action web page:

"... In 1977 Grinberg returned to Mexico City ... A deeply spiritual man, Grinberg had moved from houses where he felt bad energy, believed he once had flown, and kept a meditation room lined with books and pictures of gurus. A semi-observant Jew, he sought out great thinkers on the Kabbalah. ... at UNAM ... he ... met the person who, he wrote later, would influence him more than any other: Barbara Guerrero, a former cabaret singer and lottery ticket seller who had fought with Pancho Villa as a young girl. Doæa Pachita, as Guerrero was known, was a curandera. ... Pachita could go into a trance state during which the spirit of CuauhtØmoc, the nephew of the great Aztec ruler Moctezuma, occupied her consciousness. ... Grinberg ... believed that experience and perception were created as a result of this interaction, and that the curative powers of shamans and *curanderas* like Pachita came from their ability to gain access to the informational matrix and change it, thereby affecting reality. ... Grinberg designed an experiment . . . using two people instead of one. Both subjects, with electrodes attached to their skulls, were put in a dark room and told to try to achieve a sort of meditative union. After twenty minutes, one was sent to a separate room. The remaining person was stimulated with a series of light flashes or sounds while his or her brain waves were measured. The brain waves of the isolated person were also measured. In 1987 Grinberg recorded for the first time a simultaneous reaction to the stimuli on the part of the isolated, non-stimulated person, a phenomenon he called 'transferred potential.' Over the years, with increasingly sophisticated equipment, he documented transferred potential 25 percent of the time, he wrote. It was a remarkable finding, totally contrary to the tenets of mainstream science. Grinberg believed it supported his theory of a neuronal field connecting all human minds. ... In 1991, Grinberg, his wife, and Tony Karam visited Castaneda at the latter's invitation in Los Angeles. There, Karam says, Castaneda proposed that Grinberg leave his UNAM lab to live in his community. Grinberg declined. Their relationship disintegrated during a trip Castaneda took to Mexico City two years later. Grinberg's friends and family remember him frequently calling Castaneda an egomaniac, more interested in power than truth. They also recall that Tere [Grinberg's wife] remained enamored with Castaneda and his group. ... For Jacobo Grinberg Zylberbaum, 1994 was a pretty good year. ... At his laboratory in the psychology department of the National Autonomous University of Mexico (UNAM) in Mexico City, he recorded the brain waves of a shaman, Don Rodolfo from Veracruz, in a trance state. ... Grinberg's book on his seminal influence, Barbara Guerrero, the blind witch doctor known as Dona Pachita, was finally about to be published in English. ... Then in December, Grinberg missed some appointments with students. Two days before his long-awaited trip to Nepal on December 14, he failed to attend his own birthday party. ... When Grinberg did not return from Nepal as planned, still no one thought much of it. ... But the weeks became months. Calls were made ... Nothing. No record of Grinberg or his wife ... Tere ... even leaving Mexico. ... In the two-and-a-half years since he disappeared, no trace of him, dead or alive, has been found. All that remain are his books, his theories ... The theory for which Grinberg came to be known reflected his personality. Relying on physics and his experiences with witch doctors, or *curanderos*--a bit of Einstein, a bit of Dona Pachita-› its essential message was warm and hopeful: All humankind is interconnected. ...".

Zizzi Quantum Cosmology

In gr-qc/0007006, Paola Zizzi says, (with some editing by me denoted by [ ]):

"... the vacuum-dominated early inflationary universe ... is a superposed quantum state of qubits. ... the early universe had a conscious experience at the end of inflation, when the superposed quantum state of ... [10^18 = N quantum qubits] ... underwent Objective Reduction. The striking point is that this value of [N] equals the number of superposed tubulins-qubits in our brain ... [in the inflationary phase of our universe] ... the quantum register grows with time. In fact, at each time step ... [Tn = (n+1) Tplanck (where Tplanck = 5.3 x 10^(-44) sec)] ... a Planckian black hole, (the n=1 qubit state 1 which acts as a creation operator , supplies the quantum register with extra qubits. ... At time Tn = (n+1) Tplanck the quantum gravity register will consist of (n+1)^2 qubits. [Let N = (n+1)^2] ... By the quantum holographic principle, we associate N qubits to the nth de Sitter horizon ... remember that |1> = Had|0> where Had is the Hadamard gate ... the state ... [of N qubits] ... can be expressed as ... [|N> = (Had|0>)^N] ... As the time evolution is discrete, the quantum gravity register resembles more a quantum cellular automata than a quantum computer. Moreover, the quantum gravity register has the peculiarity to grow at each time step (it is self-producing). If we adopt an atemporal picture, then the early inflationary universe can be interpreted as an ensemble of quantum gravity registers in parallel ... which reminds us of the many-worlds interpretation. ... The superposed state of quantum gravity registers represents the early inflationary universe which is a closed system. Obviously then, the superposed quantum state cannot undergo environmental decoherence. However, we know that at the end of the inflationary epoch, the universe reheated by getting energy from the vacuum, and started to be radiation-dominated becoming a Friedmann universe. This phase transition should correspond to decoherence of the superposed quantum state. The only possible reduction model in this case is self-reduction ... during inflation, gravitational entropy and quantum entropy are mostly equivalent ... Moreover ... The value of the cosmological constant now is ... /\N = 10^(-56) cm^(-2) ... in agreement with inflationary theories. If decoherence of N qubits occurred now, at Tnow = 10^60 Tplanck (that is, n = 10^60, N = 10^120) there would be a maximum gravitational entropy ... [maximum entropy Smax = N ln2 = 10^120] ... In fact, the actual entropy is about ... [entropy now Snow = 10^101] ... [Therefore] decoherence should have occurred for ... [Ndecoh = 10^(120-101) = 10^19 = 2^64] ... which corresponds to ... [n = 9 and to] ... the decoherence time ... [Tdecoh = 10^9 Tplanck = 10(-34) sec] ...".

Is there a fundamental reason that the number of qubits at which our inflationary universe experiences self-decoherence is Ndecoh = 10^19 = 2^64 ?

From the point of view of the D4-D5-E6-E7-E8 Vodou Physics model, the fundamental structure is the 2^8 = 256-dimensional Cl(8) Clifford algebra, which can be described by 2^8 qubits. Our inflationary universe decoheres when it has Ndecoh = 2^64 qubits. What is special about 2^64 qubits ? 2^64 qubits corresponds to the Clifford algebra Cl(64) = Cl(8x8). By the periodicity-8 theorem of real Clifford algebras that Cl(K8) = Cl(8) x ... tensor product K times ... x Cl(8), we have: Cl(64) = Cl(8x8) = Cl(8) x Cl(8) x Cl(8) x Cl(8) x Cl(8) x Cl(8) x Cl(8) x Cl(8) Therefore, Cl(64) is the first (lowest dimension) Clifford algebra at which we can reflexively identify each component Cl(8) with a vector in the Cl(8) vector space. This reflexive identification/reduction causes decoherence. In my opinion, it is the reason that our universe decoheres at N = 2^64 = 10^19, so that inflation ends at age 10^(-34) sec.

Note that Ndecoh = 2^64 = 10^19 qubits is just an order of magnitude larger than the number of tubulins

Ntub = 10^18 of the human brain. In my opinion, conscious thought is due to superposition states of those 10^18 tubulins. Since a brain with Ndecoh = 10^19 tubulins would undergo self-decoherence and would therefore not be able to maintain the superposition necessary for thought, it seems that the human brain is about as big as an individual brain can be.

26-dimensional closed unoriented bosonic string theory interpreted as a Many-Worlds Quantum Theory in which strings correspond to World Lines, with massless spin-2 Gravitons in 26›dimensions corresponding to gravitational interaction among Tubulin Electrons in states with Penrose-Hameroff Superposition Separation

[[In the D4-D5-E6-E7-E8 VoDou Physics model, **closed strings represent the world-lines of fermion particle-antiparticle pairs** (the pair of fermions acting as a boson so that the entire string is bosonic) **from the time of their creation to their eventual mutual annihilation**,

```
    *
   / \    ...
  /   \ /
/      |          (The illustrated closed string is red.
\      |           It interacts with a partially shown gray string.)
  \   / \...
   \ /
    *
```

perhaps with lots of interactions with lots of other particles/antiparticles of other world-lines in the meantime, so that part of each string might represent a photon or other particle of any type formed by interaction of one of the particle/antiparticle pair.

Note that since our Universe began with a Big Bang, all its particles originate from pair creation since then. For pairs that do not appear to reconnect for mutual annihilation within the volume of 26›dimensional spacetime being considered in working with the String Theory,

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****************
  \     ...    /
   \       \ /
    \       |          (The illustrated string is red.
     \      |           It interacts with a partially shown gray string.
      \   / \...        A perfect absorber in the future
       \ /              is indicated by ******* ).
        *
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the string is closed by considering the 26-dimensional spacetime to be a compactified 25+1 dimensional Minkowski spacetime due to considering the Universe to "... be a perfect absorber in the future ...[as in]... the Wheeler-Feynman ... absorber theory of radiation ..." described by Narlikar in his book Introduction to Cosmology (Cambridge 1997) (Section 8.8.1) and related to the Collective Electrodynamics of Carver Mead. For most of the matter in our Galactic Cluster, such an absorber could be a Black Hole of the Black Hole Era. Such a compactification is also similar to the conformally compactified 3+1 dimensional Minkowski spacetime M# used by Penrose and Rindler in their book Spinors and Space-Time, Volume 2 (Cambridge 1986) (particularly Chapter 9).]]

Roger Penrose says, in Shadows of the Mind (Oxford 1994), page 344,

"... We can now consider the gravitational self-energy of that mass distribution which is the difference between the mass distributions of the two states that are to be considered in quantum linear superposition. The reciprocal of this self-energy gives ... the reduction timescale ...".

This is the decoherence time T = h / E.

For a given Particle, Stuart Hameroff describes this as a particle being separated from itself, saying that

the Superposition Separation a is "... the separation/displacement of a mass separated from its superposed self. ... The picture is spacetime geometry separating from itself, and re› anealing after time T. ...".

If the Superposition consists of States involving one Particle of Mass m, but with Superposition Separation a, then the Superposition Separation Energy Difference is the gravitational energy

$$E = G m^2 / a$$

In the Osaka paper, Hameroff says that Penrose describes Superposition Separation as "... shearing off into separate, multiple spacetime universes as described in the Everett "multi&endash;worlds" view of quantum theory. ...".

If 26-dimensional closed unoriented bosonic string theory is interpreted as a Many-Worlds Quantum Theory in which strings correspond to World Lines

(see my paper at http://arXiv.org/abs/physics/0102042)

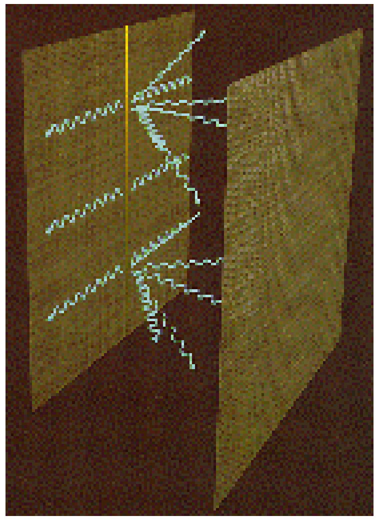
then massless spin-2 Gravitons in 26 dimensions correspond to gravitational interaction among States with Penrose-Hameroff Superposition Separation.

Such massless spin-2 Gravitons in 26 dimensions are described by Joseph Polchinski in his books String Theory vols. I and II(Cambridge 1998) where he says:

> "... [In] the simplest case of 26 flat dimensions ... the closed bosonic string ... theory has the maximal 26-dimensional Poincare invariance ... [and] ... is the unique theory with this symmetry ... It is possible to have a consistent theory with only closed strings ... with Guv representing the graviton ...", as to which Green, Schwartz, and Witten, in their book Superstring Theory, vol. 1, p. 181 (Cambridge 1986) say "... the long-wavelength limit of the interactions of the massless modes of the bosonic closed string ... [which] ... can be put in the form
>
> INTEGRAL d^26 x sqrt(g) R
>
> ...[of 26-dimensional general relativistic Einstein Gravitation]...".

A nice description of how such Gravitons propagate in the 26 dimensions is given by Stephen Hawking in his book The Universe in a Nutshell (Bantam 2001). To see how Hawking's description of gravity in 26 dimensions might be applied to the Penrose-Hameroff tubulin electron model of consciousness, first assume the validity of the interpretation of 26-dimensional bosonic string theory as a Many-Worlds Quantum Theory in which strings correspond to World Lines. However, Hawking speaks of branes rather than individual particle world lines. From the viewpoint of this paper, such branes should be regarded as 4-dimensional physical spacetime neighborhoods of individual particles. Timelike parts of such branes should be described in terms of 27-dimensional M-theory, and spacelike parts of such branes should be described in terms of 28-dimensional F-theory (for more about such M-theory and F-theory, see my paper at http://arXiv.org/abs/physics/0102042). In his book, Hawking says:

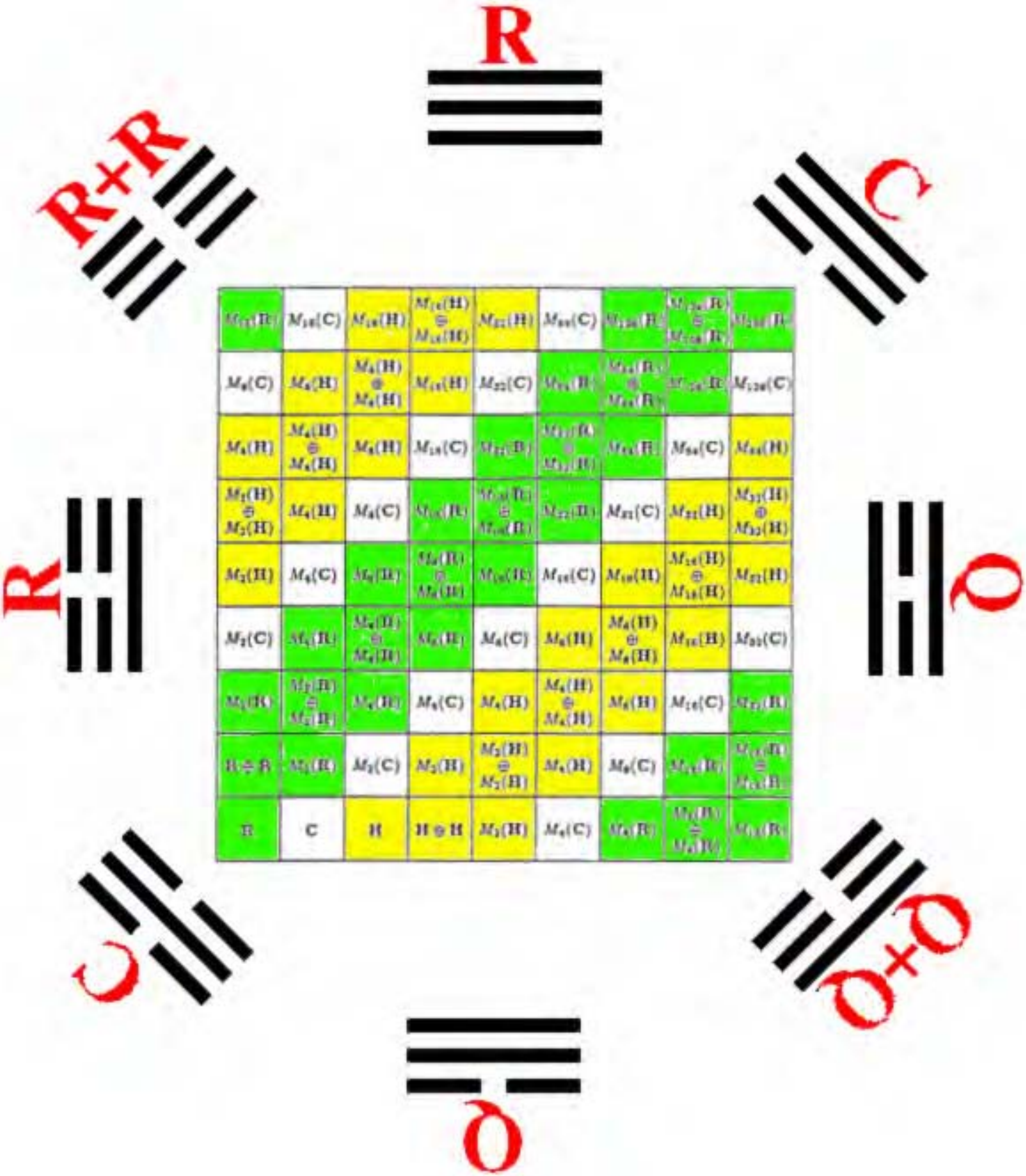
> "... Large extra dimensions ... would imply that we live in a brane world, a four-dimensional surface or brane in a higher-dimensional spacetime. Matter and nongravitational forces would be confined to the brane. ... On the other hand, gravity ... would permeate the whole bulk of the higher-dimensional spacetime ... because gravity would spread out in the extra dimensions, it ... would fall off faster with distance than it would in four dimensions. ... If this more rapid falloff of the gravitational force extended to astronomical distances, we would have noticed its effect ... However, this would not happen if the extra dimensions ended on another brane not far away from the brane on which we live. ...

 ...

[Note that in the Penrose-Hameroff model the superposition separation of two individual states in the superposition states of a single tubulin electron is of the order of a nanometer.]

> ... A second brane near our brane would prevent gravity from spreading far into the extra dimensions and would mean that at distances greater than the brane separation, gravity would fall off at the rate one would expect for four dimensions. ...
>
> ... On the other hand, for distances less than the separation of the branes, gravity would vary more rapidly. The very small gravitational force between heavy objects has been measured accurately in the lab but the experiments so far would not have detected the effects of branes separated by less than a few millimeters. ...".

Note added 18 July 2005:
Lubos Motl said in his blog post Deviations from Newton's law seen?
at http://motls.blogspot.com/ dated 6 June 2005:
"... Eric Adelberger et al. ... University of Washington ... seems to have detected deviations from Newton's gravitational law at distances slightly below 100 microns at the "4 sigma" confidence level. ... Their measured force at these multimicron distances is weaker than expected from Newton's formula. ... Note that 100 microns is also the scale of the vacuum energy - the cosmological constant. In other words, "1/(100 microns)^4" equals the energy density of the observed vacuum energy. ...".
I commented: "... If gravitational attraction does appear to decrease at distances closer than 100 microns = 10^(-2) cm = 10^31 Planck Lengths (Lp) and if that distance to the 4th power, or 10^124 Lp^4, is taken to be equivalent to the cosmological constant energy density and if the cosmological constant is seen as dark energy that causes large-scale expansion of our universe then could it be that when your experimental system is within a volume corresponding to ... the cosmological constant energy density the dark energy "force" becomes effectively a repulsive force that cancels some of the ordinary gravitational attraction and therefore makes gravity appear to be weaker at distances less than 10^31 Lp ?
In other words, the dark energy "force" may be something that manifests itself only
on large scales (expansion of the universe) and
on small scales (at or below the scale of its energy density). ...".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Tony's Home

Archetypes, Mandalas, and Muses

Although there are many examples of such things, my personal favorite example is the World Clock of Wolfgang Pauli:

"... Wolfgang Pauli is ... famous for his formulation of the two-valuedness of the electron spin, for the exclusion principle [for fermions], and for his prediction of the neutrino. ... Both ... Pauli and the psychologist Carl Gustav Jung ... stressed the inseparability of the physical and the psychical ... According to Jung, three layers can be distinguished in the human psyche:

- the conscious,
- the personal unconscious, and
- the collective unconscious.

Jung considers **the collective unconscious as "objective", prior to individual experience, and acting as a source of imagination and creative work**. ... The archetypes belong to the contents of the collective unconscious. ... Pauli favoured the thesis that **creative ideas are formed through a correspondence between the outer reality and archetypal images**. ..." [from a 28 March 1999 message from "Barron Burrow" about The Hidden Side of Wolfgang Pauli: An Eminent Physicistís Extraordinary Encounter with Depth Psychology].

[From Carl Gustav Jung, by Frank McLynn (St. Martin's Press 1996), at page 497]: "... Jung loved elaborate diagrams ... preferably in quaternary form ... He and Pauli ... sometimes 'modelled' a seven-dimensional space-time. ...".

> [If Jung and Pauli had considered a 7-dimensional space, corresponding to the 7 imaginary octonions, they might have seen the 1+7 dimensional structure of the Cl(1,7) Clifford algebra on which the D4-D5-E6-E7-E8 VoDou Physics Model is based.]

[From a psychovision web page]: "... C.G. Jung borrowed from a student of Paracelsus, Gerhard Dorn (Dorneus), who called it **the unus mundus, the "Unified World"**. The energetic principle of this unus mundus was known as **the world soul (anima mundi)** ... in the natural philosophy of the Middle Ages. Synchronicity is based upon this medieval concept of the world soul and the unus mundus, that corresponds to Wolfgang Pauli's world of "background physics" ... connections between radioactivity and space-time on a psychophysical level ...

> [As Lev Tarasov says in The World is Built on Probability (Mir 1988): "... Let us take ... the example with neutron decay. ... There is no internal "clock" in a neutron. ... only a hundred per cent isolated particle can behave spontaneously. ... a particle is not isolated, it

> interacts with the world around it. ... The idea of the unity of the world and the universal interrelation of the phenomena in it acquires a special meaning on the level of the microcosm ... A vacuum in quantum mechanics is not a void but a space in which particles are randomly born and annihilated. The neutron interacts with them. ...".]

... Wolfgang Pauli's ... Anima - in Jungian psychology the bridge to yet unknown creative ideas in the collective unconscious - manifests her conception of time with the assistance of "odd oscillation symbols", that belong to the same category of periodic symbols as "**the light and dark stripes**" and the "pendulum and the 'little men' ..." relate[d] to **his so-called world-clock vision of 1934**, which ... generated in Pauli a sensation of "sublime harmony" ... its content - understood on a psychophysical level - would have been the solution of the ... problem of Pauli's Anima. ... the relevant messages in Pauli's dreams are: "Beta radioactivity (antineutrino) and synchronicity are connected in a manner yet not understood" and "Behind the world of quantum physics another dimension is hidden" ... Bohm's idea of an implicate order behind quantum physics appears to be similar to what Wolfgang Pauli and C. G. Jung sought in their later years, the unified psychophysical or unified psychoid reality, the unus mundus ... except for one major difference. ... individual consciousness and the collective unconscious play no role in ...[Bohm's]... theory ...[while]... Pauli and Jung felt that individual consciousness is able to come into relation with this implicate order. ...

... Wolfgang Pauli was not able to find this solution. ... he was painfully conscious of the limits of his scientific creativity when he wrote to C.G. Jung in 1952 that the future challenge must include finding "that other, **more comprehensive coniunctio" (union of opposites), that transcends the artificial separation of psyche and matter** and the "smaller coniunctio" of quantum physics, namely Bohr's complementarity of particle and wave. ...".

Here is how I think Pauli's World Clock describes Physics and Psyche:

"... The World Clock.

An impression generated by artist W. Beyers-Brown based on accounts of Pauli's dream. The vision of the world clock ... originally published by C. G. Jung ...

- ... There is a vertical and a horizontal circle, having a common centre. ...
    - The vertical circle is a blue disc with a white border divided into 4 X 8 -- 32 partitions.
        - A pointer rotates upon it.
    - The horizontal circle consists of four colours. On it stand four little men with pendulums, and round it is laid the ring that was once dark and is now golden (formerly carried by four children). The world clock has three rhythms or pulses:
        - 1) The small pulse: the pointer on the blue vertical disc advances by 1/32.
        - 2) The middle pulse: one complete rotation of the pointer. At the same time the horizontal circle advances by 1/32.
        - 3) The great pulse: 32 middle pulses are equal to one complete rotation of the golden ring. ...
- It is supported by the black bird. ..." [from an F. David Peat web page].

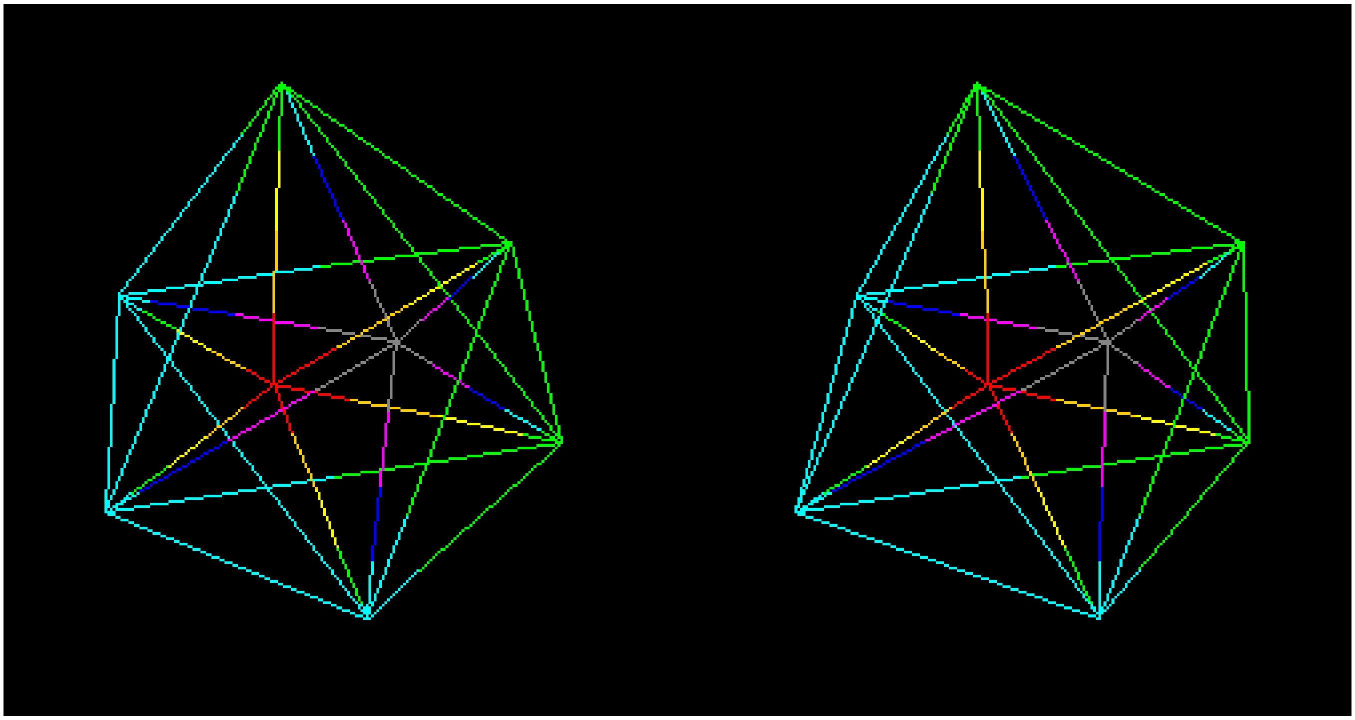
It seems to me that the black bird could be one of many, each carrying a world clock.

The above image is taken from a Bill Stillwell January 2003 web image of a murder of crows.

Physics and Psyche:

Within each of the 4 colors (shown as red, green, cyan, and magenta) of the horizontal circle there are 4x8 = 32 vertical circle pointer positions times x 32/4 = 8 horizontal circle positions, for a total of 4 x 8 x 8 = 16 x 16 = 256 = 2^8 possible positions, corresponding to the 256 possibilities of IFA =VoDou divination and the 256 binary elements of the Cl(1,7) Clifford algebra of the D4-D5-E6-E7-E8 VoDou Physics Model, so that each of the 4 colors (shown as red, green, cyan, and magenta) contains one copy of the local neighborhood model of VoDou Physics. The 256 = 32x8 = 16 x 16 = 2^8 binary choices of Cl(1,7) form the more comprehensive coniunctio (union of opposites) for which Pauli was searching.

Each copy of the world clock contains a VoDou Physics model for each of 4 local neighborhoods, which can be considered as being neighbors located on 4 vertices of one of the 16 tetrahedral 3-dimensional faces



of a cross-polytope (hyper-octahedron) in 4-dimensional physical spacetime.

The dark (black hole) state of the dark/golden ring represents a ring singularity of a Kerr-Newman black hole of a Compton radius vortex model of elementary particles. The 4 children who carried the ring in its dark state represent the 4 dimensions of internal symmetry space which, together with the 4 little men of the 4 colors of the horizontal circle (representing 4-dimensional physical spacetime), represent the 8 dimensions of the Cl(1,7) Clifford algebra and high-energy spacetime. Each little man’s pendulum measures the propagator phase of the particle at his vertex.

The golden (golden ratio) state of the dark/golden ring represents Hopf tori and Hopf-Clifford circles in a Hopf fibration of S3 related to Segal’s conformal physic and cosmology. An exotic form of S3 is Poincare dodecahedral space S3#, which has icosahedral golden ratio symmetry.

The flight path of the black bird represents a world-line of the many-worlds, which by 26-dimensional closed bosonic string theory, expanded to its 27-dimensional M-theory and 28-dimensional F-theory, describes a mechanism underlying Bohm’s implicate order that allows consciousness, through resonant connections, to influence the unfolding of the implicate order and therefore to influence fate.

Therefore,

a single black bird carries an accurate VoDou Physics model of a small-scale neighborhood,

and

many black birds acting together, as in a murder of crows, provide an accurate description of physics and psyche on larger scales.

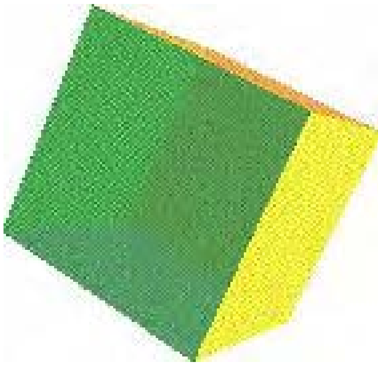
Many other Archetypes, Mandalas, and Muses are noteworthy, and here are a few of them:

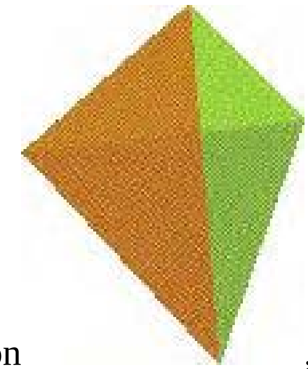
Margaret Boden said:

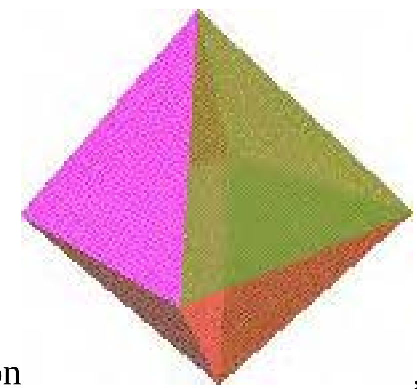
> "... Far from being the antithesis of creativity, constraints on thinking are what make creativity possible. ... **Mozart is free to create things others cannot imagine, because he is bound by principles others cannot see**. ...".

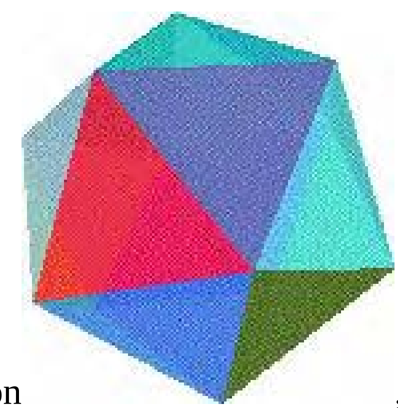
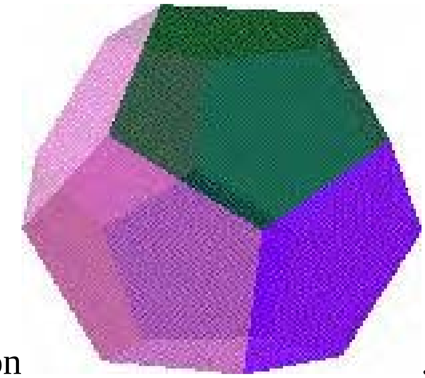
According to a web page about Kepler the mystic:

> "... there ...[are]... only five perfect polyhedra ›

the cube  ,

the tetrahedron  ,

the octahedron  ,

the icosahedron  , and the dodecahedron  . [images from a Wikipedia web page]

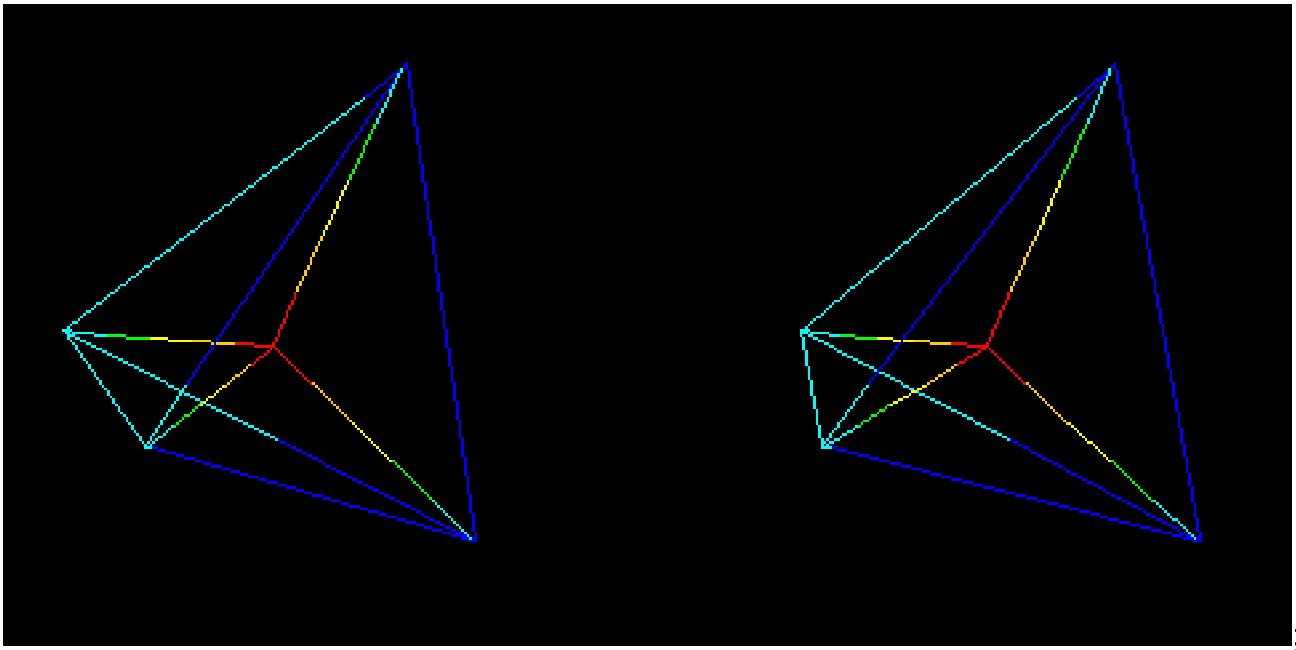
Kepler described putting these one inside another as follows:

- The Earth's orbit is the measure of all things;
- circumscribe around it a dodecahedron, and the circle containing this will be Mars.
- Circumscribe around Mars a tetrahedron, and the circle containing this will be Jupiter.
- Circumscribe around Jupiter a cube, and the circle containing this will be Saturn.
- Now inscribe within the Earth an icosahedron, and
- the circle contained within it will be Venus.
- Inscribe within Venus an octahedron, and the circle contained within it will be Mercury.

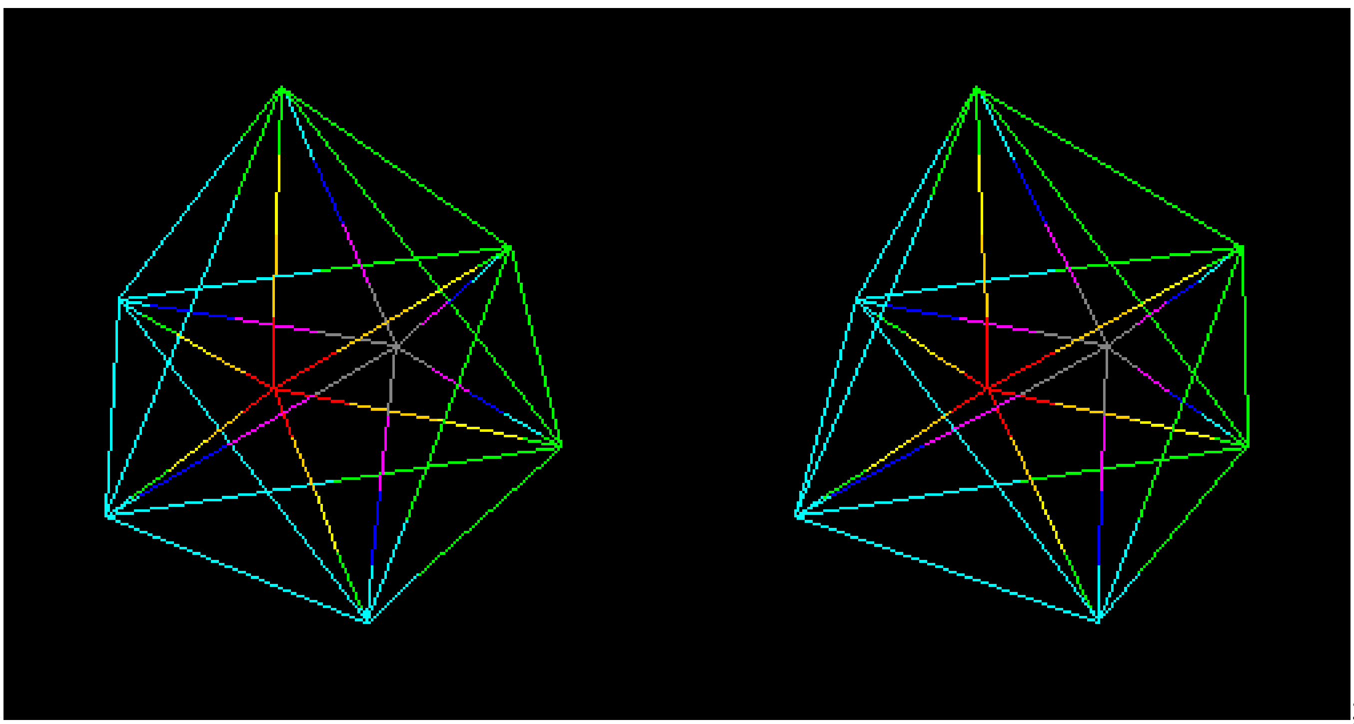
You now have the reason for the number of planets. ...".

If you go to 4-dimensional space, you have six regular polytopes:

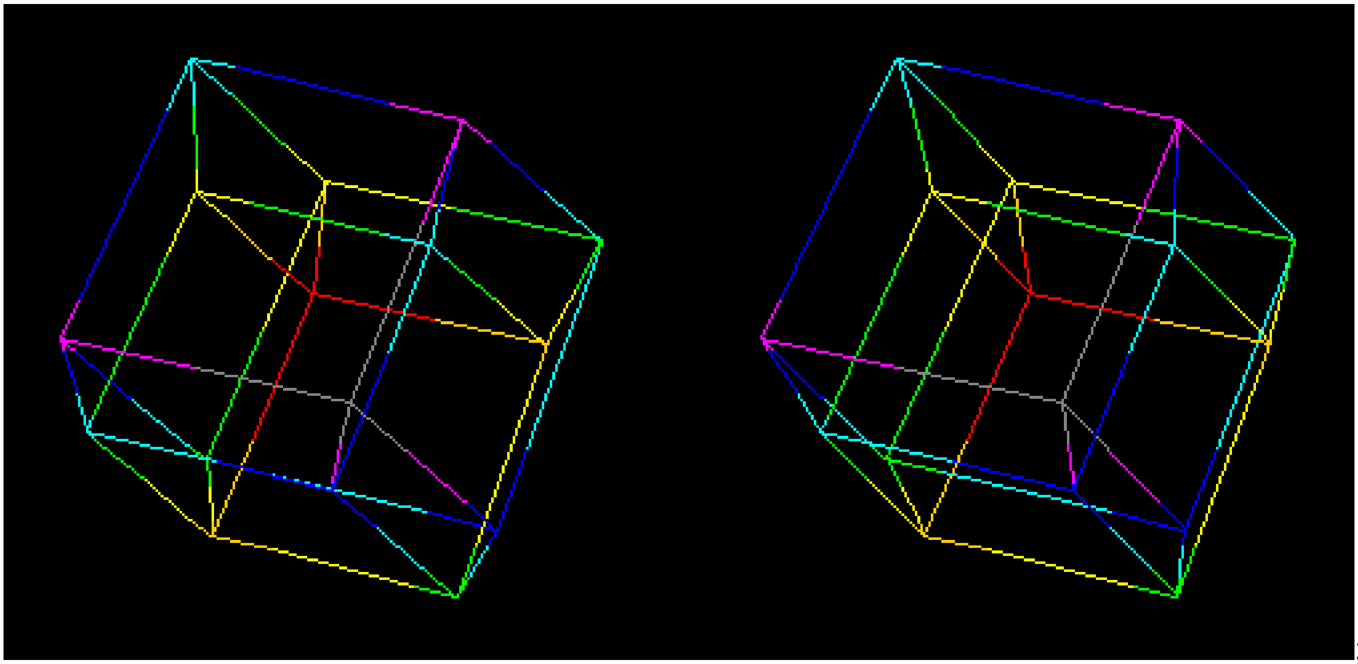
the simplex

;

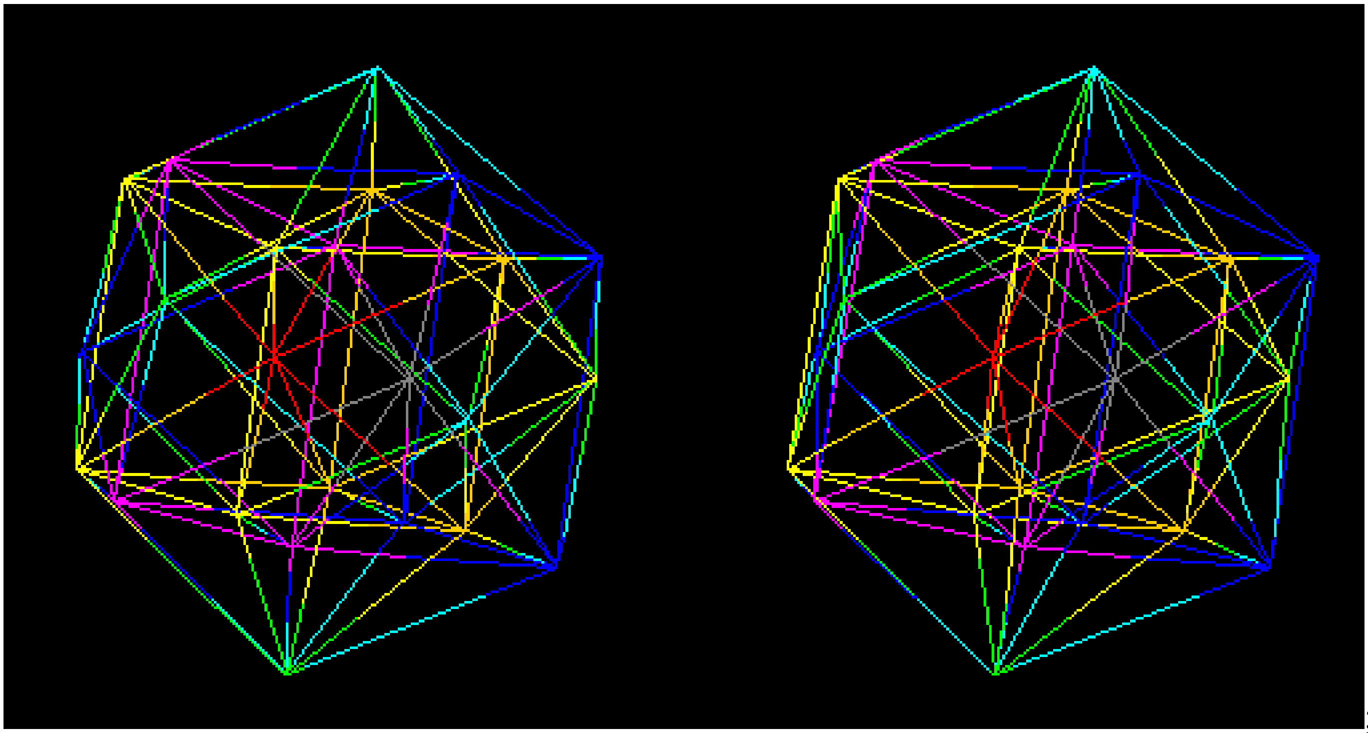
the cross-polytope (hyper-octahedron)

;

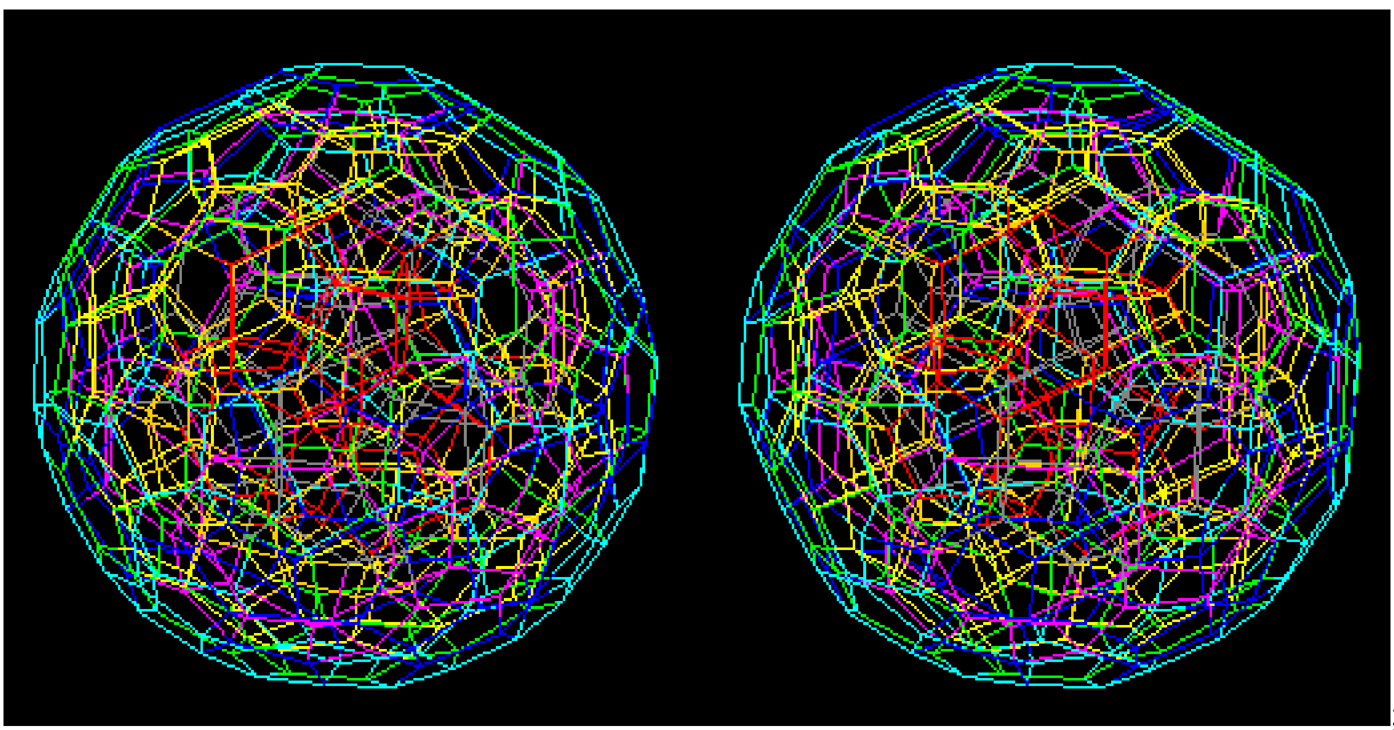
the hypercube

;

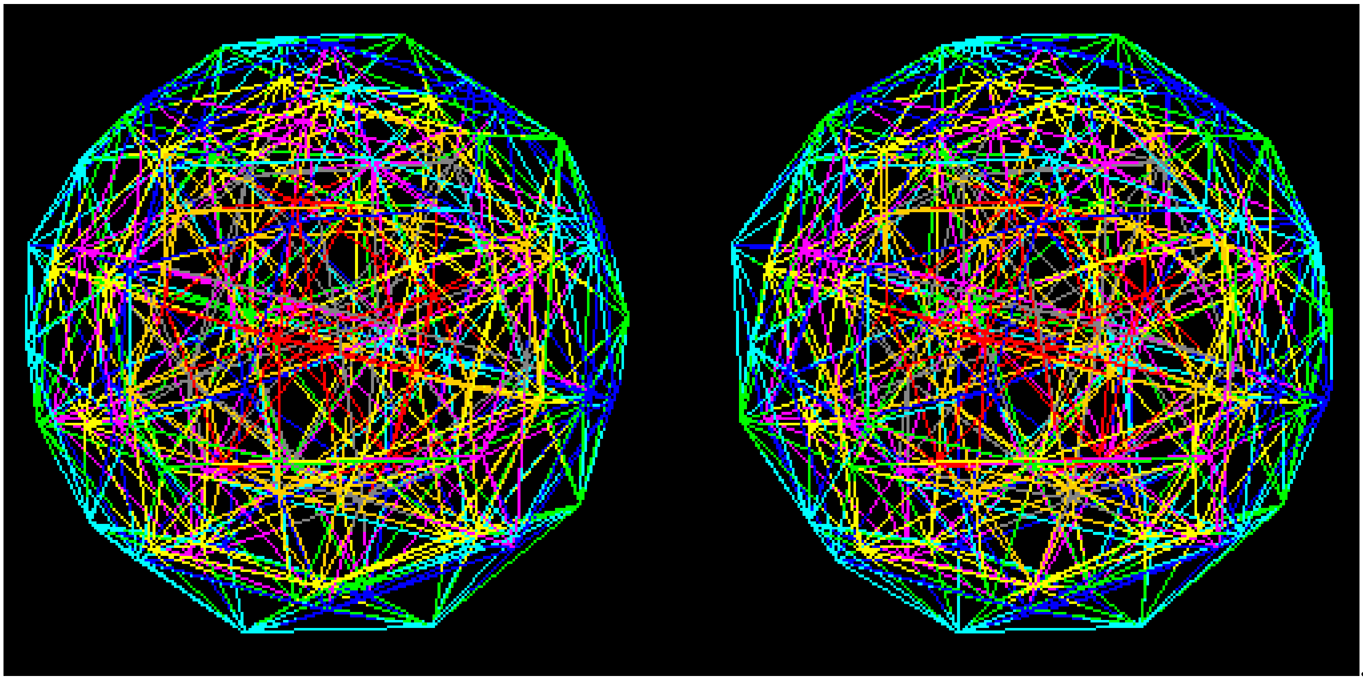
the 24-cell (the "sixth" one that appears only in 4 dimensions, which corresponds in 3 dimensions to the cuboctahedron and its dual the rhombic dodecahedron, neither of which are technically "regular" polytopes) (It is the vertex figure of the integral quaternions, and is the only centrally symmetric self-dual regular polytope, and is the root vector polytope of the D4 Lie algebra and, when combined with its dual, forms the 48-vertex root vector polytope of the F4 Lie algebra. In the years 1980-1984, it and its dual formed the archetype/mandala/vision in my mind that motivated me to continue working on what has become my D4-D5-E6-E7-E8 VoDou Physics model, and showed me the basic structure that I needed to construct the model.)

;

the 120-cell

; and

the 600-cell


.

In dimensions 5 and higher, there are only three regular polytopes: the simplex, the cross-polytope, and the hyper-cube.

The above comments pertain to real dimensionality. In complex dimensions two, three and four, there are interesting regular polytopes, as described by Coxeter in his book Regular Complex Polytopes (Cambridge, 2nd ed, 1991):

- The number of vertices of special (not belonging to an infinite series like a real 2-dim n-gon - there is are complex polygons with q and 2p and p^2 vertices) complex polygons (4 real dimensions) are:
    - 8
    - 16
    - 24
    - 48
    - 72
    - 96
    - 120
    - 240
    - 360
    - 600
- The number of vertices of special (not belonging to an infinite series like a real 2-dim n-gon - the 3-complex› dimensional cross-polytope and hypercube belong to such infinite series with 3p and p^3 vertices, respectively) complex 3-polyhedra (6 real dimensions) are:
    - 4
    - 12
    - 20
    - 27
    - 54

    - 72 (related to E6)
- The number of vertices of special (not belonging to an infinite series like a real 2-dim n-gon - the 4-complex-dimensional cross-polytope and hypercube belong to such infinite series with 4p and p^4 vertices, respectively) complex 4-polytopes (8 real dimensions) are:
    - 5 (corresponds to 4-real-dimensional simplex)
    - 24 (corresponds to 4-real-dimensional 24-cell)
    - 120 (corresponds to 4-real-dimensional 120-cell)
    - 240 (related to 8-real-dimensional Witting polytope related to E8)
    - 600 (corresponds to 4-real-dimensional 600-cell)

In On-Creativity, Boden, said:

> "... **Kekule's discovery of the benzene-ring**. ... He described it like this: I turned my chair to the fire and dozed. Again the atoms were gambolling before my eyes....[My mental eye] could distinguish larger structures, of manifold conformation; long rows, sometimes more closely fitted together; all twining and twisting in snakelike motion. But look! What was that? **One of the snakes had seized hold of its own tail,** and the form whirled mockingly before my eyes. **As if by a flash of lightning I awoke** ...".

According to How a Scientific Discovery is Made: A Case History (American Scientist 84 (July-August 1996) 364-375), by Gerald Holton, Hasok Chang and Edward Jurkowitz:

> "... In the case of Karl Alex Mueller ... a major motivation was ...[his]... feeling that the highly symmetrical crystal stucture that proved essential to the discovery of high-temperature superconductivity ...[in Perovskite-type Oxides]... had the affective power of a mandala ... Mueller later chose the Dharmaraja mandala ...

... to illustrate an introspective essay on his sources of inspiration. ... Perovskites ... are a class of ceramics that have a particular atomic arrangement. In their ideal form perovskites, which can be described by the general formula ABX3, consist of cubes that are decorated with three elements. The A cation (positively charged ion) ... lies at the center of each cube, the B cations occupy all eight corners and the X anions (negatively charged ions) lie at the midpoints of the cube's 12 edges. ... As ...[Mueller]... put it: "I was always dragged back to this symbol." ... in 1952, when he was working on his doctorate ... Wolfgang Pauli ... one of Mueller's professors at ETH, had just published an essay on the influence of archetypal conceptions in the work of the astronomer Johannes Kepler in a book coauthored with psychoanalyst Carl Jung. ... Mueller started to read Kepler avidly, thus encounhtering Kepler's deep commitment to the guidance of ... the five Platonic solids ... in his work on planetary motion. ... Mueller continued, "If you are familiar with Jung's terminology, ther perovskite structure was for me, and still is, a symbol of - it's a bit high-fetched - but of holiness. It's a mandala, a self-centric symbol which determined me ... I dreamt about htis perovskite symbol while getting my Ph.D. And more interesting about this is also that this perovskite was not just sitting on a table, but was held in the hand of Wolfgang Pauli, my teacher." ...

... Their [Mueller and Bednorz] barium cuprate copound contained well-separated planes of copper and oxygen atoms, and these layers turened out to be a universal property of high-temperature superconductors. ... these layers exist because the compound is not, after all, a true perovskite; because of the way its unit cells stack, it has orthorhombic rather than cubic symmetry. [The breaking of cubic symmetry corresponds to omitting 4 of the 12 X anions, that is, omitting 4 X anions lying on the 4 edges of one face of the cube.] As Mueller said to us in this connection, although Kepler tried to decompose planetary orbits into perfect circles, he was led to ellipses instead - but thereby helped prepare for Newton's Principia. ...

> ... the most striking feature of the culture at the Zurich laboratory [of Mueller and Bednorz] was the willingness to give good people the freedom to pursue projects with long gestation periods. ...".

In November 2003, Jack Sarfatti received a message from Constantin Ivanenko saying, in part: "... importance of barium titanate - key component of "psi-genome weapons" - was intuitively foreseen by SF author H. Kuttner; - who wrote in his '54 novel "Mutants" that "destiny of Humankind is contained in the chip of barium titanate crystal". ...". Barium titanate, like some high-temperature superconductors, has a perovskite-type crystal structure. With some such things, such as YBCO, you get superconductivity. With barium titanate, you get interesting dielectric and pizeoelectric properties. My guess is that successful Dark Energy engineering will involve a similar crystal structure with both superconductivity and properties such as pizeoelectricity to get useful transduction from gravity to EM and vice versa, and that Mead resonance will be another necessary interesting piece of engineering. There are a lot of papers about perovskite and related structures, but moleculargeuniverse.com has a nice elementary introductory web page.

According to a 1995 message from jit on a hindunet web page about a February 1990 article, COMPUTING THE MATHEMATICAL FACE OF GOD: S. RAMANUJAN Posted by Dr. Jai Maharaj in HINDUISM TODAY February 1990:

> "... **S. Ramanujan** ... died on his bed after scribbling down revolutionary mathematical formulas that bloomed in his mind like ethereal flowers -- gifts, he said, from a Hindu Goddess. He was 32 the same age that the advaitan advocate Adi Shankara died. Shankara, born in 788, left earth in 820. Srinivasa Ramanujan was born in 1887. He died in 1920 -› an anonymous Vaishnavite brahmin who became the first Indian mathematics Fellow at Cambridge University. Both Shankara and Ramanujan possessed supernatural intelligence ...
>
> ... Ramanujan **told friends the Hindu Goddess Namagiri whispered equations into his ear**. Today's mathematicians -- armed with supercomputers -- are still star-struck, and unable to solve many theorems the young man from India proved quickly by pencil and paper. ... According to his wife -- Janaki, who still lives outside Madras -- her husband predicted "his mathematics would be useful to mathematicians for more than a century." ...
>
> ... Ramanujan was born in Erode, a small, rustic town in Tamil Nadu, India. His father worked as a clerk in a cloth merchant's shop. his namesake is that of another medieval

philosophical giant -- Ramanuja -- a Vaishnavite who postulated the Vedanta system known as "qualified monism." the math prodigy grew up in the overlapping atmospheres of religious observances and ambitious academics. He wasn't spiritually preoccupied, but he was steeped in the reality and beneficence of the Deities, especially the Goddess Namagiri. Math, of course, was his intellectual and spiritual touchstone. No one really knows how early in life ramanujan awakened to the psychic visitations of Namagiri, much less how the interpenetration of his mind and the Goddess' worked. By age twelve he had mastered trigonometry so completely that he was inventing sophisticated theorems that astonished teachers. ... his first theorems unwittingly duplicated those of a great mathematician of a hundred years earlier. ... he outpaced his teachers in numbers theory, but neglected all other subjects. He could speak adequate English, but failed in it and history and other science courses. He lost a scholarship, dropped out, attempted a return but fell ill and quit a second time. By this time he was married to Janaki, a young teenager, and was supporting his mother. ... A manager at the office admire the young man's work and sensed significance. He talked him into writing to British mathematicians who might sponsor him. Ramanujan wrote a simple letter to the renowned G. W. Hardy at Cambridge ...[who]... collaborated with an odd man named Littlewood, who was so publicly retiring that people joked Hardy made him up. ... [Ramanujan's letter]... fell to them like a broadcast from alien worlds. AT first they dismissed it as a curiosity. Then, they suddenly became intrigued ... Hardy ... arranged a scholarship for the then 26-year-old Ramanujan. ... Debate still lingers as to the origins ofRamanujan's edifice of unique ideas.Mathematicians eagerly acknowledge surprise statesof intuition as the real breakthroughs, not logical deduction. There is reticence to accept mystical overtones, though ... many can appreciate intuition *in the guise* of a Goddess. But we have Ramanujan's own testimony of feminine whisperings from a Devi and there is the sheer power of his achievements. Hindus cognize this reality. ...".

According to a St. Andrews mathematicians web page:

"... Srinivasa Ramanujan was one of India's greatest mathematical geniuses. He made substantial contributions to the analytical theory of numbers and worked on elliptic functions, continued fractions, and infinite series. ... Ramanujan sailed from India on 17 March 1914. ... On 16 March 1916 Ramanujan graduated from Cambridge with a Bachelor of Science by Research (the degree was called a Ph.D. from 1920). He had been allowed to enrol in June 1914 despite not having the proper qualifications. Ramanujan's dissertation was on Highly composite numbers and consisted of seven of his papers published in England. Ramanujan fell seriously ill in 1917 ... Ramanujan sailed to India on 27 February 1919 arriving on 13 March. However his health was very poor and, despite medical treatment, he died there the following year.

The letters Ramanujan wrote to Hardy in 1913 had contained many fascinating results. Ramanujan worked out the Riemann series, the elliptic integrals, hypergeometric series and functional equations of the zeta function. On the other hand he had only a vague idea of what constitutes a mathematical proof. Despite many brilliant results, some of his theorems on prime numbers were completely wrong. Ramanujan independently discovered results of Gauss, Kummer and others on hypergeometric series. Ramanujan's own work on partial sums and products of hypergeometric series have led to major development in the topic. Perhaps his most famous work was on the number p(n) of partitions of an integer n into summands. MacMahon had produced tables of the value of p(n) for small numbers n, and Ramanujan used this numerical data to conjecture some remarkable properties some of which he proved using elliptic functions. Other were only proved after Ramanujan's death. In a joint paper with Hardy, Ramanujan gave an asymptotic formula for p(n). It had the remarkable property that it appeared to give the correct value of p(n), and this was later proved by Rademacher. Ramanujan left a number of unpublished notebooks filled with theorems that mathematicians have continued to study. ...".

A few other Archetypes (each of which may contain substructures that are also Archetypes) are:

- Real Clifford Algebra 8-Periodicity, its Octagonal Mandala, I Ching, and IFA
- J3(O) and Sri Yantra and Leech Lattice
- Octonions and E8 Lattice
- 7-sphere and D4 and Lie Sphere for D5 / D4xU(1)
- 3-sphere and its Clifford-Hopf Fibration
- Beethoven111
- VoDou Chile
- Grosse Fugue
- Es MussSein!

According to a Jack Sanders web page:

> "... a flock of crows has come to be known as a "murder" of crows. ... Bob Sear was reminded of a story a friend told him. "He said he watched a large ...[murder]... of crows surrounding a single crow and all were cawing loudly and constantly at the one crow who sat still with his head hanging down. After a long time, the one single crow suddenly just fell to the ground and died. ...".

According to a web page about crows and ravens:

> "... The raven is known throughout history as both portent and prophet. ... Muslims call the raven Abu Zajir, which means the Father of Omens. ... Among the Irish the "Raven's Knowledge" is used when describing seers. These people with extra senses and often some ability to prophesy are compared to this bird which man has attributed supernatural abilities. A group of crows is known as a "murder" of crows. A "murder" of crows is based on the persistent but fallacious folk tale that crows form tribunals to judge and punish the bad behavior of a member of the flock. If the verdict goes against the defendant, that bird is killed (murdered) by the flock. The basis in fact is probably that occasionally crows will kill a dying crow who doesn't belong in their territory or much more commonly feed on carcasses of dead crows. Also, both crows and ravens are associated with battlefields, medieval hospitals, execution sites and cemeteries (because they scavenged on human remains). ...
>
> Here is a report of a crow funeral which I found on the Internet written by Carl Cook: "The sound of many crows calling at once filled the air. I peeked out the window, and everywhere I could see, crows, maybe a couple hundred of them. They were on the sidewalk. They were on the power lines. They were on the logs that served as stops for parked cars, and they were in the trees. Almost hidden against one of the logs, I saw a dead crow. There were a few crows standing near the body. The noise continued for about a minute or so, when suddenly, an unseen conductor waved his baton, and the cawing stopped. The silence was equally as loud. There was a pause. Then, the invisible conductor again waved his baton, and there was a great and noisy flurry of feathers, as the crows took off and flew in all directions. Soon they were gone, leaving their lifeless kin to the elements. I continued my watch in silent awe, feeling that I had just witnessed something few have seen ... the crow's version of what we would call, a funeral. ...

During the 1930s my father Frank and his brother Sidney lived near Pine Mountain with the Jess Bohannon family. A crow lived with them, more as a friend than a pet. Since my parents have died, I live in the house in which I grew up with them, and, since my mother's final illness and death, a family of crows has lived here also.

Tony Smith's Home Page

......

Tony Smith's Home Page

Rig-Veda

Vedic Music (compare Torah Music)

Sanskrit and Information

Feuerstein, Kak, and Frawley, in their book In Search of the Cradle of Civilization (Quest 1995), say (In these and other quotes on this page, my comments are enclosed in [ ].):

"... The principal and, taken in its totality, the oldest of the four Vedic hymnbodies is the Rig-Veda. ...

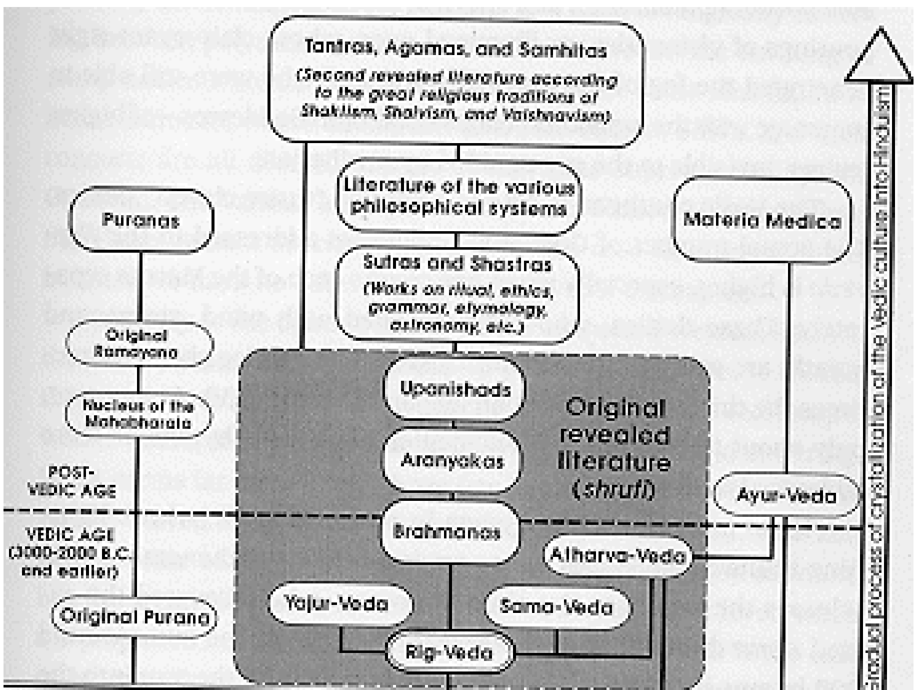


FIG. 4. *The major categories of Vedic and Hindu literature and their interconnection.*

[On this page I am primarily interested in the Reg-Veda of the early Vedic age. Although some later expository material seems to me to be consistent with the fundamental wisdom of the Vedas, I do not think that some other later material, such as, for example, the caste system of orders of human beings, is consistent with the fundamental wisdom of the Vedas.]

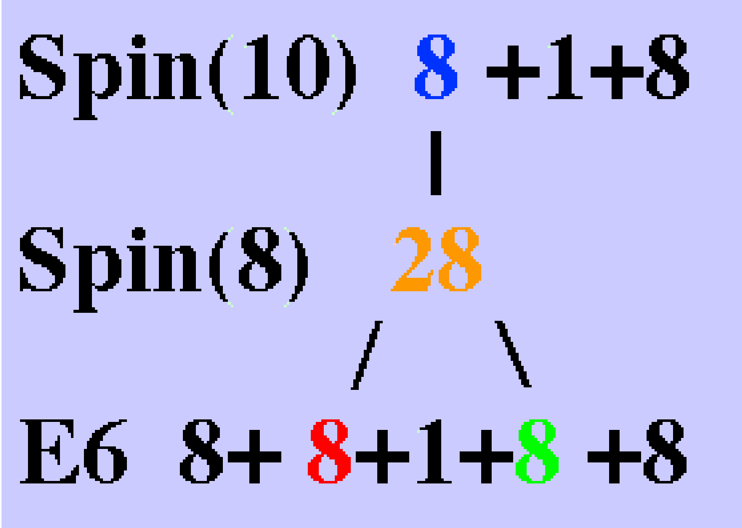
... The Sanskrit word ric, which for euphonic reasons is changed to rig, means literally "praise". ... The Sanskrit word veda means literally "knowledge" or "wisdom". ... **The Rig-**

> **Veda is the oldest book in the Sanskrit language**, indeed in any Indo-European language. More than that, if we are correct, **it is the oldest book in the world** ... The fact that the Rig-Veda mentions a stellar configuration that corresponds to a date from 6000 B.C. to 7000 B.C. - the astronomical Ashvini era [according to Underworld, by Graham Hancock (Crown 2002), quoting David Frawley: "... when the [winter] solstice first entered [the constellation of] Ashwini (i.e., when the winter solstice was at or very near the constellation of Aries)]... - must not be ... denied ... this date takes us back to the beginnings of the Indic civilization at the town of Mehgarh ... in eastern Pakistan (Baluchistan) ...[whre]... excavations have yielded the ... date of around 6500 B.C. ... Writing about two thousand years ago, Greek historians Pliny and Arrian, who based themselveson reports from the ambassadors at the Maurya courts, mention that the native historical tradition of India knew of 154 kings, ruling over a period of 6,450 years. When we reconstruct this tradition, it appears that during Mauryan times **the calendar was taken to commence in 6676 B.C.** ...".

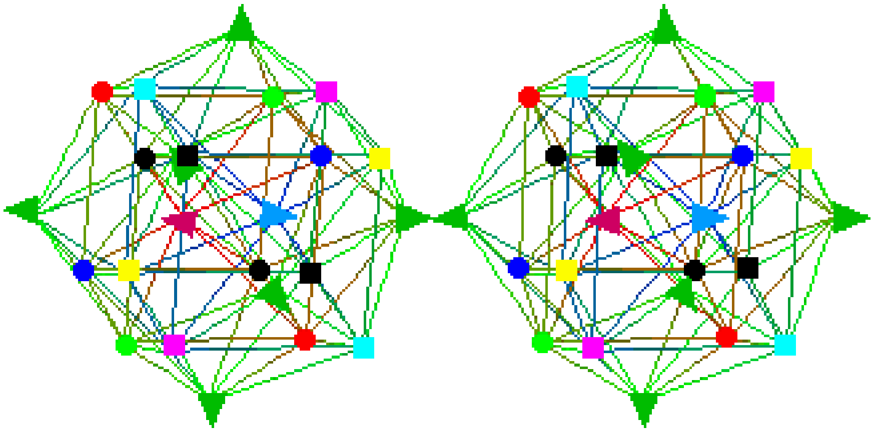
According to a Hindu Universe web site, the Rig Veda begins with 1 Madala, 1 Astaka, 1 Adhyaya, Sukta 1:

ॐ अग्निमीळे पुरोहितं यज्ञस्य देवमृत्विजम् । होतारं रत्नधातमम् ॥ 1 ॥
अग्निः पूर्वेभिर्ऋषिभिरीड्यो नूतनैरुत । स देवाँ एह वक्षति ॥ 2 ॥
अग्निना रयिमश्नवत्पोषमेव दिवेदिवे । यशसं वीरवत्तमम् ॥ 3 ॥
अग्ने यं यज्ञमध्वरं विश्वतः परिभूरसि । स इद्देवेषु गच्छति ॥ 4 ॥
अग्निर्होता कविक्रतुः सत्यश्चित्रश्रवस्तमः । देवो देवेभिरा गमत् ॥ 5 ॥
यदङ्ग दाशुषे त्वमग्ने भद्रं करिष्यसि । तवेत्तत्सत्यमङ्गिरः ॥ 6 ॥
उप त्वाग्ने दिवेदिवे दोषावस्तर्धिया वयम् । नमो भरन्त एमसि ॥ 7 ॥
राजन्तमध्वराणां गोपामृतस्य दीदिविम् । वर्धमानं स्वे दमे ॥ 8 ॥
स नः पितेव सूनवेऽग्ने सूपायनो भव । सचस्वा नः स्वस्तये ॥ 9 ॥

Note the structure of 1 first line, followed by 8 lines, each with 8+8 = 16 Sanskrit syllables left of the | line and 8 Sanskrit syllables right of the | line, for a total of 24 Sanskrit syllables per line. Note that the three sets of eight syllables correspond to



the 8 first generation fermion particles, the 8 first generation fermion antiparticles, and an 8-dimensional spacetime in the D4-D5-E6-E7-E8 VoDou Physics model, and all 24 form the vertices



of a 24-cell.

According to The Constitution of the Universe by Maharishi Mahesh Yogi, printed in newspapers including The Sunday Times (15 March 1992), The Sunday Telegraph (15 March 1992) Financial Times (16 March 1992), The Guardian (16 March 1992), The Wall Street Journal (6 January 1992), and The Washington Post (9 January 1992), a copy of which was sent to me in pamphlet form by John Small in August 2003:

> "... modern science has systematically revealed deeper layers of order in nature, from the atomic to the nuclear and subnuclear levels of nature's functioning ...
>
> ... the ancient Vedic wisdom ... identifies a single, universal source of all orderliness in nature ...

Both understandings, modern and ancient, locate the unfied source of nature's perfect order in a single, self-interacting field of intelligence at the foundation of all the laws of nature. ... The self-interacting dynamics of this unified field constitutes the most basic level of nature's dynamics ... The laws governing the self-interacting dynamics of the unified field can therefore be called the **Constitution of the Universe** ... In Maharishi's Vedic Science, ... the Constitution of the Universe ... is embodied in the very structure of the sounds of the Rik Ved, the most fundamental aspect of the Vedic literature ... According to Maharishi's Apaurusheya Bhashya, the structure of the Ved provides its own commentary - a commentary which is contained in the sequential unfoldment of the Ved itself in its various stages of expression. The knowledge of the total Ved ... is contained in the first sukt of the Rik Ved, which is presented below [and is also shown above, all on one line]:

Ahamkar	Buddhi	Manas	Akash	Vayu	Agni	Jal	Prithivi
हो	ता	रं	र	त्न	धा	त	मम्
HO	TA	RAM	RA	TNA	DHA	TA	MAM
स	दे	वाँ	ए	ह	व	क्ष	ति
य	श	सं	वी	र	व	त्त	मम्
स	इ	द्दे	वे	षु	ग	च्छ	ति
दे	वो	दे	वे	भि	रा	ग	मत्
त	वेत्	तत्	स	त्य	म	ङ्गि	रः
न	मो	भ	रं	न्त	ए	म	सि
व	र्धं	मा	नं	सु	वे	द	मे
स	चं	सु	आ	नः	स्व	स्त	ये

Ahamkar	Buddhi	Manas	Akash	Vayu	Agni	Jal	Prithivi
अक्	नि	मी	ळे	पु	रो	हि	तं
AK	NI	MI	LE	PU	RO	HI	TAM
अ	ग्निः	पू	र्वें	भिः	ऋ	षिं	भि
अ	ग्नि	ना	र	यि	म	श्न	व
अ	ग्ने	यं	य	ज्ञ	म	ध्व	रं
अ	ग्निर्	हो	ता	क	वि	क्र	तुः
य	द	ङ्ग	दा	शु	षे	तु	वं
उ	प	त्वा	ग्ने	दि	वे	दि	वे
रा	जं	न्त	म	ध्व	रा	णां	गो
स	नः	पि	ते	व	सू	न	वे

Ahamkar	Buddhi	Manas	Akash	Vayu	Agni	Jal	Prithivi
य	ज्ञ	स्यं	दे	व	मृ	त्वि	जम्
YA	GYA	SYA	DE	VA	MRI	TVI	JAM
री	ड	यो	नू	तं	नै	रु	त
त्वो	षं	मे	व	दि	वे	दिं	वे
वि	श्व	तः	प	रि	भू	र	सिं
स	त्यश्	चि	त्र	श्रं	व	स्त	मः
श्र	मैं	भ	द्रं	क	रि	ष्य	सिं
दो	षां	व	स्तर्	धि	या	व	यम्
पा	मृ	त	स्यु	दी	दिं	वि	म्
श्र	मैं	सू	पा	यु	नो	भं	व

... The precise sequence of sounds is highly significant; it is in the sequential progression of sound and silence thatthe true meaning and content of the Ved reside - not on the level of intellectual meanings ascribed to the Ved in the various translations [compare the Torah].

The complete knowledge of the Ved contained in the first sukt (stanza) is also found in the first richa (verse) - the first twenty-four syllables of the first sukt (stanza 1). This complete knowledge is again contained in the first pad, or first eight syllables of the first richa, and is also found in the first syllable of the Ved, 'AK', which contains the total dynamics of consciousness knowing itself. [compare the 64 hexagrams of the I Ching which come from the 8 trigrams which in turn come from Yin-Yang]

According to Maharishi's Apaurusheya Bhashya of the Ved,

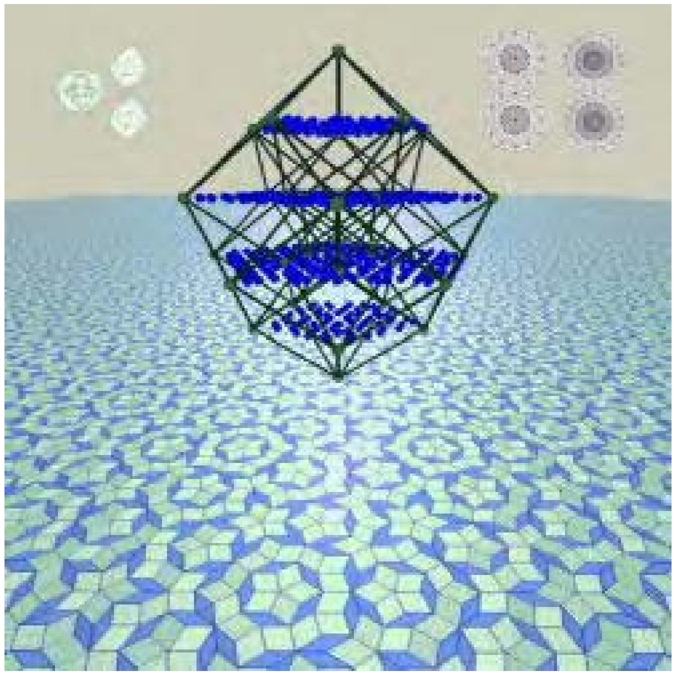
- 'AK' describes the collapse of the fullness of consciousness (A) within itself to its own point value (K). [compare the quantum decoherence/collapse of superpositions of tubulin elecctron states in the formation of a thought in the human brain] This collapse, which represents the eternal dynamics of consciousness knowing itself, occurs in eight successive stages.
- In the next stage of unfoldment of the Ved, these eight stages of collapse are separately elaborated in the eight syllables of the first pad, which emerges from, and provides a further commentary on, the first syllable of Rik Ved, 'AK'. These eight syllables correspond to the eight 'Prakritis' (Ahamkar, etc.) or eight fundamental qualities of intelligence ...[compare the 8-dimensional real Clifford algebra of the D4-D5-E6-E7-E8 VoDou Physics model and its 8-fold Periodicity leading to a Clifford Tensor Product Universe]...
- The first line, or 'richa', of the first sukt, comprising 24 syllables, provides a further commentary on the first pad (phrase of eight syllables);

  - The first pad expresses the eight Prakritis ... with respect to the knower ... observer ... or 'Rishi' quality of pure consciousness.
  - The second pad expresses the eight Prakritis with respect to the process of knowing ... process of observation ... of 'Devata' (dynamism) quality of pure consciousness.
  - The third pad expresses the eight Prakritis with respect to the known ... observed ... or 'Chhandas' quality of pure consciousness. ... [compare the 3 pads with Triality]
- The subsequent eight lines complete the remainder of the first sukt - the next stage of sequential unfoldment of knowledge in the Ved. These eight lines consist of 24 padas (phrases), comprising 8x24 = 192 syllables. [compare the 192-element Weyl group of Spin(8), whose root vector polytope is the 24-cell, and whose Lie algebra comes from the bivectors of the Cl(8) Clifford Algebra] ... these 24 padas of eight syllables elaborate the unmanifest, eight-fold structure o fhe 24 gaps between the syllables of the first richa (verse). ... Ultimately, in the subsequent stages of unfoldment, these 192 syllables of ther first sukt (stanza) get elaborated in the 192 [?or is it 191?] suktas that comprise the first mandal (circular cyclical eternal structure) of the Rik Ved, which in turn gives rise to the rest of the Ved and the entire Vedic literature. ...".

Note that

- the first richa of the first sukt has 24 syllables plus 24 gaps (if you include a silent gap at the beginning/end to close the first sukt into a circle) and
- those 24 gaps are made relevant by being elaborated by the following 8 richas of the first sukt, which have 192 syllables

so that **the total number of relevant entities in the first sukt is 24+24+192 = 240**, which is the number of vertices of



the root vector polytope of the E8 Lie algebra.

Since the E8 Lie algebra has rank 8, it has dimension 240+8 = 248, and the 2^8 = 256-dimensional real Clifford algebra Cl(8) (or Cl(1,7) if you pay attention to signature) can be constructed as

Cl(8) = E8 + 8-dimensional vector space.

Therefore:

The first Sukta of the Rig Veda - 1 Madala, 1 Astaka, 1 Adhyaya, Sukta 1:

ॐ अग्निमीळे पुरोहितं यज्ञस्य देवमृत्विजम् । होतारं रत्नधातमम् ॥ 1 ॥
अग्निः पूर्वेभिर्ऋषिभिरीड्यो नूतनैरुत । स देवाँ एह वक्षति ॥ 2 ॥
अग्निना रयिमश्नवत्पोषमेव दिवेदिवे । यशसं वीरवत्तमम् ॥ 3 ॥
अग्ने यं यज्ञमध्वरं विश्वतः परिभूरसि । स इद्देवेषु गच्छति ॥ 4 ॥
अग्निर्होता कविक्रतुः सत्यश्चित्रश्रवस्तमः । देवो देवेभिरा गमत् ॥ 5 ॥
यदङ्ग दाशुषे त्वमग्ने भद्रं करिष्यसि । तवेत्तत्सत्यमङ्गिरः ॥ 6 ॥
उप त्वाग्ने दिवेदिवे दोषावस्तर्धिया वयम् । नमो भरन्त एमसि ॥ 7 ॥
राजन्तमध्वराणां गोपामृतस्य दीदिविम् । वर्धमानं स्वे दमे ॥ 8 ॥
स नः पितेव सूनवेऽग्ने सूपायनो भव । सचस्वा नः स्वस्तये ॥ 9 ॥

contains the structure of both:

the D4-D5-E6-E7-E8 VoDou Physics model; and

the 256-element structure of IFA = VoDou.

In my opinion, the Rig Veda may be the earliest reduction to writing of the original African-based orally transmitted early global wisdom of IFA = VoDou, and, as the earliest, it may be the most nearly complete written description of that wisdom.

Here are some further comments on the Rig Veda:

```
Although current written versions of the Rig-Veda are
written in Sanskrit or later languages, the earlier
versions were transmitted orally.
Perhaps the first versions were in the Global Early Language,
or its earliest variant in the Indian region,
the Sarasvati-Sindhu language.

As Feuerstein, Kak, and Frawley have noted in their book
In Search of the Cradle of Civilization (Quest 1995),
the Rig-Veda mentions star patterns of 9,000 to 8,000 years ago,
so the Rig-Veda is of that age.
Other things they discuss include:

     The Rig-Veda has about 250 hymns to Indra.
     Indra’s Net is a net with a jewel at each intersection,
     each jewel reflecting all the other jewels of the net.
     Indra’s Net is a symbol of the internet,
     and can symbolize other interconnected systems,
     even Many-Worlds of lattice spacetime.

     As the being whose thunderbolts reveal the light of the sun
```

and release waters to flow to the ocean,
Indra could symbolize the Vela X supernova.

The Rig-Veda has about 100 hymns to Soma,
who has the nectar of immortality, also called soma.
The soma nectar is used to stimulate visions.
As it is produced by pressing and filtering the soma plant,
so the Rig-Veda describes the yoga practice of
purification of the mind by three filters,
so that higher-level truth can be perceived.

About one-fourth of the verses in the Rig-Veda
are in the gayatri meter:
3 sections of 8 syllables each;
the first 4 syllables free and the last 4 in fixed cadence.

To me - with respect to physics -
each of the 3 sections represents
one of the three 8-dimensional representations of Spin(8),
and the fixing of the last 4 syllables
of the section representing 8-dimensional spacetime
represents dimensional reduction to 4-dimensional spacetime.
In that way,
I see the music of the Rig-Veda reflecting fundamental physics.

The gayatri meter is named from the mantra
in 3 Madala, 3 Astaka, 4 Adhyaya, Sukta 62, Richa 10:
tat savitur varenyam,
bhargo devasya dhimahi,
dhiyo yo nah pracodayat.

तत् सवितुर् वरेण्यं
भर्गो देवस्य धीमहि
धियो यो नः प्रचोदयात् ॥

(English:
Behold the beautiful splendor of Savitri -
the Sun-God of the swastika -
to inspire our visions.)

According to a hindubooks riverheaven web site, David Frawley said:

"... The Rig Veda is the book of Mantra. It contains the oldest form of all the Sanskrit mantras. It is built around a science of sound which comprehends the meaning and power of each letter. Most aspects of Vedic science like the practice of yoga, meditation, mantra and Ayurveda can be found in the Rig Veda and still use many terms that come from it. ... While originally several different versions or rescensions of the Rig Veda were said to exist, only one remains. Its form has been structured in several different ways to guarantee its authenticity and proper preservation through time.

The Rig Veda consists of the hymns to various aspects of the Divine as seen by various seers, called the "rishis". There are seven primary seers, identified not only in India but also in Persia and China with the seven stars of the Big Dipper. Their names are Atri, Kanwa, Vasishta, Vishwamitra, Jamadagni, Gotama and Bharadvaja, but they appear even in the hymns of these sages and may refer to an earlier group. They relate to the guiding lights of the seven chakras. The main family of the seers was called the Angirasas (a term related to the Greek Angelos and our English word angel). ...

... The Rig Veda is composed of ten books (called mandalas in Sanskrit). Seven of the books each relate primarily to one great seer and the family he belongs to;

- The first book is a collection of hymns from seers of different families, mainly earlier ones.

- the second book belongs to Gritsamada and his family, the Bhrigus;
- the third relates to Vishwamitra and his family;
- the fourth to Vamadeva and the Gotama family;
- the fifth to Atri and his family;
- the sixth to Bharadvaja and his family;
- the seventh to Vasishta and his family; and
- the eighth to the Kanwas.

- The ninth book is the collection of Soma hymns mainly from the Bhrigus and Angirasas. It is largely outside of and earlier than the family books.

- The tenth book is a collection of various earlier and later hymns.

[As John Small said in e-mail: "... The first encapsulates the whole thing, the Tenth complements the first and "fills in the gaps" ... in the first, the remaining 8 form a sequence that is the expansion of the 8 fundamental forms displayed in the first sukta. ...". It is interesting that the central 8 correspond to the 7 seers plus 1 about Soma, similar to the 8 octonions corresponding to the 7 imaginary octonions plus 1 real octonion. The term "fills in the gaps" might mean that the tenth book explains the silent spaces between spoken/written syllables in the first book.]

Each hymn is given to a certain deity (devata). The main deities are Indra, Agni, Soma and Surya. ... each of the Gods has his consort, like Indra and Indrani, Varuna and Varunani. ....

- Indra is the God of Prana or the awakened life-force. ...
- Agni is the God of consciousness, awareness and mindfulness. His symbol is the sacred fire. ...
- Soma is the mystic plant that yields the nectar of immortality. He is also the Moon and the lord of the waters. He symbolizes bliss, Ananda.
- Surya is the Sun which is the visible face and presence of the Deity. He symbolizes the enlightened mind and creative intelligence. He is the Divine creator and transformer.
- Varuna, the lord of the cosmic ocean and the Divine judge;
- Mitra the Divine friend and lord of compassion and
- Savitar, the Sun God of creative intelligence. ...
- Usha, the Goddess of the Dawn or spiritual aspiration;
- Saraswati, the Goddess of the Divine Word, of wisdom and inspiration;
- Aditi the Goddess of Infinite Oneness and Wholeness; ...
- Apas, the Cosmic Waters. ....
- Brahma ... the creator ... is Brihaspati, also called Brahmanaspati, the priest of the Gods.
- Vishnu ... the maintainer ... is an important form of the Sun God and later all forms of the Sun God were merged into him. [Avatars of Vishnu include Rama and Krishna]
- Shiva ... the destroyer ... is present as Rudra, the seldom invoked but very much respected and feared father of all the Gods. [Ganesha is a son of Shiva] ...

... Collective deities exist like the Adityas, the solar deities, the Maruts or Rudras, Gods of the storm, the Ribhus or Divine craftsmen and the Vishvedevas, literally the universal Gods who symbolize the unity of all the Gods. ... Each God or Goddess can be any or all the Gods. The concepts of monotheism, polytheism, pantheism and monism are all woven together in the Vedic vision of totality. The Divine is seen as both One and Many without contraction. ...".

Feuerstein, Kak, and Frawley, in their book In Search of the Cradle of Civilization (Quest 1995) also say:

> "... Vedic cosmology evolved in conjunction with a complex system of sacrificial ritualism. ... the rituals are not to be done mechanically but with full attention and proper control of body, mind, speech, and breath. In other words, the constitute a form of yogic practice. ...
>
> ... The Vedic rituals were generally performed at an altar .... meant to symbolize the universe at large ... the fire altars were surrounded by 360 enclosing stones; of these, 21 ...[corresponded to]... the earth ... , 78 ...[to]... the atmosphere ... , and 261 ...[to]... the sky ... the two principal cosmological numbers were 21 and 339 (78+261) ...
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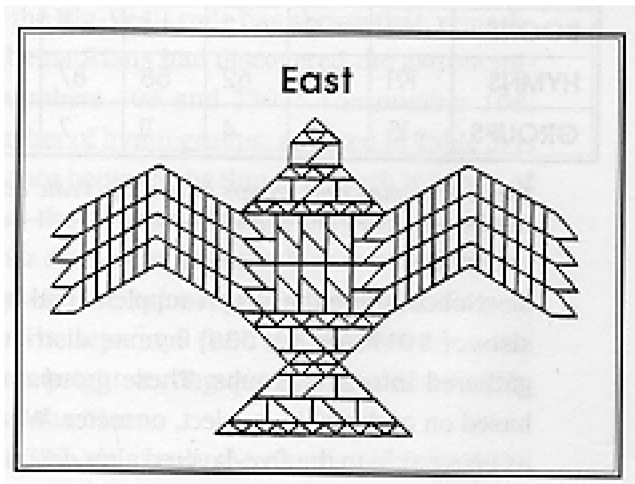
> 
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>
> FIG. 42. *Bird variant of the Vedic fire altar.*
>
> .. the Rig-Veda ... was itself taken to represent a symbolic altar. Thus the number of syllables in the Rig-Veda is supposed to add up to the number of muhurtas (1 day = 30 muhurtas) in forty years, which is 432,000. ... In reality, however, the syllable count of the Rig-Veda is somewhat less ... 397,265 ... [compare the Torah] because certain syllables are meant to be left unspoken. ...
>
> ... Not counting the eleven supplemental hymns, the Rig-Veda consists of 1017 (or 3x339) hymns distributed over 10 books and gathered into 216 groups. ...

Books	Hymns	Groups
1	191	15
2	43	5
3	62	4
4	58	11

5	87	7
6	75	5
7	104	12
8	92	18
9	114	7
10	191	132

... These groups are the natural divisions based on authorship, subject, or meter. ...

- ... the first four books contain 354 hymns, which correspond to the length of the lunar year ...
- ... the total number of hymns in the middle four books ... is 324, which equals the nakshatra (constellation) year of 12x27 days. When this is multiplied by a close approximation of pi, we arrive at 1017, which corresponds to the number of hymns in the entire Rig-Vedic collection (excludng eleven supplemental hymns). ...
- ... The number 108, which is one-half the number of hymn groups, ... is roughly the average distance between the Sun and the Earth in terms of solar diameters. It is also the average distance between the Moon and Earth in terms of lunar diameters. ... For example, if a pole of a certain height were to be separated from the observer by a distance that is 108 times this height, its angular size would be ... equal to that of the Sun or the Moon. ... 108 beads are used in Hindu rosaries ...
- ... 339 ... is simply the number of solar disks it takes to measure the Sun’s path across the sky during equinox: pi x 108 = circa 339. ...
- ... the actual - rather than the idea - Vedic year was reckoned as consisting of 366 days ... divided into two equal parts of 183 days ... the ancients sought to reconcile the 339 steps of the Sun with th symbolic value of 183 ... by postulating a value of 78 for the atmosphere, since 339 - 183 + 2x78 ...
- the Rig-Veda speaks of the thirty-four "lights", which are the twenty-seven lunar constellations ... ... , the five planets, and the Sun and the Moon. ...
- ... a tithi was reckoned as a 360th part of the lunar year ... somewhat shorter than a day ... There are 371 tithis in a year of 365 plus days, and when we multiply ... by 9 we arrive at 3339 ... the total number of deities given in the Rig-Veda ...

... the sacred syllable om ... is said to be the quintessence of the Vedas ... The syllable om is not mentioned in the Rig-Veda, possibly because it was deemed too sacred to be spoken out loud [compare the Torah, in which the name of g-d is not to be written completely; and the Taoist Dao De Ching] ... In one Rig-Vedic hymn (I.164.39) ... we may have an oblique reference to the sacred syllable om. ... also, no graphic representation of om has so far been found in the excavated Indus towns ... om is first named or written out ...

> ... in such Vedic scriptures as the Shukla-Yjur-Veda. ...".

Note that Maharishi says that the first Mandal of the Rig-Veda has 192 Suktas, while Feuerstein, Kak, and Frawley say that it (the first book) has 191 hymns (Suktas).

John Small told me by e-mail that

> Maharishi considers the 192nd Sukta to be "... the "Avyukta Sukta", it means the "empty sukta" and it's just a complete absence of any sound at all. It complements the first sukta, and with it in place you can line up the first mandala in a circle with each sukta matching up to another diametrically opposite in the circle. .... The Avyukta Sukta ... In Maharishi's scheme ... there are two processes in operation, one the collapse from fullness to emptyness and then the expansion from emptyness back to fullness. ... in terms of Goedel's Theorems, any formal system that is complete must be inconsistent, that is it must contain a statement that negates the system itself ...".

To see how the cycle of 192 Suktas in the first Mandal, start with a given system T. Then as you process that system you will find a Godelian undecidable thing A

and then Maharishi's Avyukta (= avyakta = unmanifest) Sukta is used to make T "more complete" by adding A (true and false) as new propositions to make it a "pair" of possible systems like a quantum superposition of two possible worlds of the Many-Worlds:

S = T + Atrue combined with T + Afalse

and then, you start again with the system S and process it again to find a new Godelian undecidable thing B - this is a second collapse "collapse" - and then expand again with Avyukta Sukta to get a "newer bigger"

R = S + Btrue combined with S + Bfalse

giving you twice again as many possible quantum worlds, and you continue the process ad infinitum

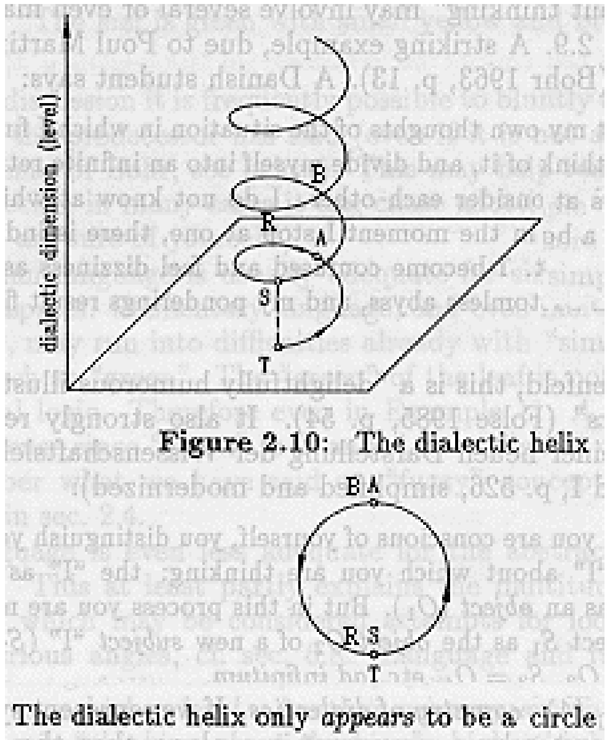


Figure 2.10: The dialectic helix

The dialectic helix only *appears* to be a circle

Each half-cycle T to A, S to B, etc ... , corresponds to the first 191 Suktas of the first Mandal of the Rig Veda.

Each half-cycle A to S, B to R, etc ... , corresponds to to the 192nd empty = soundless Avyukta Sukta, which constructs the helix covering the closed circle of the first Mandala .

Each cycle T to S, S to R, etc ... , corresponds to introducing new branches

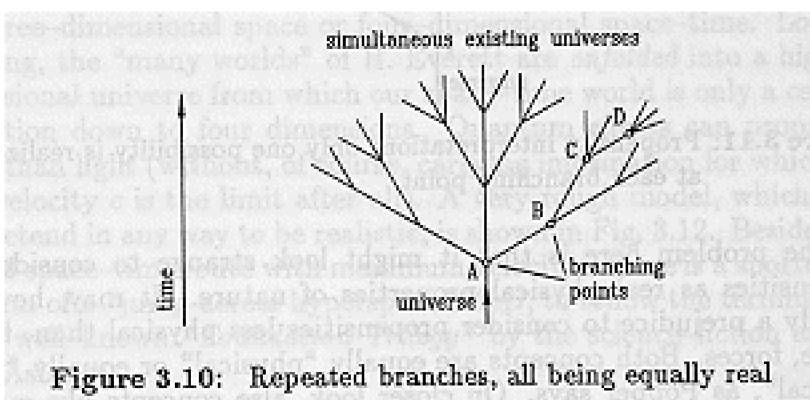
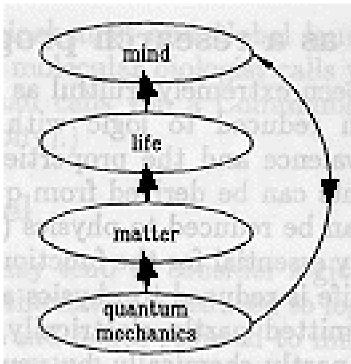


Figure 3.10: Repeated branches, all being equally real

in the possible quantum worlds of the [Many-Worlds Quantum Theory](#).

The "whole Veda" is therefore nothing that you can ever write down in any finite number of steps, but is an infinitely branched Many-Worlds Tree of Helical Coils, with its Total Sound being OM, which is therefore, as John Small says, "... The OM sound is the sound of the whole of the Veda from a distance ... like listening to a bee hive from a distance. Then as you get close you can distinguish the individual sounds themselves until finally you can experience each separate bit quite clearly. ...".

The process of a human trying to "tune in" to part of the "whole Veda"



is a self-referential loop involving the Quantum Consciousness of the human brain.

(The above three images, and some related ideas, are derived from the book Science, Mind and the Universe by Helmut Moritz (Wichmann 1995))

Graham Hancock, in Underworld (Crown 2002), says:

> "... In order to ensure that the Vedas can be repromulgated for future mankind after each pralaya ... destruction and rebirth [as by floods at the end of an Ice Age about 11,600 years ago]... the gods have ... designed an institution to preserve them ... the Seven Sages ... Sapta Rishis ... a brotherhood of adepts ... who reincarnate from age to age as the guides of civilization and the guardians of cosmic justice. ..[They] survive[d] the deluge in the Ark with Manu ... According to Bal Ganghadar Tilak: The Vedas were destroyed in the deluge ... the Sages ... reproduced ... the antediluvian Vedas ...
>
> ... Seven Sages in both the Sumerian and Vedic traditions ...[have]... similarities ...
>
> - Both groups are associated with fish symbolism of some sort - the Seven Sages of Sumer are themselves half men, half fish, and the Vedic Seven Sages take refuge on Manu's survival ship, which is towed by a gigantic fish ...
> - Both groups of sages perform an identical function - which is to preserve the gifts of civilization and bring them to mankind in their respective areas. ...
>
> ... The Rig Veda conjures up a compelling image of a demon in the form of a great dragon, or serpent, that has wrapped itself around the ice-covered mountain ranges ... and strangled

seven great rivers. The name of the demon is sometimes Ahi but more often Vrta and the story of how he is slain by the god Indra and of how the seven rivers are freed, is repeated again and again in the hymns of the Rig Veda [compare the Chinese Jade Emperor Yu Di of about 4,200 years ago]...".

Vedic Music

(compare Torah Music and IFA Music)

According to a Sanathana Dharma web page:

".... According to the Hindu view of creation, **it was sound and not light that appeared first. In Vedic parlance it is called Nada Brahma or the Sound Celestial**. Vedic rishis believed that the evolution of the Brahmand or universe was caused as a result of Bindu Vsphot or an atomic explosion, that produced infinite waves of sound, which represent cosmic ascent and expansion.

The sound was a monosyllable: Om. Since **Om is related to the beginning of the universe**, Hindus consider it the most sacred syllable with which Vedic mantras commence. Om is the principal name of the Supreme Being. It refers to all that it manifest and beyond. ...

According to Vedic literature music originated from nada or sound, which is the product of akash or ether: There are two types of sound. The ahat or struck sound is audible whereas the anahata or unstruck sound is inaudible. Sound originates in living beings from the friction between air æpran vayu or vital breath and agni or heat energy (will power). It evolves first in a causal forms as anahata and then in the gross form of sound emanates from the vocal chord and is sweet and soothing, it is called snageetam or music. The anahata nada is most significant for yogis who have reached the highest level of consciousness. It is the internal sound they hear, after prolonged meditation and ardous yogic discipline. Ordinary human beings are engaged with the ahat nada.

Indian musical traditions trace the origin of music to the Sama Veda. It is a compendium of melodies, chants and rules required for the recitation of sacred hymns. It serves as a textbook for priests officiating at Soma sacrifices. ... Vedic chants are set in a musical pattern, collectively known as Samgan. To this day, the chants are in three accented musical patterns called swaras, precursor of the present seven-note musical system. ...".

According to an Indian Classical Music web page:

"... Though, Vedas are considered the source of Indian Music, it should not be assumed that classical music in its present form was fully developed by then. Infact, concept of Raga, Tala, Shruti or even Nava Rasas come only later.

All except SamaVeda were sung using only three notes, Anudaatta (low), Udaatta(middle) and Svarita(high). As used today the Anudaatta, Udaatta and Svarita svaras of RigVeda, can be equated with Ni, Sa, and Ri of the North Indian Kafi scale (Kharaharapriya of the Carnatic). In early manuscrpts of RigVeda, the text was written along with accent notes. Anudaatta is marked with an underline and Svarita is marked with a small vertical line above the syllable. Udaatta is left unmarked.

Sama Veda consists of about 1900 verses, called samans. **Ninety-five percent of the verses of Sama Veda Samhita are in Rig Veda Samhita**. One can see from the text of the Sama Veda mantra that the chanting notation in it is much more elaborate than that in the corresponding Rig Veda mantra. **SamaVeda was chanted using all seven notes** (prathama, dvitheeya, tritheeya, chathurtha, panchama, shashta and sapthama), in descending order, of the Vaidika scale (or of sama gana) which have been equated to (Ma,Ga,Ri,Sa,Dha,Ni,Pa) of the Laukika or Gandhara scale in later classical sanskrit texts like NaradiyaShiksha.

RigVedic hymns are directed at Gods, to be chanted during sacrifices to please them. It is possible Gods were thought to be fond of music and that it would be easier to please them if the hymns were sung rather than just chanted. Thus, many of the Rig Vedic hymns were set to music and sung and were known as samans, rather than just hymns (Rik). The chanted Sama-Veda hymns or Samans were believed to possess the supernatural qualities capable of petitioning and even supporting the deities that controlled the forces of the universe. **Since Rig Vedic hymns are just metered they could not be sung using all the seven notes. Thus started a tradition of insertion of a number of seemingly ‘meaningless’ words or syllables** (stobha) for musical and lyrical effect, such as o, hau, hoyi, va, etc. It was these stobha syllables which were extended vocally with long duration on various notes of the Sama-Veda scale by the priests who had the special function of summoning the gods to the celebration through the use of droning (monotone) on a number of these tones, believing them to hold magical properties. The wife of the chief sacrificer (i.e. chief priest, brahmana) would play the Vina, during sacrifices.

Precise methods of singing the Samans were established and preserved in three different schools, the Kauthumas, Ranayaniyas, and the Jaiminiyas, the oldest. Each has maintained a distinct style with regard to vowel prolongation, interpolation and repetition of stobha, meter, phonetics, and the number of notes in scales. Accordingly, there has been a fervent regard for maintaining continuity in Sama-Veda singing to avoid misuse or modification over many years. **Since written texts were not in use, in fact prohibited, the priests memorized the chants with the aid of accents and melodies, and passed this tradition down orally from one generation to the next for over three thousand years** ...".

According to a Music of South India web site:

"... Indian Music is probably the most complex musical system in the world with a very highly developed melodic and rhythmic structure. This (structure) includes complicated poly-rhythms, delicate nuances, ornamentations and microtones which are essential characteristics of Indian music. This makes it very difficult to notate every detail in Indian music.

Originally Indian music was passed on by oral tradition ... from one generation to another for centuries. The music was never written down until much later. The notation system was actually developed much later more as a memory-aid than something from which to learn or something from which to perform. This is why the tradition wherein the student learns from a Guru on a "one-on-one" basis is considered to be the only real way to learn music since there are so many aspects that cannot be learned from a book because the existing notations are only a skeletal representation of the music.

Indian Music had its origins in the Vedas ... Four in number, the Vedas are the most sacred texts which contain about a thousand hymns. They were used to preserve a body of poetry, invocations and mythology in the form of sacrificial chants dedicated to the Gods. Great care was taken to preserve the text, which was passed down by oral tradition, so much so that both the text and the rituals remain unchanged to this day. The literature of the Vedas is divided into four parts: the Rig Veda, the Sama Veda, the Yajur Veda and the Atharva Veda.

- The oldest, the Rig, ... was recited, at first, in a monotone; it was later developed to three tones (one main tone, and two accents, one higher and the other lower called Udatta and Anudatta respectively.) This was done to accentuate the words since the text was of primary importance.
- The Yajur Veda which mainly consists of sacrificial formulas mentions the Veena as an accompaniment to vocal recitations during the sacrifices. By this time, the chants had evolved to two main notes with two accents forming the first concept of

the tetrachord (four notes.)

- The Sama Veda laid the foundation for Indian Music. The origin of Indian Music can be traced back to this Veda. Three more notes were added to the original tetrachord resulting in the first full scale of seven notes; within this scale were all the important and known musical intervals. The concept of the octave is also mentioned here.
- The Atharva Veda was a collection of formulas that deal with ... spells. The text of the Vedas is in Sanskrit, the classical language of India.

... The period of the Epics, the Ramayana and the Mahabharata (500 B.C. - 200 A.D.) saw the development of the Jati system on which the modern Raga system is based. Also, various melodic and percussion instruments are mentioned during this time. Mention must be made of the Natyashastra, a treatise written by Bharata in 300 B.C. It is the most authoritative and ancient work on the classical science of music and dance. ...".

According to a Performing Arts in India web page:

"... Love, humor, pathos, anger, heroism, terror, disgust, wonder and serenity are the nava rasas or nine basic emotions which are fundamental to all Indian aesthetics. Sage Bharata, the earliest Indian musicologist said to have lived in the 1st or 2nd century AD, enunciated these moods and believed that it was the musician's task to evoke a particular emotion or mood. The classical music tradition in India is based on the principles enunciated by sage Bharata and continues to be a form of meditation, concentration and worship.

The Raga, or musical mode, forms the basis of the entire musical event. The Raga is essentially an aesthetic rendering of the seven musical notes and each Raga is said to have a specific flavor and mood.

Tala is what binds music together. It is essentially a fixed time cycle for each rendition and repeats itself after completion of each cycle. Tala makes possible a lot of improvisations between beats and allows complex variations between each cycle.

With the help of the Raga, Tala and the infinite shrutis or microtones, Indian musicians create a variety of feelings. ...".

According to an India Music web page:

"... Vedic Hymns ... are considered the foundation of later styles (like Gregorian chants) ... Physical vibrations of musical sound (nada) is connected to spiritual world ...

... Raga and Tala form the basis of Indian music. ...

- ... Raga (rag in North, ragam in Tamil) ... a scalar melody form including basic scale and basic melodic structure. Sanskrit ranj means to color with emotion Scale of raga is shown in both ascending and descending form. Some raga include notes changing directions Some notes may have specific ornamentation (gamaka) Ground tone (beginning tone) is sa (like do in do re mi) Sa is most important note of the drone ... Later ... **72 possible combinations** [compare 72 root vector elements of E6] ...
- ... Tala = cyclic measure of time (rhythm) [compare toque of IFA] Laya = tempo (fast or slow) Druta = fast Madhya = medium Vilambita = slow Matra (Hindustani) or Akshara (Karnatak) = basic beat (like metronome) **Tala cycle (Vibhaga or avarta) &endash; varies from 3 to 128 beats** in length; 7-16 are common ...". [compare 3 quaternion imaginaries and 3-sphere, 7 octonion imaginaries, 16 spinors of Cl(8) and 16 eyes of FA, and 128 elements of the even Clifford subalgebra Cl(8)e]

Sanskrit and Information

According to Knowledge Representation in Sanskrit and Artificial Intelligence, by Rick Briggs:

"... there is a widespread belief that natural languages arc unsuitable for th transmission of many ideas that artificial languages can render with great precision and mathematical rigor. ... But ... There is at least one language, Sanskrit, which for the duration of almost 1000 years was a living spoken language with a considerable literature of its own Besides works of literary value, there was a long philosophical and grammatical tradition that has continued to exist with undiminished vigor until the present century. Among the accomplishments of the grammarians can be reckoned **a method for paraphrasing Sanskrit in a manner that is identical not only in essence but in form with current work in Artificial Intelligence** This article demonstrates that a natural language can serve as an artificial language also, and that much work in AI has been reinventing a wheel millenia old ...

... hierarchical structure ... and ... explicit descriptions of set-relations are essential to really capture ... meaning ... and to facilitate inference. It is believed by most in the AI and general linguistic.community that natural languages do not make such seemingly trivial hierarchies explicit. Below is a description of a natural language, Shastric Sanskrit, where for the past millenia successful attempts have been made to encode such information. The sentence:

> (1) "Caitra goes to the village." (graamam gacchati caitra)

receives in the analysis given by an eighteenth-century Sanskrit Grammarian from Maharashtra, India, the following paraphrase:

> (2) "There is an activity which leads to a connection-activity which has as Agent no one other than Caitra, specified by singularity, [which] is taking place in the present and which has as Object something not different from 'village'."

The author, Nagesha, is one of a group of three or four prominent theoreticians who stand at the end of a long tradition of investigation. Its beginnings date to the middle of the first millennium B.C. when the morphology and phonological structure of the language, as well as the framework for its syntactic description were codified by Panini. His successors elucidated the brief, algebraic formulations that he had used as grammatical rules and where possible tried to improve upon them. A great deal of fervent grammatical research took place between the fourth century B.C and the fourth century A.D. and culminated in the seminal work, the Vakyapadiya by Bhartrhari. Little was done subsequently to advance the study of syntax, until the so-called "New Grammarian" school appeared in the early part of the sixteenth century with the publication of Bhattoji Dikshita's Vaiyakarana› bhusanasara and its commentary by his relative Kaundabhatta, who worked from Benares. Nagesha (1730-1810) was responsible for a major work, the Vaiyakaranasiddhantamanjusa, or Treasury of definitive statements of grammarians, which was condensed later into the earlier described work. These books have not yet been translated. The reasoning of these authors is couched in a style of language that had been developed especially to formulate logical relations with scientific precision. It is a terse, very condensed form of Sanskrit, which paradoxically at times becomes so abstruse that a commentary is necessary to clarify it. One of the main differences between the Indian approach to language analysis and that of most of the current linguistic theories is that the analysis of the sentence was not based on a noun-phrase model with its attending binary parsing technique but instead on a conception that viewed the sentence as springing from the semantic message that the speaker wished to convey. In its origins, sentence description was phrased in terms of a generative model: From a number of primitive syntactic categories (verbal action, agents, object, etc.) the structure of the sentence was derived so that every word of a sentence could be referred back to the syntactic input categories. ... It should be pointed out that these Sanskrit Grammatical Scientists actually wrote and talked this way. The domain for this type of language was the equivalent of today's technical journals. In their ancient journals and in verbal communication with each other they used this specific, unambiguous form of Sanskrit in a remarkably concise way. ... it would seem that detailed analyses of sentences and discourse units had just received a great impetus from Nagesha, when history intervened: The British conquered India and brought with them new ... means for studying and analyzing languages. The subsequent introduction of Western methods of language analysis ... has for a long time acted as an impediment to further research along the traditional ways. Lately, however, serious and responsible research into Indian semantics has been resumed, especially at the University of Poona, India. ...

... **the main point in which the two lines of thought [AI computer language and Sanskrit] have converged is that the decomposition of each prose sentence into karaka-representations of action and focal verbal-action, yields the same set of triples as those which result from the decomposition of a semantic net into nodes, arcs, and labels.**

It is interesting to speculate as to why the Indians found it worthwhile to pursue studies into unambiguous coding of natural language into semantic elements. It is tempting to think of them as computer scientists without the hardware, but a possible explanation is that a search for clear, unambiguous understanding is inherent in the human being. Let us not forget that among the great accomplishments of the Indian thinkers were the invention of zero, and of the binary number system a thousand years before the West re-invented them. ...".

Tony Smith's Home Page

......

3s 7p 3w 5c 10p

4w 6c 6w 5w 10w

2w 4c 8w 3c 10s

2c 2p 8p 8c Fo

2s 4p 8s 7c Hr

4s 6p 6s 5s Em

7s 3p 7w 5p Pr

Pc Pp Pw Ps Es

Ac Jc Qc Kc Ap Jp Qp Kp Aw Jw Qw Kw As Js Qs Ks

Dv

St Wh Jt Mg Wo Lv Ch Ht Mo Sr Tm Js Su HM Dt Tw

Africa

Moses and Tharbis - Solomon and Sheba - Jesus and Mary Magdalene

Here I use Africa to refer to Abyssinia, Eritrea, Ethiopia, Axum, Yemen, and other nations / cultures of the Nile / African Rift / Sahara-SubSahra region. Some, such as Yemen, may not even be on what is now conventionally defined as the continent of Africa, but my use is based on my cultural / historical perspective. Unless a more restricted meaning is clear from context, as used herein, any and all such terms are to be regarded as interchangeable synonyms for Africa.

Africa

According to a 21-27 August 2003 Al-Ahram article by Gamal Nkrumah:

> "... It is in Ethiopia that the story of the evolution of mankind began. The remains of the earliest ancestral humans or hominids have been found there. ...
>
> Two Ethiopian regions stand out as preeminent sites favoured for habitation by the early hominids - the Omo Valley in the southwestern part of the country, and the Afar or Danakil Depression. To this day, these remote and inhospitable regions remain largely cut off from the outside world. They form different parts of Africa's Great Rift Valley which runs from central Africa, through the eastern part of the continent, dissecting the Horn of Africa, dividing Arabia from Africa, marking out the outlines of the Sinai Peninsula, and ending somewhat unobtrusively with the Gulf of Aqaba and the River Jordan Valley.
>
> - ... the Omo Valley is a veritable Garden of Eden with a rich and luxuriant tropical flora and teaming with exotic fauna.
> - ... the Danakil Depression ... is a desolate and dreary desert, 100 metres below sea level and one of the hottest places on earth ...
>
> Remains of Australopithecus Afarensis, an early hominid dating as far back as four million years, have been found in an almost complete state in the Danakil Depression, which was not always the arid desert it is today. When the early hominids roamed the Afar region, it was a well-watered and wooded savanna country. In 1974 archaeologists excavating sites in the Awash River Valley discovered the skeletal remains of a female hominid whom they promptly named "Lucy" ... three-and-half-feet tall Lucy ... lived some 3.5 million years ago. ...
>
> ... Ethiopians ... (6200-3000 BC) ... began cultivating grains and crops ... The Early Bronze Age (3000 BC) witnessed the domestication of cattle ...
>
> ... The close proximity of the Ethiopian highlands to the Red Sea has always provided the main line of external communication.

[Culture, trade, and genes spread from the Ethiopian highlands

South along the Rift Valley, West along the SubSharan Corridor, East across the Red Sea to Yemen and beyond, and North along the Nile Valley to the Mediterranean and beyond. (image adapted from National Geographic Atlas website)]

> ... To ... Egyptians... Punt was the most ancient country, a sacred territory. Queen Hatshepsut in the 18th dynasty (1540-1304 BC) dispatched a diplomatic and trading mission to Punt ... Could ... Ethiopia be the Punt of the Egyptians? ... the sturdy tankwas, or papyrus canoes, that ply Lake Tana

[

(image from National Geographic Maps CD-ROM)

According to a January 2004 solomonstemple.com web page article by Bob Cornuke:

> "... Lake Tana, a body of water 53 miles long and 41 miles wide, [is] located on the headwaters of the Blue Nile. Isolated far out on the waters of Lake Tana is Tana Kirkos Island, considered by the Ethiopians to be a holy island, and populated only by Ethiopian Christian monks. The monks of Tana Kirkos believe they are living on the island where the Ark of the covenant rested, and where Levitical-style blood sacrifices were performed until 338 AD, when the nation of Ethiopia converted to

> Christianity ... the Ark itself was taken to Axum, where today it is kept in absolute isolation at St. Mary's of Zion Church. ...
>
> ... the Ark ...[is]... a gold box with two winged creatures on the top ... 24 smaller angelic-type figures form ... a molding around the top, with two green stones ... at either end ...".]

- the source of the Blue Nile - are curiously reminiscent of the Ancient Egyptian reed boats. ...

... Axum...[was]... a prosperous state which at its zenith stretched from Nubia to Yemen and Hejaz, and encompassed much of the Horn of Africa ... The Axumite empire's heartland was the highlands of northern Ethiopia and southern Eritrea. ...

... The history of Ancient Ethiopia cannot be separated from that of Ancient Yemen, whose recorded history stretches back over 3,000 years. ...

... settled agricultural communities were established in the Yemeni highlands by the third millennium BC. Urban centres soon developed supported by the surrounding farming countryside. Masonry flourished and monumental sculptures and massive stone architecture were erected. Sophisticated irrigation works were also constructed which attest to a high degree of material sophistication. States like Hadhramaut, Saba, with it capital Ma'rib, and later Himyar thrived as industrious mercantile nations that monopolised the spice and incense trade of the ancient world.

Successive civilisations of Mineans, Sabaeans and Himyarites interacted closely with their counterparts in Ethiopia ... due to geographical proximity, strong cultural and trading links developed between the most celebrated of Ancient Yemeni civilisations, Saba, and the peoples of Ethiopia. ... **Sheba, or the Kingdom of the South, could equally refer to either Yemen or Axum**. ...

... In Yemen, the Minaean Civilisation was absorbed or superseded by the celebrated **Sabaean Civilisation about 1000 BC**. Trade relations were revolutionised when the inhabitants of Arabia domesticated the dromedary, or one-humped camel, in the 11th century BC. ...

... The Sabaeans united southern Arabia into a single political entity by the third century BC. By **the time of the birth of Jesus Christ, they had expanded their empire to include Ethiopian lands across the Red Sea**. With Sabaean power waning in the fifth and sixth centuries AD, **their empire was conquered by the Ethiopians in 525**. The Sabaean civilisation endured for 14 centuries lasting from around 800 BC to 600 AD. And as Saba declined, Axum arose. ... With the rise of Islam **in the seventh century AD, Axum lost Yemen** ... and the once flourishing empire shrunk back to its **original core region of the northern Ethiopian highlands**. ...".

According to a sacredsites.com web page:

"... Axum began to decline in the early decades of the 7th century following the rise and rapid expansion of the Muslim Arabs throughout the Middle East. Both Byzantium and the Persian Empire fell to the Arabs and this dealt a deathblow to the trading endeavors of the Axumite kings. Little is known of what became of the Axumite kingdom between the 8th and 11th centuries.

Around the middle of **the 11th century the Ethiopian state reappeared as** the Christian Zagwe dynasty with its center in the town of Roha in the Amhara region of the Ethiopian highlands. The **Zagwe dynasty, ruled over by eleven kings, lasted until the 13th century, when its last king abdicated in favor of a descendant of the old Axumite dynasty**.

The most notable of the rulers of the Zagwe dynasty was **King Lalibela who reigned from 1167 to 1207.** ... According to legend, a dense cloud of bees surrounded the Prince Lalibela at the moment of his birth. His mother, claiming that the bees represented the soldiers who would one day serve her son, chose for him the name Lalibela, meaning "the bees recognize his sovereignty". ... The Ethiopian Orthodox church later canonized the King and changed the name of the city of Roha to Lalibela. ... **A brilliant achievement of his reign was the construction of a dozen beautiful rock-hewn churches.** ...

[]

... The churches of Lalibela are among the most extraordinary architectural creations of human civilization. Each church is sculpted, both inside and out, directly from the living bedrock of the earth (this type of architecture was not new to the area for there are numerous other examples around Ethiopia dating to earlier periods; the Zagwe constructions, however, took the art form to a new level). There are two basic types at Lalibela: rock-hewn cave churches which are cut inward from more or less vertical cliff faces and rock-hewn monolithic churches which imitate a built-up structure but are actually cut in one piece from the surrounding rock and separated from it by an encircling trench. ...".

Moses and Tharbis - ca 1500 BC

According to a hope-of-israel web page by William F. Dankenbring and John D. Keyser:

"... the Jewish historian **Josephus points out that ...[Moses]... had been a great general who led Pharaoh's army to victory over the kingdom of Ethiopia, which had conquered most of Egypt**. While attacking the Ethiopian capital city, **Tharbis, the daughter of the king of Ethiopia ... bargained to deliver the city into his hands if he would but marry her. ... Moses married her, and fulfilled the obligation of a husband to her, causing her to become pregnant** (Josephus, Antiquities, II, x). This occurred **sometime before 1532 B.C., when Moses was driven out of Egypt for slaying an Egyptian** (Exodus 2: 11-150.....".

According to the King James Bible (Numbers 12: 1, 3, 5, 6, 7, 8 and Deuteronomy 5: 1, 4, 5, 22):

"... Miriam and Aaron spake against **Moses** because of the Ethiopian woman whom he had married: for he **had married an Ethiopian woman**. ... the man **Moses was very meek,**

[In my opinion, **"meek"** as used here and elsewhere **(as in "The meek shall inherit the earth.") in the King James Bible means "patient and humble", NOT "submissive"**. Patience is needed to carry out long-range subtle sophisticated projects. Humility is needed so that Ego does not get in the way of acting in accord with the True Laws of Nature.]

> **above all the men which were upon the face of the earth** ... And the Lord came down in the pillar of the cloud, and ... said ... With ... My servant Moses ... will I speak mouth to mouth, even apparently, and not in dark speeches; and the similitude of the Lord shall he behold ...
>
> ... And Moses called all Israel, and said unto them ... The Lord talked with you face to face in the mount out of the midst of the fire, (I stood between the Lord and you at that time, to shew you the word of the Lord; for ye were afraid by reason of the fire, and went not up into the mount;) ... These words the Lord spake ... And he wrote them in two tables of stone, and delivered them unto me. ...".

Solomon and Sheba - ca 1000 BC

Since a person has 2^25 = 33,554,432 ancestors of the 25th degree, and the population of Africa at 1500 BC (25 20-year generations after 1500 BC) was far less than that, and assuming more or less random mating, an African (including Sheba) at the time of Solomon might well be a descendant of Moses and Tharbis.

According to a 21-27 August 2003 Al-Ahram article by Gamal Nkrumah:

> "... the Kebra Negast or Book of the Glory of Kings - from the Queen of Sheba to the rise of the Zagwe dynasty, is believed to be a 13th-century creation; its aim seems to have been to establish ... an Ethiopian king-list that traces the rulers of Ancient Axum to Menelik I (originally Bin Ha Malik, The King's Son), the son of the "Israelite" King Solomon and the "Ethiopian" Queen Makeda, the Queen of Sheba ... historians suggest that **King Solomon must have reigned around the 10th century BC**. ...".

According to the Kbre Nege'st in the book "The Kebra Nagast" edited by Gerald Hausman (St. Martin's Press, New York1997):

> "... **Solomon [said] ... to the Queen [of Sheba]: ... I saw many visions in a dream. The sun rose on Israel, but it went away and lighted up the country of Ethiopia**. So that country shall be blessed through you. ... Nine months aand five days ...[later]... the Queen ... brought forth a man-child [Solomon's firstborn] ... and she called him Bayna-Lehkem. ...[when]... he was twenty-two years old ... Bayna-Lehkem came through ...[the]... gate ... [of his father King Solomon]... when King Solomon sw his son he ... said, "Behold my father David has renewed his youth and has risen from the dead." Then he said to all of his court, "... He is David ...".
>
> ... Gabriel ... the Angel of Death ... said to ... Solomon ... "... Harken to what I say, for God has sent me. From being a wise man you have turned into a fool ... and all because you have broken the commandment of God. You held this lightly, thinking you were wiser than God and believing you would have many male children. Know that your Salvation was created in the belly of Adam. And it began in the form of a pearl before Eve. The pearl ... went forth from the belly of Adam into the belly of Seth. And then it ... came to Arbam. And it .. went into Isaac the pure ... into Jacob the humble ... into Judh, the innocent ... And ... it came to Fares the patient. And from him the pearl went to the firstborn until it came into the belly of Jesse, your grandfather. And then ... it went to the seventh, David, your innocent and humble father. Now the pearl of your salvation will pass through many generations until it will reach him who ... is crucified without sin and who rises without corruption. He who goes into Sheol and tears down its walls. ...
>
> ... **the pearl shall be carried in the belly of Rehoboam your [second-born] son, and shall be the savior of all the**

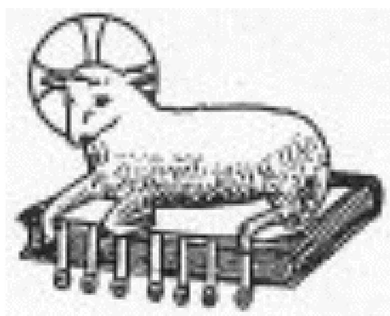
world. ...

... **Zion [the Ark of the Covenant], taken up by [David] your firstborn [son], shall be the salvation of the people of Ethiopia forever** ..."

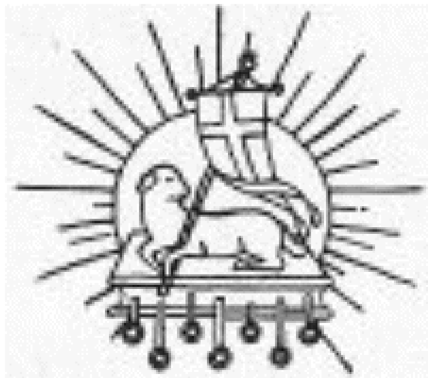
Jesus and Mary Magdalene - ca 0 AD/BC

Since a person has 2^25 = 33,554,432 ancestors of the 25th degree, and the population of Africa at 1000 BC (Jesus being 26 generations removed from David, and so 25 generations from Solomon) was far less than that, and assuming more or less random mating, an African (including Mary Magdalene) at the time of Jesus might well be a descendant of Solomon and Sheba.

The Lamb was the symbol of Christians until the Quinisext Synodi Council of Constantinople decreed in 692 AD that the image of Christ on the Cross should replace the Lamb. According to The Revelation of St. John the Divine (Chapters 5-22, King James Version):



"... I saw in the right hand of him that sat on the throne a book ... sealed with seven seals. ... And I beheld ... a Lamb as it had been slain, having seven horns and seven eyes, which are the seven spirits of God sent forth into all the earth. ... And he came and took the book ... the four beasts and four and twenty elders fell down before the Lamb ... saying, Thou art worthy to take the book, and to open the seals thereof; for thou wast slain, and hast redeemed us ... out of every kindred, and tongue, and people, and nation; ... and I heard the voice of many angels ... the number of them was 万 ten thousand times ten thousand, and thousands of thousands; ... And when ... the Lamb ... had opened the seventh seal ... I saw the seven angels ... and to them were given seven trumpets. And another angel came ... having a golden censer ... And another ... angel ... with ... a rainbow ... upon his head ... had in his hand a little book open ... And sware ... that there should be time no longer .... But ... when ... the seventh angel shall begin to sound, the mystery of God should be finished .... And the seventh angel sounded ... And I saw a new heaven and a new earth ...[and]... that great city, the holy Jerusalem ... the city was pure gold, like unto clear glass. ...[and] a pure river of water of life, clear as crystal ... and on either side of the river, was there the tree of life, which bare twelve manner of fruits, ... And the city had no need of the sun, neither of the moon, to shine in it: for ... the Lamb is the light thereof ...".



Blessed are the meek; for they shall inherit the earth.

(Beatitude from the Gospel According to St. Matthew 5:5 King James Version)

(Lamb images from a Three Lions Redempion web page of Doug Gray)

It is interesting that

up to age 12, Jesus was far from meek = patient and humble.

According to The Gospel of Infancy Thomas (as translated by Harold Attridge & Ronald F. Hock in the book The Complete Gospels, Harper Collins, ©1992):

> "... When ... Jesus, was five years old, he was playing at the ford of a rushing stream ... collecting the flowing water into ponds ... He then made soft clay and shaped it into twelve sparrows. He did this on the sabbath day ... So Joseph went there, and as soon as he spotted him he shouted, "Why are you doing what's not permitted on the sabbath?" ... Jesus simply clapped his hands and shouted to the sparrows: "Be off, fly away, and remember me, you who are now alive!" And the sparrows took off and flew away noisily. ...
>
> The son of Annas the scholar, standing there with Jesus, took a willow branch and drained the water Jesus had collected. Jesus ... became angry, saying to him, "Damn you, you irreverent fool! What harm did the ponds of water do to you? From this moment you, too, will dry up like a tree, and you'll never produce leaves or root or bear fruit." In an instant the boy had completely withered away. ...
>
> The parents of the boy who had withered away ... came to Joseph and accused him: "It's your fault - your boy did this." ...
>
> Later ... a boy ran and bumped him [Jesus] on the shoulder. Jesus got angry and said to him, "You won't continue your journey." And all of a sudden, he fell down and died. ...
>
> ... The parents of the dead boy came to Joseph and blamed him saying, "Because you have such a boy, you can't live with us in the village, or else teach him to bless and not curse. He's killing our children!" So Joseph summoned his child and admonished him in private, saying, "Why are you doing all this? These people are suffering and so they hate and harass us." Jesus said, "... those people must take their punishment." There and then his accusers became blind. ...
>
> ... Joseph ... got angry and grabbed his ear and pulled very hard. ...[Jesus]... became infuriated with him and replied, "... Don't you know that I don't really belong to you? Don't make me upset." ... A teacher by the name of Zacchaeus was listening to everything Jesus was saying to Joseph, and was astonished ... so he summoned Joseph and said to him, "You have a bright child, and he has a good mind. Hand him over to me so he can learn his letters. I'll teach him everything he needs to know so as not to be unruly." ... Jesus ... said to Zacchaeus, "... If you wish to be a perfect teacher, listen to me and I'll teach you a wisdom that no one else knows except for me and the one who sent me to you. It's you who happens to be my student ..." ....

... the teacher said to Joseph, "Bring him to the classroom and I'll teach him the alphabet." ... The teacher wrote the alphabet for him and began the instruction by repeating the letter alpha many times. But the child was quiet and did not answer him for a long time. ... the teacher got angry and struck him on the head. The child took the blow calmly and replied to him, "I'm teaching you rather than you're teaching me, and your condemnation is great. To you these letters are like a bronze pitcher or a clashing cymbal, which can't produce glory or wisdom because it's all just noise. ... Since you don't know the real nature of the letter alpha, how are you going to teach the letter beta? ... " he said to Zacchaeus, "Listen, teacher, and observe the arrangement of the first letter:

> How it has two straight lines or strokes proceeding to a point in the middle, gathered together, elevated, dancing, three-cornered, two-cornered, not antagonistic, of the same family, providing the alpha has lines of equal measure."

After Zacchaeus the teacher had heard the child expressing such intricate allegories regarding the first letter, he ... spoke ..."... I can't endure the severity of his look or his lucid speech. ... I strove to get a student, and I've been found to have a teacher. ... Therefore, I ask you, brother Joseph, take him back to your house. ..." ... [Jesus] ... laughed loudly and said, "Now let the infertile bear fruit and the blind see and the deaf in the understanding of their heart hear ..." ... When the child stopped speaking, all those who had fallen under the curse were instantly saved. And from then on no one dared to anger him for fear of being cursed and maimed for life.

A few days later Jesus was playing on the roof of a house when one of the children playing with him fell off the roof and died. When the other children saw what had happened, they fled, leaving Jesus standing all by himself. The parents of the dead child came and accused Jesus: "You troublemaker you, you're the one who threw him down." Jesus responded, "I didn't throw him down - he threw himself down. He just wasn't being careful and leaped down from the roof and died." Then Jesus himself leaped down from the roof and stood by the body of the child and shouted in a loud voice: "Zeno!" - that was his name - "Get up and tell me: Did I push you?" He got up immediately and said, "No, Lord, you didn't push me, you raised me up." ...

A few days later a young man was splitting wood in the neighborhood when his axe slipped and cut off the bottom of his foot. He was dying from the loss of blood. ... Jesus ... forced his way through the crowd and grabbed hold of the young man's wounded foot. It was instantly healed. He said to the youth, "Get up now, split your wood, and remember me." ...

... Joseph ... handed him over to another teacher. (2)The teacher said to Joseph, "First I'll teach him Greek, then Hebrew." This teacher, of course, knew of the child's previous experience (with a teacher) and was afraid of him. Still, he wrote out the alphabet and instructed him for quite a while, though Jesus was unresponsive. Then Jesus spoke: "If you're really a teacher, and if you know the letters well, tell me the meaning of the letter alpha, and I'll tell you the meaning of beta." The teacher became exasperated and hit him on the head. Jesus got angry and cursed him, and the teacher immediately lost consciousness and fell facedown on the ground. The Child returned to Joseph's house. But Joseph was upset and gave instruction to his mother: "Don't let him go outside, because those who annoy him end up dead." ...

... another teacher, a close friend of Joseph, said to Joseph, "... this child ... already he's full of grace and wisdom. So I'm asking you, brother, to take him back home." When the child heard this, he immediately smiled at him and said, "Because you have spoken and testified rightly, that other teacher who was struck down will be healed." And right away he was. Joseph took his child and went home. ...

... When he was twelve years old his parents went to Jerusalem, as usual, for the Passover festival, along with the their fellow travelers. After Passover they began the journey home. But while on their way, the child Jesus went back up to Jerusalem ... in the temple area, sitting among the teachers, listening to the law and asking them questions. ... And Jesus continued to excel in learning and gain respect. ...".

More details about twelve-year-old Jesus in the temple are given in The Arabic Gospel of the Infancy of the Saviour:

> "... when He was twelve years old, they took Him to Jerusalem to the feast. And when the feast was finished, they indeed returned; but the Lord Jesus remained in the temple among the teachers and elders and learned men of the sons of Israel, to whom He put various questions upon the sciences, and gave answers in His turn. ... And a philosopher who was there present, a skilful astronomer, asked the Lord Jesus whether He had studied astronomy. And the Lord Jesus answered him, and explained
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> - the number of the spheres, and of
> - the heavenly bodies, their natures and operations;
> - their opposition; their aspect, triangular, square, and sextile;
> - their course, direct and retrograde;
> - the twenty-fourths, and sixtieths of twenty-fourths; and other things beyond the reach of reason.
>
> There was also among those philosophers one very skilled in treating of natural science, and he asked the Lord Jesus whether He had studied medicine. And He, in reply, explained to him
>
> - physics and metaphysics, hyperphysics and hypophysics, the powers likewise and humours of the body, and the effects of the same; also
> - the number of members and bones, of veins, arteries, and nerves; also
> - the effect of heat and dryness, of cold and moisture, and what these give rise to;
> - what was the operation of the soul upon the body, and its perceptions and powers;
> - what was the operation of the faculty of speech, of anger, of desire; lastly,
> - their conjunction and disjunction, and other things beyond the reach of any created intellect. ...
>
> And from this day He began to hide His miracles and mysteries and secrets, and to give attention to the law, until He completed His thirtieth year, when His Father publicly declared Him at the Jordan by this voice sent down from heaven: This is my beloved Son, in whom I am well pleased; the Holy Spirit being present in the form of a white dove. ...".

What did Jesus do between the age of 12 and the age of 30?

According to the Acts of Yesu ("... Acts of Yesu became public in the Europe as the apocryphal book that Fr. Martin Corzeni, who worked in the Vatican archives for years, secretly removed from the library. After his terrible death in 1982, Acts of Yesu was discovered (by his landlord) among his possessions in a room where he sometimes boarded. He died from inhalation of a nerve toxin. ... The copy of Acts of Yesu available here is not the original that Fr. Corzeni brought into the light. This is an English translation of the original text, discovered in North western Pakistan in 1999. Translation was made by a female monk who specialize in ancient Persian language. What is remarkable is the slight differences between the English text in use by some groups and the ancient Corzeni copy in the original text. ...".):

> "... In Egypt the child, Yesu received education of reading and writing and he was reading and singing Holy Scripture ... when he was five years of age. When the seventh year of Yesu came to pass, he was moved with his mother to the schools of the Greeks of Alexandria to learn the tradition. When the 11th year of Yesu came to pass, he was moved with his mother to the Hebrew schools of Siphora in Galilee to learn the tradition. ...
>
> When Yesu was a young man and his year was fourteen he took the caravan up to the plains of Dash't and continued his schooling as his ministry began. ...

[According to a yesinet web page:

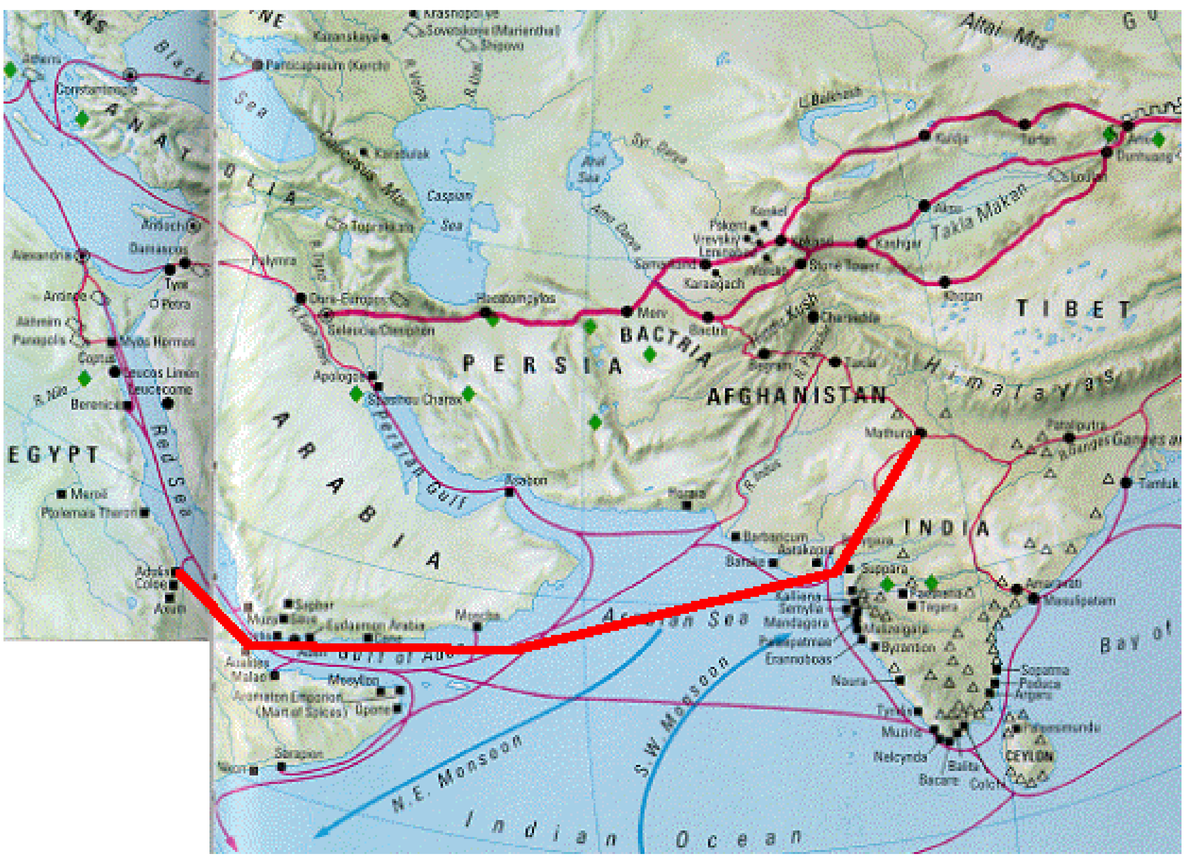
"... "It is not certain what route Jesus took on his journey to the East. Here is one possible itinerary via ancient roads and trade routes, reconstructed from Notovich, Abhedananda, and Roerich texts and legends: Jesus departed Jerusalem (follow the yellow line),

took the Silk Road to Bactra, headed south to Kabul, crossed the Punjab and proceeded to a Jain area on the Kathiawar peninsula where Jain temples were later built bear the town of Palitana. He crossed India to Juggernaut (Puri), made trips to Rajariha (Rajgir), Benares, and other holy cities and, fleeing his enemies went to Kapilavatsu--birthplace of Gautama Buddha. Jesus took a trail just west of Mt. Everest to Lhasa (where the palace of the Dalai Lama was built in the 17th century). On the return trip (follow the violet line), he took the caravan route to Leh, went south to the state of Rajputana and the north to Kabul. He proceeded on the southern trade route through Persia where Zoroastrian priests abandoned him to wild beasts. Jesus survived and arrived unharmed in Jerusalem." Map and text from The Lost Years of Jesus. ...".]

> ... In the Sistia it came to pass that Yesu mastered the art of affinity when the high priest of the temple planned to poison the Saviour. The priests crafted to tell Yesu the drinking of the poison was the test for mastery of the tradition; that Yesu may not leave before the test. ... And Yesu, led by the Spirit of the Mother, agreed to take the test on his final day before departing to India. ... And He drank the whole of the cup; and those priests and teachers who were vexed in evil toward the Saviour and his pupils and followers fell to the ground and died a horrible death for all to see their deceit. ...
>
> ... To Kashmiri ... The Saviour left that town by the East road, alone as he came into it. ... On the way to Kashmiri our Saviour entered by the valley ... On the way to Kashmiri our Saviour entered by the valley road and at the pass the man asked him for his name because the news of Yesu had not yet reached those areas. Yesu said to the gatekeeper, 'Nada, my older brother, I am returning home after many years. I desire to visit my family and to meet my younger sister which I know not.' ...
>
> ... Yesu took to the schools of the northern areas ... Jammu or Tibet ... when he was twenty four years; and mastered the art of self-control taught by those as the Way; and Yesu loved the Scriptures and meditated on the healings it wrought. ... prostitutes were brought in to the ashrama to sleep in the beds of the monks as the tradition was. For many months the monks disrobe and sleep naked by them without any issue before gaining success in self-control. The child brought in for Yesu was called **Magdalene, from an important family in the province where the Buddha was born in India**. ... The child told Yesu how she fell in lust with a girl from her town and how they were discovered in sexual embrace, and they were hauled before the town elders. **Her parents were disgraced and sold her to a brothel owner and told him to send her far away from there** but the other girl, from a poor house, was sent to work in the gold mines where she will surely die. ...

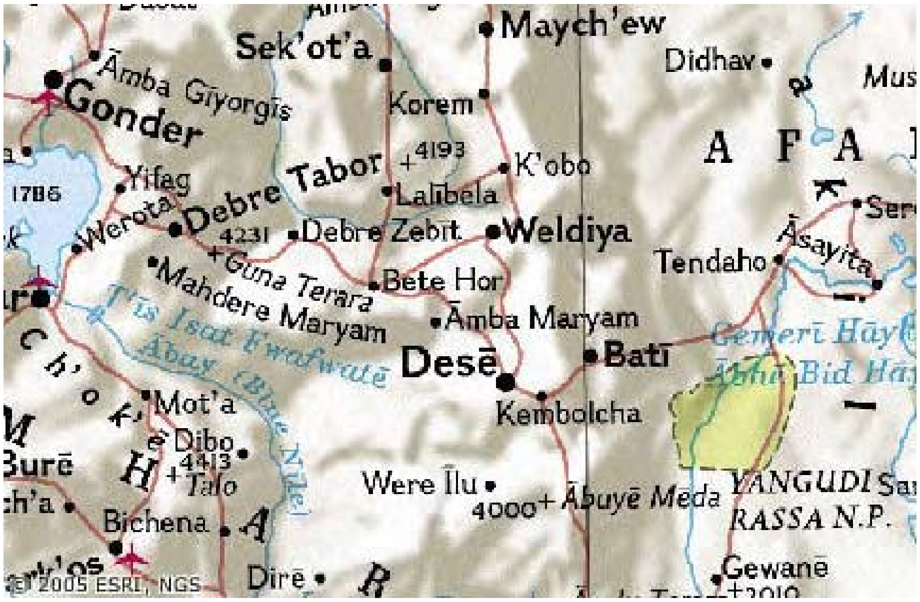
[My comment: The Acts of Yesu say that Mary Magdalene was from Kapilavastu, the birthplace of Gautama Buddha, and some say that Mary Magdalene was from a town called Magdala on the Sea of Galilee. However, I thnk that Tibet is too near Kapilavastu to be "far away from there", and I think that transportation links from the Sea of Galilee Magdala to Tibet are too convoluted for substantial slave trade. My opinion is that Mary Magdalene was from

the town of Magdala in Ethiopia (map from National Geographic Maps CD, Africa: Countries of the Nile, October 1963), as it is both "far away" from Tibet and accessible to Tibet by major trade routes of the first millenium BC: by land from Magdala to Massawa, by sea from Massawa to India near Astakapra, and by land from Astakapra to Mathura and then on through Kapilavatsu to the monastery in Tibet.



(map of major trade routs modified from Past Worlds, The Times Atlas of Archaeology (Crescent Books 1995))

As shown by a later map (from National Geographic Atlas web site)



the town known as Madgala during the time of Jesus is now known as Amba Maryam. Although it is commonly thought that Ethiopian references to Mary refer to Mary the Mother of Jesus, I speculate that the Mary of Amba Maryam refers to Mary Magdalene, the Mary from the town formerly known as Magdala. ...]

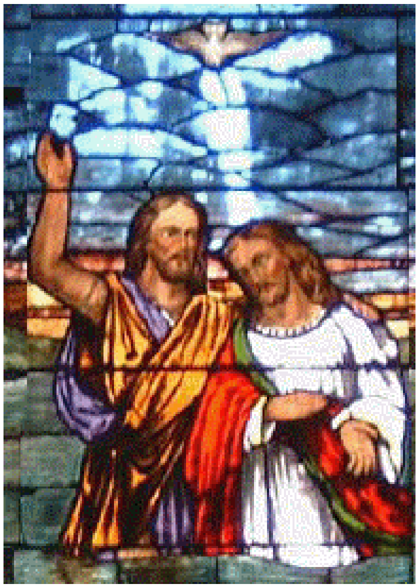
> Yesu took pity on the young girl; and following the rules of the initiation, told her to undress and sit on his bed. And Yesu taught her the secret art of sacred sensuality; of using the body and the senses to engender holy energy to the purpose of purification and control over the senses and the bodily impulses. ... Magdalene advanced quickly ... and she controlled her intelligence and she became an expert yogi for her love and sensitivity. She conquered the lust which ran wild within her and tamed it and gained control over her soul; and ... the Saviour taught Magdalene the Greek reading and the Aramaic, and she read.
>
> Magdalene learned by night, but for according to monk's rule the prostitute was naked throughout, sharing the mat. In the mornings the master teacher came to see if any issue from the monk was there but he only found Yesu and Magdalene in holy meditation. ... When the time was fulfilled Yesu presented Mari to the elders and asked for her to be tested along with the men. These words caused much dissension for never has a woman been to school for holy initiation. ... A great riot resulted in the temple ... Yesu took Mari and they left that city to be purified by its own fire. ...
>
> ... Yesu walked with Mari but stopped by a river to rest on the way down the valley where women were washing. Mari went down to the women and spoke with them, and told them everything that happened; and how Yesu taught her to read the Scriptures; and the women became exited and Mari recited verses from the Scriptures and told them what they meant. Mari brought the women up to speak with Yesu and they asked him many questions about birth and marriage and transmigration and love and children and duty. ...
>
> ... in Sringa ... it was the time of the Feast of Shiva ... the Temple of All Bodhisattvas and Buddha the Merciful ... was in silence because the festival was not one of the Buddha tradition ... Mari ran down the road to the shrine to meet Yesu ... Yesu and Mari stayed with the begging children and taught them how to find food and to make clothing and huts for winter time. ... After the festival ... Yesu ... the elders to explain why, even if their Scriptures tell them otherwise, do they refuse to feed and heal the children ... But the elders answered that the children are from another caste and sect. ... And Yesu said, 'I was not aware that you are from a different caste to mine. I and my disciple and the children are from the caste of the children of God the Father and Mother but you say that we are different &endash; now this means that you are from the caste of evil because only the caste of evil thinks of themselves as belonging elsewhere than the caste of the children of God.' ... And Yesu and Mari stayed with them two months ... teaching ... The Way and the tradition purified itself from the rust and moths of years of neglect. ...When the time came for Yesu

to leave for India the beggar children were no longer left but were cared for by the Ashrama of the city. ...

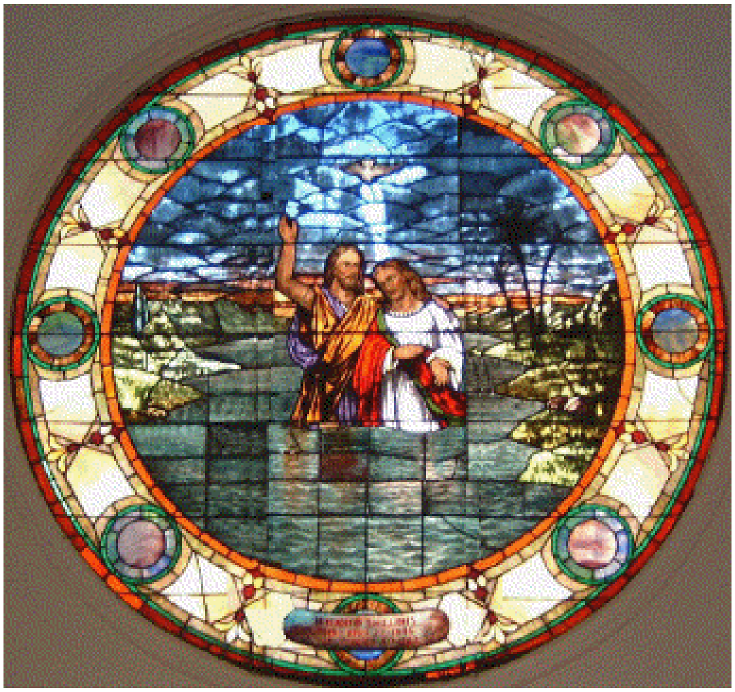
... And Yesu was 27 years when, as he was instructed by the holy ones, he entered the gates of the Nazoreans at Edes-Ra'y ... [i]n Persia ... Mari followed the Lord through the towns to the community of the devout by the river Jordan, in the land of Palestine ...

And it came to be said the Lord's cousin was preparing the way for him from Egypt to the Dead Sea to start the ministry of the Saviour among the people of that land ... And the angel of God ... spoke to Yesu saying the baptism of John is the way to serve all the nations ... And the Lord followed the way to Egypt where John was preparing. ...

When the baptism of John the Nazorean came to be done after seven days on the way ...[In this stained glass window in the First Baptist Church, Cartersville, Georgia,



John (purple and gold) and Jesus (red and green, and bright white, are in the River Jordan below a Holy Spirit dove. The entire stained glass window



(click here for a larger image) was given to the Church (which was built in 1904) by Methodist Rev. Sam Jones as a memorial to his brother, Rev. Joe Jones. The border reminds me of a Lo Pan, with:

- an orange inner ring of 48 segments;
- a wide ring with 8 circular designs, each separated from its neighbor by a pattern of 2 large things and 12 + 4 + 2 + 3 + 3 = 24 small things (the 2 + 24 = 26 large and small things remind me of J3(O)o, and all 8x24 = 192 small things remind me of the Rig Veda). Each circular design has:
  - a central circle surrounded by:
  - a ring of 6 segments (together with the central circle, these remind me of a 7-sphere); and
  - a green ring of 8 segments (together with the 7 inner circle and segments, these remind me of a 15-sphere, and all 8 of them remind me of a 600-cell);
- a green ring of 48 segments; and
- a red outer sixth ring of 48 segments (the 48 + 48 + 48 orange-green-red things plus 12x8 of the small things remind me of the 240 vertices of the E8 root vector polytope, and if the 2x8 = 16 large things are added, I am reminded of the Cl(8) Clifford algebra).]...

... the countenance of Yesu was changed, and he retained his human form by will, and the Light went up for all those in waiting in the ashrama in all the worlds; and in (the Mediterranean) and Syria and Parthia and in India the saints were shaken by the Lord's presence as if He was present with them in their rooms and in the fields. ... From this time on the Lord ministered to all at once and remained in his human form for those hard at heart in the lands of Palestine, Samaria, Judah, Galilee, Syria and Phoenicia. ...

... Yesu added to John's baptism also that baptism of fire from within and he lifted many devotees on high and sent them out to minister to the congregations of holy ones all over the world.

Mari with more than three hundred women who became virgins and were liberated from their afflictions also followed. And they followed behind the Lord and cared for him greatly. And the Magdalenes taught of healings and making the enjoyment of the sense pleasures holy chariots; and they kept pure and secret the mystical teachings and it was taken to many parts of the world.

When the time came for the Lord to finish the ministry in body he was 34 years old and accomplished in spirit to the Saviour, and he commanded many to teach the mysteries of the baptisms to worthy ones. ...

... Yesu the Lord prepared for seven days and went up to give himself to the evil ones of the pious of those lands to hang him up as despicable, for that is what the world does with holiness, unto to the death of the body; because he was to discard it for the sake of the ministry in the other universes; and he left the body to die and he gained union with God as the beloved son. ...

... after three days he removed that dead body from its filthy grave and swaddling clothes and made it alive again when he needed it. And the Lord travelled the lands of his former ministries, appearing whenever he needed; and he brought with him a great army of angels to light the Way.

And the Lord appeared first to Mari his beloved companion and to his blessed mother and the devotees (apostles) of that land, that they too may believe; and he sent the devotees to minister in different lands and appeared to be with them. And **the Lord ministered to the congregations of** Yuda in Kushan, and James in Egypt and **Mari in Alexandria, in Ethiopia**, Peter in Armenia, in Syria, with Matthew in Parthia and Yuda when he became the Thoma in India for many years. ...".

Why did Mary Magdalene return to Ethiopia, the country of her home town of Magdala, after Jesus was crucified ?

Consider the role of Ethiopia in the history of Judaic/Christian/Islamic religion:

According to "The Historic Implications of the Kebra Nagast" in the book "The Kebra Nagast" edited by Gerald Hausman (St. Martin's Press, New York1997):

"... the Great Pyramid at Giza ..., as a mystical and scientific symbol and also as a practical archtectural design and building structure, goes back ... to the Ethiopian roots of the world culture in Kemet. ... The authorized King James Bible, which first appeared in 1611, was ... going to include ... the Kebra Nagast ... However, the editors were told, presumably by the clergy - although it came down by royal decree - to excise the chapters which included the Kebra Nagast. ...".

According to the Kbre Nege'st in the book "The Kebra Nagast" edited by Gerald Hausman (St. Martin's Press, New York1997):

"... Solomon [said] ... to the Queen [of Sheba]: ... I saw many visions in a dream. The sun rose on Israel, but it went away and lighted up the country of Ethiopia. So that country shall be blessed through you. ... Nine months aand five days ...[later]... the Queen ... brought forth a man-child [Solomon's firstborn] ... and she called him Bayna-Lehkem. ...[when]... he was twenty-two years old ... Bayna-Lehkem came through ...[the]... gate ... [of his father King Solomon]... when King Solomon sw his son he ... said, "Behold my father David has renewed his youth and has risen from the dead." Then he said to all of his court, "... He is David ...".

... **Gabriel ... the Angel of Death ... said to ... Solomon** ... "... Harken to what I say, for God has sent me. From being a wise man you have turned into a fool ... and all because you have broken the commandment of God. You held this lightly, thinking you were wiser than God and believing you would have many male children.

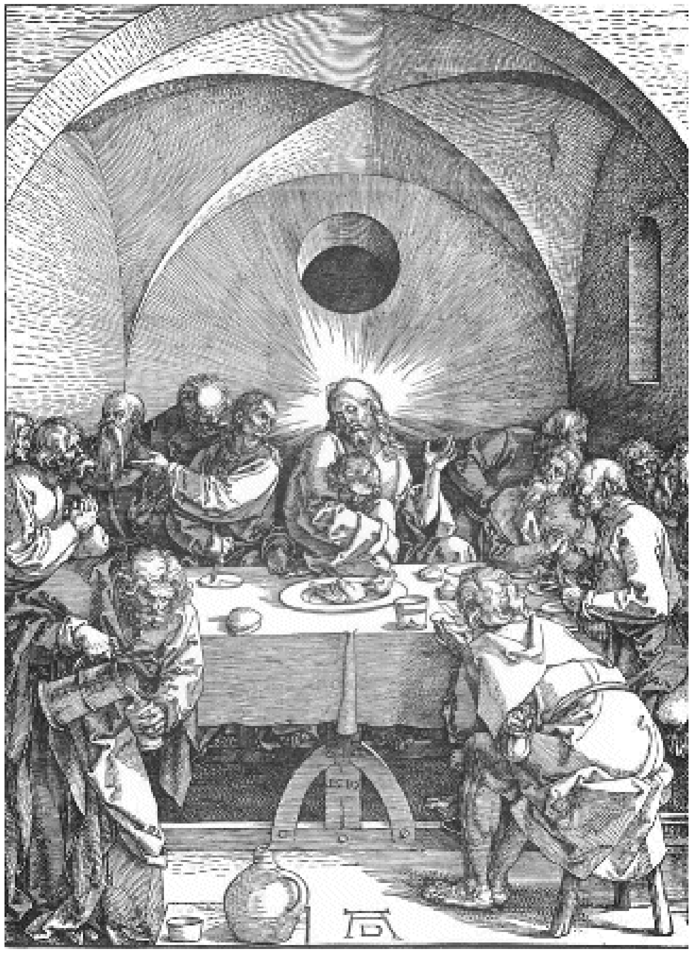
Know that your Salvation was created in the belly of Adam. And it began in the form of a pearl before Eve. The pearl ... went forth from the belly of Adam into the belly of Seth. And then it ... came to Arbam. And it .. went into Isaac the pure ... into Jacob the humble ... into Judh, the innocent ... And ... it came to Fares the patient. And from him the pearl went to the firstborn until it came into the belly of Jesse, your grandfather. And then ... it went to the seventh, David, your innocent and humble father. Now the pearl of your salvation will pass through many generations until it will reach him who ... is crucified without sin and who rises without corruption. He who goes into Sheol and tears down its walls. ... and **Zion [the Ark of the Covenant], taken up by [David] your firstborn [son], shall be the salvation of the people of Ethiopia forever**; and t**he pearl shall be carried in the belly of Rehoboam your [second-born] son, and shall be the savior of all the world**. ..."

... when David the son of Solomon returned [to Ethiopia] with the Ark of the Covenant, he met his mother Makeda [Queen of Sheba] and she granted that he should be King of Ethiopia. ...

... When the Pearl, the Son of the Lord, was born ... **the people of Ethiopia were loved by God because the Savior of the World, his Son, was beloved by them**. ...".

Also, consider the relationship of Mary Magdalene and Jesus:

This Durer woodcut The Large Passion - 9 of 12 - Last Supper - 1510



showing 6 apostles on each side of the couple Jesus and Mary Magdalene indicates that in Durer's Europe ca 1500 it was believed (at least by some) that Jesus and Mary Magdalene were man and wife, with Mary Madgalene being even closer to Jesus than the 12 apostles.

According to a Web Gallery of Art web page:

> "... In the summer of 1518 he [Durer] went to Augsburg where he met Martin Luther, who had in the previous year circulated his Ninety-five Theses denouncing the sale of papal indulgences. **Dürer** later **became a devoted follower of Luther**. ...".

According to an 11 August 2003 Time article by David Van Biema found on a danbrown web page:

> "... The Gnostic Gospel of Philip describes Magdalene as "the one who was called [Jesus'] companion," claiming that he "used to kiss her on her [mouth]." ... **Martin Luther believed that Jesus and Magdalene were married**, as did Mormon patriarch Brigham Young. ...
>
> The notion that Magdalene was pregnant by Jesus at his Crucifixion became especially entrenched in France, which already had a tradition of her immigration in a rudderless boat, bearing the Holy Grail, his chalice at the Last Supper into which his blood later fell. Several French kings promoted the legend that descendants of Magdalene's child founded the Merovingian line of European royalty, a story revived by Richard Wagner in his opera Parsifal ... The Wachowski brothers ... named a villain in The Matrix Reloaded Merovingian, filming him surrounded by Grail-like chalices. His wife in that film was played by Italian actress Monica Bellucci, who will also play Magdalene in Mel Gibson's upcoming Jesus film ... The idea that Magdalene herself was the Holy Grail - the human receptacle for Jesus' blood line - popped up in a 1986 best seller, Holy Blood, Holy Grail, which inspired Brown's Da Vinci Code. ...

[In my opinion, it is unlikely that a pregnant Mary Magdalene would have gone to France, which was in the part of the world controlled by the Roman Empire, which Roman Empire at that time was quite hostile to Christianity. I think that it is more likely that Mary Magdalene would have returned to the Christian-friendly land of her birth, Ethiopia.]

The idea that Magdalene herself was the Holy Grail - the human receptacle for Jesus' blood line - popped up in a 1986 best seller, Holy Blood, Holy Grail, which inspired Brown's Da Vinci Code. ...".

According to a book "Bloodline of the Holy Grail" by Laurence Gardner on a karenlyster web page and related pages:

"... Dynastic heirs such as Jesus were expressly required to perpetuate their lines. Marriage was essential, but community law protected the dynasts against marriage to women who proved barren or kept miscarrying. This protection was provided by the three-month pregnancy rule. Miscarriages would not often happen after that term, subsequent to which it was considered safe enough to complete the marriage contract. ..

... Jesus ... was a Messiah, which means ... an 'Anointed One'. ... all anointed senior priests and Davidic kings were Messiahs; Jesus was not unique in this regard. Although not an ordained priest, he gained his right to Messiah status by way of descent from King David and the kingly line, but he did not achieve that status until he was ritually anointed ... the bridal anointing of the king ... used ... the oil ...[of]... spikenard (an expensive root oil from the Himalayas) ... spikenard ... was the express prerogative of a Messianic bride who had to be a 'Mary' - a sister of a sacred order. Jesus's mother was a Mary; so too would his wife have been a Mary, ...

... There are seven lists given in the Gospels of the women who were Jesus's regular companions. These lists all include his mother, but in six of these seven lists the first name given (even ahead of Jesus's mother) is that of Mary Magdalene, making it plain that she was, in fact, the First Lady: the Messianic Queen. ...

... **Messianic marriages were always conducted in two stages**. ... Chronologically, these anointings (as given in the Gospels) were two-and-a-half years apart. ...

Of all the four Gospels, only John records the wedding feast at Cana ...[which]... can be dated to the summer of AD 30, in the month equivalent to our modern June. ... the Cana ceremony ... appears to have been their own betrothal feast ...[It]... embodie[d] the ... water and wine ... wine taken at betrothal feasts was only available to priests and celibate Jews, not to married men, novices or any others who were regarded as being unsanctified. They were allowed only water ... Mary ... and Jesus then flouted convention, abandoning the water to provide wine for everyone. ...

... **The first (the anointing in Luke) ... was the legal commitment to wedlock** ... First weddings were always held in the month of Atonement (modern September) and betrothal feasts were held three months before that. In this particular instance, we find that the first marital anointing of Jesus by Mary Magdalene was **at the Atonement of AD 30**, three months after the Cana ceremony ...

... **the second (the later anointing in Matthew, Mark and John) was the cementing of the contract. ... the ... anointings of Jesus by Mary at Bethany**. ... From that day she would carry a vial of spikenard around her neck, throughout her husband's life, to be used again on his entombment. It was for this very purpose that Mary Magdalene would have gone to Jesus's tomb, as she did on the Sabbath after the Crucifixion. .... In Jesus and Mary's case the second anointing was of particular significance for, as explained by Flavius Josephus in the 1st-century Antiquities of the Jews, **the second part of the marriage ceremony was never conducted until the wife was three months pregnant**. ... the trial and crucifixion of Jesus are mentioned in the Annals of Imperial Rome. We can now determine from chronological survey that **the Crucifixion took place at the March Passover of AD 33, while the Bethany second marriage anointing was in the week prior to that**. We also know that, at that stage, **Mary Magdalene had to have been three months pregnant - which means she should have given birth in September of AD 33**. ...".

[As Laurence Gardner noted in his article, the birth of Jesus (celebrated in December but possibly actually in February or March) violated the rule of birth in the Atonement month of September. However, Gardner says that "... special dispensation for the birth was granted by the ... priest ...". That, and the calendrical customs described in the above quotes from Gardner, sound reasonable to me, so that **I agree with Gardner that Mary Magdalene was three months pregnant with her child conceived with Jesus when the Crucifixion took place at the March Passover of AD 33.** However, in the rest of his book "Bloodline of the Holy Grail", Gardner goes beyond the Gospels to Acts, Revelations, etc., and in doing so contends that Jesus survived the Crucifixion and that Mary Magdalene had two more children by Jesus and that they moved to France and founded the Merovingian bloodline. I find those ideas implausible and inaccurate, and **I do not believe Gardner is correct about those**

Merovingian ideas. Even though Gardner may be wrong about his Merovingian ideas, their inaccuracy is not grounds to question his material on the Gospels and wedding customs, which I find plausible and convincing.]

Perhaps Jesus and Mary Magdalene, knowing that Jesus would die on the Cross, conceived a child to have been born around the September month of Atonement of AD 30.

Mary Magdalene returned to her home country of Ethiopia because it was the most friendly country to Christianity, much more friendly than the Roman Empire, Zoroastrian Persia, Hindu/ Buddhist India, and Confucian Han China.

Ethiopia would be the best place to raise a child conceived by Jesus and Mary Magdalene.

Thus Ethiopia became the Land of Reunification of Zion and the Pearl,

which had been separated since the time of Solomon.

Since a person has 2^25 = 33,554,432 ancestors of the 25th degree and assuming more or less random mating, anyone with any African ancestry, as of now, around 2000 AD, more than 25 generations after 0 AD/BC, when the population of the entire Earth was around 200,000,000 , might well be a descendant of Jesus and Mary Magdalene.

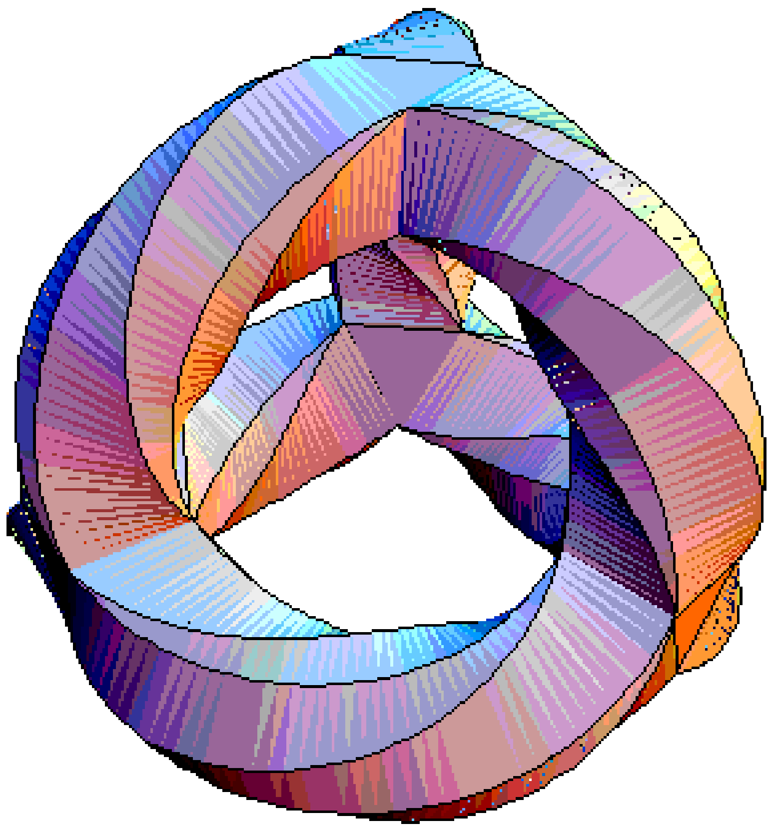
Nicolas Notovitch, in his book The Unknown Life of Jesus Christ, gives an account similar to that of the Acts of Yesu. According to a web page about his work: "... During the latter part of the 1870s, Notovitch decided to embark on an "extended journey through the Orient." ... reaching India in 1887 ... [heard] that the life of Jesus Christ had been recorded in Buddhist manuscripts. ... Jesus is referred to as "Issa" in Buddhist documents, as "Isa" in the scripture of Islam, the Quran, and as "Isa" in the Hindu scripture, the Bhavishya Mahapurana. ... Notovitch decided to delay his return to Europe ... and ... to ... journey to Thibet [Tibet] ... While riding his horse near Hemis Monastery, Notovitch suffered a terrible fall from his horse and broke his right leg, and he was forced to remain under the care of the Buddhist monks at Hemis until his leg healed. After requesting to see the manuscripts concerning Jesus in India, the monks brought to his bedside two books with loose, yellowed leaves. During the next two days one of the monks read these documents to Notovitch while an interpreter translated and Notovitch took notes. ... Notovitch now felt that he had come across the most powerful discovery in 2000 years: written manuscripts giving stunning details of the lost years of Jesus, between the ages 12 and 30, that are not mentioned in the Bible, and showing that Jesus had been tutored by Buddhists. ...

... Notovitch is just one tiny part of the story. ... there still exists Persian, Tibetan and Sanskrit documents, all of which mention the sojourn of Jesus in India. The Tarikh-i-Kabir-i-Kashmir, the Bagh-i-Sulaiman, the Ain-ul-Hayat, the Wajees-ut-Tawareekh, the Negaristan-i-Kashmir, the Usool-al-Kafi, the Book of Balauhar and Buddasaf, the Rauzat-us-Safa, Ikmal-ud-Din, the Grugtha Thams Chand, the Bhavishya Mahapurana, the oral traditions of the people of Kashmir, the oral traditions of the Followers of Jesus in Afghanistan, the inscriptions of the Takhat Sulaiman monument in Srinagar, as well as other documents, all mention the sojourn of Jesus in Kashmir ...".

According to a web page about Swami Abhedananda: "... Swami Abhedananda read Notovitch's account, and in 1922 he decided to travel to the Hemis Monastery himself ... The lama who was acting as the Swami's guide took a manuscript from the shelf and displayed it to the Swami. He told him that it was an exact translation of the original manuscript which was lying in the monastery of Marbour near Lhasa. The original manuscript, he explained, was in the Pali language, while the manuscript that was preserved at Hemis (the one Nicolas Notovitch claimed to have seen, and that the Swami had later been shown in 1922) was written in the Tibetan language. It is said to consist of fourteen chapters and two hundred twenty-four couplets called slokas. ...".

Physics of the Klein Quartic

To make a physics model based on the Klein Quartic, start with 336-element SL(2,7), which double covers the



Klein Quartic (animated image by Greg Egan) . According to Coxeter's book Complex Regular Polytopes (2nd edition, Cambridge 1991), **the 48-element binary octahedral group <4,3,2> is a subgroup of index 7 in SL(2,7)**.

Since the basic building block of the Klein Quartic covering SL(2,7) is <4,3,2>, t**he first task is to see**

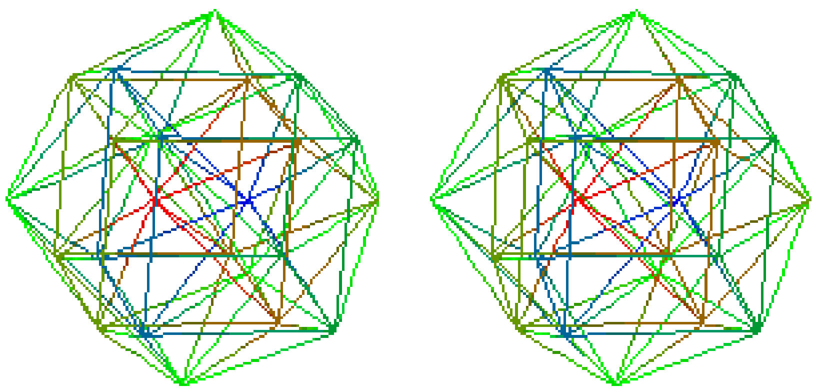
the structure of <4,3,2> and how it might be related to a physics model.

Now consider the 24-element binary tetrahedral group <3,3,2> as a normal subgroup of 48-element <4,3,2> and look at the coset space <4,3,2> / <3,3,2> .

According to Coxeter, given quaternionic space with basis {1,i,j,k} , <3,3,2> = the 24 vertices

- +/- 1, +/- i, +/- j, +/- k, and
- (1/2)(+/- 1 +/- i +/- j +/- k)

of the 24-cell



and

<4,3,2> = the 24 + 24 = 48 vertices

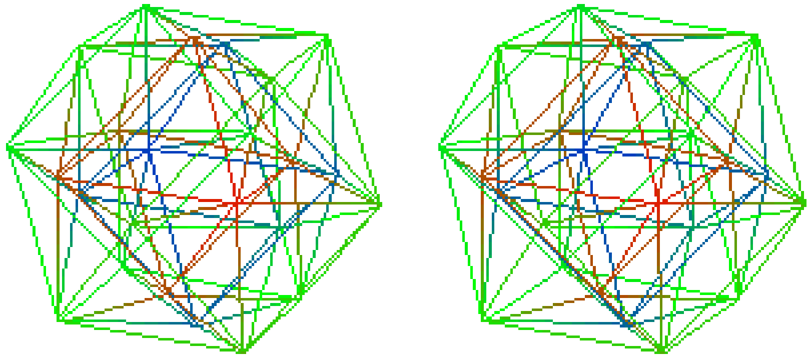
- +/- 1, +/- i, +/- j, +/- k,
- and (1/2)(+/- 1 +/- i +/- j +/- k)

of the 24-cell

plus

- (1/2)(+/- 1 +/- i) and
- (1/2)(+/- 1 +/- j) and
- (1/2)(+/- 1 +/- k) and
- (1/2)(+/- i +/- j) and
- (1/2)(+/- j +/- k) and
- (1/2)(+/- k +/- i)

of the dual/reciprocal 24-cell



Therefore,

the coset space <4,3,2> / <3,3,2> is represented by the vertices

- (1/2)(+/- 1 +/- i) and
- (1/2)(+/- 1 +/- j) and
- (1/2)(+/- 1 +/- k) and
- (1/2)(+/- i +/- j) and
- (1/2)(+/- j +/- k) and
- (1/2)(+/- k +/- i)

of the dual/reciprocal 24-cell.

The next task is to see whether the coset space has a natural group structure, and if so, what it is.

Coxeter says (here I use the notation Cm for the cyclic group of order m): "... every finite reflection group has a subgroup of index 2 which is a rotation group, generated by products of pairs of reflections. ... A convenient symbol for this rotation group of order 2s is (p,q,r) ...

- the tetrahedral group (3,3,2) of order 12,
- the octahedral group (4,3,2) of order 24,
- the icosahedral group (5,3,2) of order 60

... are subgroups of index 2 in ...

- [3,3]
- [4,3]
- [5,3] respectively ..."

Consider the 12-element tetrahedral rotation group (3,3,2) = A4 and add Euclidean reflections to get the 24-element tetrahedral rotation/reflection group [3,3] .

As John Baez says: "... The tetrahedral rotation/reflection group [3,3] is isomorphic to the octahedral rotation group (4,3,2). ...".

So, look at the coset space <4,3,2> / (4,3,2)

Given that 24-element (4,3,2) = [3,3]

and that Coxeter says (where Cm denotes the cyclic group of order m):

"... [3,3] ... of order [24] ... yields

(C4/C2 ; <4,3,2> / <3,3,2>) = GL(2,3) ... of order ...[48]...

... Apart from the little complication caused by the common element -1 of ... C4 ... and ... <4,3,2> ... we have here an instance of a 'subdirect product' (Hall 1959 ... The Theory of Groups ... pp. 63-4) ...", we see that, apart from the complication noted by Coxeter, and another complication due to factoring out the C4/C2 part,

<4,3,2> / <3,3,2> = [3,3] = (4,3,2) = S4 = permutations of 4 elements

so that an intuitive picture (subject to the indicated complications) is that <4,3,2> is made up of <3,3,2> plus (4,3,2) = S4 or in other words <4,3,2> is made up of the 24 vertices

- +/- 1, +/- i, +/- j, +/- k, and
- (1/2)(+/- 1 +/- i +/- j +/- k)

of the 24-cell

plus the S4 permutations of the 4 quaternion basis elements {1,i,j,k}

Here is a physical interpretation:

For the 24-cell,

- +/- 1, +/- i, +/- j, +/- k correspond to 8-dim spacetime
- (1/2)(+ 1 +/- i +/- j +/- k) correspond to 8 fermion particles
- (1/2)(- 1 +/- i +/- j +/- k) correspond to 8 fermion anti-particles

For the dual 24-cell,

24 gauge bosons corresponding to the elements of S4, which, according to Barry Simon's YABOGR book, more formally titled Representations of Finite and Compact Groups AMS Grad. Stud. Math. vol 10 (1996), are:

- e^1
- (12)^6
- (12)(34)^3
- (123)^8
- (1234)^6

You can see this structure from another point of view by recalling that the root vector diagram of F4 has 48 elements, which are, just as above, the 24-cell and the dual 24-cell.

The 4 Cartan subalgebra elements of F4 should be added to the dual 24-cell root vectors to produce a 28›dim Spin(8) gauge group whose generators correspond to:

- e^1
- (12)^6
- (12)(34)^3
- (123)^8
- (1234)^6
- Cartan^4

As Pierre Ramond said in hep-th/0112261 , "... the triality of ... SO(8) ... links its tensor and spinor representations via a Z3 symmetry. The exceptional group F4 is the smallest which realizes this triality explicitly. ...".

Although I do not agree with Ramond's general superstring-type approach to physics, I quote him as an authority figure to allay fears against putting fermions and bosonic structures in the same algebra, such as F4. In my view, exceptional E and F Lie algebras are effectively in some sense superalgebras that have pure Lie algebra structure.

Since an 8-dim spacetime with a Spin(8) gauge group does not look like the world in which we live, let the model so far correspond to high-energy regions, with our world being described by the model after dimensional reduction of 8-dim spacetime into 4-dim spacetime, with the remaining 4-dim corresponding to a CP2 Kaluza-Klein internal symmetry space, as done by Batakis in Class. Quantum Grav. 3 (1986) L99-L105.

Then, here is what happens to the 28 Spin(8) gauge bosons with generators

- e^1
- (12)^6
- (12)(34)^3
- (123)^8
- (1234)^6
- Cartan^4

The 16 generators

- (12)^6
- (1234)^6
- Cartan^4

produce a U(2,2) = U(1)xSU(2,2) = U(1)xSpin(2,4) Lie algebra which gives gravity by the MacDowell-Mansouri mechanism.

The remaining 12 generators

- e^1
- (12)(34)^3
- (123)^8

produce U(1), SU(2), and SU(3) respectively.

Here, based on e-mail conversation with Garrett Lisi in June 2005, is another way to see what happens to the 28 Spin(8) gauge boson generators:

```
Let F8 denote a Spin(8) bivector 2-form over octonionic 8-dim spacetime.
As Garrett Lisi pointed out, a conventional definition of F8 would be
F8 = d A8 + 1/2 A8 A8, where A8, a Cl(8) 1-form, is regarded as the
fundamental field variable. However, in my physics model, I prefer
to think of bivector gauge bosons not as derived from vectors by d,
but, by using triality, to see them as bivector = bihalfspinor
antisymmetric (+half-spinor, -half-spinor) pairs.
Since the triality isomorphism among vectors and half-spinors
is only available fully in 8-dim, it is one of the reasons
that I think that Cl(8) is the uniquely best building block
for a realistic particle physics model.
Equivalence of those two definitions of F8 may imply a relationship
between spinors and the nilpotent covariant derivative.

Let *8 be the 8-dim Hodge star.
```

F8 /\ *8F8 is an 8-form over 8-dim spacetime.

Introduce
a preferred quaternionic subspace 4S that will be 4-dim spacetime.

Now, follow F. Reese Harvey's book Spinors and Calibrations:

The spatial part of 4S is defined by an associative 3-form,
which can be defined by an element g of G2 = Aut(octonions).

g also fixes a coassociative 4-form
that defines an internal symmetry space 4I.

The associative form 4S can be written as
w123 - w156 - w426 - w453 - w147 - w257 - w367

The coassociative form 4I can be written as
w4567 - w 4237 - w1537 - w1267 - w2536 - w1436 - w1425

and we have 4S /\ 4I = 7 w1234567

The F8 bivectors are generators of Spin(8) = G2 + (vector S7 + spinor S7)

Fixing a g in G2 reduces G2 to SU(3)
and
because it defines an associative 3-dim subspace of the vector S7
it breaks the vector S7 into associative S3 + coassociative S4
so
we reduce Spin(8) to SU(3) + ((vector S3 + vector S4) + spinor S7)

Since the vector S3 belongs to 4S and the vector S4 belongs to 4I
we have,
for the internal symmetry gauge groups after dimensional reduction,
SU(3) + vector S4

If SU(3) is to act globally on the 4I internal symmetry space,
the global structure of 4I should morph from S4 to CP2 = SU(3)/U(2),
which then would give a Batakis-type 8-dimensional Kaluza-Klein
model with CP2 extra dimensions and standard model gauge group
generators SU(3)xU(2) = SU(3)xSU(2)xU(1).

The left-over spinor S7 + associative S3 + G2/SU(3) look like:
spinor S7 = spinor S3 + spinor S4
associative S3
set of G2 associative structures left over after picking g and SU(3).

Now look at how the SU(3) and U(2) generators fit inside the 24-cell root
vector diagram of D4 Spin(8).
First, look at 2-dimensional the root vector diagram
(including Cartan elements in the center)

```
          yb

    xb            zb

         tb tr
```

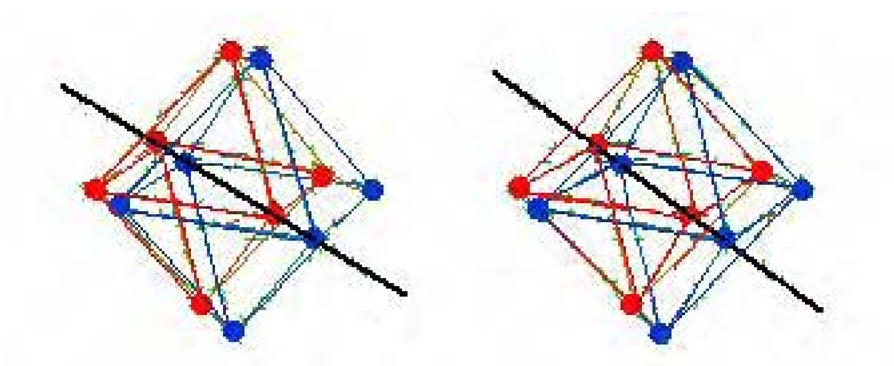
```
    zr           xr

           yr
```

and then blow it up into a 3-dimensional cube

```
  tb----xb
   |\   | \
   | zb----yb
   | |  |  |
  yr-|--zr |
    \|    \|
     xr----tr
```

and then consider the front and back square faces of the cube
as two squares on the base planes, parallel to each other,
of two octahedra

see 2octaimage.jpg

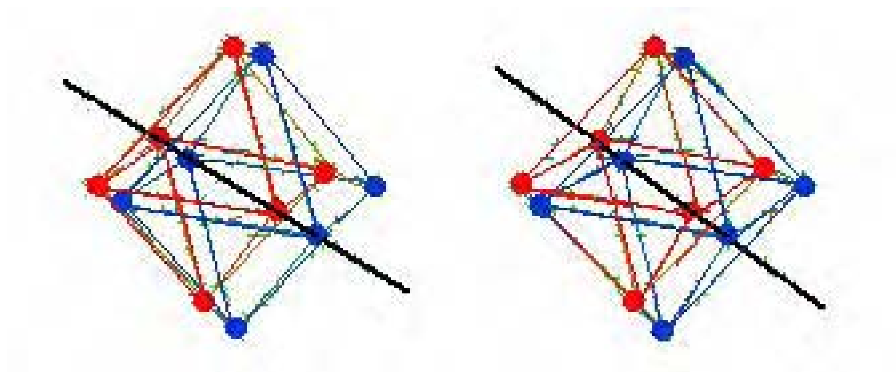


The U(2) root vectors can be represented as four vertices
(including the abelian U(1) and the SU(2) Cartan element)
along a line

```
wr       kr  kb       wb
```

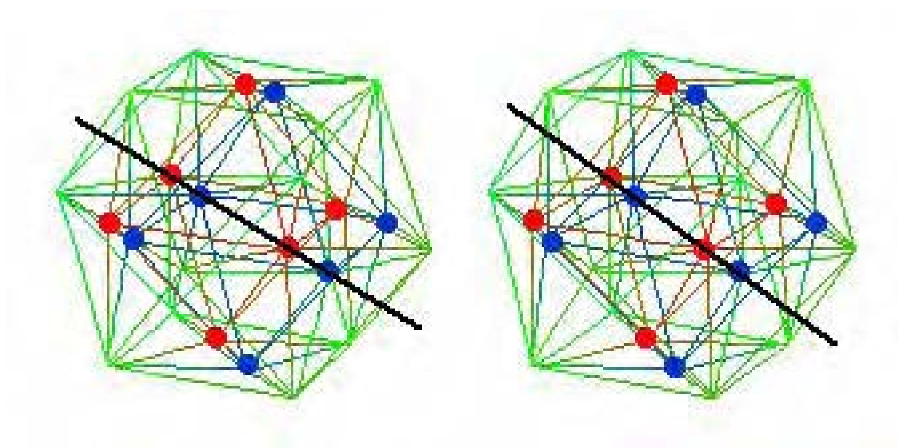
and then consider the line as the common axis perpendicular
to the base planes of the two octahedra, containing the
remaining2+2 = 4 vertices of the two octahedra,

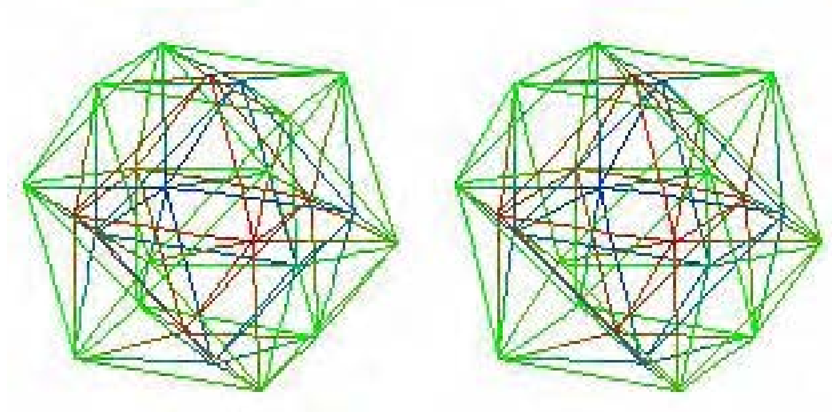
see 2octaimage.jpg



and then consider the two octahedra as part of the 24-cell
root vectors of D4 Spin(8)

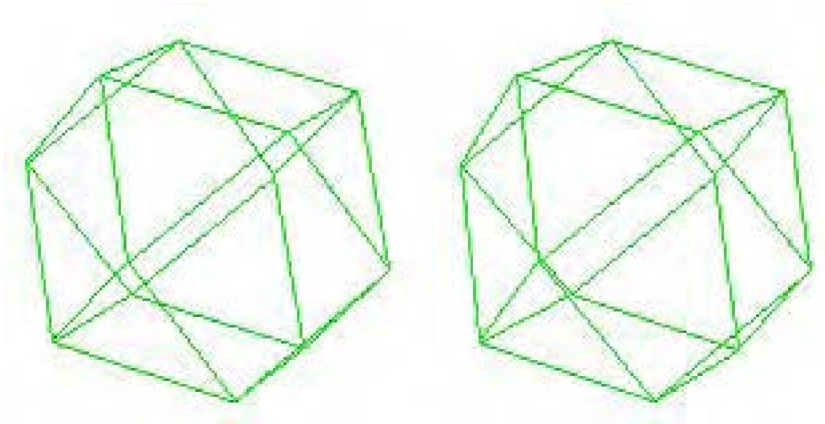
see 2octa24cell.jpg and 24cellD4.jpg





After the Standard Model SU(3)xU(2) vertices are removed
from the D4 Spin(8) 24-cell root vector diagram (including
4 Cartan subalgebra elements at the origin)
what remains is a 3-dim cuboctahedron

see D3cubo.jpg



Since a 3-dim cuboctahdron with 3 origin vertices is
the root vector diagram of D3 = Spin(2,4) = SU(2,2) = A3
and adding a fourth origin vertex gives U(1)xSU(2,2) = U(2,2).

Therefore
the 16 remaining generators give you U(2,2) = U(1) x Spin(2,4)
and Spin(2,4) gives gravity by the MacDowell-Mansouri mechanism.

Those 16 remaining generators correspond to
vector S3
spinor S7 = spinor S3 + spinor S4
the 6 dimensions of G2 associative structures

Then, identify the vector S3 + spinor S3 + spinor S4 with Sp(2)
Anti deSitter Sp(2) = Spin(2,3) has
6 Lorentz and 4 translation-like generators
and (from the point of view of compact signature SU(4))
SU(4) / Sp(2) = 5-dimensional set of quaternionic structures of C4 is
identified with a 5-dimensional subset of the G2 associative structures.
The 6th dimension of the G2 associative structures
gives 16-dimensional U(2,2) with compact version U(4).

To see more explicitly how this all works in terms of the 24-cell
root vector diagram of D4 Spin(8):

The 4 origin root vectors can correspond to

```
01

        23

                45

                        67
```

and the 24-cell vertices can correspond to

```
    02  03  04  05  06  07
    12  13  14  15  16  17
```

```
            24  25  26  27
            34  35  36  37
                    46  47
                    56  57
```

In terms of the basis (x,y,z,t,k,w,r,b), they are

```
xy  xz  xt  xk  xw  xr  xb
    yz  yt  yk  yw  yr  yb
        zt  zk  zw  zr  zb
            tk  tw  tr  tb
                kw  kr  kb
                    wr  wb
                        rb
```

The 6 that involve only (0,1,2,3) = (x,y,z,t) form the Lorentz boosts
and rotations of physical spacetime:

```
xy  xz  xt
    yz  yt
        zt
```

Note that (01,02,12) = (xy,xz,yz) are rotations
and (03,13,23) = (zt,yt,zt) are Lorentz boosts.

Now let them interact with 4 = k.
Moving in 5-space (k-space) can be regarded as
just an "extra" dimension added to 4-dim spacetime
in which "rotations" look like translations,
and we then get the 10 with indices 0,1,2,3,4
which are taken to be generators of deSitter/Poincare gravity

```
01  02  03  04
    12  13  14
        23  24
            34
```

or

```
xy  xz  xt  xk
    yz  yt  yk
        zt  zk
            tk
```

where (04,14,24,34) = (xk, yk, zk, tk) are translations.

Next let the 10 interact with 5 and let 5 have SU(3) color (r+g+b).
Moving in 6-space (w-space) can also be regarded as an "extra" dimension.
In it "rotations" look like conformal transformations
(1 dilation and 4 special conformal transformationsi),
and we then get the 15 with indices 0,1,2,3,4,5
which are taken to be generators of Segal's conformal Spin(2,4) = SU(2,2)
which can also be gauged to produce gravity:

```
01  02  03  04  05
    12  13  14  15
        23  24  25
            34  35
                45
```

or

```
xy  xz  xt  xk  xw
    yz  yt  yk  yw
        zt  zk  zw
            tk  tw
                kw
```

Note that the 45, which is only in (k,w) space,
corresponds to the dilation
and
(05,15, 25, 35) = (xw, yw, zw, tw) are
the 4 special conformal transformations.

That leaves 13 generators left over, those with at least one index 6 or 7

```
06  07
16  17
26  27
36  37
46  47
56  57
    67
```

or

```
xr  xb
yr  yb
zr  zb
tr  tb
kr  kb
wr  wb
    rb
```

Let 67 = rb represent the U(1) phase of particle propagators,
which is the U(1) of 16-dimensional U(1)xSU(2,2) = U(2,2).

That leaves 12 generators:

```
06  07
16  17
26  27
36  37
46  47
```

56 57

or

xr xb
yr yb
zr zb
tr tb
kr kb
wr wb

and they correspond to the 6+6 = 12 vertices of the two octahedra
described above as giving the standard model SU(3)xU(2), where
SU(3) is represented by

```
          yb

    xb           zb

         tb tr

    zr           xr

           yr
```

(Note that the 3 colors have structure similar
to that of the 3 spatial dimensions.)

and U(2) is represented by

```
wr       kr  kb       wb
```

Note that
the local U(2) action on the 4I internal symmetry space is
totally confined to the kwrb 4I space itself,
while
the global SU(3) action on 4I involves not only the rb color
space of 4I but also the txyz 4S physical spacetime,
somewhat similarly to the actions of the Batakis CP2 Kaluza-Klein model.

How does the Hodge star work in 8-dim and 4-dim spacetimes?

The Hodge star for Spin(8) is defined in 8-dim spacetime
by letting mn be lower indices and MN be upper indices for F
so that *Fmn = (1/2) e(mnabwxyz) FABWXYZ
which is natural because of the Clifford algebra
structure of Cl(8) with Spin(8) generators being the bivectors.

However, it is not so natural in 4-dim spacetime
because the standard model group SU(3)xSU(2)xU(1) is bigger
than the bivector algebra Spin(1,3) of the Clifford algebra Cl(1,3)
of 4-dim Minkowski spacetime,
and

the question arises as to what the 8-dim Hodge star morphs into
when spacetime is reduced to 4-dim.

By looking at the conformal Spin(2,4) that gives gravity
after reduction you can see that its natural Clifford structure
is on a 6-dim vector space so that it would want to have
a 6-dim Cl(2,4) Hodge star, since a 6-dim spacetime is the
spacetime of linear actions of the Clifford-algebra conformal group.

However,
due to the special automorphism Spin(2,4) = SU(2,2),
the conformal group can be written in a way that acts
naturally on a 4-dim spacetime as a unitary group.
Since the standard model groups are also unitary,
all the relevant gauge groups after reduction are unitary:
U(2,2), SU(3), SU(2), and U(1).

Therefore, after reduction, the Hodge star should be the usual one
for conventional Yang-Mills physics theories,
based on the graded exterior algebra structure of SU(n) Lie algebras.
Since that structure is, for example for U(4):

1 4 6 4 1 graded structure
(coinciding with the graded structure of the Clifford algebra
for Cl(1,3) Minkowski spacetime)

where the second 4 can be regarded in terms of the first 4 as *4:
U(4) = 4 (x) *4 is 4x4 = 16-dim
so there is a natural Hodge star for U(4)
and it can be used for subgroups including SU(3), SU(2), and U(1),
and therefore to describe accurately gravity (MacDowell-Mansouri)
and the standard model.

In April 2005 sci.physics.research discussions with John Baez,
Garrett Lisi describes the MacDowell-Mansouri Mechanism this way:

> "... I only have one reason for justifying the use of Clifford
> algebra for this stuff -- it comes unavoidably from the application
> of Occam's razor. ... Describing fermions requires the use of
> a Clifford bundle. So, I figure, since there is no getting out
> of having this Clifford fiber bundle thing,
> might as well make the best possible use of it.
> And what I'm finding is that, along with the vectors and forms
> that almost come for free with a manifold,
> that's ALL one needs to describe the physical fields. ...
> The fermions come in as a Grassman valued section of the Clifford
> bundle as a result of applying the BRST gauge fixing method ...
> ... Let me do the whole thing from the ground up ... :
> The only dynamic variable is the connection:
> A = e + W
> With e the Clifford vector valued 1-form (the frame),
> and W the Clifford bivector valued 1-form (the spin connection).
> The curvature is F = d A + (1/2) A A = Fo + Fe
> where the Clifford odd part of this curvature,
> a Clifford vector valued 2-form, is the torsion
> Fo = d e + W x e

where for two one forms the cross product
is W x e = (1/2)(W e + e W),
but in general for forms of orders that commute
it’s A x B = (1/2) (A B - B A).
The even part of this curvature is
the Clifford bivector valued 2-form
Fe = d W + (1/2) W W + (1/2) e e = R + (1/2) e e
The Bianchi identity is d R + W x R = 0.
The action we start with is
S = (1/2) int < F F g > = (1/2) int < Fe Fe g >
which works since g is the Clifford unit 4-vector,
and only 4-vectors times g give a trace.
Plugging in F, this action is equivalent to
S = (1/2) int < R e e g + (1/4) e e e e g >
the GR action, since the other term we get is a boundary term,
< R R g > = < d (W d W + (1/3) W W W) g >
The ONE equation of motion then,
arising from varying A in the action, is
0 = D (Fe g) = d Fe g + A x (Fe g)
  = d R g + (1/2) d e e g +
    + (1/2) (e + W) (R + (1/2) e e) g - (1/2) (R + (1/2) e e) g (e + W)
  = (1/2)((e R + R e) + e e e) + (1/2) (d e e + W x (e e)) g
The third line came from the second using the Bianchi identity.
The first term on the last line, a Clifford odd 3-form,
is Einstein’s equation, and the second term on the last line,
a Clifford even 3-form,
is the equation for the torsionless spin connection.
That’s pretty dense to read, but it’s the whole derivation.
One other thing I’ve noticed is that
the Hamiltonian formulation of this stuff is pretty nice.
If one is a truly cretinous physicist one can define
the momentum 2-form as
p = (delta / delta A) S = (1/2) (F g + g F) = Fe g
And writing the action as
S = int <p d A - H>
with Hamiltonian 4-form
H = - (1/2) p A A - (1/2) p p g
gives the BF action
S = int < p (F + (1/2) p) g >
with the p equal to the even part of the usual B,
and the sign changed.
To further annoy mathematicians one could write
the equations of motion as
d A = (d/d p) H
d p = (d/d A) H
and cook up a Poisson bracket formulation.
... diffeomorphisms and local frame rotations enter through
the same infinitesimal gauge transformation of the connection:
A’ = A + d C + A x C
The weird thing I just got is that the conserved
Noether current 3-form corresponding to this symmetry is
< (d B + A x B) C >
which vanishes because that’s the equation of motion.
Does that make sense and mean anything? It seems strange
for a conserved current corresponding to a symmetry to vanish.
It looks like if I include the whole Clifford bundle connection

we get Einstein-Cartan theory (non-vanishing torsion)
and a couple of other gauge fields. ...
... one cool thing we could do in the complex Cl ... that’s
build the duality projector:
P = (1/2) (1 - i g)
So we could then work in the "sef-dual" formulation of GR
by just using the self-dual half of the action,
S = i < Fe P Fe >
And a lot of people like to do that,
Plebanski and Ashtekar for example. ...".

A question that arises is how does the
1 8 28 56 70 56 28 8 1 Clifford Hodge star
morph into the
1 4 6 *4 *1 unitary/exterior Hodge star ?
(note that the 6 can be written as 3 + *3)

The way I see it is that the 8-dim Hodge star uses
an 8-dim txyzabcd pseudoscalar,
the first 4 terms txyz of which will go to physical spacetime
and the second 4 terms abcd of which will go to CP2 Kaluza-Klein space,
and
that the first 4 terms txyz will go to the first unitary/exterior 4
and the last 4 terms abcd will go to the dual unitary exterior *4.

A closely related questin is
how is the low-energy g_munu curvature "embedded"
in the flat-looking Spin(8) up in Cl(8) 8-dim high-energy spacetime ?

In 8-dim at high energies my Cl(8) model is flat with
no dynamic relativity-type g_munu curvature,
and so no nontrivial g_munu raising and lowering.

Dynamic g_munu curvature only appears after:
1 - picking a quaternionic subspace splits 8-dim spacetime
into 4-dim Minkowski physical spacetime and 4-dim internal
symmetry space that is CP2;
2 - the U(2,2) part of Spin(8) acts by MacDowell-Mansouri
to produce Einstein etc gravity, by which process
the dynamic g_munu curvature emerges and you can then
do raising and lowering with the dynamic g_munu.

In the above-mentioned April 2005 sci.physics.research conversation
of **Garrett Lisi** with John Baez, John Baez said

"... If you’re working over the complex numbers,
as evil physicists usually do,
the Clifford algebra Cl_4 is isomorphic to the algebra
of 4x4 complex matrices.
So, if we think of it as a Lie algebra via [a,b] = ab-ba,
we get the Lie algebra of 4x4 complex matrices,
usually known as gl(4,C).
But this is a complexification of u(4),
and since evil physicists never even *care* about
the difference between real and complex Lie algebra,

I can easily imagine someone saying that the answer is u(4). ..",

and **Garrett Lisi** said

"... I'm more than happy to work with real Clifford algebras. ...".

Since real Clifford algebras have the periodicity 8 property
that I need for my physics model for such things as building
the generalized hyperfinite II1 von Neumann algebra factor
(In this I may be sloppy about signature.):

At Cl(8) high energy, we have 28 Spin(8) as gauge group.

Spin(8) has a natural U(4) subgroup (for MacDowell-Mansouri gravity)
and
the standard model groups correspond to
the coset space Spin(8) / U(4) which is the set of complex structures
on R8 that are compatible with its Euclidean structure (see
Besse, Einstein Manifolds (Springer 1987)).

As John Baez said,
consider U(4) as roughly M(4,C) the 4x4 complex matrices.

M(4,C) is the real Clifford algebra Cl(2,3) of the anti-deSitter group
Spin(2,3) = Sp(2) that is the basis of the MacDowell-Mansouri mechanism,
which uses the bivector 10 of the Cl(2,3) grading 1 5 10 10 5 1
to get gravity (4 of that 10 giving gravity and 6 for torsion).

So,
the dynamic g_munu of 4-dim gravity comes from 4 of the bivector 10 of U(4)
which U(4) in turn is embedded in the 8-dim Spin(8).

As to how the U(4) fits inside the Spin(8),
look at the e0, e1, e2, e3, e4, e5, e6, e7 of Cl(8)
and see the U(4) as generated by
e0 - i e1
e2 - i e3
e4 - i e5
e6 - i e7
Let the Spin(8) Dirac operator is d8 + *d8 (where * is Cl(8) pseudoscalar)
Then, with the map #: i -> -i, d8 for Spin(8) goes to d4 + #d4 for U(4).

The U(4) subgroup of Spin(8) has a natural Sp(2) subgroup
(for MacDowell-Mansouri gravity)
and
the 5 special conformal generators related to Higgs
correspond to the 5-dim coset space SU(4) / Sp(2) which
is the set of quaternionic structures on C4
that are compatible with its Hermitian structure (see
Besse, Einstein Manifolds (Springer 1987)).

The 6th element of U(4) containing Sp(2)
is the U(1) of U(4) = U(1) x SU(4),
which in my model corresponds to
the complex phase of particle propagators.

```
Taking that into account, there is a nesting of coset spaces
Spin(8) / U(4) =  complex structures = standard model generators
SU(4) / Sp(2) = quaternionic structures = conformal Higgs stuff
Sp(2) = MacDowell-Mansouri gravity (with torsion if you use all 10 dim).

As to how the Sp(2) fits inside the Spin(8),
look at the e0, e1, e2, e3, e4, e5, e6, e7 of Cl(8)
and see the Sp(2) as generated by
e0 - i e1 - j e2 - k e3
e4 - i e5 - j e6 - k e7
where k = ij (quaternion imaginaries
Let the Spin(8) Dirac operator is d8 + *d8 (where * is Cl(8) pseudoscalar)
Then, with the maps #: i -> -i and $: j -> -j
d8 for Spin(8) goes to d2 + #d2 + $d2 + #$d2 for Sp(2).

Some further interesting questions are:

Is there a duality between Minkowski spacetime and K-K CP2 ?

Can the *4 (or K-K CP2) part be thought of as an imaginary part of
a complex space of which Minkowski spacetime is a real part ?

Are there shadows of D4 triality that can be seen in conformal D3=A3
in the details of the relationship between the Clifford 6-dim D3
and the unitary/exterior 4-dim A3
and
can those remnants of triality be used to establish relations
(after dimensional reduction)
among spinor fermions, gauge bosons, and torsion?
```

Therefore,

Klein Quartic Physics gives a 4-dim spacetime with CP2 Kaluza-Klein and gravity and the U(1)xSU(2)xSU(3) Standard Model.

As to the fermions,

- the (1/2)(+ 1 +/- i +/- j +/- k) 8 fermion particles and
- the (1/2)(- 1 +/- i +/- j +/- k) 8 fermion anti-particles

give the Standard Model first generation, with the second and third generations being given by considering how the fermions move in the 4-dim spacetime and/or the Kaluza-Klein CP2.

See Sets2Quarks9.html#sub13 for details of how that works.

Why does SL(2,7) need 7 copies of <4,3,2> ?

Having gotten F4 structure out of Klein Quartic Physics, consider further structures:

F4 can be complexified to get E6, and the E6 5-grading

g = E6 = g(-2) + g(-1) + g(0) + g(1) + g(2)

such that

- g(0) = so(8) + R + R
- dimR g(-1) = dimR g(1) = 16 = 8 + 8
- dimR g(-2) = dimR g(2) = 8

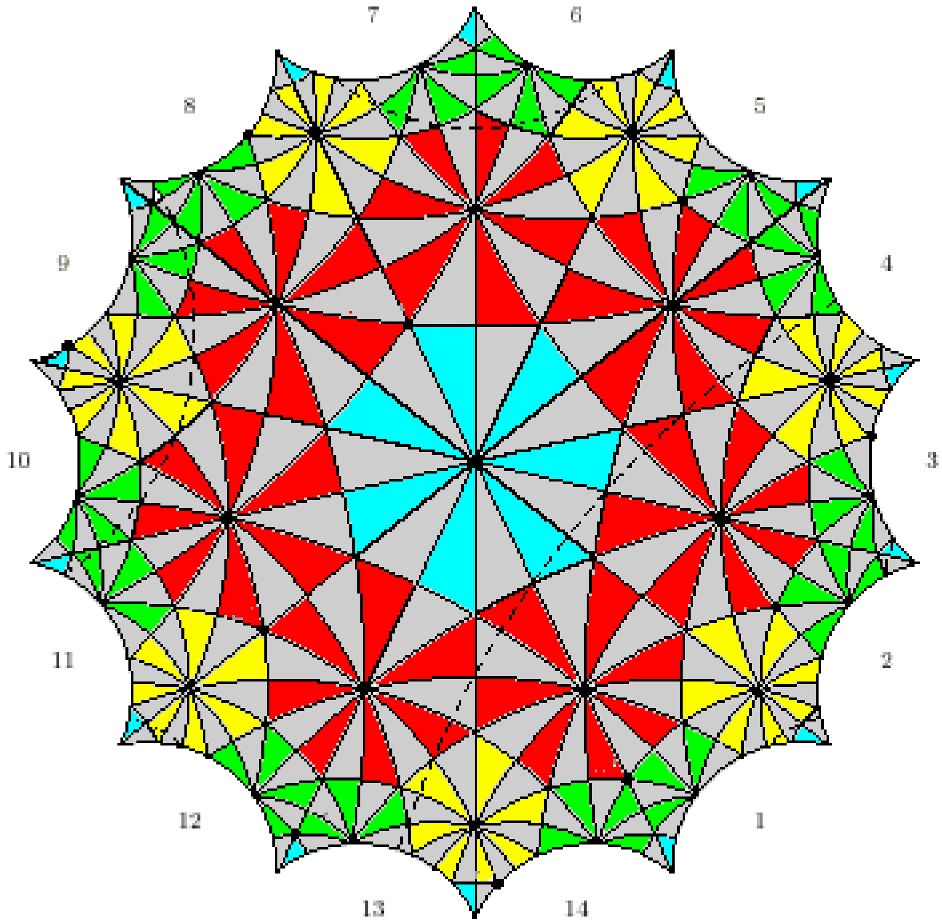
is useful in seeing that the fermionic part of the model lies in the odd part of the E6 5-grading, and is useful in interpreting the model with respect to string theory, as described in CERN-CDS-EXT-2004›031 which is at http://cdsweb.cern.ch/ .

In that E6 string model, each Planck-scale E8 lattice D8 brane is a superposition / intersection / coincidence of eight E8 lattices.

7 of the 8 lattices are independent E8 lattices, each corresponding to one of the 7 imaginary octionion basis elements i, j, k, E, I, J, K.

The 8th E8 lattice is dependent on the 7, and can be thought of as corresponding to the real octonion basis element 1.

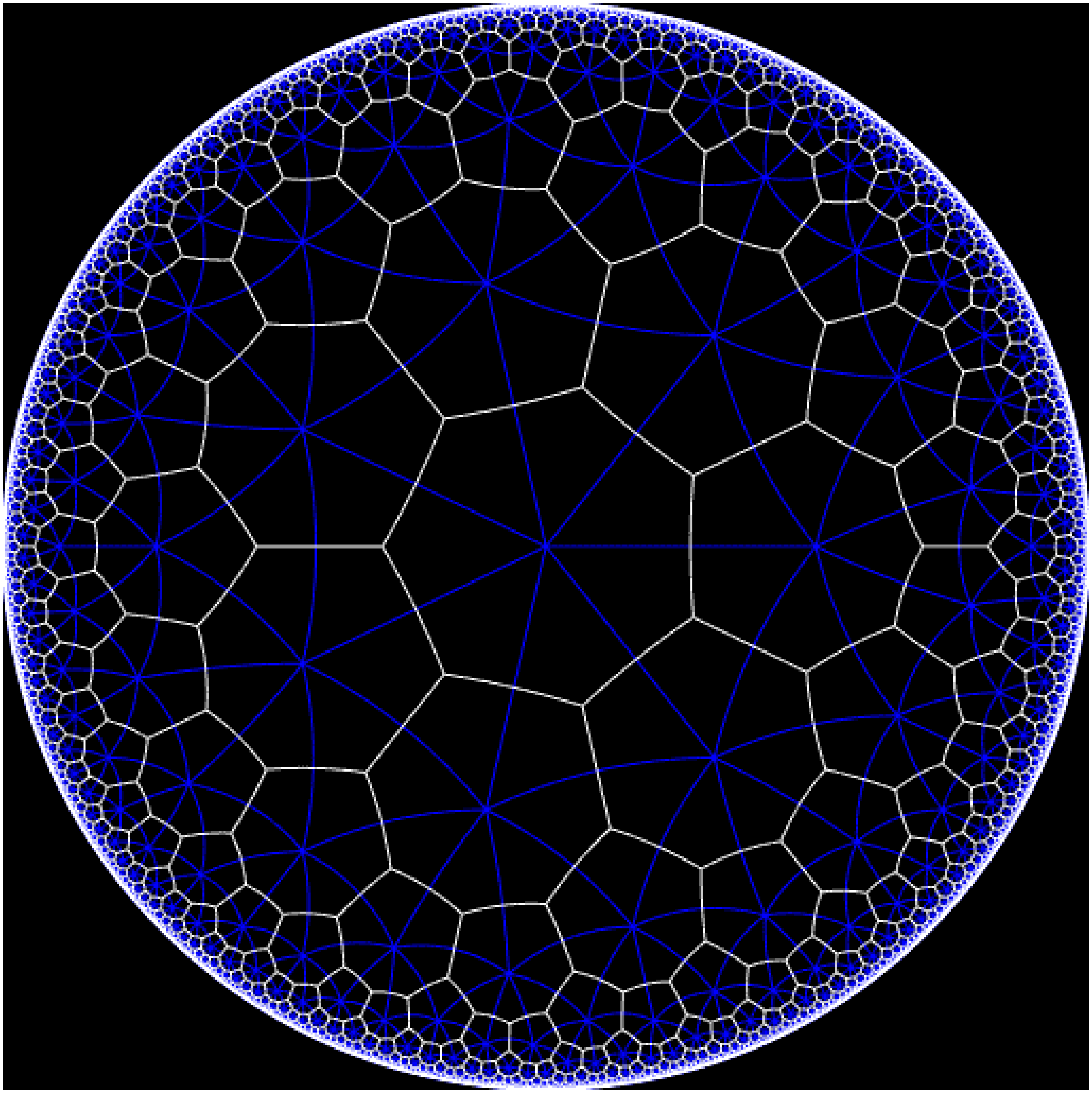
The representations of the Klein Quartic by triangles



may be related to the fact that the 7 imaginary octonions, and therefore the 7 coset spaces of SL(2,7) / <4,3,2> , correspond to the 7 associative 3-dimensional quaternionic triangles:

```
                    i
                   / \
                  k---j

     i     j     k     I     J     K
    / \   / \   / \   / \   / \   / \
   K---J I---K J---I E---i j---E k---E
```

The representations of the Klein Quartic by heptagons (image from [Don Hatch](#))



may be related to the fact that the 7 imaginary octonions, and therefore the 7 coset spaces of SL(2,7) / <4,3,2> , also correspond to the 7 octonionic heptavertons / Onarhedra. Arthur Young, in his book The Reflexive Universe (Robert Briggs Associates 1978), says: "... The Heptaverton: Connecting seven points each to each requires 21 lines or edges. ... This figure can be thought of as adding a point at the center of the Octahedron, and this additional point creates a set of 6 compressed diagonals in addition to the 15 ...[12 edges plus 3 full diagonals of the octahedron]...".

The outer hull of a heptaverton / Onarhedron is an octahedron.

It has 4 pyramids (half of the 8 pyramids of a simplicial decomposition of the octahedron) plus 4 triangles that make up the other faces of the outer octahedron.

All 4 pyramids share 1 central vertex and the 6 outer vertices are each shared by 2 pyramids and 2 triangles.

The term Onarhedron comes from a later rediscovery, coming from studying octonions, of the heptahedron by Onar Aam and his namesake, Onar, the high god in Norse mythology who created the universe. Here are the 7 heptavertons / Onarhedra:

```
                                      E
                                     / \
                                    /   \
                                  J-----j             E j
          J          I---j      / |     | \            |/
I  -->  / \  -->  |   | -->   i   |  I  |   i   =  J--I--k
       i---K      k---E         \ |     | /          /|
                                  K-----k           K i
                                    \   /
                                     \ /
                                      E
```

```
                                      E
                                     / \
                                    /   \
                                  K-----k             E k
          j          J---i      / |     | \            |/
J  -->  / \  -->  |   | -->   j   |  J  |   j   =  K--J--i
       I---K      k---E         \ |     | /          /|
                                  I-----i           I i
                                    \   /
                                     \ /
                                      E
```

```
                                      E
                                     / \
                                    /   \
                                  I-----i             E i
          J          K---i      / |     | \            |/
K  -->  / \  -->  |   | -->   k   |  K  |   k   =  I--K--j
       I---k      j---E         \ |     | /          /|
                                  J-----j           J k
                                    \   /
                                     \ /
                                      E
```

```
                                      k
                                     / \
                                    /   \
```

```
                                  I-----J             k J
         I        J---j       / |     | \         |/
i  -->  / \  -->  |   | -->   j   |  i  |   j   =  I--i--E
       E---i      K---k       \ |     | /          /|
                                  K-----E           K j
                                   \   /
                                    \ /
                                     k



                                     k
                                    / \
                                   /   \
                                  J-----I             k I
         J        K---k       / |     | \         |/
j  -->  / \  -->  |   | -->   i   |  j  |   i   =  J--j--E
       E---j      I---i       \ |     | /          /|
                                  K-----E           K i
                                   \   /
                                    \ /
                                     k



                                     i
                                    / \
                                   /   \
                                  K-----J             i J
         K        I---i       / |     | \         |/
k  -->  / \  -->  |   | -->   j   |  k  |   j   =  K--k--E
       E---k      J---j       \ |     | /          /|
                                  I-----E           I j
                                   \   /
                                    \ /
                                     i



                                     I
                                    / \
                                   /   \
                                  J-----k             I k
         j        I---J       / |     | \         |/
E  -->  / \  -->  |   | -->   i   |  E  |   i   =  J--E--j
       i---k      K---E       \ |     | /          /|
                                  K-----j           K i
                                   \   /
                                    \ /
                                     I
```

Heptavertons / Onarhedra may be useful in constructing in 4-dimensional spacetime with 3 space dimensions a quantum cellular automata model, or generalized Feynman Checkerboard model, because, just as

- 8-dimensional E8 lattices can be formed by Witting polytopes, and
- 4-dimensional space can be filled by 24-cells, and
- 2-dimensional space can be filled by hexagons, triangles, or squares,

so 3-dimensional space can be filled by octahedra and cuboctahedra, and Onar Aam has shown that onarhedra and cuboctahedra consistenly fit together to form an onarhedral lattice that tiles 3-dim space.

```
K---k---E---I---i---K---J---j---E---i---I---k---J---E---j---K---I
|       |   +   |       |   +   |       |   +   |       |   +   |
j       j+++i+++k       k+++E+++K       K+++J+++i       i+++I+++E
|       |   +   |       |   +   |       |   +   |       |   +   |
I---k---J---E---j---K---I---J---k---i---j---I---K---E---k---j---i
|   +   |       |   +   |       |   +   |       |   +   |       |
K+++J+++i       i+++I+++E       E+++j+++J       J+++k+++I       I
|   +   |       |   +   |       |   +   |       |   +   |       |
j---I---K---E---k---j---i---J---K---k---E---I---i---K---J---j---E
|       |   +   |       |   +   |       |   +   |       |   +   |
J       J+++k+++I       I+++K+++j       j+++i+++k       k+++E+++K
|       |   +   |       |   +   |       |   +   |       |   +   |
E---I---i---K---J---j---E---i---I---k---J---E---j---K---I---J---k
|   +   |       |   +   |       |   +   |       |   +   |       |
j+++i+++k       k+++E+++K       K+++J+++i       i+++I+++E       E
|   +   |       |   +   |       |   +   |       |   +   |       |
J---E---j---K---I---J---k---i---j---I---K---E---k---j---i---J---K
```

This is a chessboard lattice of onarhedra and cuboctahedra. The 2D cross made of +'es are the onarhedra and the "empty" squares next to them are "flattened" cuboctahedra. If you deform the above lattice by contracting the cuboctahedra so that the similar imaginaries on the opposite sides merge, you get two interwovern onarhedral lattices.

You can also use onarhedra to get triangular tilings that may be similar to tilings of tetrahedra and truncated tetrehedra:

```
i___E___J___I___j___k___K___i
 \*/ \*/ \*/ \*/ \*/ \*/ \*/ \
  I___j___k___K___i___E___J___I
 / \*/ \*/ \*/ \*/ \*/ \*/ \*/
k___K___i___E___J___I___j___k
 \*/ \*/ \*/ \*/ \*/ \*/ \*/ \
  E___J___I___j___k___K___i___E
 / \*/ \*/ \*/ \*/ \*/ \*/ \*/
I___j___k___K___i___E___J___I
 \*/ \*/ \*/ \*/ \*/ \*/ \*/ \
  K___i___E___J___I___j___k___K
```

The * is inside the octonionic triangles, those pointing downward. The triangles pointing upward are not associative, but they can be made into co-associative tetrahedra by adding an appropriate imaginary above them. This tiling is self-similar in that, if you replace each triangle with its corresponding imaginary, then you get exactly the same tile.

The cuboctahedron-onarhedron tiling uses the interior coassociative squares of Onarhedra, while the triangular tiling uses the exterior associative triangles.

These tilings might be useful to construct something like a spin network or a spin foam model or a discrete spacetime model. Roger Penrose, in the USA edition (Knopf 2005) of his book The Road to Reality, says:

> "... The original ... spin-network proposal ... was ... of a completely discrete character, but the standard loop-variable picture is still dependent upon the continuous nature of the 3› surface in which the 'spin networks' are taken to be embedded. ... a spin foam ... can [be] picture[d] ... as a time-evolving spin network. ... Other suggestions take spacetime to have a discrete periodic lattice structure ... schemes like Raphael Sorkin's causal-set geometry ... [take]... spacetime ... to consist of a discrete, possibly finite, set of points for which the notion of causal connection between points is taken to be the basic notion. ... Other ideas ... arise from ... quaternionic geometry ... octonionic ... physics ... etc. ...".

With respect to spin foam models and how E6 and F4 might be used in them, John Baez said (in some spr posts):

> "... Taking the quotient (structure group) / (automorphism group) we get homogeneous spaces of the sort used to construct spin foam models of quantum gravity. ... with a certain real form of E6 and the compact real form of F4 ...[in the case of H3(O), the quotient (structure group) / (automorphism group) = E6 / F4]... the quotient of Lie groups E6 / F4 is what matters for the spin foam models, and this is a bit "curvier" ...[than the]... quotient of Lie algebras e6 / f4 [which] is a vector space that can be naturally identified with H3_0 (O) [the traceless subalgebra of the 27-dim octonionic Jordan algebra H3(O)]... e6 / f4 can be viewed as a tangent space of E6 / F4. ...".

Note that F4 is the automorphisms of the exceptional Jordan algebr J3(O) and E6 is the automorphisms of the Freudenthal algebra Fr(3,O).

I am happy that Klein Quartic Physics as I have described it seems to me to

be not only consistent with, but also equivalent to, my D4D5E6E7E8 VoDou Physics model.

Quaternionic SL(2,3) and Octonionic SL(2,7)

Since

- 1 copy of binary tetrahedral of tetrahedron = 1x24 = 24-element SL(2,3) and
- 7 copies of binary octahedral of cube = 7x48 = 336-element SL(2,7)

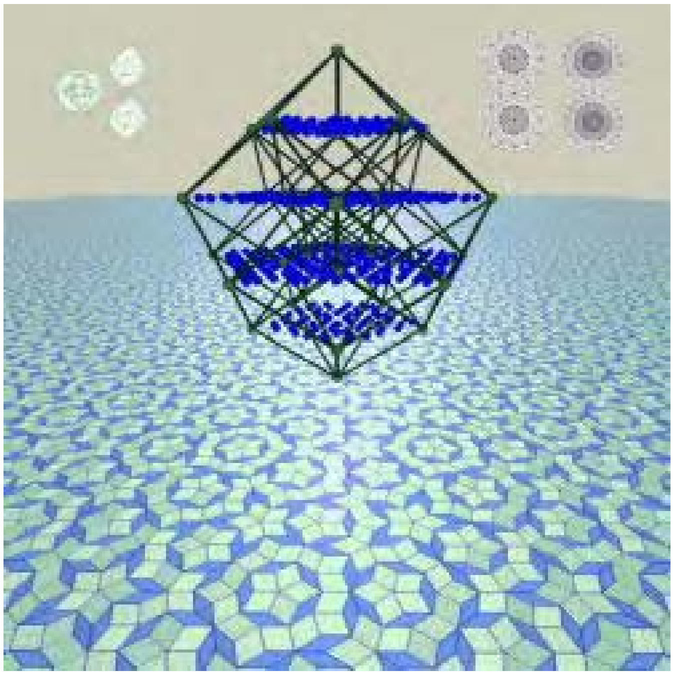
then it seems to me that it is probably true that

- the 4 faces of the tetrahderon are like the 4 dimensions of quaternions with the 3 of SL(2,3) being the 3 quaternion imaginaries and the 1 copy is due to the 1 associative triangle that can be constructed from the 3 imaginary quaternions, and
- the 8 faces of the octahedron are like the 8 dimensions of octonions with the 7 of SL(2,7) being the 7 octonion imaginaries and the 7 copies are due to the 7 associative triangles that can be constructed from the 7 imaginary octonions.

Klein Quartic Physics and the McKay Correspondence

The McKay correspondences (using his notation of <r,q,p> instead of <p,q,r>) include:

```
D4 corrresponds to <2,2,2> = quaternion group of order 4+4 = 8
E6 corresponds to <2,3,3> = 2.Alt[4] binary tetrahedral group of order 12+12 = 24
E7 corresponds to <2,3,4> = 2.Symm[4] binary octahedral group of order 24+24 = 48
E8 corresponds to <2,3,5> = 2.Alt[5] = SL(2,5) binary icosahedral group of order 60+60 =
120
By root vector structure, in the sense that F4 = D4 + 8 + 16 = D4 + <2,3,3> ,
```



D5 = D4 + 1 + (8+8) = D4 + 1 + 2.<2,2,2>

E6 = D5 + 1 + (16+16) = D5 + 1 + (4+4) + (12+12) = D5 + 1 + <2,2,2> + <2,3,3> =
= D4 + 1 + (8+8) + 1 + (4+4) + (12+12) = D4 + 2 + (8+8+8) + (12+12) =
= D4 + 2 + (24+24) = D4 + 2 + <2,3,4> =
= D4 + 1 + (8+8) + 1 + (16+16) = D4 + 8 + 16 + 2 + (8+16) = F4 + 2 + <2,3,3>

E7 = E6 + 1 + (27+27) = E6 + 1 + (3+3) + (24+24) = E6 + 1 + (3+3) + <2,3,4> =
= E6 + 3 + (1+3 + 24+24) = E6 + 3 + F4

E8 = E7 + 1 + (56+1+56+1) = E7 + 3 + (56+56) = E7 + 3 + (30+30) + (24+2+24+2) =
= E7 + 7 + (2,3,5) + <2,3,4> =
= E7 + 3 + Alt[5] + (4+24+24) = E7 + 3 + PSL(2,5) + F4

Note that (2,3,5) = Alt[5] = PSL(2,5) is a simple group as
it is an alternating group of at least 5 elements.

Visualization of the Klein Quartic

According [The Eightfold Way: The Beauty of Klein's Quartic Curve, edited by Silvio Levy (MSRI Publications -- Volume 35, Cambridge University Press, Cambridge, 1999)]:

"... The Klein surface is the Riemann surface of the algebraic curve with equation ... x^3 y + y^3 z + z^3 x = 0 ... that ... is mapped into itself by 168 analytic transformations. Since the equation is real, the surface is also mapped on itself by complex conjugation, which can be composed with the analytic maps to give a further 168 antianalytic mappings, yielding a group of order 336. Klein concentrated ... on the subgroup of index 2 and order 168 ... [The Klein Quartic group PSL(2,7) = PSL(3,2) of order 168]... is the second smallest simple noncommutative group. ...

> [According to The Classification of the Finite Simple Groups, by Gorenstein, Lyons, and Solomon (AMS Surveys and Monographs Vol. 40, No. 1, 1994), the smallest is PSL(2,5) = A5 = of order 60 , and some others are PSL(2,8) of order 504 and PSL(2,10) = A6 of order 360.]

... Klein ... approached the ... group and Riemann surface ... by studying the modular group GAMMA(1) of all functions z -> (p z + q) / (r z + s) where p,q,r,s are in Z, and ps - qr = 1. These are permutations of the upper half-plane U ... The upper half-plane is a Riemann surface, so its quotient surface U / GAMMA(1) is also a Riemann surface - a sphere with one ... puncture. ... The congruence subgroups GAMMA(n), which consist of [such] mappings ... such that

```
p  q
        = +/- Id (mod n)
r  s
```

are ... kernel[s] of a homomorphism, GAMMA(n) is a normal subgroup of GAMMA(1), and the factor group acts on the quotient surface as a group of automorphisms. The quotient surfaces for GAMMA(2), GAMMA(3), GAMMA(4), and GAMMA(5), are spheres with 3, 4, 6, and 12 punctures. The factor groups include the symmetry groups of the platonic solids (tetrahedron, octahedron and icosahedron). The quotient surface of GAMMA(6) ...[is]... a torus with twelve punctures ... the factor group GAMMA (1) / GAMMA(6) is rather dull. ... At GAMMA(7) ... Klein found ...[a]... surface ...[of]... genus 3 with 24 punctures. The punctures are "removabele singularities" ... so he had a Riemann surface of genus 3 with 168 automorphisms. The quotient group is ... PSL(2,7) ... The Riemann surface of ...[the Klein Quartic]... is a 168-sheeted covering of the sphere, branched over three points of the sphere.

- Above one of these points the 168 sheets join together in sevens to geve 24 points of the surface. These are the points of inflection. They are also the Weirstrass points.
- Above another branch point, there are 84 points of the surface, where the sheets join in twos. These are the sextactic points, through which pass a conic section that has six-fold contact with the curve.
- Above the third branch point the sheets join in threes to give 56 points of the surface. These 56 points are the of contact of ...[the Klein Quartic]... with the 28 bitangents, or lines that are tangent to the curve at two points.

... The numbers 2, 3, 7 reflect the fact that the universal cover of the whole picture is the triangle group (2,3,7) acting on ... the upper half-plane ... U. The modular group GAMMA(1) is the triangle group (2,3, oo). Replacing oo by 7 amounts to removing the removable singularities. ...

... Fricke discovered the ... group PSL(2,2^3) of order 504 and genus 7 ...".

Roger Penrose's book The Road to Reality comes in two editions:

- UK edition (ISBN: 0224044478, Publisher: Jonathan Cape, July 29, 2004) and
- USA edition (ISBN: 0679454438, Publisher: Knopf, February 22, 2005).

  T**he two editions are NOT identical**. For example:

  The UK edition on page 1050 says in part: "... Bibliography ... There is one major breakthrough in 20th century physics that I have yet to touch upon, but which is nevertheless among the most important of all! This is the introduction of arXiv.org, an online repository where physicists ... can publish preprints (or 'e-prints') of their work before (or even instead of!) submitting it to journals. ...as a consequence the pace of research activity has accelerated to unheard of heights. ... In fact, Paul Ginsparg, who developed arXiv.org, recently won a MacArthur 'genius' fellowship for his innovation. ..."

  but

  The USA edition on its corresponding page (also page 1050) says in part: "... Bibliography ... modern technology and innovation have vastly improved the capabilities for disseminating and retrieving information on a global scale. Specifically, there is the introduction of arXiv.org, an online repository where physicists ... can publish preprints (or 'e-prints') of their work before (or even instead of!) submitting it to journals. ...as a consequence the pace of research activity has accelerated to an unprecedented (or, as some might consider, an alarming) degree. ...". However, **the USA edition omits the laudatory reference to Paul Ginsparg that is found in the UK edition**.

  For another example:

  The USA edition adds some additional references, including (at page 1077): "... **Pitkanen, M.** (1994). p-Adic description of Higgs mechanism I: p-Adic square root and p-adic light cone. [hep-th/9410058] ...".

  Note that Matti Pitkanen was in 1994 allowed to post papers on the e-print archives now known as arXiv (obviously including the paper referenced immediately above), but since that time **Matti Pitkanen has been blacklisted by arXiv** and is now barred from posting his work there. His web page account of being blacklisted is at http://www.physics.helsinki.fi/~matpitka/blacklist.html .

  It seems to me that it is likely that the omission of praise of arXiv's Paul Ginsparg and the inclusion of a reference to the work of now-blacklisted physicist Matti Pitkanen are deliberate editorial decisions.

Also, since the same phrase "... physicists ... can publish preprints (or 'e-prints') of their work before (or even instead of!) submitting it to journals. ..." appears in both editions, it seems to me that Roger Penrose favors the option of posting on arXiv without the delay (and sometimes page-charge expense) of journal publication with its refereeing system.

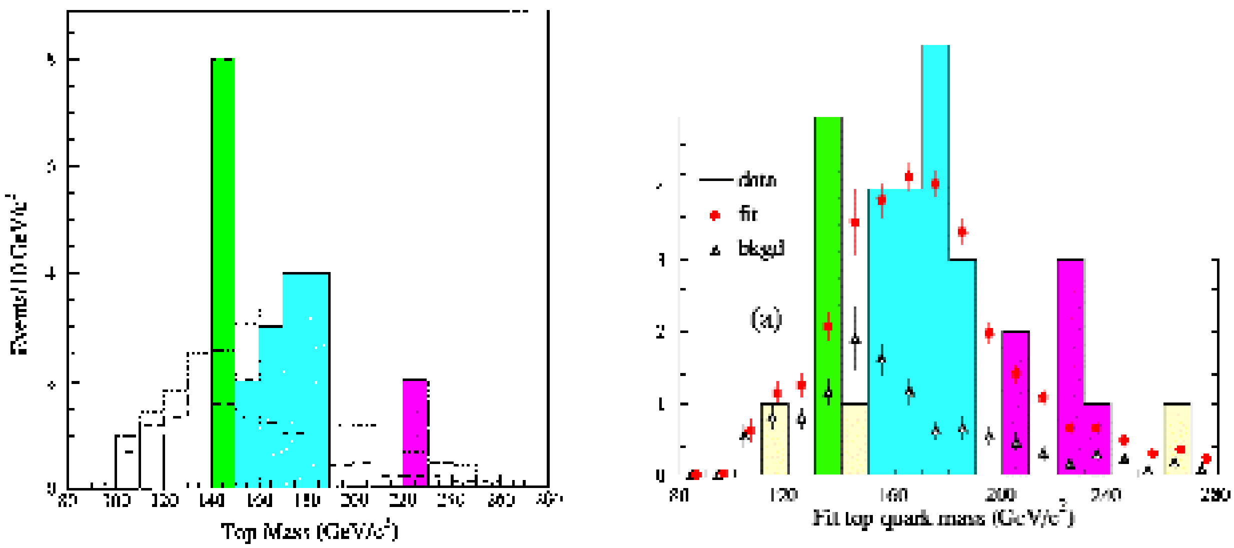
I wonder what events between UK publication on July 29, 2004 and USA publication on February 22, 2005 might have influenced Roger Penrose to make the above-described changes in the USA edition ?

There are two possibly relevant events in that time frame of which I am aware:

- The appearance around November 2004 of the ArchiveFreedom web site, which web site documents some cases of arXiv blacklisting etc;
- According to a CERN web page at http://documents.cern.ch/EDS/current/access/action.php?doctypes=NCP "... CERN's Scientific Information Policy Board decided, at its meeting on the 8th October 2004, to close the EXT-series. ...". Note that the CERN EXT-series had been used as a public repository for their work by some people (including me) who had been blacklisted by arXiv .

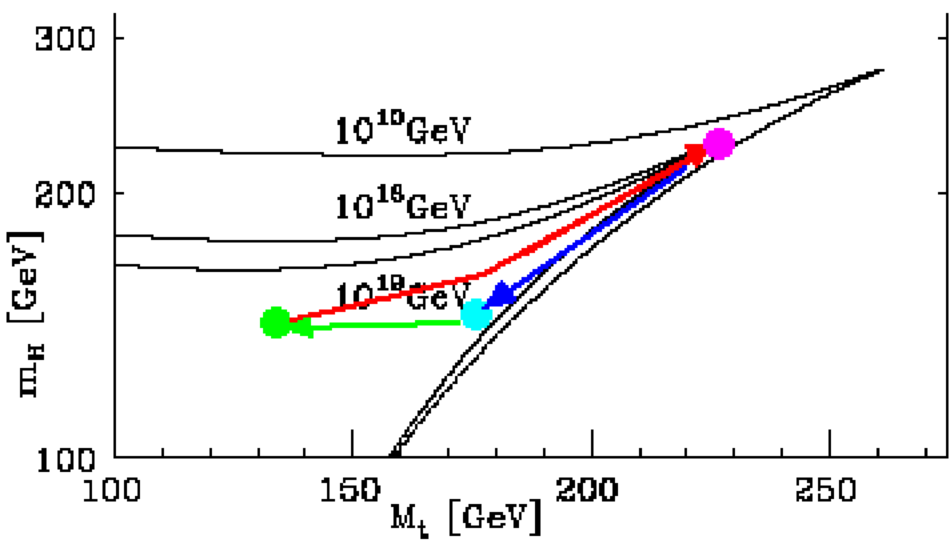
Tony Smith's Home Page

CDF and D0 observed 3 peaks in their T-quark data:



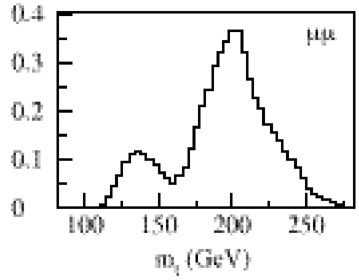
The middle (cyan) peak (around 175 GeV) is the one they initially identified as the T-quark.

The low peak (green) and the high peak (magenta) can be understoon in terms of Froggatt's paper [hep-ph/0307138]:



in terms of a 3-part system of the T-quark, the Higgs, and the Vacuum.

The high and low peaks can be seen when you look closely at dilepton events, such as the D0 event Run 84395, Event 15530 (mu mu) described in the 1997 UC Berkeley PhD thesis of Erich Ward Varnes and in hep-ex/9808029



as analyzed using the matrix-element weighting algorithm that, according to hep-ex/9808029, "... is an extension of the weight proposed in [R.H. Dalitz and G.R. Goldstein, Phys. Rev. D45, 1531 (1992)] ...".

Close study of all 3 peaks might give useful information about not only the T-quark and the Higgs, but also our Vacuum itself.

Koichi Yamawaki in his paper at hep-ph/9603293 describes T-quark condensate Higgs models (NJL and BHL) that seem to be related to the low and high T-quark peaks

and

Michio Hashimoto, Masaharu Tanabashi, and Koichi Yamawaki in their paper at hep-ph/0311165 describe a T-quark condensate models in 8› dimensional spacetime (with 4 compact dimensions) that seem to be related to the middle T-quark peak.

In his paper, Yamawaki says in part:

> "... tightly bound composite Higgs models such as ... top quark condensate ...[which have]... nontrivial short distance dynamics of the gauged Nambu-Jona-Lasinio (NJL) models (gauge theories plus four- fermion interactions)

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

> ... in which the critical phenomenon in the gauged NJL model [yield] a simple reason why the top quark can have an extremely large mass compared with other quarks and leptons. ... the four-fermion theory

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

in the presence of gauge interactions (gauged NJL model) can become renormalizable and nontrivial in sharp contrast to the pure NJL model without gauge interactions. ...

... The Higgs boson was predicted as a tbar-t bound state ...

... the top quark can have a large mass, or more properly, why other fermions can have very small masses ... if only the top quark coupling is above the critical coupling, while all others [are] below it ...

The top quark condensate ... indeed yields a standard gauge symmetry breaking pattern ... to feed the mass of W and Z bosons. ...

The largest physically sensible (new physics scale) would be the Planck scale 10^19 GeV at which we have a minimum value prediction mt = 145 GeV ... with the pure NJL case ...

The BHL [Bardeen-Hill-Lindner] value is then given by mt = 218 +/- 3 GeV, at 10^19 GeV ... The Higgs boson was predicted as a tbar-t bound state ... Its mass was also calculated by BHL through the full RG equation ... the result being ... MH = mt x 1.1 at 10^19 GeV ...[which gives]... MH = 239 +/- 3 GeV for mt = 218 +/- 3 GeV ...[and MH = 143 GeV for mt = 130 GeV which is reasonably close to the 145 GeV value of mt]...".

In other words, Yamawaki indicates that

the NJL model describes the low T-quark peak around 145 GeV, which is reasonably close to the 130 GeV value of the D4-D5-E6-E7-E8 VoDou physics model

the BHL model describes the high T-quark peak around 218 GeV and

the BHL model Higgs / T-quark mass ratio of 1.1 is consistent with the 145.8 GeV / 130 GeV = 1.12 ratio of the D4-D5-E6-E7-E8 VoDou physics model.

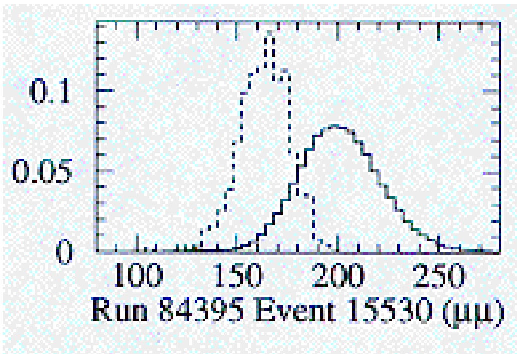
Also, Hashimoto, Tanabashi, and Yamawaki in their paper at hep-ph/0311165 say:

"... We perform the most attractive channel (MAC) analysis in the **top mode standard model with** TeV-scale **extra dimensions**, where the standard model gauge bosons and the third generation of quarks and leptons are put in D(=6,8,10,...) dimensions. In such a model, bulk gauge couplings rapidly grow in the ultraviolet region. In order to make the scenario viable, only the attractive force of the top condensate should exceed the critical coupling, while other channels such as the bottom and tau condensates should not. We then find that the top condensate can be the MAC for D=8 ... We predict masses of the top (m_t) and the Higgs (m_H) ... based on the renormalization group for the top Yukawa and Higgs quartic couplings with the compositeness conditions at the scale where the bulk top condenses ...

for ...[Kaluza-Klein type]... dimension... D=8 ... m_t = 172-175 GeV

and m_H=176-188 GeV ...".

The middle peak can be seen when you look closely at the D0 dilepton event Run 84395, Event 15530 (mu mu) described in the 1997 UC Berkeley PhD thesis of Erich Ward Varnes and in hep-ex/9808029



using the neutrino weighting algorithm. It has 3 jets. **If all 3 jets are included** (the solid line in the graph), energy around 200 GeV, corresponding to the Standard Model Critical Point Truth Quark excited state at the magenta dot. **If only the 2 highest energy jets are included** (the dashed line in the graph), it has energy around 170 GeV, corresponding to the 2-vacuum intermediate excited Truth Quark state at the cyan dot, and **the energy of the third jet would correspond to decay down the blue curve along the Vacuum Stability bound of 10^19 GeV**.

Here are some more details from **Yamawaki**'s paper at hep-ph/9603293:

"... mass of all particles in the ... standard model (SM) ... is attributed to a single order parameter, the vacuum expectation value (VEV) of the Higgs doublet. Thus the problem of the origin of mass is simply reduced to understanding the dynamics of the Higgs sector...

... the situation very much resembles the Ginzburg-Landau (GL)'s macroscopic theory for the superconductivity, the mysterious parts of which were eventually explained by the microscopic theory of Bardeen-Cooper-Schrieffer (BCS): The GL's phenomenological order parameter was replaced by the Cooper pair condensate due to the short range attractive forces.

... the sigma-model description by Gell-Mann and Levy (GML) works very well as far as the low energy (macroscopic) phenomena are concerned, while the deeper understanding of it was first given by Nambu and Jona-Lasinio (NJL)1 based on the analogy with the BCS dynamics.

Nowadays people believe that essentially the same phenomena as described by the NJL paper takes place in the microscopic theory for hadrons, QCD.

In QCD the VEV of sigma ... 93 MeV, has been replaced by the quark-antiquark pair condensate ... an analogue of the Cooper pair condensate, formed by the attractive color forces.

The Nambu-Goldstone (NG) boson, the pion, is now a composite state of quark and antiquark.

This is actually the prototype of the dynamical symmetry breaking (DSB) due to composite order parameters like fermion pair condensates.

In fact **Higgs sector in the SM is precisely the same as the sigma model except that ... the VEV of sigma ... 93 MeV ... is now replaced by the Higgs VEV ... 250 GeV** ...

One is thus naturally led to speculate that there might exist a microscopic theory for the Higgs sector, with the Higgs VEV being replaced by the fermion-antifermion pair condensate ...

... tightly bound composite Higgs models were ... proposed based on the ... gauged NJL model (gauge theory plus four-fermion interaction)

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

within the framework of ladder Schwinger-Dyson (SD) equation. The gauged NJL model was shown to have a phase structure divided by a critical coupling (critical line) similarly to the NJL model, and have a large anomalous dimension due to strong attractive forces at relatively short distance or high energy. Such a system may actually be regarded as a theory with ultraviolet fixed point(s) in contrast to the asymptotic freedom. A remarkable feature of this dynamics is that the four-fermion interation in four dimensions

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

may become renormalizable ... in a non-perturbative sense ... in sharp contrast to the pure NJL model ...

... We give a detailed comparison between the original formulation of Miransky-Tanabashi-Yamawaki (MTY) and another one of Bardeen-Hill-Lindner (BHL) ...

... **current masses ... are entirely due to the Higgs VEV through the Yukawa coupling** in the Glashow-Salam-Weinberg model and have nothing to do with the QCD dynamics ...

... QCD has no elementary order parameters. If the quark and gluon fields were order parameters, then the Lorentz invariance, color symmetry and charge symmetry would have been spontaneously broken in QCD in contrast to the reality. Then only possible order parameters are composite ones, variation of n-point Green functions or that of **local composite fields. ... where ... a dynamical mass of quark, signals the spontaneous chiral symmetry breaking due to the QCD dynamics. We may define an "on-shell" dynamical mass m* ... which is often called constituent mass (it also includes the effects of the explicit breaking due to the current mass**). In contrast to the sigma model where ... there is no Yukawa coupling ... at Lagrangian level in QCD. However, we have an "induced" Yukawa vertex ... which is a "wave function" of [pi] as a composite of [quark and antiquark] and is related to the dynamical mass ...

... As a low energy scale we take the scale parameter of QCD, /_QCD, which is typically of order 100 MeV - 1 GeV and actually characterizes the scale of the order parameters ... [pion force].. 93 MeV, ...[constituent light quarks]... 300 MeV or ...[/_QCD = 250 MeV]...

... **Nambu-Jona-Lasinio Model** ... the gauged NJL models (gauge theories plus four-fermion theories) ...

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

... encompass a variety of tightly bound composite Higgs models, such as .. top quark condensate ...[with anomalous dimension 2]... The NJL model is of course non› renormalizable and trivial theory, i.e., we cannot take the UV cutoff to infinity to have a sensible continuum theory, in contrast to the gauged NJL model ...

... **Gauged Nambu-Jona-Lasinio Model** ...

... **Tightly Bound Composite Higgs Models** ... There are a variety of tightly bound composite Higgs models based on the gauged NJL model ... top quark condensate ...[with anomalous dimension 2]...

... **Top Quark Condensate** ... the ... extremely large ... top quark ... mass ... compared with mass of all other quarks and leptons and seems to suggest a special role of the top quark in the electroweak symmetry breaking, the origin of mass, and hence a strong connection with the Higgs boson itself. ... the top quark condensate proposed by Miransky, Tanabashi and Yamawaki (MTY) and by Nambu independently ... entirely replaces the standard Higgs doublet by a composite one formed by a strongly coupled short range dynamics (four-fermion interaction)

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

which triggers the top quark condensate. The Higgs boson emerges as a tbar-t bound state and hence is deeply connected with the top quark itself. ... MTY introduced explicit four-fermion interactions

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

responsible for the top quark condensate in addition to the standard gauge couplings. Based on the explicit solution of the ladder SD equation, MTY found that even if all the dimensionless four-fermion couplings

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

are of O(1), only the coupling larger than the critical coupling yields non-zero (large) mass ... The model was further formulated in an elegant fashion by **Bardeen, Hill and Lindner (BHL) in the SM language, based on the RG equation and the compositenes condition**. BHL essentially incorporates 1/Nc sub-leading effects such as those of the composite Higgs loops and ... gauge boson loops which were disregarded by the MTY formulation. We can explicitly see that BHL is in fact equivalent to MTY at 1/Nc-leading order. Such effects turned out to reduce the above MTY value 250 GeV down to 220 GeV ...

... **Top Quark Mass Prediction** ... the central part of the ... MTY ... model ... relat[es]... the dynamical mass of the condensed fermion (top quark) to the mass of W/Z bosons. ... the mass of W and Z bosons in the top quark condensate is generated via dynamical Higgs mechanism .... where ... 250 GeV ...determine[s] the IR scale of the model ... we could predict mt by fixing ... [t]he decay constants of these composite NG bosons ...[about]... 250 GeV so as to have a correct mW ... Actually, ... mt ...[is] determine[d]... as a decreasing function of cutoff /\. The largest physically sensible /\ (new physics scale) would be the Planck scale /\ = 10^19 GeV at which we have a minimum value prediction mt = 145 GeV. ... Now in the gauged NJL model, QCD plus four-fermion interaction ...

[In an 8-dimensional Kaluza-Klein version the four-fermion interaction is not needed.]

> ...[f]or the Planck scale cutoff /\ = 10^19 GeV, we have mt = 250 GeV ... This is compared with **the pure NJL case mt = 145 GeV** ...
>
> ... **RG Equation plus Compositeness Condition (BHL)** ... the BHL formulation of the top quark condensate, which is based on the RG equation combined with the compositeness condition ... start[s] with the SM Lagrangian which includes explicit Higgs field at the Lagrangian level ...
>
> ... **BHL versus MTY** ...MTY formulation is based on the nonperturbative picture ... On the other hand, BHL is crucially based on the perturbative picture ...[which]... breaks down at high energy near the compositeness scale /\ ...[10^19 GeV]... there must be a certain matching scale /_Matching such that the perturbative picture (BHL) is valid for mu < /_Matching, while only the nonperturbative picture (MTY) becomes consistent for mu > /_Matching ... However, thanks to the presence of a quasi-infrared fixed point, BHL prediction is numerically quite stable against ambiguity at high energy region, namely, rather independent of whether this high energy region is replaced by MTY or something else. ... Then we expect mt = mt(BHL) = 1 ˆ 2yt(mu = mt) v = 1/(sqrt(2)) ybart v within 1› 2%, where ybart is the quasi-infrared fixed point given by Beta(ybart) = 0 in ... the one-loop RG equation ... The composite Higgs loop changes ybart^2 by roughly the factor Nc/ (Nc +3/2) = 2/3 compared with the MTY value, i.e., 250 GeV -> 250 x sqrt(2/3) = 204 GeV, while the electroweak gauge boson loop with opposite sign pulls it back a little bit to a higher value. **The BHL value is then given by mt = 218 +/- 3 GeV, at /\ = 10^19 GeV**.
>
> The Higgs boson was predicted as a tbar-t bound state with a mass MH = 2mt based on the pure NJL model calculation1. Its mass was also calculated by **BHL through the full RG equation** ... the result being ... **MH / mt = 1.1**) at /.\ = 10^19 GeV ...".

Here are some more details from the paper of **Hashimoto, Tanabashi, and Yamawaki** at hep›ph/0311165:

> "... The idea of the top quark condensate explains naturally the large top mass of the order of the electroweak symmetry breaking (EWSB) scale. In the explicit formulation of this idea often called the "top mode standard model" (TMSM), the scalar bound state of tbar-t plays the role of the Higgs boson in the SM.

There are ... problems in the original version of the TMSM:

- We need to introduce ad hoc four-fermion interactions of the top quark in order to trigger the EWSB.
- ... if we take /\ to the Planck ... scale ...[s]uch a huge /\ ... causes a serious fine-tuning problem.

As a possible solution to these problems, following the line of an earlier attempt of the TMSM in the TeV-scale extra dimension [**Kaluza-Klein**] scenario Arkani- Hamed, Cheng, Dobrescu and Hall (ACDH) proposed an interesting version of such where the SM gauge bosons and the third generation of quarks and leptons live in the D(= 6, 8, • • •)› dimensional bulk, while the first and second generations are confined in the 3-brane (4› dimensional Minkowski space-time).

[Compare the D4-D5-E6-E7-E8 VoDou physics model. in which

- the first generation fermions move purely in 4-dimensional Minkowski Physical Space-Time (PST),
- the second generation fermions have one foot in 4-dimensional Internal Symmetry Space (ISS) and move from one of PST or ISS to the other, and
- the third generation fermions have two feet in PST but move in ISS

where 4-dim PST and 4-dim ISS are the products of dimensional reduction of a high-energy 8› dimensional SpaceTime.]

Gauge interactions in higher dimensions than four become strong in a certain high-energy region. **Bulk gauge interactions are expected to trigger the top condensation without adding ad hoc four-fermion interactions, in contrast to the original version of the TMSM**.

However, the dynamics of bulk gauge theories was not concretely analyzed ...[by ACDH]... In particular, as it turned out **the bulk QCD coupling, which is the most relevant interaction for the top condensation, has an ultraviolet fixed point (UV-FP) or upper bound within the same MSbar scheme of the truncated Kaluza-Klein (KK) effective theory as that ...[the work of ACDH]... was based on**. Thus, it is quite nontrivial whether the top condensation is actually realized or not.

... we have studied the dynamical chiral symmetry breaking (DxSB) in bulk gauge theories, based on the ladder Schwinger-Dyson (SD) equation. Switch ing off the electroweak interaction in the bulk, we then found that **the bulk QCD coupling can ... become suffciently large to trigger the top condensation for ... D = 8**.

For the purpose of model building, we further need to study the effect of the bulk electroweak interactions: Since the bulk U(1)Y interaction grows very quickly due to the power-like running behavior and reaches immediiately its Landau pole /_LY , it may affect the most favored channel for condensate, i.e., the most attractive channel (MAC). We also need to study whether or not the prediction of the top mass agrees with the experiments.

... we demonstrate a possibility that the top condensate is actually the MAC even including all of the bulk SM gauge interactions. This is quite nontrivial, because inclusion of the strong bulk U(1)Y interaction may favor the tau condensation rather than the top condensation. In order for only the top quark to acquire the dynamical mass of the order of the EWSB scale, the binding strength should exceed the critical binding strength ... only for the top quark ("topped MAC" or "tMAC"). Namely, **our scenario works only when... the binding strength... of the top ... condensate...[exceeds]... the critical binding strength ...[which in turn exceeds]... the binding strength ... of the ... bottom... and tau condensates at the scale /**, ... We refer to the scale /\ satisfying ...[those relationships]... as the tMAC scale /_tM.

For the MAC analysis, **we study binding strengths ... by using the one-loop renormalization group equations (RGEs) of dimensionless bulk gauge couplings**. It is in contrast to the analysis of ACDH where all of bulk gauge couplings are assumed equal (and strong enough for triggering the EWSB). In order to check reliability of our MAC analysis, we also study the regularization-scheme dependence of the binding strengths. We calculate gauge couplings in two prescriptions, the MSbar scheme of the truncated KK effective theory and the proper-time (PT) scheme.

There are some varieties in the estimation of ... the critical binding strength ... The naive dimensional analysis (NDA) implies ... the critical binding strength ...[is about]... 1, while the ladder SD equation yields much smaller value ... the critical binding strength ... [about]... 0.1 . As the estimate of ... the critical binding strength ... increases ... the region of the tMAC scale gets squeezed. Even if we adopt the lowest possible value of ... the critical binding strength ... given by the ladder SD equation, we find that the tMAC scale does not exist for the simplest scenario with D = 6. On the other hand, **the tMAC scale does exist in D = 8 for the value of the ladder SD equation, /_tM R = 3.5&endash;3.6, where the compactification scale R^(-1) is taken to be 1-100 TeV**. For D = 10, the MAC analysis significantly depends on the regularization scheme.

Once we obtain the tMAC scale tM, we can easily predict the top mass mt and the Higgs mass mH by using the renormalization group equations (RGEs) for the top Yukawa and Higgs quartic couplings, and the compositeness conditions at the scale /\ = /_tM. This is in contrast to the earlier approach ..[of ACDH]... where the composite scale /\ is treated as an adjustable free parameter and fixed so as to reproduce the experimental value of mt.

Without such an adjustable parameter, we predict the top quark mass

mt = 172 - 175 GeV for D = 8 and R^(-1) = 1-100 TeV.

... We find that the value of mt near the compactification scale R^(-1) is governed by the quasi infrared fixed point (IR-FP) for the top Yukawa coupling y ... We also predict the Higgs boson mass as mH = 176 - 188 GeV ...[which is close to the range of 1.1 mt = 189 › 193 GeV]...

Thanks to the IR-FP property, the prediction for mt and mH is stable. ...

Let us consider a simple version of the TMSM with extra dimensions where the SM gauge group and the third generation of quarks and leptons are put in D-dimensional bulk, while the first and second generations live on the 3-brane (4-dimensional Minkowski space-time).

[Compare the D4-D5-E6-E7-E8 VoDou physics model. in which

- the first generation fermions move purely in 4-dimensional Minkowski Physical Space-Time (PST),
- the second generation fermions have one foot in 4-dimensional Internal Symmetry Space (ISS) and move from one of PST or ISS to the other, and
- the third generation fermions have two feet in PST but move in ISS

where 4-dim PST and 4-dim ISS are the products of dimensional reduction of a high-energy 8› dimensional SpaceTime.]

The D-dimensions consist of the usual 4- dimensional Minkowski space-time and extra ... spatial dimensions compactified at a TeV-scale R^(-1). The number of dimensions D is taken to be even, D = 6, 8, 10, • • •, so as to introduce chiral fermions in the bulk. In order to obtain a 4-dimensional chiral theory and to forbid massless gauge scalars, we compactify extra dimensions on the orbifold ... [T^(D-4) / Z^((D-4)/2)_2]...

We emphasize that there is no elementary field for Higgs in our model. The chiral condensation of bulk fermions may generate dynamically a composite Higgs field, instead.

Hence we investigate RGEs of bulk gauge couplings including loop effects of the composite Higgs.

We expand bulk fields into KK modes and construct a 4-dimensional effective theory. ...

... We calculate the RGEs by using the UV-BCs ... and determine mt and mH through the conditions,

- mt = (v / sqrt(2)) y(mt),
- mH = v sqrt(lambda(mH)) ...
- with v = 246 GeV.

We show results of mt and mH in Fig ... 8 ...

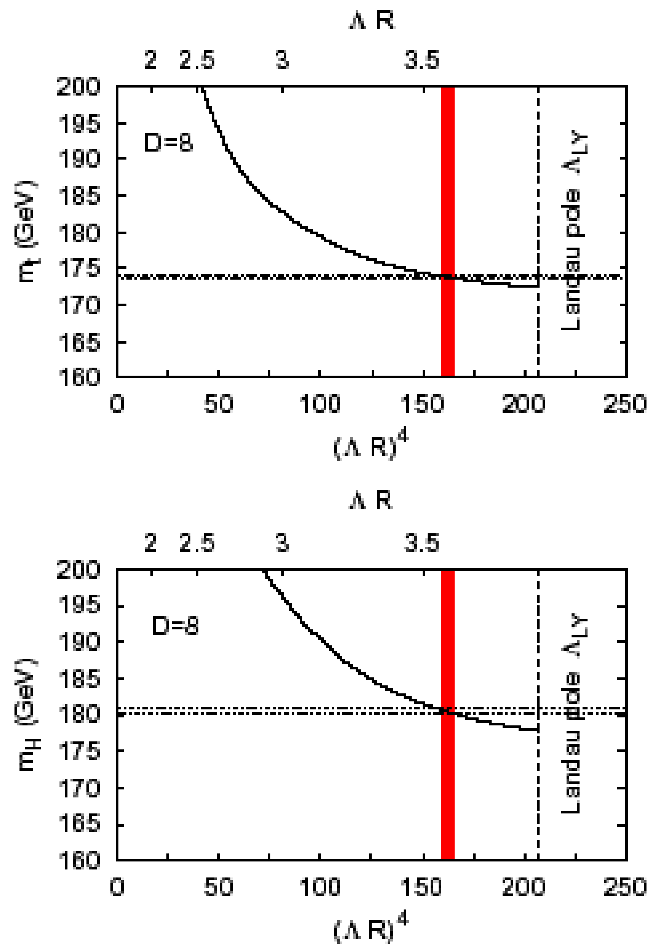


FIG. 8: Solutions m_t and m_H of Eq. (60) with the compositeness conditions (52) for $D = 8$, $R^{-1} = 10$ TeV. The dashed vertical line represents the Landau pole Λ_{LY}. The shaded region is the tMAC scale Λ_{tM} satisfying Eq. (41).

for D = ... 8 ... , R^(-1(= 10 TeV for various values of the compositeness scale /\. ... the tMAC scale does exist only for D = 8 without much ambiguity, /_tM R = 3.5-3.6. Identifying /\ with tM, we depict the region of the tMAC scale for D = 8 by the shaded area in Fig. 8. ... For D = 8 we predict mt = 172 - 175 GeV, and mH = 176 - 188 GeV, for the range of the compactification scale R^(-1) = 1-100 TeV. The uncertainties ... also include error of alpha_3(MZ) = 0.1172 +/- 0.0020 .

... the prediction ... for mt is consistent with the reality, the MSbar mass mt = 164.7 +/- 4.9

GeV which is calculated from the observed value of the pole mass, 174.3 +/- 5.1 GeV . ... our compositeness scale is fixed by the tMAC scale tM by requiring that the top quark condensation actually takes place, while other condensations do not. Hence the top mass as well as the Higgs mass is the prediction in our approach. ...

... the value ... is significantly smaller than that of the original TMSM in four dimensions which predicted mt >= 200 GeV. Let us consider a simplified RGE for y neglecting the electroweak gauge interactions ... we find the quasi IR fixed point y_qIR(mu) ... decreases as ...(D-4) increases at mu = R^(-1) ... As a result, the prediction of mt with ...[D-4]... > 0 is substantially lower than that of the original TMSM with ...D-4]... = 0. ...

The mechanism is still operative even including the electroweak gauge interactions: In Fig. 10,

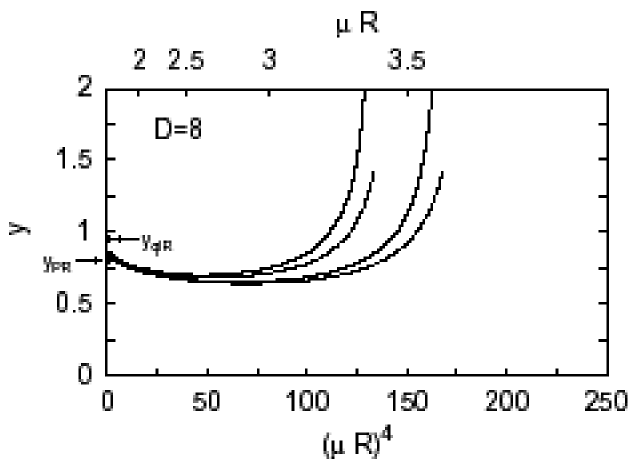


FIG. 10: RGE flows for the top Yukawa coupling y. We also show the quasi IR fixed point y_{qIR} and the PR fixed point y_{PR} at $\mu = R^{-1}$. The graph represents running of y for $D =$ 8 $R^{-1} = 10$ TeV was assumed. We used the full one-loop RGE [54]. The UV-BCs are $y(\Lambda) \to \infty$ (solid lines) and $y(\Lambda) = \sqrt{2}$ (dashed and dash-dotted lines) for two typical values of Λ.

we show the quasi IR fixed point and the behavior of y based on the full one-loop RGE with various boundary conditions at /\. We also show the Pendleton-Ross (PR) fixed point ... As far as ... D = ... 8 ... the value of the PR fixed point is smaller than that of the quasi IR fixed point ... The top Yukawa coupling at R^(-1) for D = ... 8 ... is actually between ... the PR fixed point ... and ... the quasi IR fixed point ... for a sufficiently large top Yukawa, y)/_ >= 1 , at high energy scale(/\ R)^(D-4) .>> 1 ... We note here that the actual prediction of mt with D = ... 8 is even smaller than the value expected from y_qIR.

We also comment that the predicted values of mt and mH would be stable thanks to these fixed points, even if the estimate of the tMAC scale were somewhat changed from ours for some reason. ... the lower value prediction of mt than that of the original TMSM can also be understood as follows: Since KK modes of the top quark (t^(n)) as well as its zero mode (t^(0)) contribute to the VEV v ... the condensate < tbar^(0) t^(0) > is suppressed compared with the original TMSM and so is the top mass.

Now we discuss implication of our Higgs mass prediction ... The upper limit of mH from radiative corrections in the SM is mH < 199 GeV at 95% CL . The prediction ... is still below this upper limit. ...

... SUMMARY AND DISCUSSIONS

We have argued a viable top mode standard model (TMSM) with TeV-scale extra dimensions where bulk SU(3) x SU(2) x U(1) SM gauge interactions (without ad hoc four-fermion interactions) trigger condensate o only the top quark, but not of other quarks and leptons.

In order for such a situation to be realized, the binding strength ... should exceed the critical binding strength ... only for the top quark (tMAC) ... The binding strengths ... were calculated by using RGEs for bulk SM gauge couplings. ... We then found that the region of the tMAC scale is squeezed out for D = 6 ... while it does exist for D = 8, /\ = (3.5-3.6) R^(-1). We were not able to draw a reliable conclusion for D = 10 since the MAC analysis for D = 10 strongly depends on the regularization scheme.

For D = 8, we predicted the top mass mt and the Higgs mass mH: mt = 172 - 175 GeV and mH = 176 - 188 GeV, by using RGEs for the top Yukawa and Higgs quartic couplings with the compositeness conditions at the tMAC scale tM. Our predictions are governed by the quasi IR- FP and hence are stable against varying the composite cale. The predicted values would not be changed so much, even if the region of the tMAC scale got wider than our estimate for some reason.

Why is the value ...[of mt]... significantly smaller than that of the original TMSM in four dimensions which predicted mt >= 200 GeV? The value of the top Yukawa coupling at the quasi IR-FP is ... suppress[ed] ...[by a]... factor 2^(-(D-4)/2) ...[so].. the mass of the top quark decreases as the number of dimensions increases. ...

Many issues remain to be explored:

- 1) Our results on the tMAC scale are sensitive to the value of ... the critical binding strength ... Although we used the reference value of ... the critical binding strength ... in the approach of the ladder SD equation neglecting the effect of the compactification, it would be more preferable if we can determine ... the critical binding strength ... more reliably. For such a purpose, we should take into account effects of the compactification scale R^(-1) which turned out not so small compared with the tMAC scale /_tM in our analysis. We also need running of bulk gauge couplings beyond one-loop perturbation.

- 2) We incorporated only one composite Higgs doublet into RGEs, assuming other possible bound states such as vector/axial-vector bosons are irrelevant. In order to justify the assumption, we need to solve bound state problems in the bulk gauge theories. Once such a composite scalar exists, it should be a tightly bound state formed by strong short distance dynamics with large anomalous dimension. Such a system is expected to resemble the gauged Nambu-Jona-Lasinio (GNJL) model where the compositeness condition is explicitly formulated. Actually, as it happened in the 4-dimensional case, the pure gauge dynamics strong at short distance in our case can also induce strong four-fermion nteractions which may become relevant operators due to large anomalous dimensions, gamma_m = D/2 › 1. ...
- 3) There are potential constraints on our model from precision electroweak measurements. The summation of KK modes below the cutoff /\ contributes to delta rho as delta rho = (/\ R)^(D-6) (M_W R)^2 . In our case with /\ = /_tM, (/ _tM R)^(D-6) = 10 for D = 8, we thus need to take R^(-1) > O(10 TeV), which may be subtle about the fine tuning. ...
- 4) Masses of other quarks and leptons have not been dealt with in this paper. In the original TMSM, these masses are descended from the top condensate through ad hoc flavor-breaking four-fermion interactions. The origin of such four-fermion interactions will be highly hoped for in the present scenario.
- 5) Our scenario crucially relies on the short distance strong dynamics around the composite scale. We thus need a better-controlled theory in the UV-region. It would be interesting to study a deconstructed/latticized version of our model. ...".

Tony Smith's Home Page   Here is pdf version of this NJL-BHL-HTYamawaki page

......

Extra gauge field structure uncovered in the Kaluza-Klein framework,

Class. Quantum Grav. 3 (1986) L99-L105, by **N. A. Batakis** says:

"... In a standard Kaluza-Klein framework,

M4 x CP2 allows the classical unified description of an SU(3) gauge field with gravity.

However,

the possibility of an additional SU(2) x U(l) gauge field structure is uncovered.

... As a result, M4 x CP2 could conceivably accommodate the classical limit of a fully unified theory for the fundamental interactions and matter fields. ... [There are]... two generic possibilities ... for the enlargement of Einstein's framework, namely

- ... increase the number of spacelike dimensions ...[which]... is mainly exploited in the ...[ordinary]... Kaluza-Klein programme ...[in which]... the extra dimensions form a vertical 'internal' compact space of very small ... volume ... and ...
- ... allow the presence of torsion without upsetting the metricity of connections ... [which involves not only]... a torsion (totally within M4) ... in the context of the Einstein-Cartan theory ...[but also]... the ... mixed components of a torsion in the total space, namely components which are neither totally vertical nor completely horizontal. ... such a torsion creates a new and non-trivial possibility for the accommodation of unified theories in the KK framework ...[in a]... way in which an eight-dimensional manifold, locally of the form M4 x CP2, could ... accommodate the classical limit of a fully unified theory for the fundamental interactions and matter fields ...

...**[In]... M4 x CP2 ... the groups G1 and G2 are SU(3) and SU(2) x U(1)**, respectively.

The ... **G1 [SU(3)] ... results from the well known identification of CP2 with the coset space SU(3)/U(2)**.

... the **G2 ... SU(2) x U(1)** ...[has a]... Killing form is not zero but ... is degenerate, namely (- 1, - 1, - 1, 0). However, in view of the U(1) factor ... a non-degenerate metric (- 1, - 1, - 1, - 1) can be (and often is) defined on SU(2) x U(1). This possibility makes SU(2) x U(1) a perfectly acceptable G2 ...The metric is given by ...

$$g_{MN} = \left(\begin{array}{c|c} \overset{0}{g}_{\mu\nu} + \kappa_1^2 \xi^a_P \xi^b_Q A^{(1)P}{}_\mu A^{(1)Q}{}_\nu \overset{0}{g}_{ab} & \kappa_1 \xi^a_Q A^{(1)Q}{}_\mu \overset{0}{g}_{an} \\ \hline \kappa_1 \xi^a_Q A^{(1)Q}{}_\nu \overset{0}{g}_{am} & \overset{0}{g}_{mn} \end{array} \right)$$

... and the connection 1-form w^M_N is defined as w^M_N = w^0M_N + K^M_n with w^0M_N the Riemannian connection of the metric [shown immediately above]... and the contorsion K^M_N defined ... in terms of the torsion ... T^m_ab = k2 theta^m_I F^(2) I*_ab where * denotes the M4 dual, k2 is a constant and theta^m_I is a vielbein (employed to change the group index I to the [CP2]... index m) such that g_mn theta^m_I theta^n_J = -g_IJ ... The Riemann scalar curvature is then given by an equation similar to ...

$$R^{(5)} = \overset{1}{R}{}^{(5)} - 2K^{MN}{}_{M;N} - K^{MN}{}_N K_{ME}{}^E + K_{MNE} K^{ENM}$$ ...

$$R^{(5)} = \overset{1}{R}{}^{(5)} - \tfrac{1}{4}\kappa_2^2 (F^{(2)})^2 + \text{surface terms}$$ ...

$$R^{(5)} = R^{(4)} - \tfrac{1}{4}\kappa_1^2 (F^{(1)})^2 - \tfrac{1}{4}\kappa_2^2 (F^{(2)})^2 + \text{surface terms.}$$

... and the Bianchi identities hold ... **The resulting Einstein-Hilbert action ... when expressed totally within M4 will, besides gravity (with a cosmological constant), contain the two gauge fields [SU(3) and SU(2) x U(1)], with the relative scales between the three parts set by ... constants k1 and k2 as in ...**

the Einstein–Hilbert action reduces in four dimensions (with κ_0 a constant) to

$$I = \kappa_0^2 \int (-\overset{0}{g}{}^{(4)})^{1/2}\, d^4x\, (-R^{(4)} + \tfrac{1}{4}\kappa_1^2 (F^{(1)})^2 + \tfrac{1}{4}\kappa_2^2 (F^{(2)})^2). \tag{17}$$

... We recall

- that **A(1) [of SU(3)] has been introduced at the level of the metric via the Kaluza ansatz ...[and] has a role for the coset space ...[CP2]... analogous to that of the Lorentz (or Poincare) group for ordinary spacetime**,
- while A(2) has been introduced directly through a field strength F(2) at the level of the connection. In view of the Bianchi identities for the manifold [M4 x CP2] ... **F (2) will have a well defined and conserved energy-momentum tensor. However, its gauge group structure is apparently not mandatory. What our construction has shown is that the geometry allows a maximal gauge group structure ... The corresponding [G2 = SU(2) x U(1)] gauge symmetry is**

> **apparently unprotected, in contrast to the G1 gauge symmetry**.
>
> These results are obviously desirable in view of the ... association we seek for the two gauge fields with the strong and electroweak interactions. We also observe that we have exhausted the generic possibilities for the introduction of interaction fields into the geometry: besides the metric and a general metric connection, there is no other independent intrinsic geometric structure available within our framework. Thus, the following geometric picture seems to be emerging.
>
> - The gravitational and SU(3) gauge field potentials must be considered as more fundamental and they completely specify the metric - essentially they are the metric of M4 x CP2. If no torsion exists, a symmetric metric connection is uniquely defined from this metric and M4 x CP2 would then exhibit a complete left-right symmetry.
> - However, ... [SU(2) x U(1)] symmetry will break ... with the introduction of torsion. The mixed [torsion] components of the ...[SU(2) x U(1) symmetry.].. will be associated with the spin-1 field F(2) with a (possibly broken) SU(2) x U(l) gauge symmetry.
> - ...[The torsion]... components totally within M4 or CP2 could accommodate matter fields in the form of, respectively, spin density and energy-momentum density condensates, with mechanisms analogous to those already known ...".

In the paper, Batakis does not discuss "... the introduction of matter fields ... or related ... issues ...".

With respect to spinor fermions and spin structure, even though CP2 is not a spin manifold, it is a spin_c (complex) manifold as described in the book Spin Geometry by Lawson and Michelsohn (Princeton 1989) particularly page 392.

Also, the book Analysis, Manifolds, and Physics by Choquet-Bruhat andDeWitt-Morette with Dillard-Bleick (North-Holland 1982 rev ed) says at page 418:

> "... In cases where no spinor structure exists, one may define a generalized spin structure. In this scheme one makes topological room for a "spin structure" by mixing in with the group of a spin bundle an "internal" symmetry group, which is inextricably involved in the generalized spinor transformation rule.

It seems to me that the KK model of Batakis may well have a realistic generalized spin structure, and that if the spinor fermion spectrum is inherited from the 8-dim Dirac structure of Cl(1,7) prior to breaking the 8-dim spacetime into MxCP2 at lower energies, then the Batakis structure may turn out, upon further development, to be very similar to the D4-D5-E6-E7-E8 VoDou Physics model (which is in agreement with experiments).

An interesting thing about the 1986 paper of Batakis is that it provides a constructive counterexample to a well-known paper by Edward Witten entitled Search for a Realistic Kaluza-Klein Theory, published in Nuclear Physics B (1981) 412-428, in which **Witten said**:

> "...**seven dimensions is in fact the minimum dimensionality of a manifold with SU(3)xSU(2)xU(1) symmetry ... If, therefore, we wish to construct a theory in which SU(3)xSU(2)xU(1) gauge fields arise as components of the gravitational field in more than four dimensions, we must have at least seven extra dimensions**. ...".

It is sad that Witten's brilliant understanding of higher mathematics is accompanied by such a lack of physics intuition.

In a 1983-84 paper

Calculation of Gauge Couplings and Compact Circumferences from Self-Consistent Dimensional Reduction

by Candelas and Weinberg in Nuclear Physics B237 (1984) 397-441 (reprinted in a book

Modern Kaluza-Klein Theories

edited by Applequist, Chodos, and Freund (Addison-Wesley 1987), **Candelas and Weinberg** say:

> "... we wish to show how fine-structure constants in general can be calculated in certain theories, in which the gauge fields arise from the metric of a higher-dimensional space. ... There are more general (4+N)-dimensional models ... in which N dimensions form a compact manifold, and a massless gauge field appears in four dimensions for each Killing vector of this manifold. A general prescription has ... been given for calculating the various gauge couplings in such models in terms of the ratio of 2 pi (16 pi G)^(1/2) and various r.m.s. circumferences. ... In this paper we consider dynamical compactification ... The (4+N)-dimensional space is again suposed to break up into a 4-dimensional Minkowski space and a curved compact N-dimensional manifold, with the curvature governed by Einstein's field equations. ... the energy-momentum tensor on the right-hand side on the right-hand side of these equations is ... supposed to arise ... from the one-loop fluctuations in various matter fields. ... the energy-momentum tensor is balanced by the curvature, ans solutions are possible without mass parameters in the lagrangian, and with the scale of the compact manifold set by the gravitational constant ... For an N-dimensional compact manifold whose linear dimensions are of order rho, the one-loop energy density of f light matter fields is of order f rho^(-4-N) . The (4+N)-dimensional gravitational constant Gbar is or order G rho^N , and the Einstein tensor is of order rho^(-

2) . Hence ... rho^2 = G f . The L-loop gravitational corrections to the one-loop matter energy density ... are less for L >= 2 than the one-loop matter terms by a factor ... (1 / f)^(L-1) . Also, the L-loop purely gravitational contributions to the energy density ... are less for L >= 1 than the one-loop matter terms by a factor ... (1 / f)^L . ... for f sufficiently large the scale of the compact manifold is of order sqrt(G f) ... For manifolds ... [including]... spheres, CPN, and manifolds of simple groups ... we can normalize the one free parameter rho^2 in the metric ...

We now make the further assumptions that the matter fields are massless in 4+N dimensions ... When a (4+N)-dimensional space breaks up into a 4-dimensional Minkowski space and a compact manifold, the perturbations of this metric appear in 4 dimensions in part as a set of massless fields: the Yang-Mills fields A^mu_a(x) and the gravitations field g_mu nu(x) .

... the classical Einstein-Hilbert action of pure gravity in 4+N dimensions yields in 4 dimensions an action .. where ... F^mu nu_e are the Yang-Mills curls of those gauge fields A^mu_e that correspond to closed Killing curves of the compact manifold ...[if there were not many species of matter fields]... then G_0 could be identified as the Newton gravitational coupling constant G, and the normalization condition for the Yang-Mills fields would yield ... g_e = (2 pi (16 pi G)^(1/2) / N_e s_e) ...[where]... s_e is the r.m.s. circumference of the manifold along these curves ... However ... assuming ... many species of matter fields ... radiative corrections generate induced ... terms ...[involving]... new dimensionless coefficients ... D_N_e adn E_N ... we see that [for one-parameter manifolds ... of odd dimensionality]... the true Newton constant G is given by (1 / 16 pi G) = (1 / 16 pi G_0) + (E_N / rho^2) ...

Even a manifold that is stable against all deformations will become unstable if the temperature is raised above a critical value T_c ... This suggests that there is a dramatic phase transition at T = T_c , in which the compactified dimensions explode outward. One wonders ... whether our universe started with equal circumferences in all 3+N spatial directions, and became tightly contracted in N of those dimensions only when the temperature fell below the critical temperature T_c . ...".

Note that the critical temperature for dimensional reduction is consistent with the cosmology, high-temperature physics, and current-experiment-energy-level physics of the D4-D5-E6-E7-E8 VoDou Physics model.