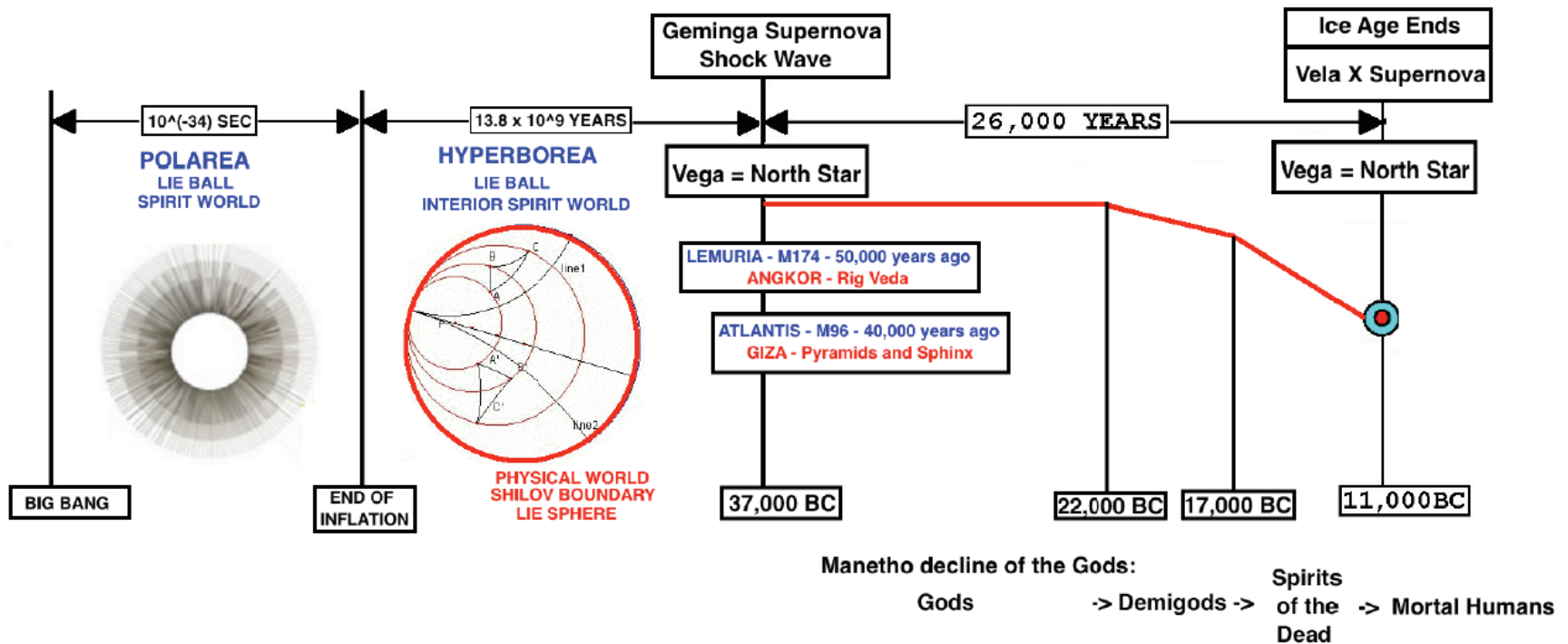


Grosse Fugue and E8-Cl(16) Physics

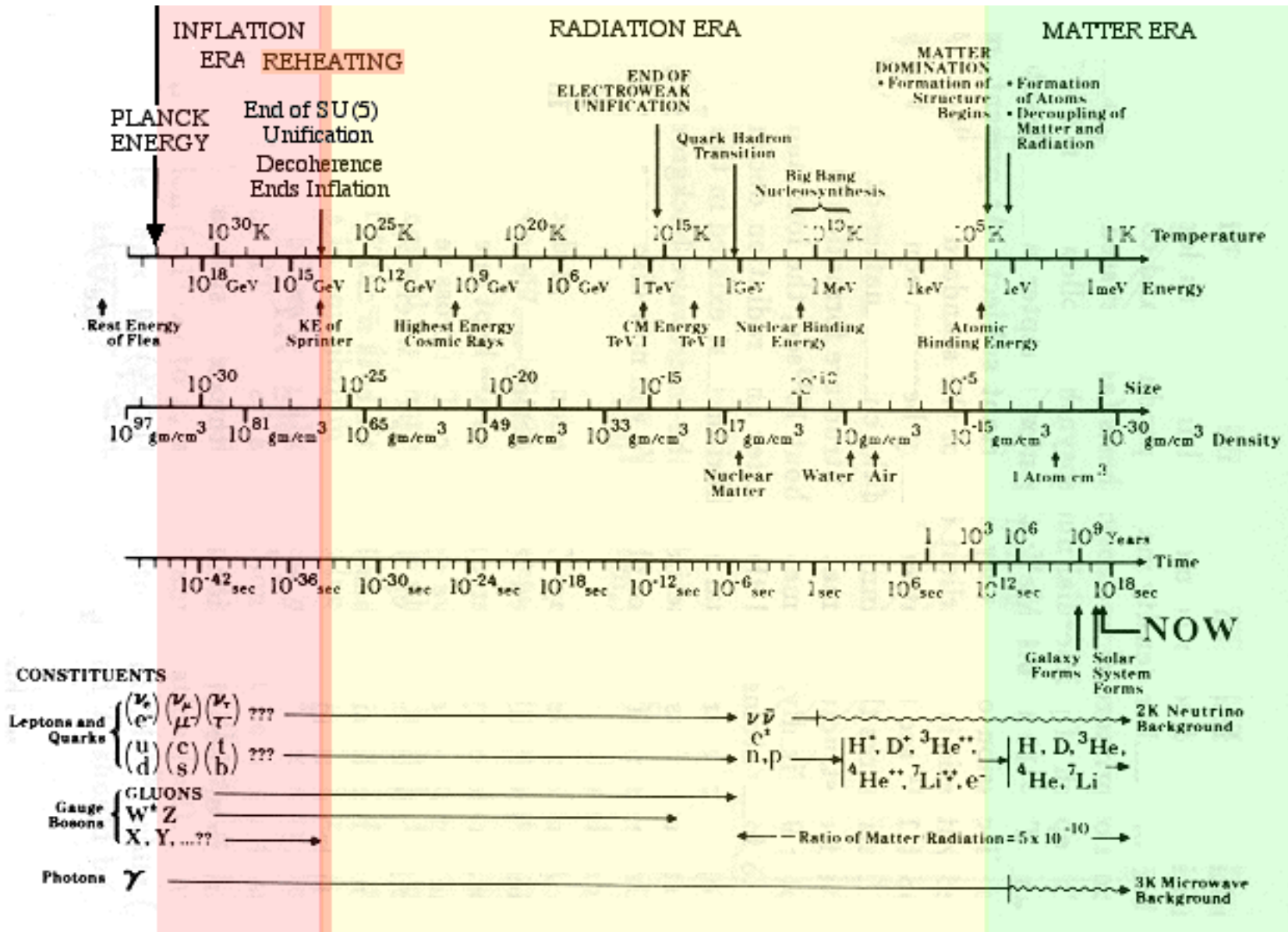
Frank Dodd (Tony) Smith, Jr. - 2019

Abstract

The Structure of Beethoven's Grosse Fugue (Opus 133 and 134) corresponds to Cl(16) - E8 Physics (viXra 1810.0365) and the evolution of our Universe and Human civilization. Since Beethoven wrote the Grosse Fugue in 1825, two years before his death in 1827, and the E8 Lie Algebra and the Cl(16) Real Clifford Algebra were not known until the work of Lie, Killing, and Clifford in the 1870s-1880s, it was not possible for Beethoven to have used the math knowledge of his day in writing the Grosse Fugue. A possible explanation could be that (Appendix on Quantum Consciousness - page 24) our conscious brains have structure similar to the structure of Cl(16) - E8 so that when Beethoven was composing, looking deep inside his conscious brain to "hear" music mentally that he could not hear normally because of his deafness, he was "seeing" Cl(16) - E8. Human quantum consciousness is based on microtubules containing maximally about 65,536 Tubulin Dimers. E8 lives in the 65,536-dimensional Real Clifford Algebra Cl(16). Cl(16) is the basic structure of our Universe so Beethoven could have been "seeing" in his mind that the E8 inside Cl(16) looks like part of the structure of microtubules of his consciousness and then writing that structure into the Grosse Fugue. The Grosse Fugue correspondences with Cl(16) - E8 are shown in this paper using visualizations by Stephen Malinowski. The Timetable of evolution of Human civilization is based on viXra 1810.0365 and this chart derived from it:



The Timetable of evolution of our Universe is based on this chart derived from a Fermilab chart:



The correspondences seem to me to be too extensive to be mere coincidence, although it is possible that I am just seeing what I want to see in the Grosse Fugue. Even so, the structural correspondences are useful to me (the music reinforces the math / physics and vice versa).

A similar line of reasoning might explain correspondences between Cl(16) - E8 Physics and the Archetype images of Jung's Red Book (Appendix on Red Book Physics - page 38).

Beethoven wrote String Quartet Opus 135 in 1826, the year after writing the Grosse Fugue and the year before his death. Its last movement is headed “Der schwer gefasste Entschluss” (“The Difficult Decision”). In it Beethoven wrote in the manuscript “Muss es sein?” (Must it be?) to which he responds “Es muss sein!” (It must be?). (Wikipedia)

Der schwer gefasste Entschluss.



(Elias String Quartet - The Beethoven Project)

My view is that Beethoven sees that the Grosse Fugue has the deep theoretical / historical correlations that I describe in this paper and that he is asking himself to make the Difficult Decision of whether or not those correspondences made it inevitable that he write the Grosse Fugue as he did write it and continue to support it despite the fierce dislike of it expressed by his audience and his publisher. His answer “Es muss sein!” is a declaration that the Grosse Fugue is as important and accurate as to theory and history as I think it is.

There are 3 Appendices to this paper:

Appendix I - Some details about Grosse Fugue Overture page 16

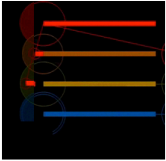
Appendix II - Quantum Consciousness ... page 24

Appendix III - Red Book Physics ... page 38

Grosse Fugue - Structural Correspondence with Cl(16) - E8 and History

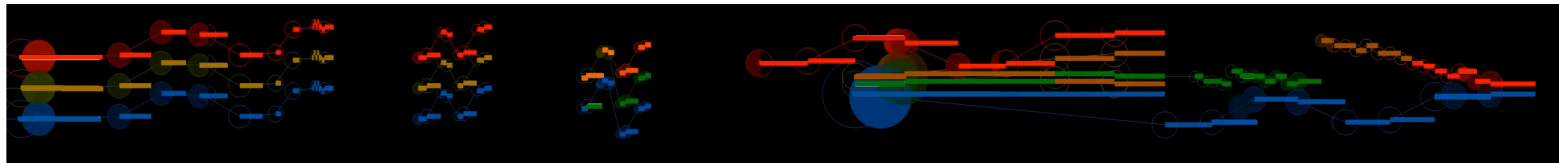
0:04 4 Generators from M4 of Parent Universe - Clifford Iteration of M4 = Cl(16)

16-dim Cl(16) Vectors = Lie Sphere Bounded Domain with 8-dim Spacetime Lie Sphere Shilov Boundary

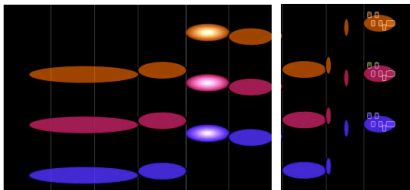


0:08 Overture - Quantum Fluctuation Vacuum Organizes Itself as Cl(16) containing E8

248-dim E8 = 120-dim Cl(16 BiVectors + 128-dim Cl(8) half-Spinors



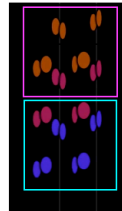
E8 Lattice 8-dim Spacetime
E8xE8xE8 = 24-dim Leech Lattice of 26D String=World-Line Theory



M4
M4 x CP2 Kaluza-Klein Quaternionic Spacetime

Gravity D4

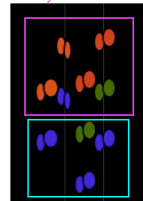
12 Standard Model Ghosts



12 SU(2,2) Root Vectors

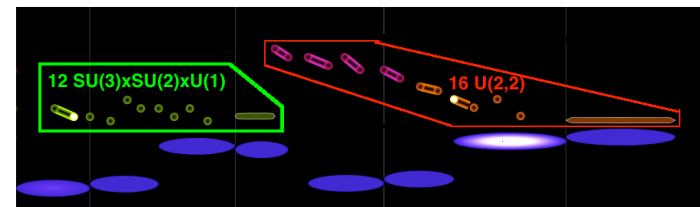
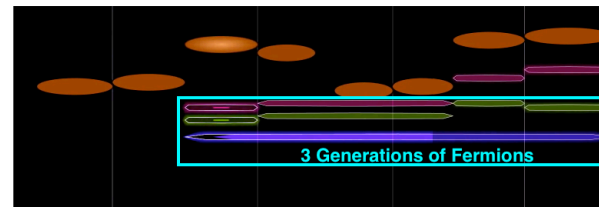
Standard Model D4

12 of 16 Gravity Ghosts
4 Gravity Ghosts are slier



8 Standard Model Root Vectors

8 Fermion Particles



8 Fermion AntiParticles

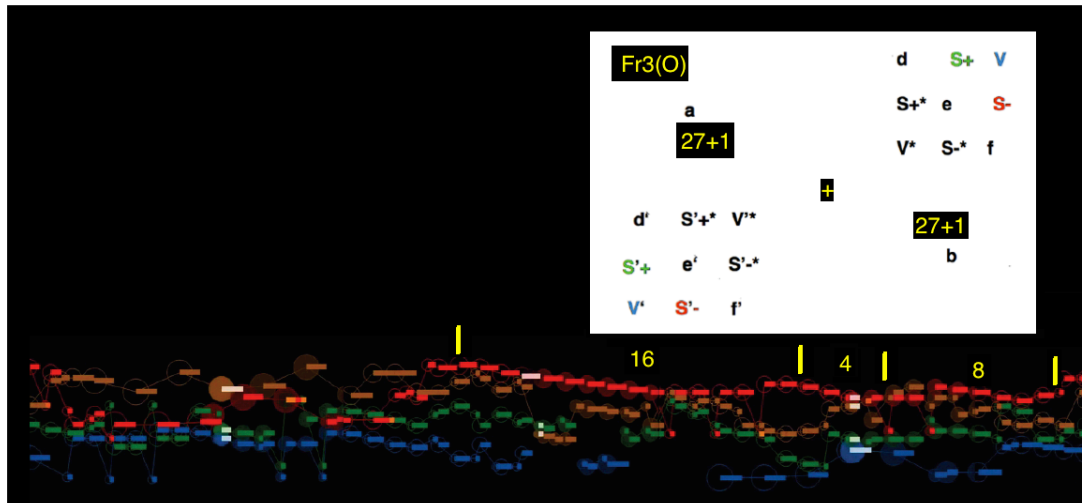
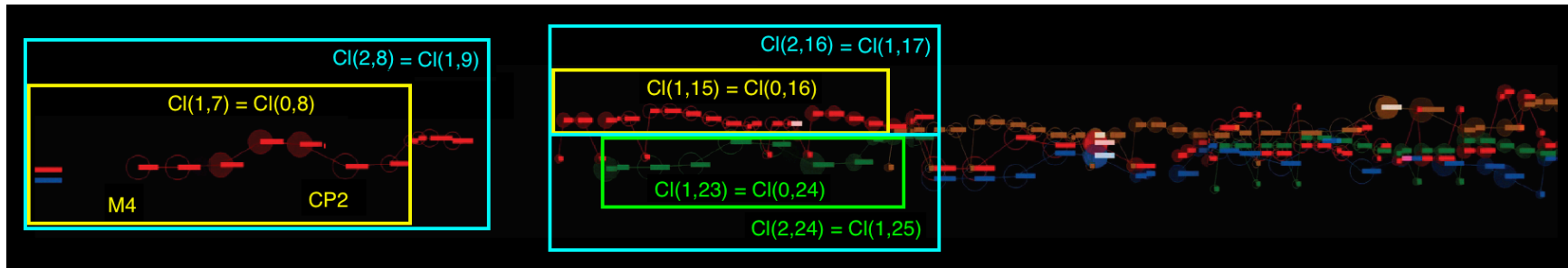
Beethoven's Grosse Fugue Opus 133 Overture
is an Outline of E8 Lie Algebra

0:44 560-dim Cl(16) TriVectors = 10 copies of 56-dim Fr3(O)

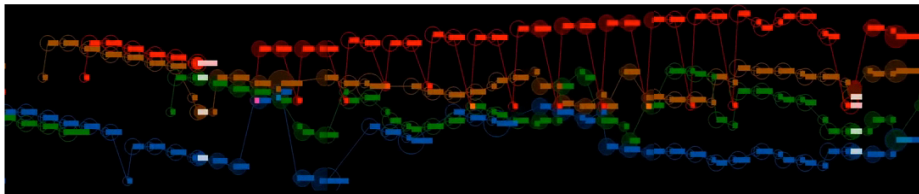
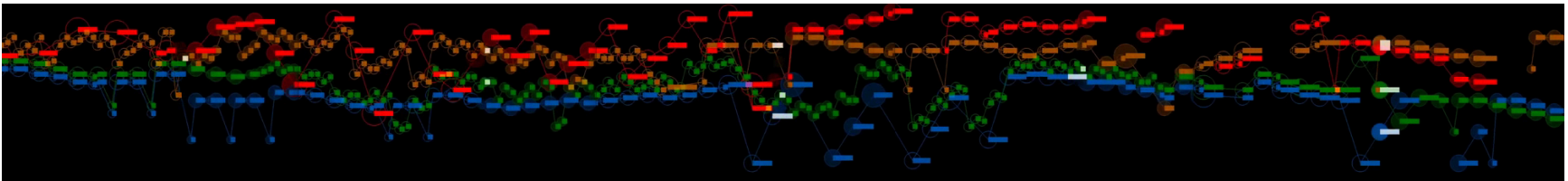
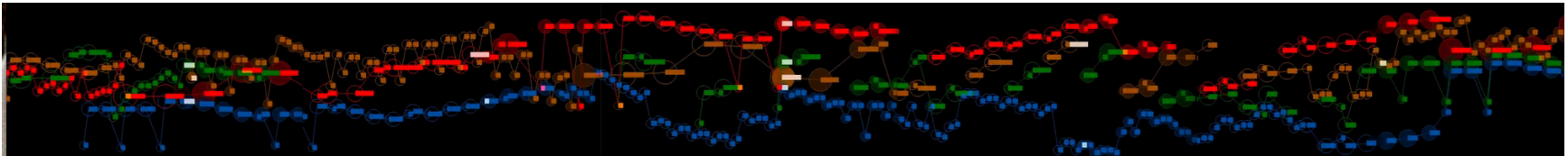
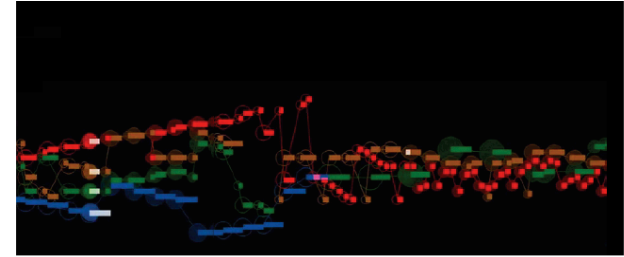
Fr3(O) = complexification of 27-dim J3(O) with traceless part = J3(O) of 26D String=World-Line Theory

26D Clifford Algebra Cl(1,25) = Cl(0,26) = M(2,Cl(0,24)) = 2x2 Matrices of Cl(0,24)

Cl(0,24) = Cl(0,16) x Cl(0,8) by Real Clifford 8-Periodicity

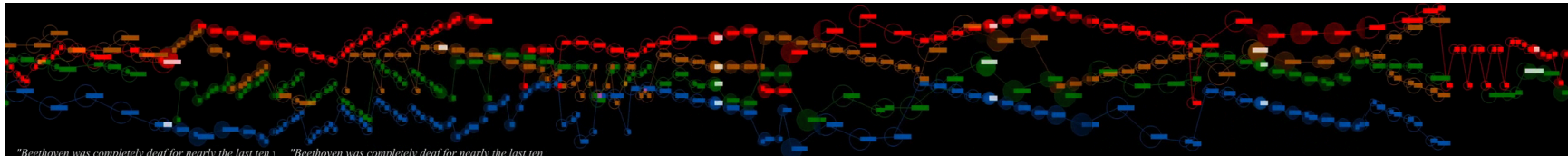
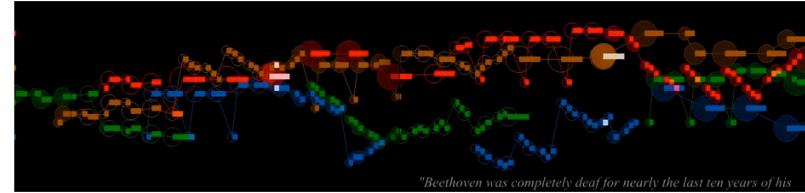


1:39 Non-Unitary Octonionic Inflation and Creation of $2^{256} = 10^{77}$ Particles
Everything is in Coherent Superposition



3:14 End of Inflation 10^{-34} sec 10^{14} GeV

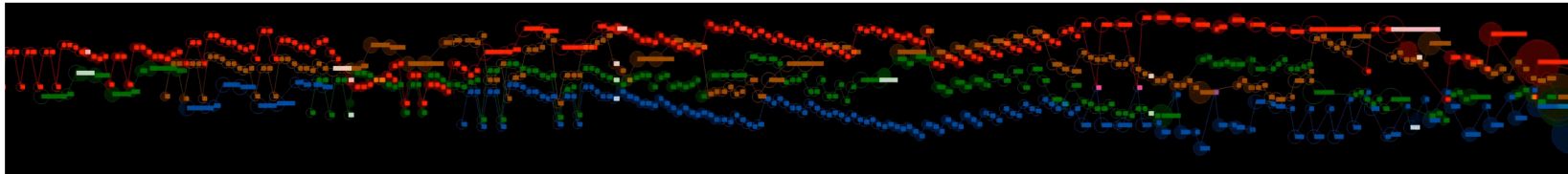
Quantum Decoherence selects Initial Low Entropy Universe



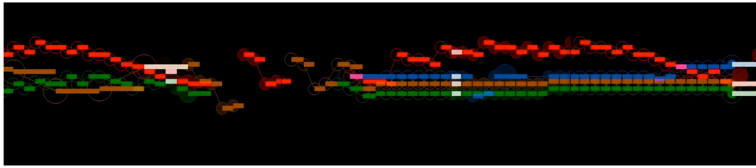
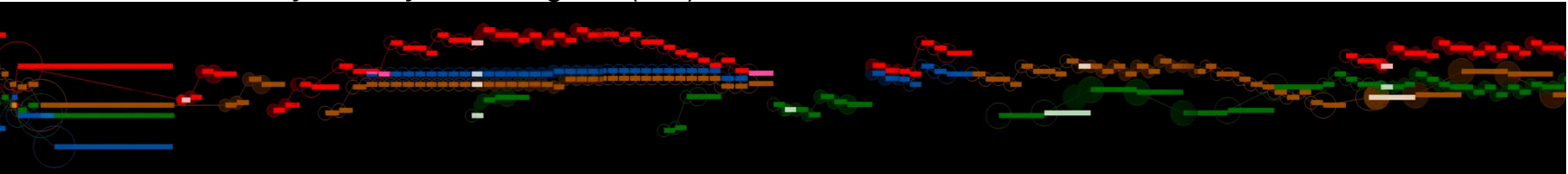
No Reheating was needed

because the Inflationary Universe was filled by Particles created by Non-Unitary Octonionic Processes.

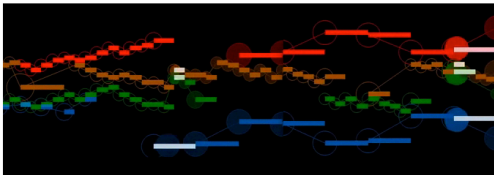
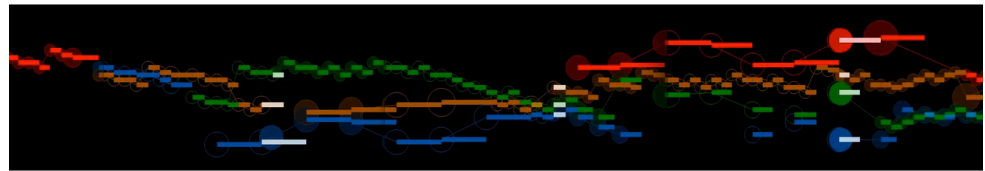
4:43 Quaternionic Radiation Expansion Begins 10^{-33} sec 10^{13} GeV



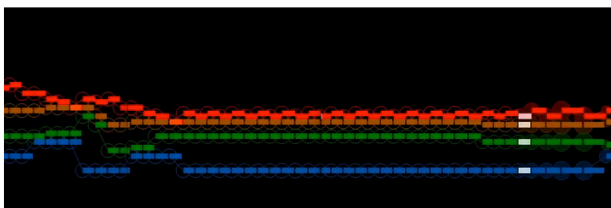
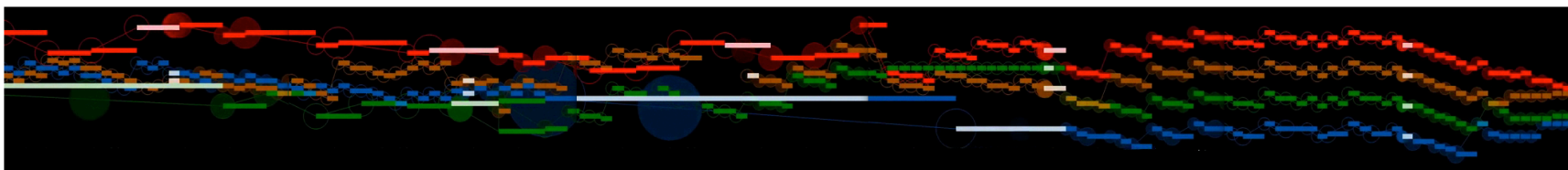
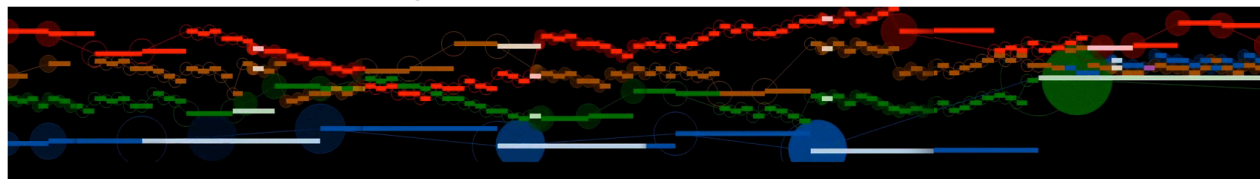
5:00 Electroweak Symmetry Breaking 10^{-12} sec 250 GeV



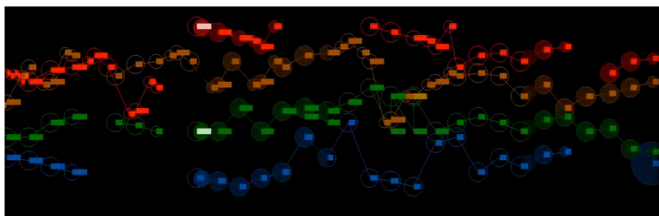
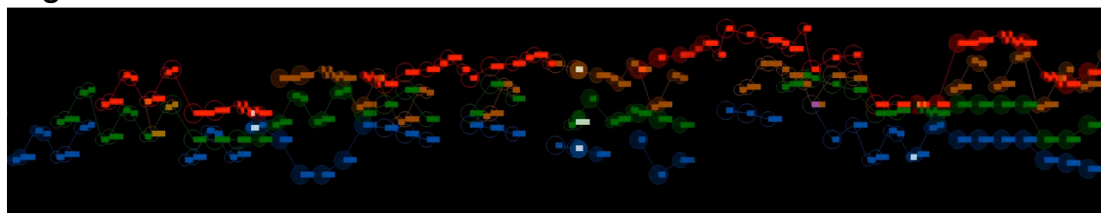
5:34 Quark-Hadron Transition 10^{-6} sec 1 GeV



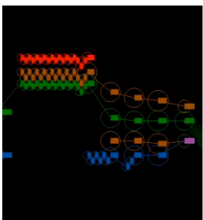
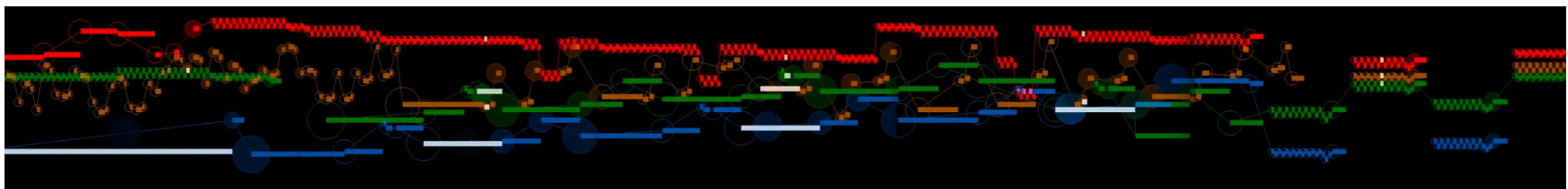
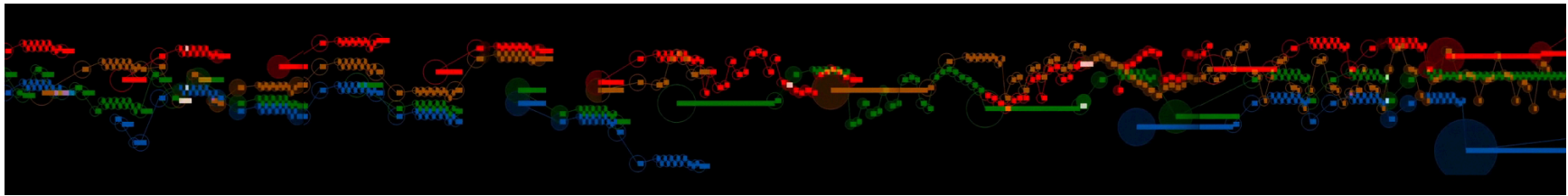
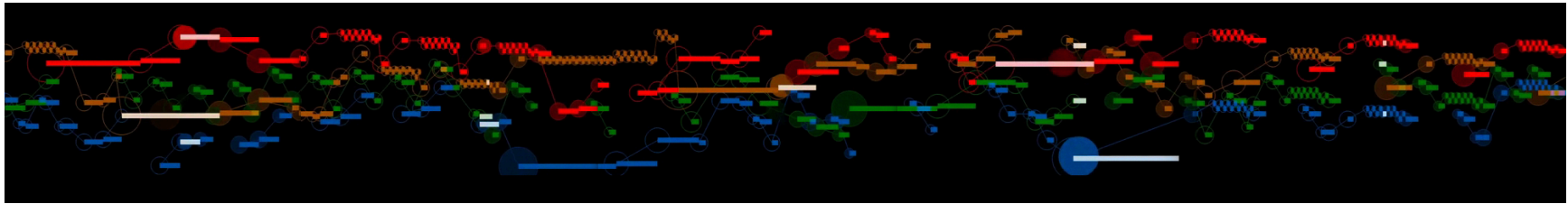
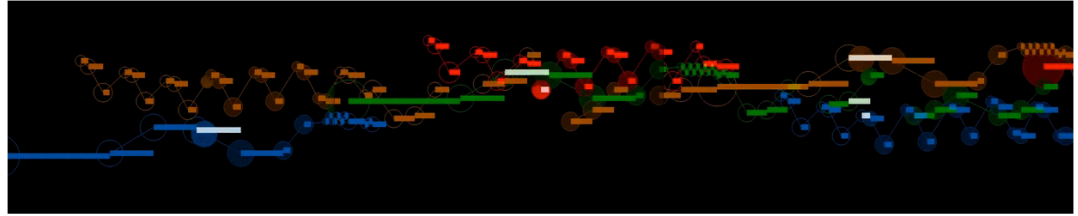
[6:15](#) Nucleosynthesis 1 sec 10 MeV Neutrino fog ends



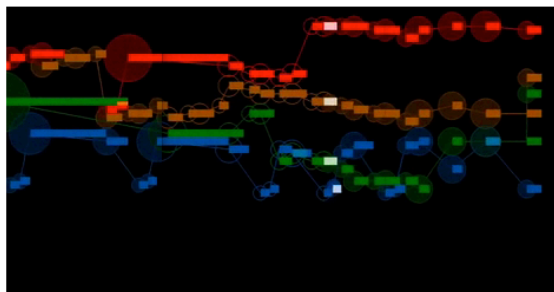
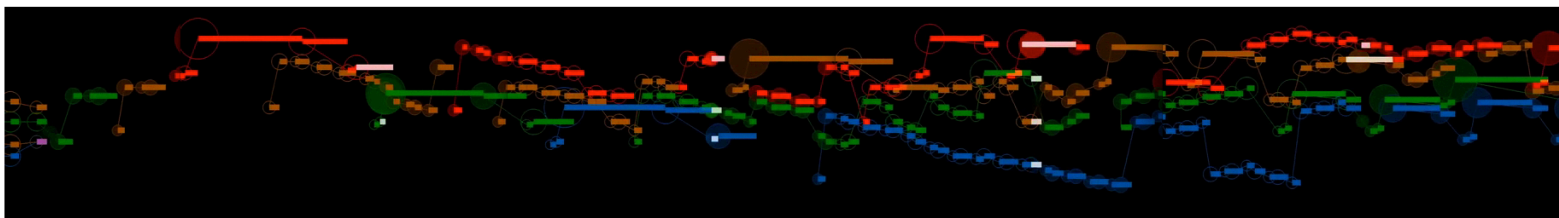
[7:22](#) Quaternionic Matter Expansion Begins 10^{11} sec 1 KeV



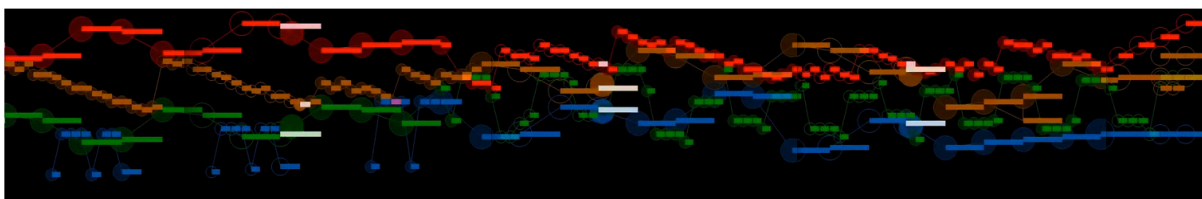
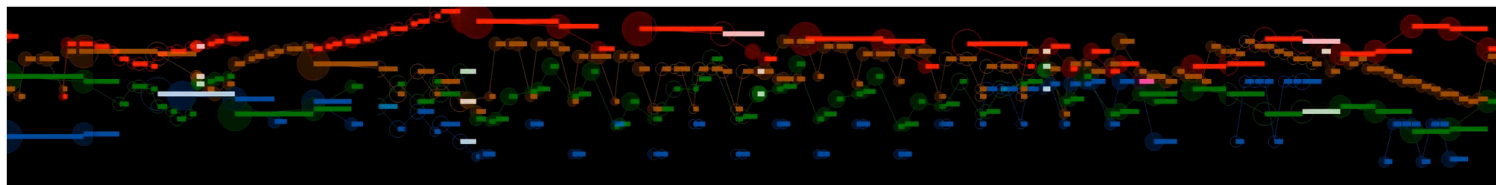
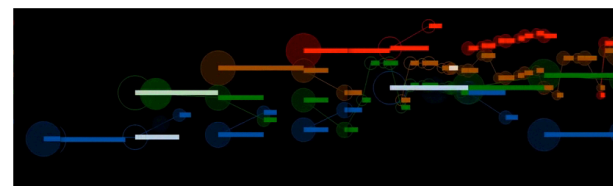
[7:57](#) Recombination Atoms Form at age 10^{13} sec 100,000 years 1 eV
Photon fog ends, Cosmic Microwave Background radiation at 3000 K then (2.75 K now)
Dark Age begins



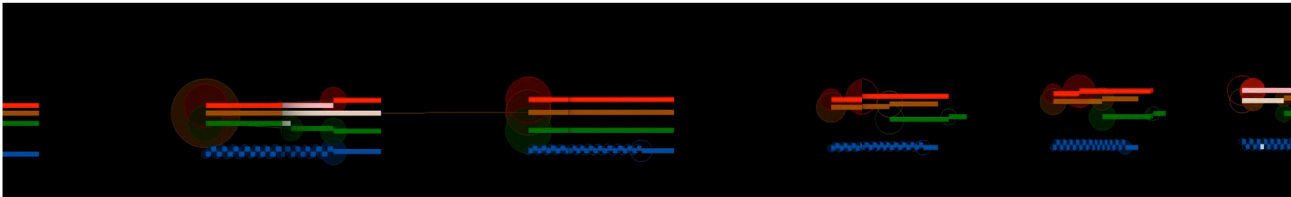
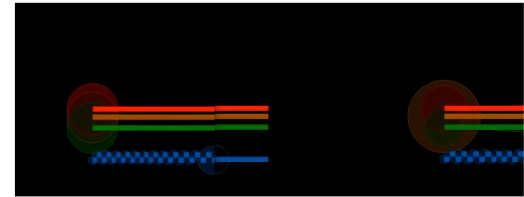
[10:00](#) First Stars burn H and He for heavy elements and photons to end Dark Age by Reionization at age 400×10^6 years



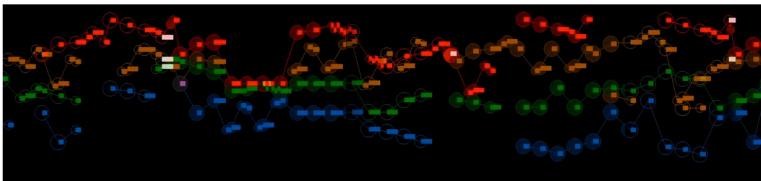
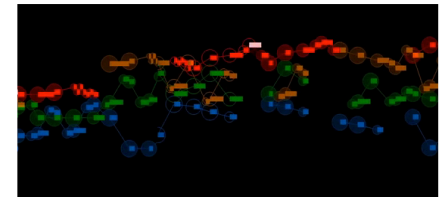
[10:37](#) Globular Clusters, then Galaxies, form 10^9 years



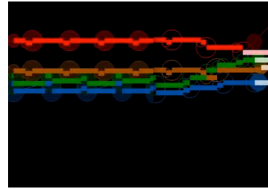
[11:48](#) Dark Energy Accelerated Expansion begins at about 6×10^9 years = 7.5×10^9 years ago



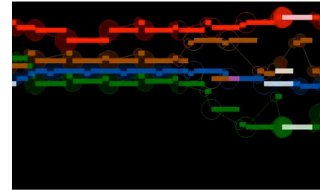
[12:22](#) Solar System 4.5×10^9 years ago



[12:48](#) Earth 4.5×10^9 years ago

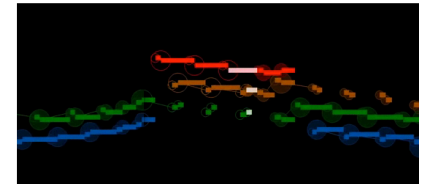


Moon by Collision 4.4×10^9 years ago

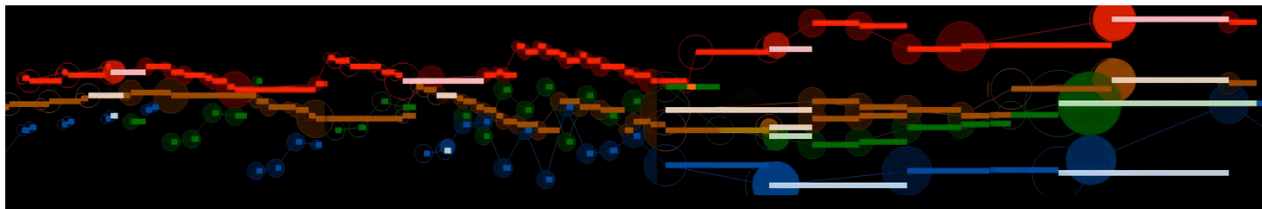


[13:02](#) Bacteria Life 4×10^9 years ago

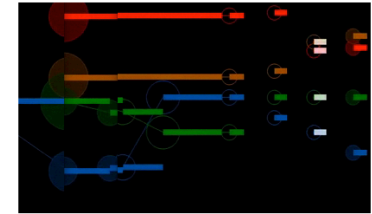
The big event around 2×10^9 years ago was the start of biological production of atmospheric Oxygen.



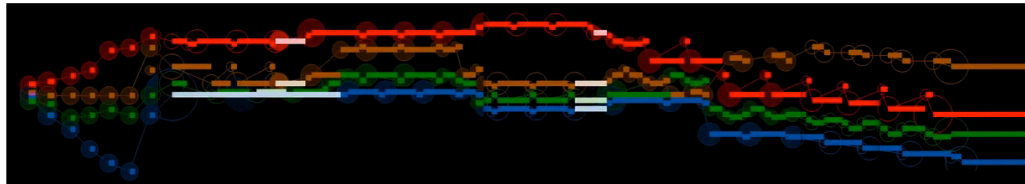
[13:12](#) Cambrian explosion of Life 500×10^6 years ago



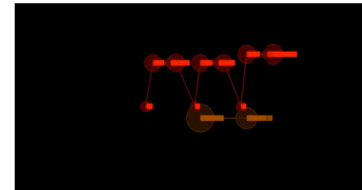
[13:42](#) Dolphin Life 20×10^6 years ago



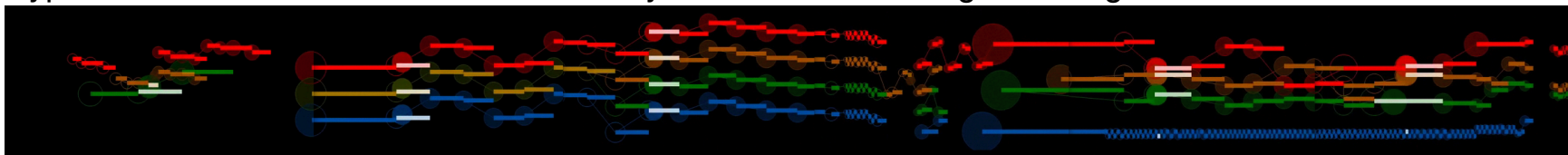
[13:49](#) Humans Evolve in Africa 100,000 years ago



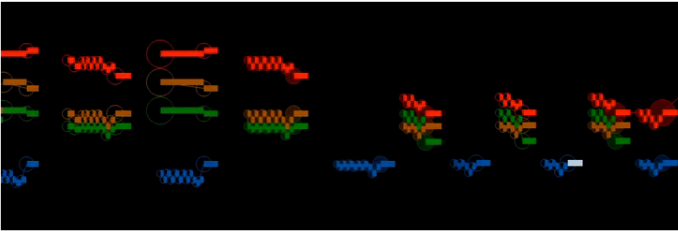
[14:12](#) Hyperborean Spirit Consciousness Connects with Human Consciousness 50,000 years ago



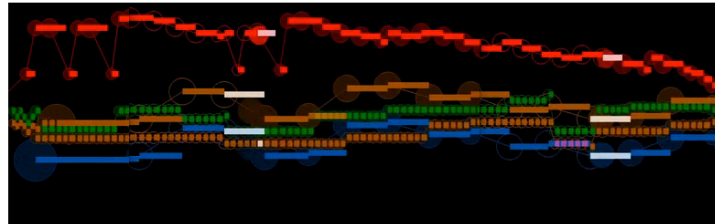
Hyperborean / Human Connection is initially Harmonious but begins to degrade



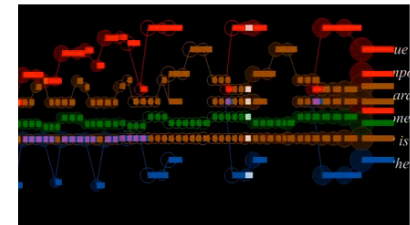
[14:57](#) African IFA - Lemurian Angkor Rig Veda - Atlantean Giza Britain America 40,000 years ago



[15:09](#) Humans Disconnect from Hyperboreans



after Flood 12,000 years ago Humans use Technological Consciousness



The Grosse Fugue History ends in 2012,
as do the Mayan Calendar and the Timewave of Terence McKenna derived from the I Ching.

There are 3 Appendices to this paper:

Appendix I - Some details about Grosse Fugue Overture page 16

Appendix II - Quantum Consciousness ... page 24

Appendix III - Red Book Physics ... page 38

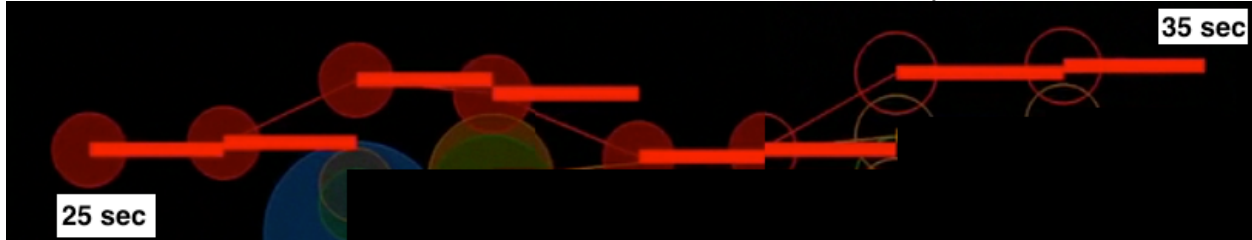
Grosse Fugue Overture Details

Visualizations of Beethoven's Grosse Fugue (Opus 133) (about 16 minutes long) have been done by Stephen Malinowski

<http://www.musanim.com/GrosseFuge/GrosseFugeViewersGuide.pdf>

Its Primary Subject has 8 notes

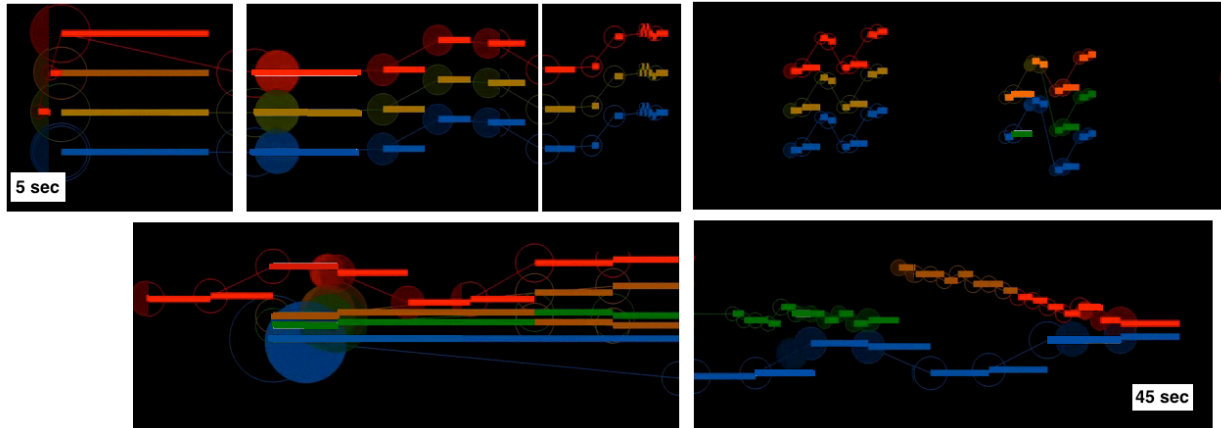
that can be seen as basis elements of 8-dimensional Euclidean Space



According to Wikipedia, it is played in every possible variation: fortissimo and pianissimo, different rhythms, upside down and backwards.

The E8 Lie Algebra is constructed from the largest possible consistent group of reflections in 8-dim Euclidean space, analogous to the variations of the Grosse Fugue Primary Subject.

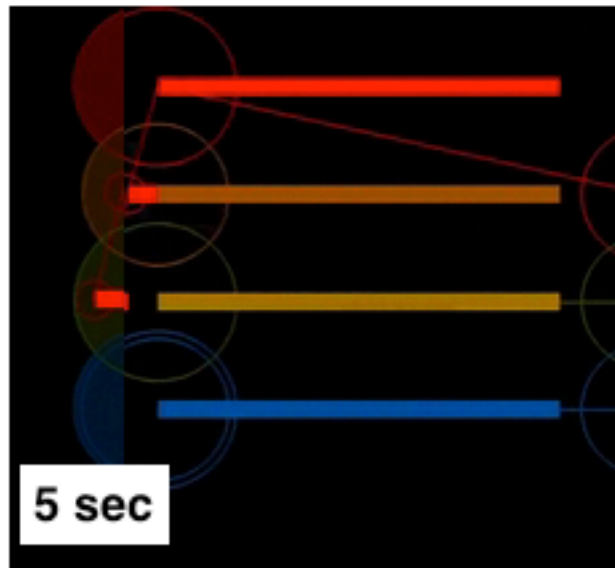
The Overture to the Grosse Fugue (24 bars, about 40 seconds)"... presents ... the material that will make up the entire piece ..." (quote from Wikipedia)



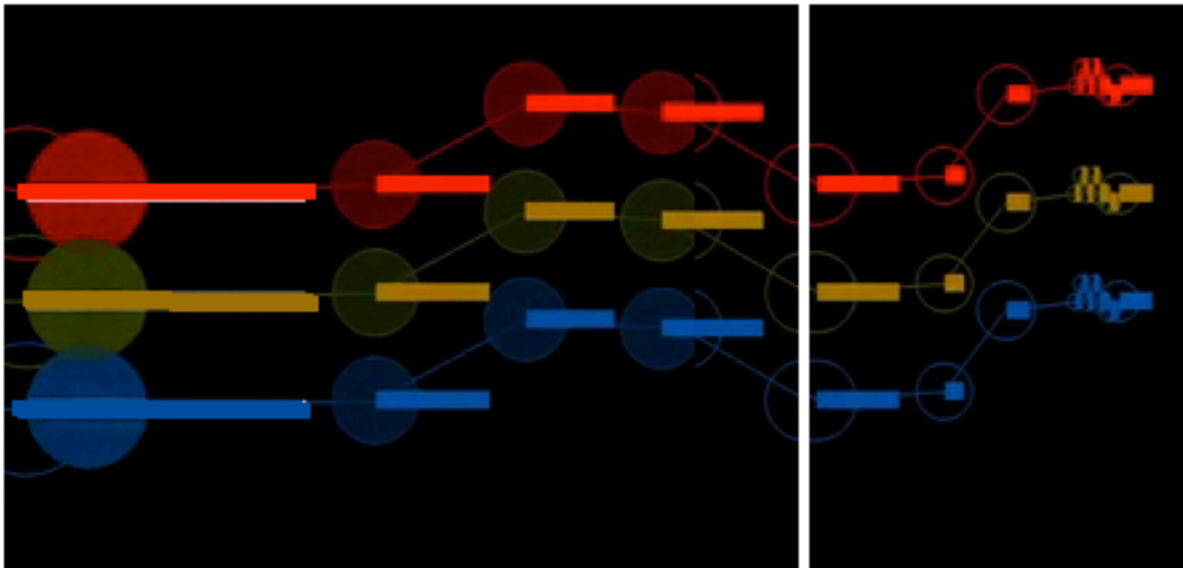
Here is how those segments of the Overture correspond to E8 Lie Algebra structures:

The initial segment introduces the instruments of the String Quartet:

first violin; second violin; viola; cello



Statement of the 8 elements of the Main Fugal Subject



corresponds to the 8 dimensions of an Octonionic Vector Space.

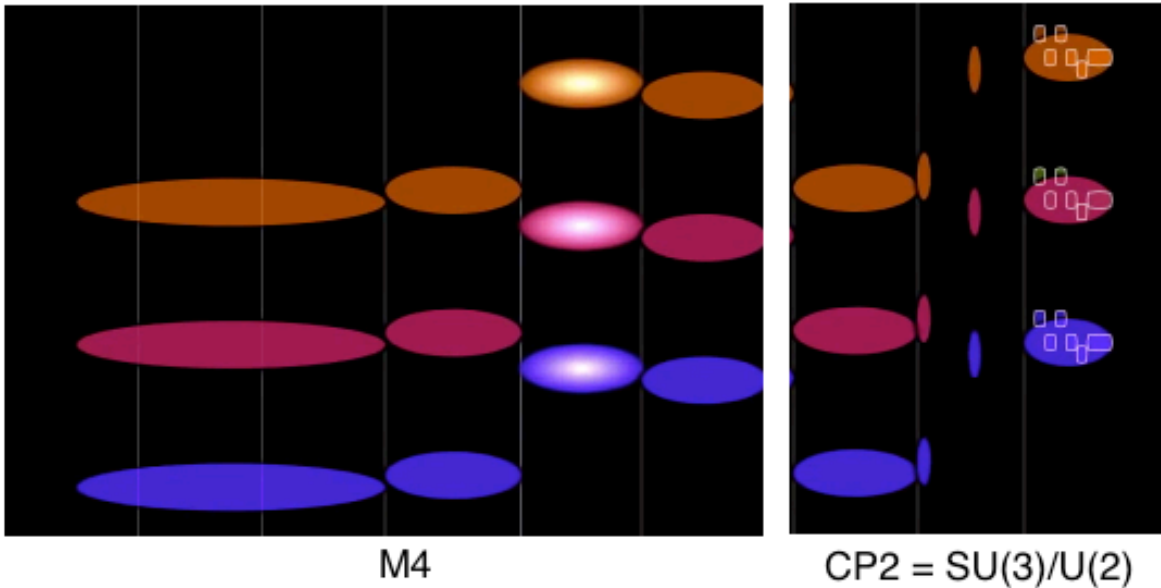
E8 has a D8 subalgebra that acts as rotations / reflections in a 16-dimensional Space that is an 8-complex-dimensional Complex Domain known as a L1e Ball.

The Shilov Boundary of the L1e Ball is an 8-real-dimensional Lie Sphere $RP^1 \times S^7$ with symmetry $Spin(10) / Spin(8) \times U(1)$ corresponding to 8-dim Octonionic Spacetime and to the 8 elements of the First Fugue.

At low energies (relative to the Planck Energy) the Octonionic Symmetry of Spacetime breaks to Quaternionic Symmetry of (4+4)-dim Kaluza-Klein $M4 \times CP2$

E8 Lattice 8-dim Spacetime

$E8 \times E8 \times E8 = 24\text{-dim Leech Lattice of } 26\text{D String=World-Line Theory}$



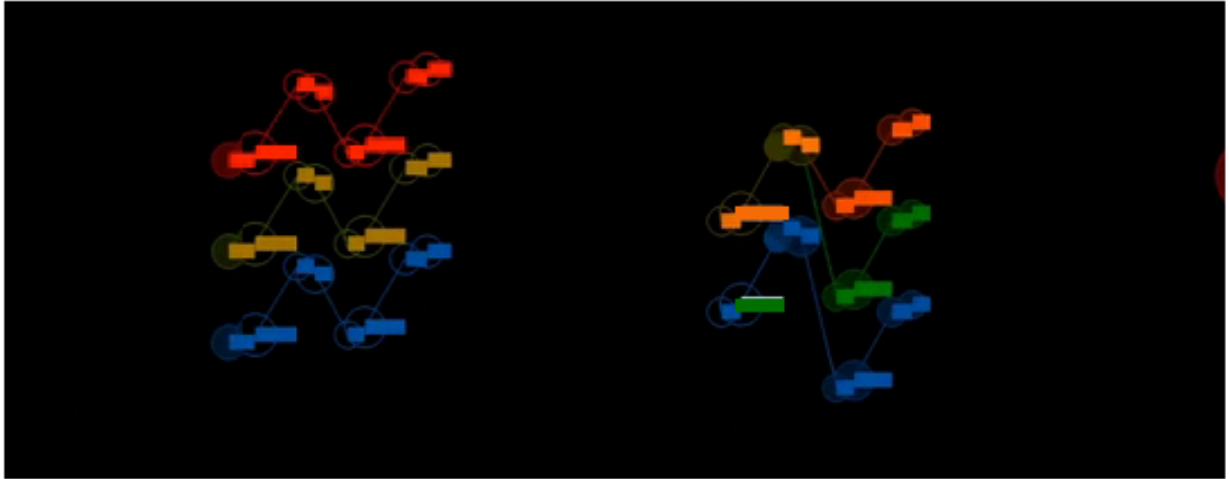
$M4 \times CP2$ Kaluza-Klein Quaternionic Spacetime

The $M4$ Physical Spacetime with Lie Sphere structure $RP1 \times S3$ corresponds to 1 long note (time) and 3 medium notes (space).

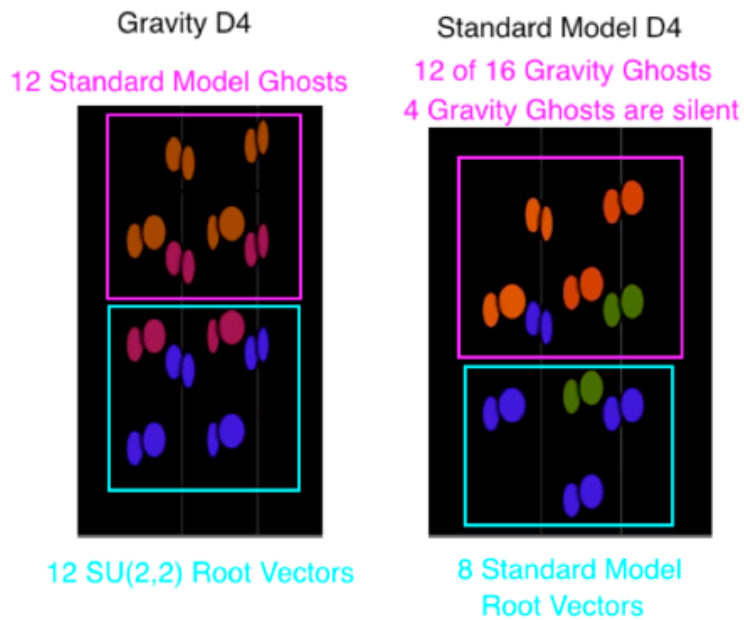
The $CP2$ Internal Symmetry Space of $CP2 = SU(3) / SU(2) \times U(1)$ corresponds to 1 medium note, 2 short notes, and one complicated medium note.

The whole thing is repeated in 3 instruments (second violin, first violin, cello) to correspond to the 24-dim Leech Lattice and to the 3 Octonions of the 56-dimensional $Fr3(O)$ Freudenthal Algebra (10 copies of which are $Cl(16)$ TriVectors) $Fr3(O)$ is the complexification of the 27-dimensional Jordan Algebra $J3(O)$ whose traceless part $J3(O)_o$ is the basic structure of 26D String=World-Line Theory

Repetition of Main Fugal Subject twice, in diminution



corresponds to the two D4 subalgebras in the D8 subalgebra of E8.

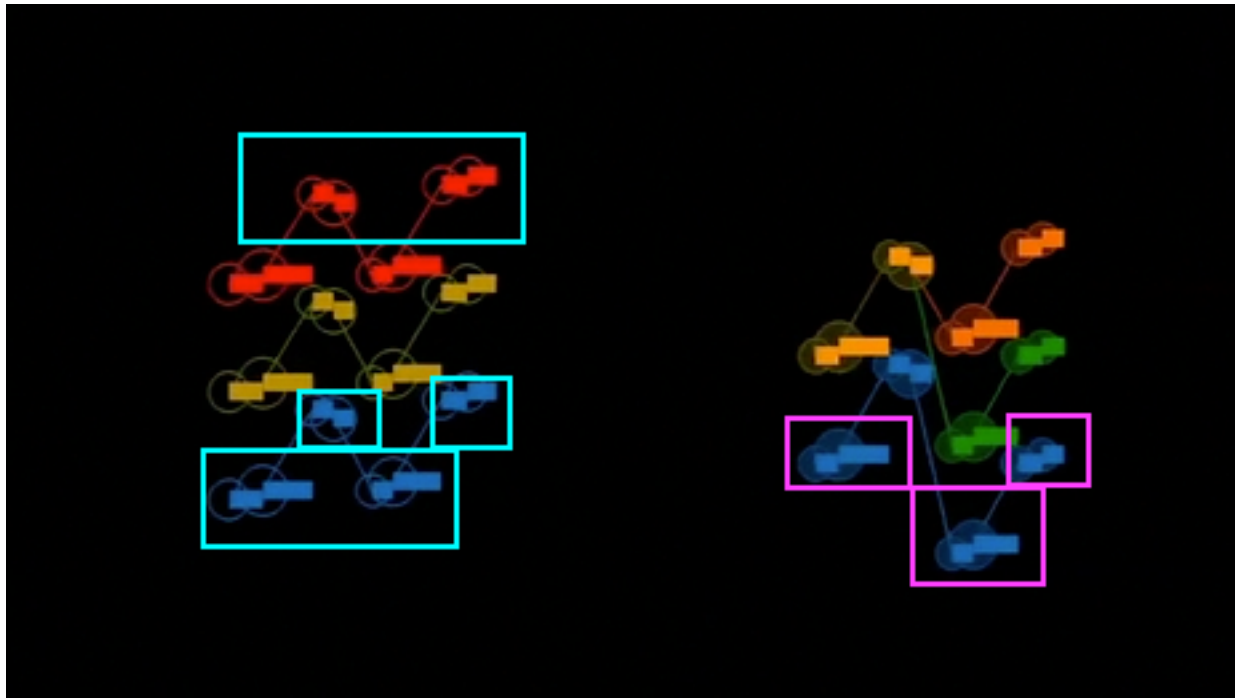


Here

<http://www.valdostamuseum.com/hamsmith/BeethovenGFovtD4D4.mov>

is an animation by Stephen Malinowski of the Gravity D4 and Standard Model D4 parts of the Grosse Fugue Overture

As to what effects the Grosse Fugue Overture music and animation have on my feelings compared to effects of the D4 subalgebras of E8 Physics,



When I hear the Grosse Fugue Overture two-part sample of music and see the animation of it I get feelings that are specific to that experience. It is reproducible: the same hearing / seeing gives the same feeling

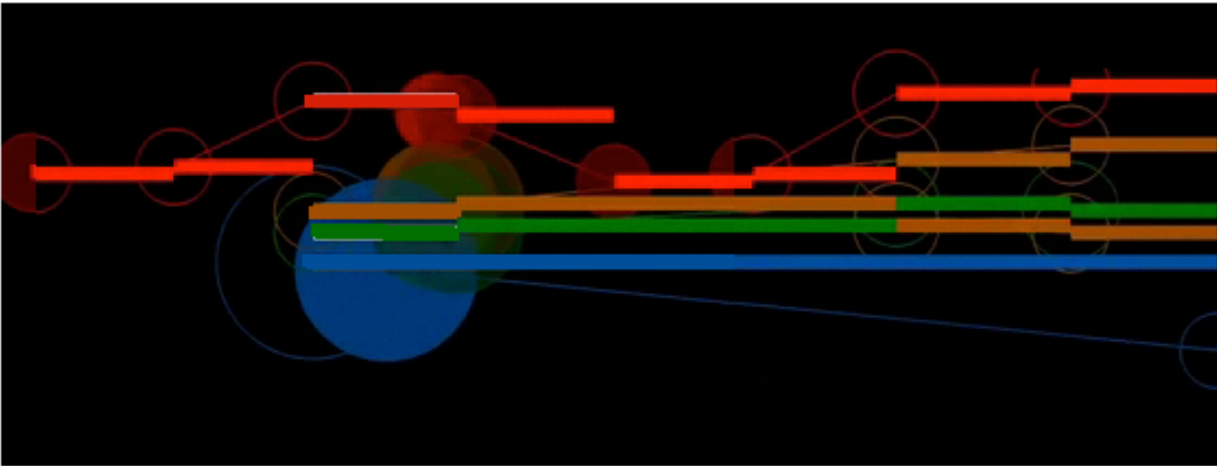
I also work on the physics of the $Cl(16)$ Clifford Algebra which contains E8 Lie Algebra which contains two D4 subalgebras - one D4 for Gravity+Dark Energy and another D4 for Standard Model with Color Force. When I think of the Gravity D4 and the Color Force D4 I get exactly the same feeling as from the two-part sample of the Grosse Fugue Overture.

The feeling for the first of the two parts (the 12 notes in the cyan boxes - 8 blue of Gravity and 4 red of Dark Energy) is the same as the feeling for Gravity D4

The feeling for the second of the two parts (the 6 notes (blue) in the magenta boxes) is the same as the feeling for Color Force D4

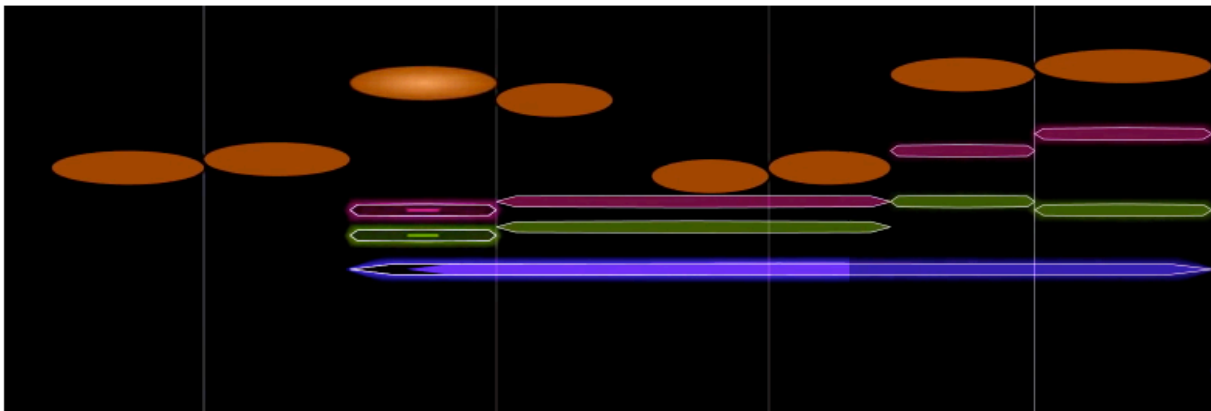
I hypothesize that the same patterns of Tubulin excitations in my brain Microtubules are activated by the Grosse Fugue experiences and by the Gravity - Color Force D4 subalgebras of E8 in $Cl(16)$.

The Main Fugal Subject again (first violin)

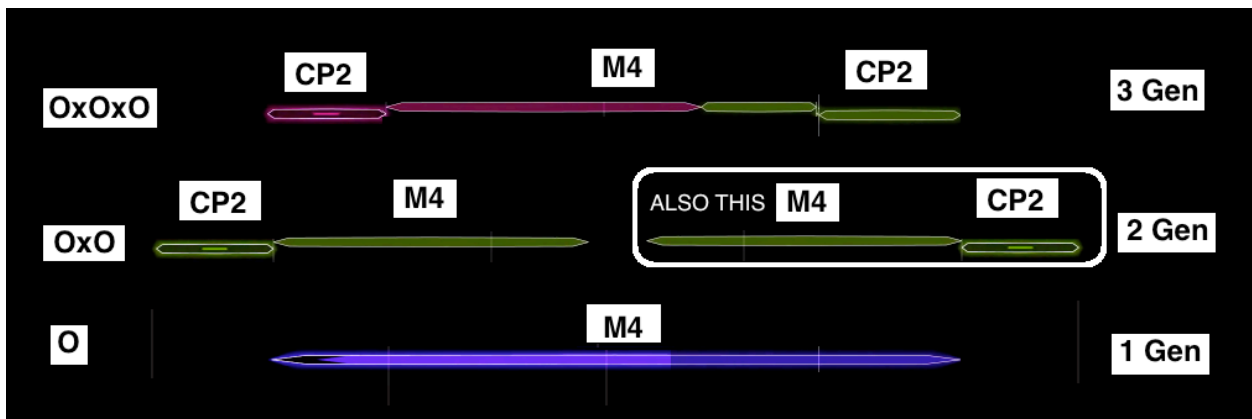


corresponding to 8 Fermion Particles of the First Generation.

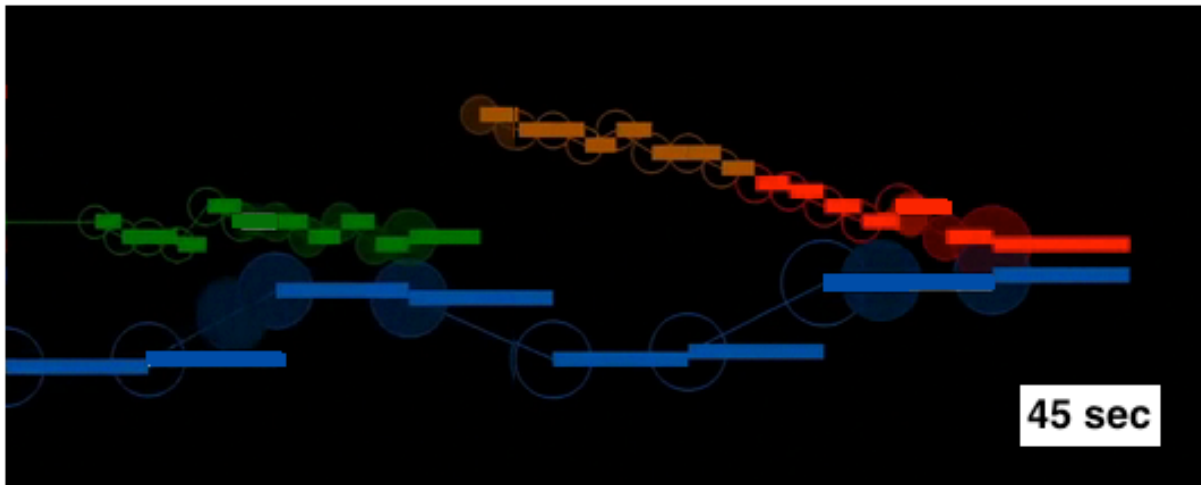
8 Fermion Particles



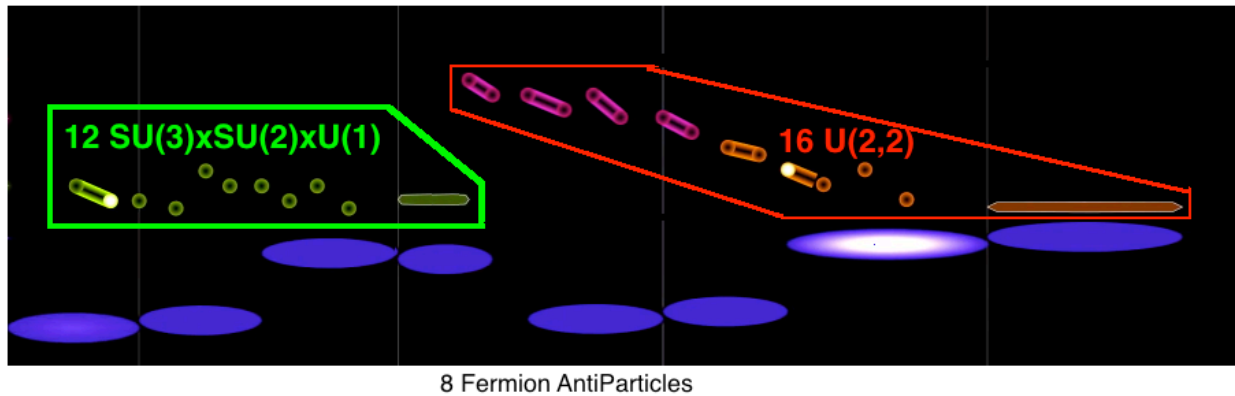
Its three recapitulations (second violin, viola, cello) correspond to the 3 Generations of Fermions.



Statement of the Other Fugal Subject with 12 + 16 elements corresponding to the 12-element Standard Model $SU(3) \times SU(2) \times U(1)$ and to the 16-element Conformal Gravity+Dark Energy $U(2,2)$ of the two 28-dimensional D4 subalgebras of the D8 subalgebra of E_8

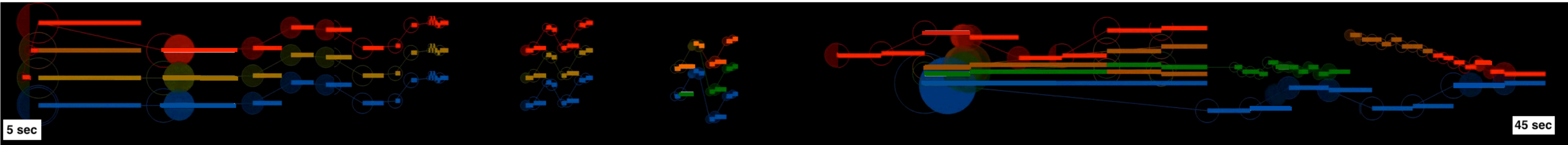


Statement of the First Subject in the cello corresponding to 8 Fermion AntiParticles of the First Generation

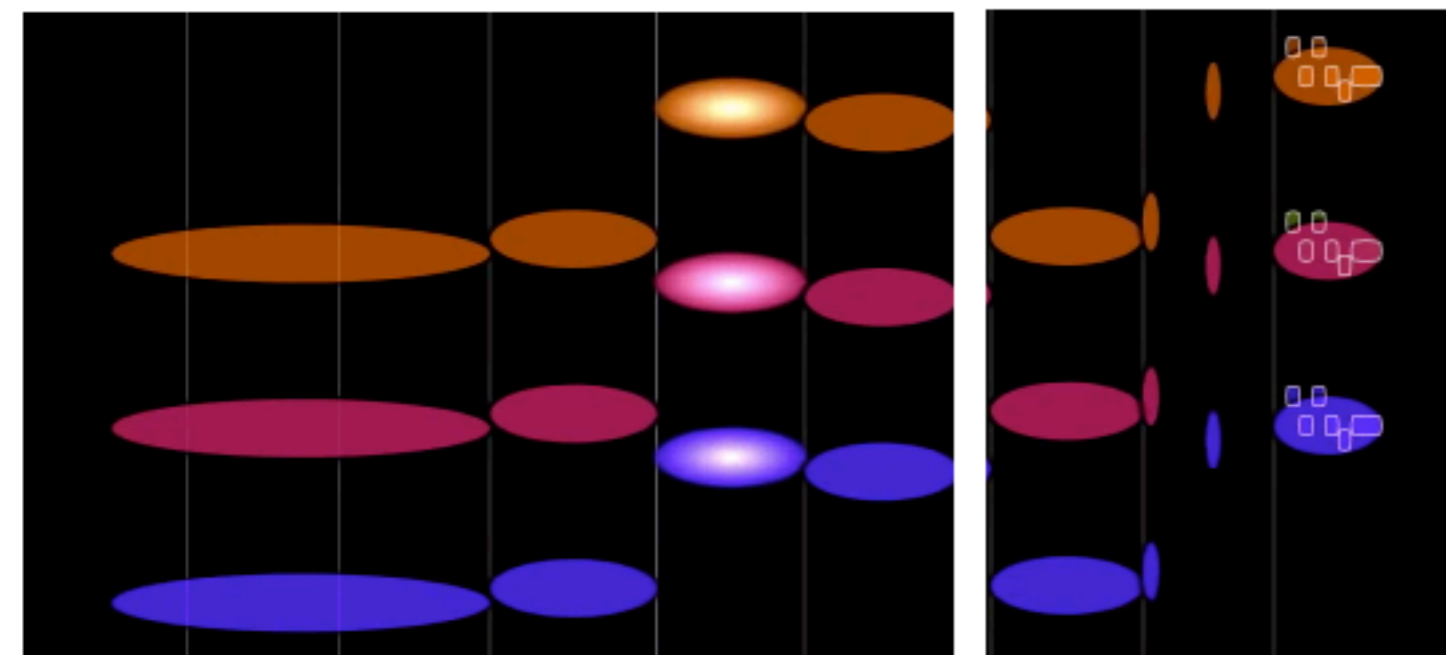


On the following page is a summary diagram of the Grosse Fugue Overture and E_8 :

Beethoven's Grosse Fugue Opus 133 Overture



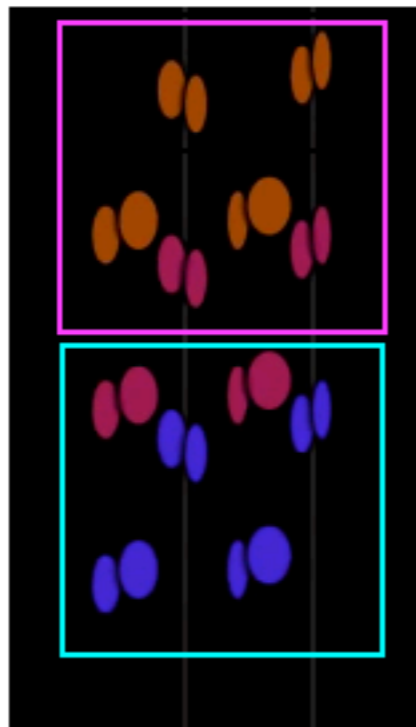
E8 Lattice 8-dim Spacetime
 $E8 \times E8 \times E8 = 24\text{-dim Leech Lattice of } 26\text{D String=World-Line Theory}$



M4
 M4 x CP2 Kaluza-Klein Quaternionic Spacetime

Gravity D4

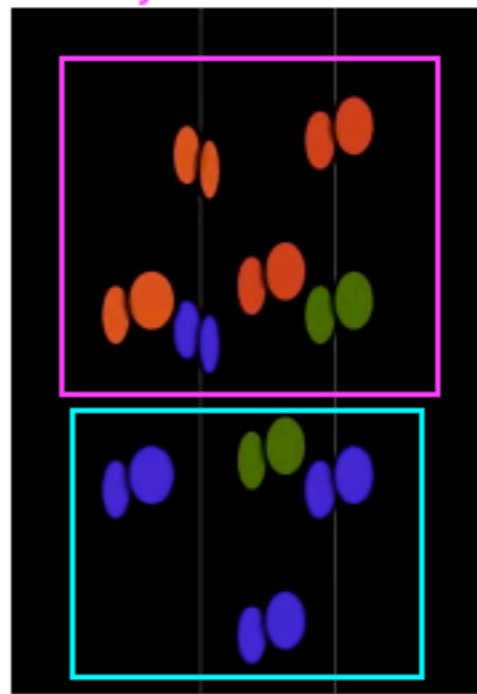
12 Standard Model Ghosts



12 SU(2,2) Root Vectors

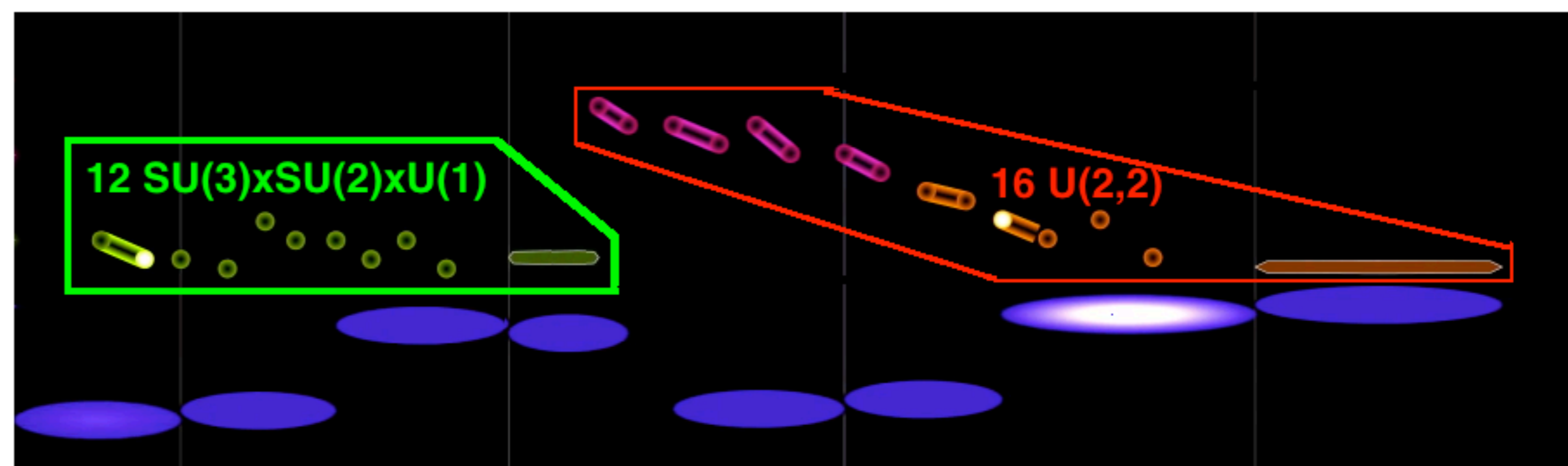
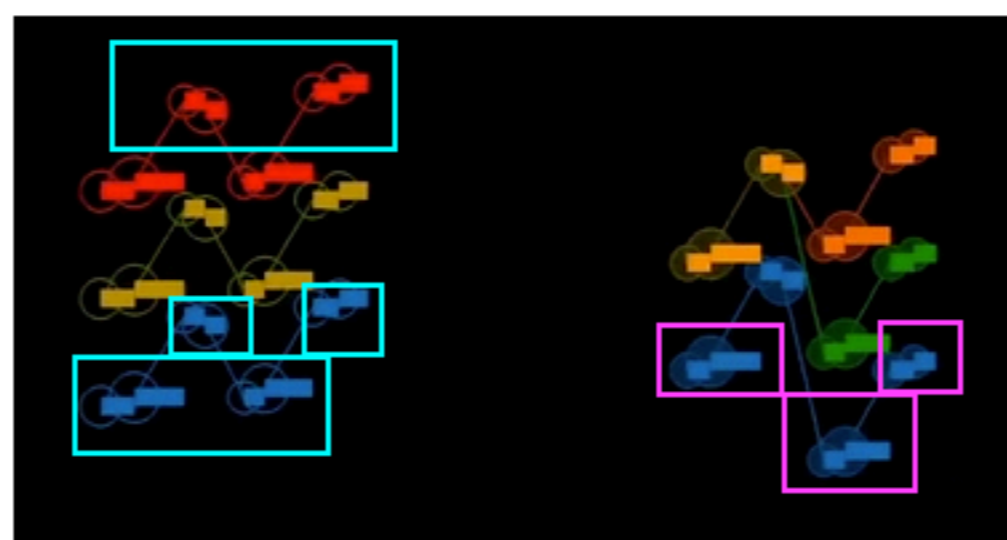
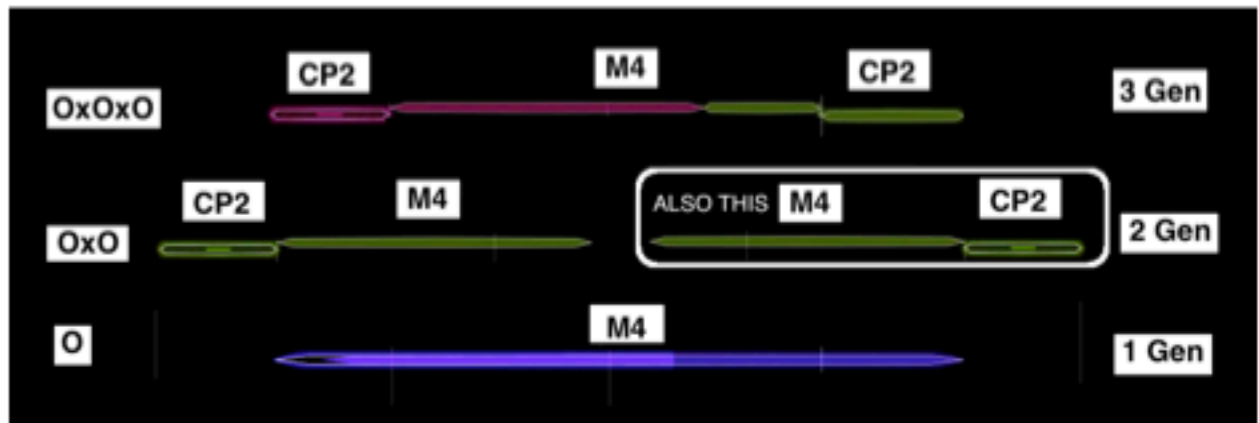
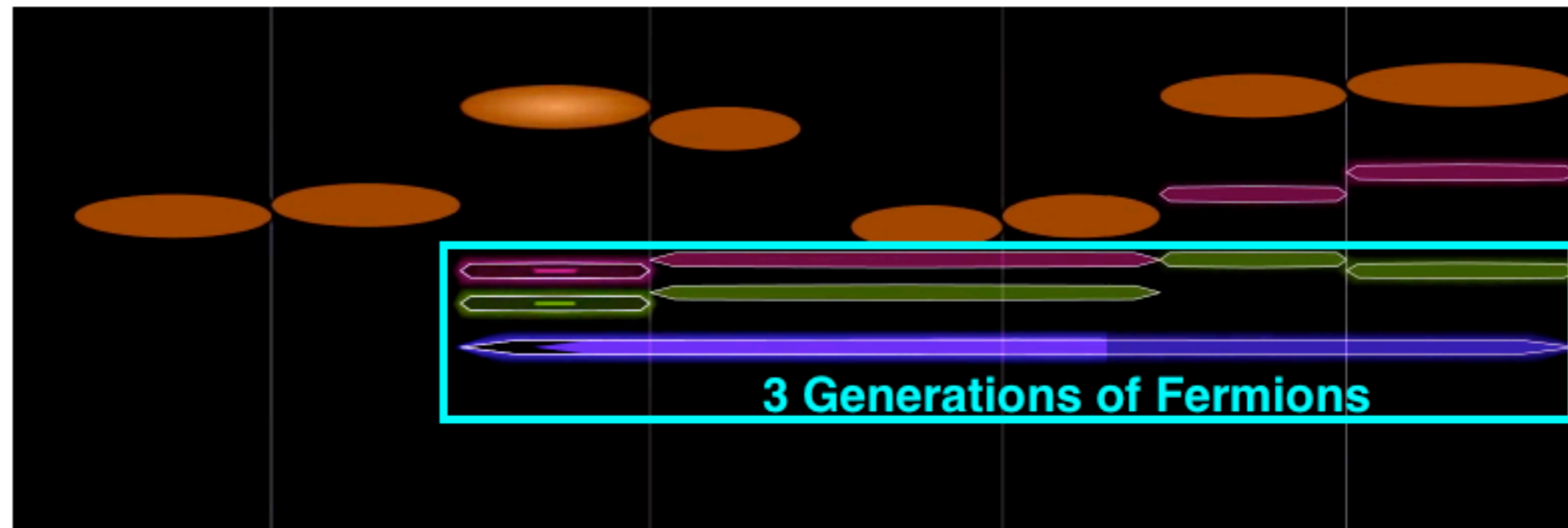
Standard Model D4

12 of 16 Gravity Ghosts
 4 Gravity Ghosts are silent



8 Standard Model Root Vectors

8 Fermion Particles



8 Fermion AntiParticles

Beethoven's Grosse Fugue Opus 133 Overture
 is an Outline of E8 Lie Algebra

Quantum Consciousness

The Algebraic Quantum Field Theory (AQFT) structure of the Bohm Quantum Potential of 26D String Theory is given by the Cl(16) Physics Local Lagrangian

$$\int_{8\text{-dim SpaceTime}} \text{Gauge Gravity} + \text{Standard Model} + \text{Fermion Particle-AntiParticle}$$

and by 8-Periodicity of Real Clifford Algebras,
as the **Completion of the Union of all Tensor Products of the form**

$$\text{Cl}(1,25) \times \dots (\text{N times tensor product}) \dots \times \text{Cl}(1,25)$$

which is analogous to Fock Space Hyperfinite II₁ von Neumann factor algebra that is based on 2-Periodicity of Complex Clifford Algebras.

For $N = 2^8 = 256$ the copies of Cl(1,25) are on the 256 vertices of the 8-dim HyperCube



For $N = 2^{16} = 65,536 = 4^8$ the copies of Cl(1,25) fill in the 8-dim HyperCube as described by William Gilbert's web page: "... 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. ...".

The vertices of the Hilbert curve are at the centers of the 2^8 sub-8-HyperCubes whose edge lengths are 1/2 of the edge lengths of the original 8-dim HyperCube

As N grows, the copies of Cl(1,25) continue to fill the 8-dim HyperCube of E8 SpaceTime

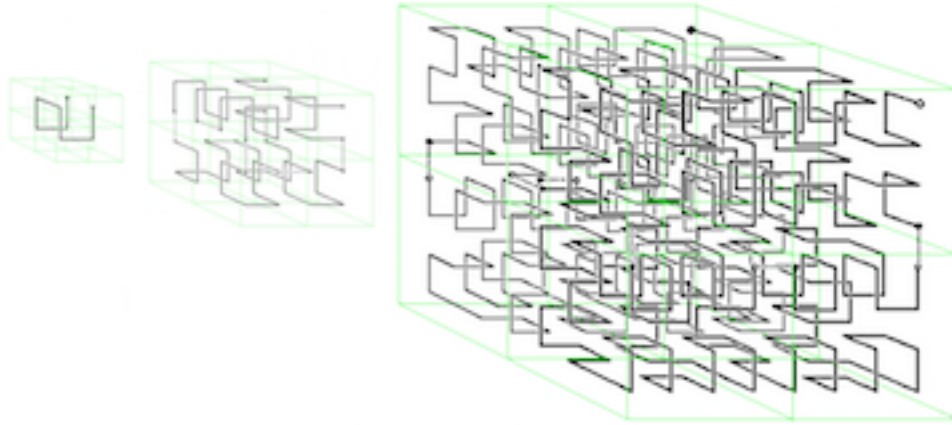
using higher Hilbert curve stages from the 8-bit reflected binary Gray code subdividing the initial 8-dim HyperCube into more and more sub-HyperCubes.

If edges of sub-HyperCubes, equal to the distance between adjacent copies of Cl(1,25), remain constantly at the Planck Length, then the

full 8-dim HyperCube of our Universe expands as N grows to 2^{16} and beyond

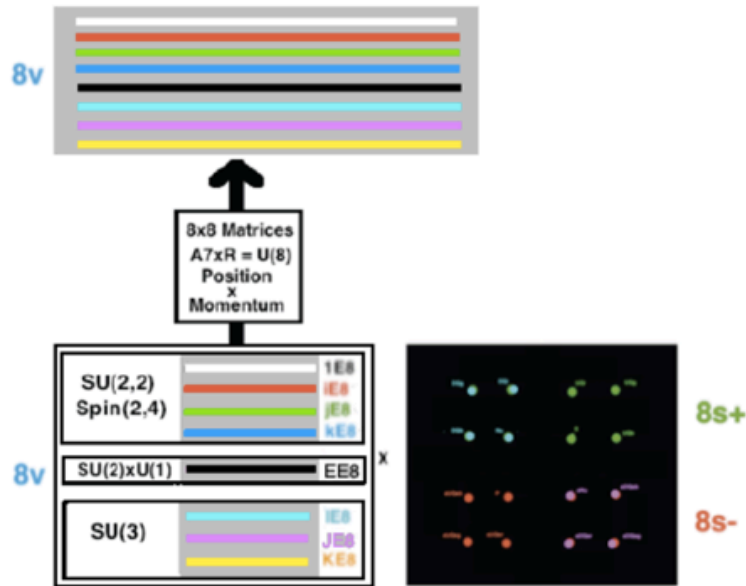
similarly to the way shown by this 3-HyperCube example for $N = 2^3, 4^3, 8^3$

from William Gilbert's web page:



The Union of all $Cl(1,25)$ tensor products is
 the Union of all subdivided 8-HyperCubes
 and
 their Completion is a huge superposition of 8-HyperCube Continuous Volumes
 which Completion belongs to the Third Grothendieck Universe.

26D String Theory Structure is



Green, Schwartz, and Witten, in "Superstring Theory" vol. 1, describe 26D String Theory saying "... The first excited level ... consists of ...

the ground state ... **tachyon** ...

and ... a scalar ... **'dilaton'** ...

and ... **SO(24)** ... **little group of a ...[26-dim]... massless particle** ...

and ... a ... **massless ... spin two state** ...".

Tachyons localized at orbifolds of fermions produce virtual clouds of particles / antiparticles that dress fermions by filling their Schwinger Source regions.

Dilatons are Goldstone bosons of spontaneously broken scale invariance that (analogous to Higgs) go from mediating a long-range scalar gravity-type force to the nonlocality of the Bohm-Sarfatti Quantum Potential.

The SO(24) little group is related to the Monster automorphism group that is the symmetry of each cell of Planck-scale local lattice structure.

The massless spin 2 state = Bohmion = Carrier of the Bohm Force of the Bohm Quantum Potential.

Similarity of the spin 2 Bohmion to the spin 2 Graviton accounts for the Bohmion's ability to support Penrose Consciousness with Superposition Separation Energy Difference $G m^2 / a$

where, for a Human Brain, m = mass of electron and a = 1 nanometer in Tubulin Dimer

"... Bohm's Quantum Potential can be viewed as an internal energy of a quantum system ..."

according to Dennis, de Gosson, and Hiley (arXiv 1412.5133)

and

Bohm Quantum Potential inherits Sarfatti Back-Reaction from its spin-2 structure similar to General Relativity

Peter R. Holland says in "The Quantum Theory of Motion" (Cambridge 1993):

"... the total force ... from the quantum potential ... does not ... fall off with distance ... because ... the quantum potential ... depends on the form of ...[the quantum state]... rather than ... its ... magnitude ...".

Penrose-Hameroff-type Quantum Consciousness is due to Resonant Quantum Potential Connections among Quantum State Forms.

The Quantum State Form of a Conscious Brain is determined by the configuration of a subset of its 10^{18} to 10^{19} Tubulin Dimers described by a large Real Clifford Algebra.

Paola Zizzi in gr-qc/0007006 describes the Octonionic Inflation Era of Our Universe as a Quantum Consciousness Superposition of States ending with Self-Decoherence after 64 doublings of Octonionic Inflation, at which time Our Universe is

"... a superposed state of quantum ... [qubits].

the self-reduction of the superposed quantum state is ... reached at the end of inflation ...[at]... the decoherence time ... [Tdecoh = 10^9 Tplanck = $10^{(-34)}$ sec] ... and corresponds to a superposed state of ... [$10^{19} = 2^{64}$ qubits]. ...".

64 doublings to 2^{64} qubits corresponds to the Clifford algebra

$$Cl(64) = Cl(8 \times 8) = Cl(8) \times Cl(8) \times Cl(8) \times Cl(8) \times Cl(8) \times Cl(8) \times Cl(8) \times Cl(8)$$

By the periodicity-8 theorem of Real Clifford algebras, Cl(64) is the smallest Real Clifford algebra for which we can reflexively identify each component Cl(8) with a basis vector in the Cl(8) vector space.

This reflexive identification causes our universe to decohere at $N = 2^{64} = 10^{19}$.

Octonionic Quantum Processes are Not Unitary and so can produce Fermions.

(see Stephen Adler's book "Quaternionic Quantum Mechanics ..." at pages 50-52 and 561).

At the end of 64 Unfoldings, Non-Unitary Octonionic Inflation ended having produced about $(1/2) 16^{64} = (1/2) (2^4)^{64} = 2^{255} = 6 \times 10^{76}$ Fermions.

At the End of Inflation Our Universe had Temperature / Energy $10^{27} \text{ K} = 10^{14} \text{ GeV}$ so each of the 10^{77} Fermions had energy of 10^{14} GeV and collisions among them would for each of the 10^{77} Fermions produce jets containing about 10^{12} particles of energy 100 GeV or so so that the total number created by Inflation was about 10^{89} .

The End of Inflation time was at about $10^{(-34)} \text{ sec} = 2^{64} \text{ Tplanck}$ and

the size of our Universe was then about $10^{(-24)} \text{ cm}$

which is about the size of a Fermion Schwinger Source Kerr-Newman Cloud.

The 2^{64} qubits created by Inflation is roughly 10^{19} which is roughly the number of Quantum Consciousness Tubulins in the Human Brain.

Therefore

the Human Brain Quantum Consciousness has evolved in Our Universe to be roughly equivalent to the Maximum Consciousness of Our Inflationary Era Universe.

Further,

each cell of E8 Lagrangian Spacetime corresponds to 65,536-dim $Cl(16)$ which contains 248-dim E8 = 120-dim D8 bivectors + 128-dim D8 half-spinors
Human Brain Microtubules 40 microns long have 65,536 Tubulin Dimers



(image adapted from 12biophys.blogspot.com Lecture 11)

and so

can have Bohm Quantum Resonance with $Cl(16)$ Spacetime cells so that at any and all Times

the State of Consciousness of a Human is in exact resonant correspondence with a subset of the cells of E8 Classical Lagrangian Spacetime

Therefore

E8 Lagrangian Spacetime (as a Nambu-Jona-Lasinio Condensate) is effectively the Spirit World

in which the Human States of Consciousness = Souls exist.

After the death of the Human Physical Body the Spirit World interactions with its Soul are no longer constrained by Physical World interactions with its Body so that the Spirit World can harmonize the individual Soul with the collective Universal Soul.

**A Single Cell of E8 26-dimensional Bosonic String Theory,
in which Strings are physically interpreted as World-Lines,
can be described by taking the quotient of its 24-dimensional O+, O-, Ov
subspace modulo the 24-dimensional Leech lattice.
Its automorphism group is the largest finite sporadic group, the Monster Group,
whose order is
8080, 17424, 79451, 28758, 86459, 90496, 17107, 57005, 75436, 80000, 00000 =
= 2^46 .3^20 .5^9 .7^6 .11^2 .13^3 .17.19.23.29.31.41.47.59.71
or about 8 x 10^53.**

“... Bohm’s Quantum Potential can be viewed as an internal energy of a quantum system ...” according to Dennis, de Gosson, and Hiley (arXiv 1412.5133) and Peter R. Holland says in "The Quantum Theory of Motion" (Cambridge 1993): "... the total force ... from the quantum potential ... does not ... fall off with distance ... because ... the quantum potential ... depends on the form of ...[the quantum state]... rather than ... its ... magnitude ...".

**Penrose-Hameroff-type Quantum Consciousness is due
to Resonant Quantum Potential Connections among Quantum State Forms.**

The Quantum State Form of a Conscious Brain is determined by
the configuration of a subset of its 10^18 to 10^19 Tubulin Dimers
with math description in terms of a large Real Clifford Algebra:

Resonance is discussed by Carver Mead in “Collective Electrodynamics“ (MIT 2000):
"... we can build ... a resonator from ... electric dipole ... configuration[s] ...



[such as Tubulin Dimers]

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 ... the coupling of ... two ... configurations ... is the same, whether retarded or advanced potentials are used. Any ... configuration ... couples to any other on its light cone, whether past or future. ... The total phase accumulation in a ... configuration ... is the sum of that due to its own current, and that due to currents in other ... configurations ... far away ...

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 arbitrary separation between the resonators ... 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! ... 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. ...”.

For the 10^{18} Tubulin Dimers of the human brain,
the resonant frequencies are the same and exchanges of energy among them
act to keep them **locked in a Quantum Protectorate collective coherent state.**

Philip W. Anderson in cond-mat/0007287 and cond-mat/007185 said:

"... 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 ... flux quantization in superconductors, equivalent to the Josephson frequency relation which again has mensuration accuracy and is independent of imperfections and scattering. ...

... 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, macroscopic behavior is mostly determined by overall conservation laws ... a "quantum protectorate" ... [is]... a state in which the manybody 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 ...".

Mershin, Sanabria, Miller, Nawarathna, Skoulakis, Mavromatos, Kolomenskii, Scheussler, Ludena, and Nanopoulos in physics/0505080 "Towards Experimental Tests of Quantum Effects in Cytoskeletal Proteins" said:

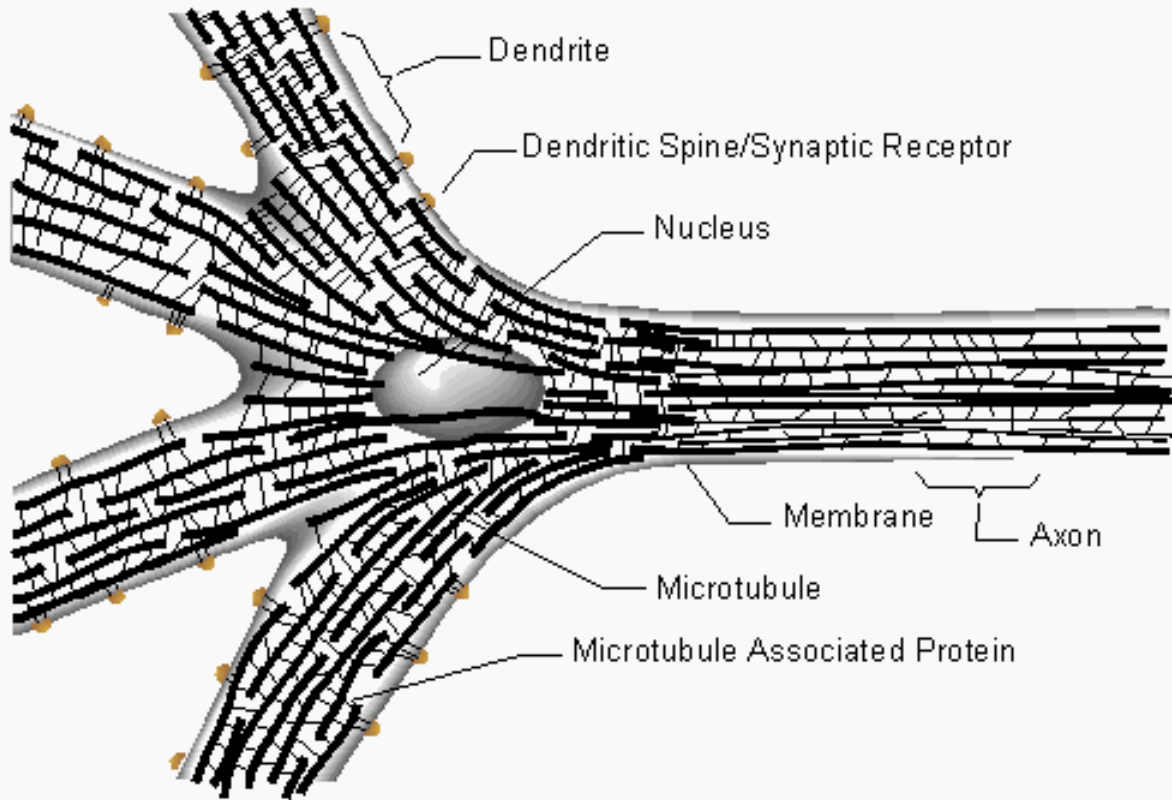


Classically, the various dimers can only be in the ... []... conformations. Each dimer is influenced by the neighboring dimers resulting in the possibility of a transition. This is the basis for classical information processing, which constitutes the picture of a (classical) cellular automaton.

If we assume ... that each dimer can find itself in a QM superposition of ... [those]... states, a quantum nature results. Tubulin can then be viewed as a typical two-state quantum mechanical system, where the dimers couple to conformational changes with $10^{(-9)} - 10^{(-11)}$ sec transitions, corresponding to an angular frequency $\sim 10^{10} - 10^{12}$ Hz. In this approximation, the upper bound of this frequency range is assumed to represent (in order of magnitude) the characteristic frequency of the dimers, viewed as a two-state quantum-mechanical system ... [

The Energy Gap of our Universe as superconductor condensate spacetime is from $3 \times 10^{(-18)}$ Hz (radius of universe) to 3×10^{43} Hz (Planck length). Its RMS amplitude is 10^{13} Hz = 10 THz = energy of neutrino masses = critical temperature T_c of BSCCO superconducting crystal Josephson Junctions]... large-scale quantum coherence ... [has been observed]... at temperatures within a factor of three of biological temperatures. MRI magnets contain hundreds of miles of superconducting wire and routinely carry a persistent current. There is no distance limit - the macroscopic wave function of the superfluid condensate of electron pairs, or Cooper pairs, in a sufficiently long cable could maintain its quantum phase coherence for many thousands of miles ... there is no limit to the total mass of the electrons participating in the superfluid state. The condensate is "protected" from thermal fluctuations by the BCS energy gap at the Fermi surface ... The term "quantum protectorate" ... describe[s] this and related many-body systems ...".

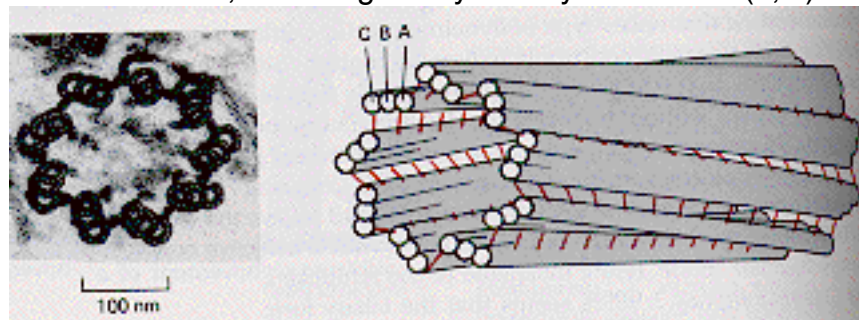
The Human Brain has about 10^{11} Neuron cells, each about 1,000 nm in size.
 The cytoskeleton of cells, including neurons of the brain, is made up of Microtubules



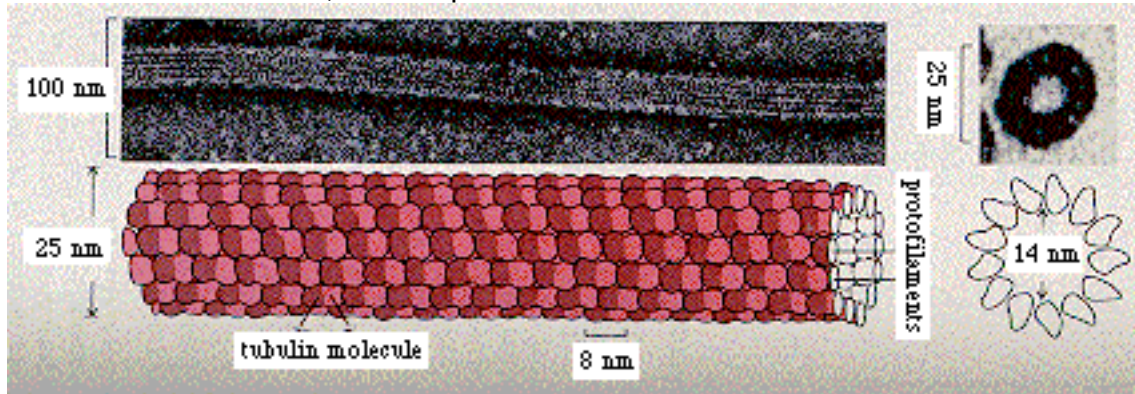
(image from "Orchestrated Objective Reduction of Quantum Coherence in Brain Microtubules: The "Orch OR" Model for Consciousness" by Penrose and Hameroff)

Each Neuron contains about 10^9 Tubulin Dimers, organized into Microtubules some of which are organized by a Centrosome. Centrosomes contain a pair of Centrioles.

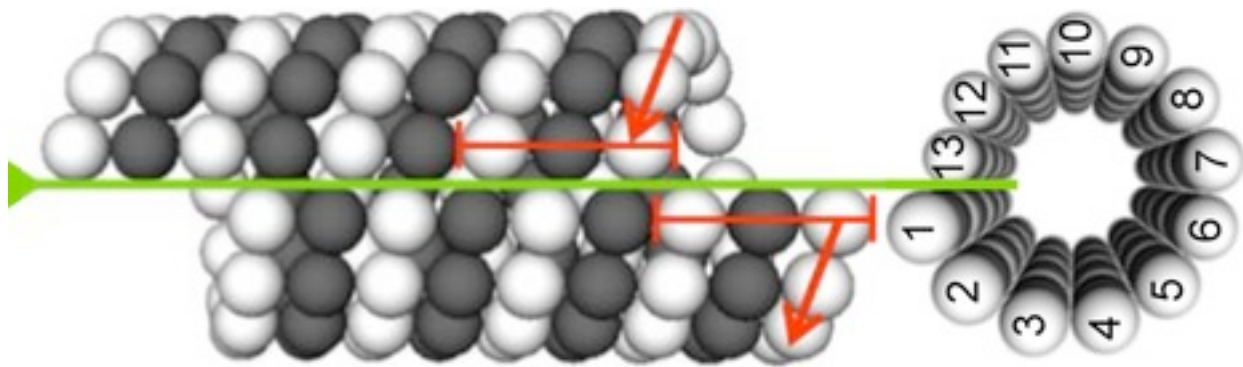
A Centriole is about 200 nm wide and 400 nm long. Its wall is made up of 9 groups of 3 Microtubules, reflecting the symmetry of 27-dim $J(3,0)$



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



(illustrations and information about cells, microtubules, and centrioles are from Molecular Biology of the Cell, 2nd ed, by Alberts, Bray, Lewis, Raff, Roberts, and Watson (Garland 1989))



(image from Wikipedia on Microtubule)

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 containing roughly 20 Atoms)
 A Microtubule 40 microns = 40,000 nm long contains $13 \times 40,000 / 8 = 65,000$ Dimers



(images adapted from nonlocal.com/hbar/microtubules.html by Rhett Savage)

The black dots indicate the position of the Conformation Electrons.

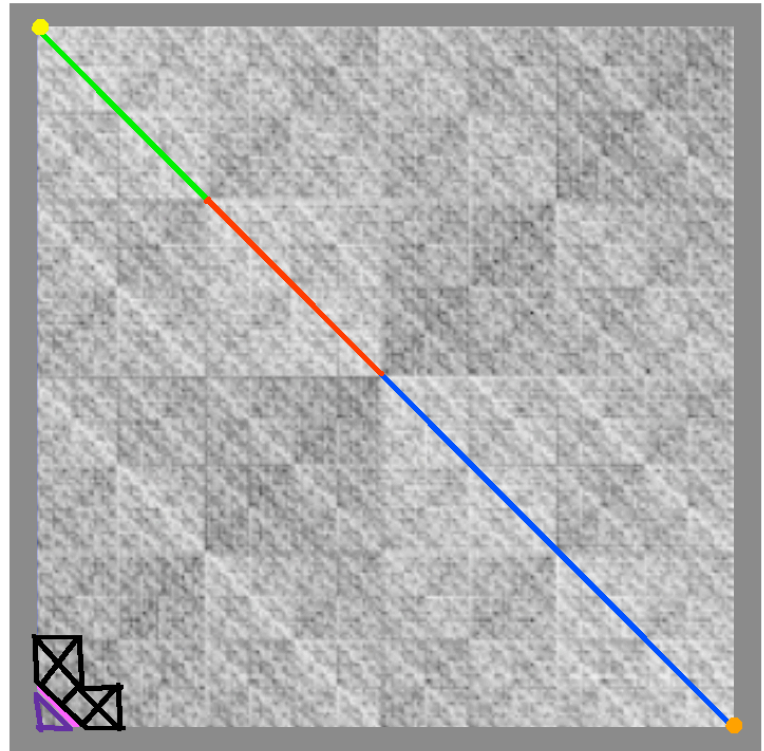
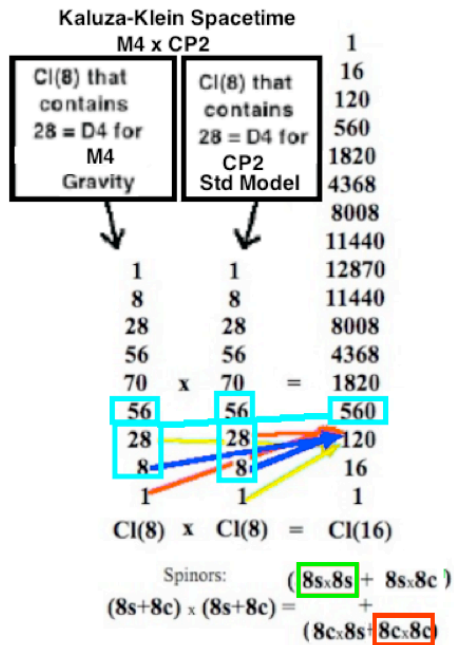
There are two energetically distinct configurations for the Tubulin Dimers:

Conformation Electrons Similarly Aligned (left image) - State 0

Conformation Electrons Maximally Separated (right image) - State 1

The two structures - State 0 ground state and State 1 higher energy state - make Tubulin Dimers the basis for a Microtubule binary math / code system.

Microtubule binary math / code system corresponds to Clifford Algebras $Cl(8)$ and $Cl(8) \times Cl(8) = Cl(16)$ containing 16-dim V_{16} (magenta) and 120 (inside purple outline) + 128-dim (yellow green red) = 248-dim E_8 and 560 (inside black outline) 10 copies of 56-dim $Fr_3(O)$:

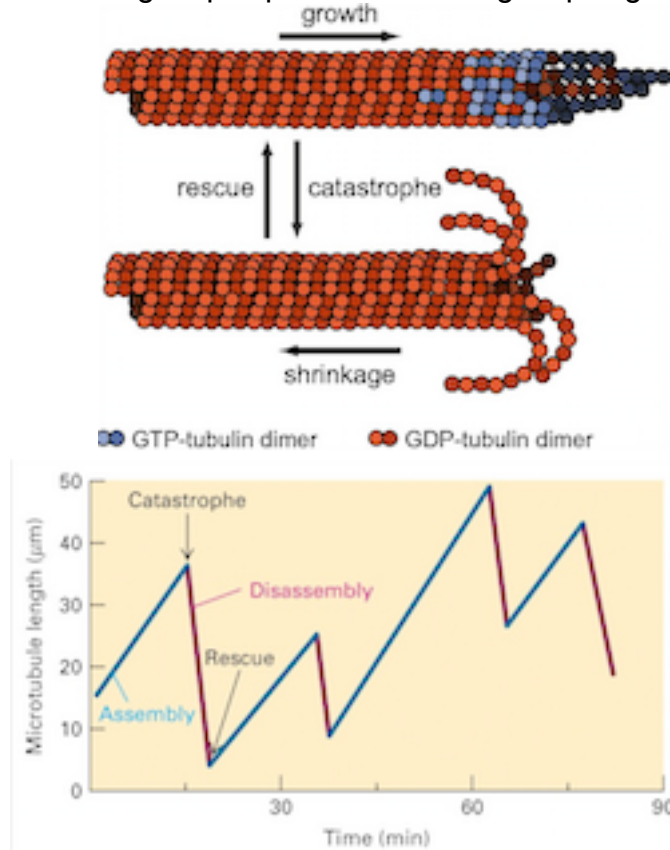


That leaves 1 (orange) + and 127 (blue) = 128-dim Mirror Fermion half-spinors and $65,536 - 256 - 560 - 120 - 16 = 64,584$ elements of $Cl(16)$ available to carry information in the processes of Quantum Consciousness.

According to 12biophys.blogspot.com Lecture 11 Microtubule structure is dynamic: "... One end of the microtubule is composed of stable (GTP) monomers while the rest of the tubule is made up of unstable (GDP) monomers. The GTP end comprises a cap of stable monomers. Random fluctuations either increase or decrease the size of the cap.

This results in 2 different dynamic states for the microtubule.

Growing: cap is present Shrinking: cap is gone ...




...”.

Microtubules spend most of their lives between 10 microns and 40 microns, sizes that can represent E8 as half of the Even Part (half) of CI(16) (10 microns) or as the Even Part (half) of CI(16) (20 microns) or as full CI(16) (40 microns).

In a given Microtubule

the 128 CI(8) Half-Spinor part  is represented by a line of 128 Dimers in its stable GTP region and

the 120 CI(16) BiVector part  by a 12 x 10 block of Dimers in its stable GTP region
The 560 CI(16) TriVector part is represented similarly.

(image adapted from 12biophys.blogspot.com Lecture 11)



How do the Microtubules communicate with each other ?

Consider the Superposition of States State 0 and State 1 involving one Tubulin Dimer with Conformation Electron mass m and State1 / State 0 position separation a .

The Superposition Separation Energy Difference is the internal energy

$$E_{\text{ssediff}} = G m^2 / a$$

that can be seen as **either the energy of 26D String Theory spin two gravitons** or the **Bohm Quantum Potential internal energy**, equivalently.

Communication between two Microtubules is by the Bohm Quantum Potential between their respective corresponding Dimers with the correspondence being based on connection between respective E8 and Fr3(O) subsets

How is information encoded in the Microtubules ?

Each Microtubule contains E8 and Fr3(O), allowing Microtubules to be correlated with each other. The parts of the Microtubule beyond E8 and Fr3(O) are in Cl(16) for 40 micron Microtubules, or the Even Subalgebra of Cl(16) for 20 micron Microtubules, or half of the Even Subalgebra of Cl(16) for 10 micron Microtubules so since by 8-Periodicity of Real Clifford Algebras $Cl(16) = Cl(8) \times Cl(8)$ and since Cl(8) information is described by the Quantum Reed-Muller code $[[256, 0, 24]]$ **the information content** of Cl(16) and its Subalgebras **is described by the Tensor Product Quantum Reed-Muller code $[[256, 0, 24]]$ x $[[256, 0, 24]]$**

What about information in the Many Microtubules of Human Consciousness ?

The information in one Microtubule is based on Cl(16) which is contained in the Cl(1,25) of 26D String Theory E8 Physics

How does this give rise to Penrose-Hameroff Quantum Consciousness ?

Consider the Superposition of States State 0 and State 1 involving one Tubulin Dimer with Conformation Electron mass m and State1 / State 0 position separation a . The Superposition Separation Energy Difference is the internal energy

$$E_{\text{ssediff}} = G m^2 / a$$

that can be seen as the energy of 26D String Theory spin two gravitons which physically represent the Bohm Quantum Potential internal energy.

For a given Tubulin Dimer $a = 1$ nanometer = 10^{-7} cm so that

$$T = h / E_{\text{electron}} = (\text{Compton} / \text{Schwarzschild}) (a / c) = 10^{26} \text{ sec} = 10^{19} \text{ years}$$

Now consider the case of N Tubulin Dimers in Coherent Superposition connected by the Bohm Quantum Potential Force that does not fall off with distance. Jack Sarfatti defines coherence length L by $L^3 = N a^3$ so that the Superposition Energy E_N of N superposed Conformation Electrons is

$$E_N = G M^2 / L = N^{(5/3)} E_{ssediff}$$

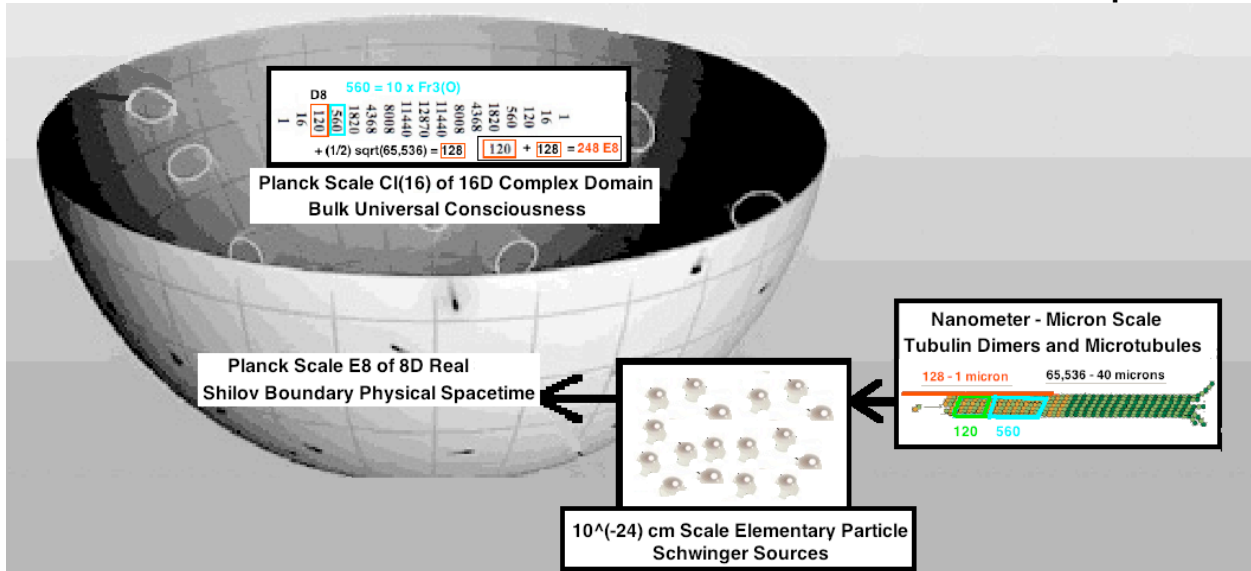
The decoherence time for the system of N Tubulin Electrons is

$$T_N = h / E_N = h / N^{(5/3)} E_{ssediff} = N^{(-5/3)} 10^{26} \text{ sec}$$

so we have the following rough approximate Decoherence Times T_N

Number of Involved Tubulin Dimers	Time T_N
$10^{(11+9)} = 10^{20}$	$10^{(-33 + 26)} = 10^{(-7)} \text{ sec}$ 10^{11} neurons x 10^9 TD / neuron 10^{20} Tubulin Dimers in Human Brain
10^{16}	$10^{(-27 + 26)} = 10^{(-1)} \text{ sec} - 10 \text{ Hz}$ Human Alpha EEG is 8 to 13 Hz Fundamental Schumann Resonance is 7.8 Hz Time of Traverse by a String World-Line Quantum Bohmion of a Quantum Consciousness Hamiltonian Circuit of 10^{16} TD separated from nearest neighbors by 10 nm is $10^{16} \times 10 \text{ nm} / c = (10^{16} \times 10^{(-6)}) \text{ cm} / c = 10^{10} \text{ cm} / c = 0.3 \text{ sec}$

Each cell of E8 Classical Lagrangian Spacetime corresponds to 65,536-dim Cl(16) which contains 248-dim E8 = 120-dim D8 bivectors +128-dim D8 half-spinors



In E8 Physics (viXra 1602.0319)

Spacetime is the 8-dimensional Shilov Boundary RP1 x S7

of the Type IV8 Bounded Complex Domain Bulk Space

of the Symmetric Space Spin(10) / Spin(8)xU(1)

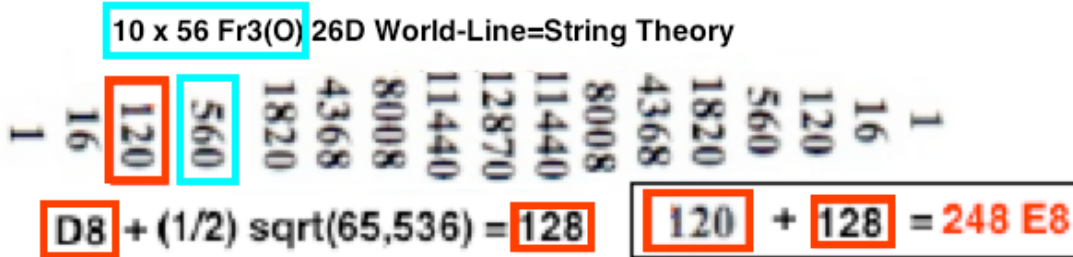
which **Bulk Space** has 16 Real dimensions

and is the Vector Space of the Real Clifford Algebra Cl(16).

By 8-Periodicity,

Cl(16) = tensor product Cl(8) x Cl(8) = Real 256x256 Matrix Algebra M(R,256)

and so has 256x256 = 65,536 elements.



Cl(8) has 8 Vectors, 28 BiVectors, and 16 Spinors with 8+28+16 = 52 = F4 Lie Algebra.

Cl(16) has 120 BiVectors and 128 Half-Spinors for 120+128 = 248 = E8 Lie Algebra giving a Lagrangian for the Standard Model and for Gravity - Dark Energy.

Cl(16) has 560 TriVectors for 10 copies of Fr3(O) and Cl(1,25) AQFT

so 65,536 - 248 - 560 = 64,728 elements of Cl(16) are for Consciousness Information.

The Complex Bulk Space Cl(16)

contains the Maximal Contraction of E8 which is H92 + A7

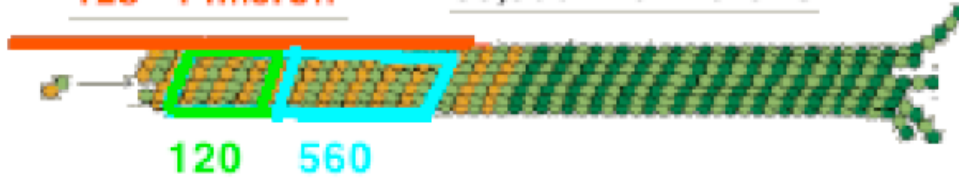
a generalized Heisenberg Algebra of Quantum Creation-Annihilation Operators with graded structure

$$28 + 64 + ((SL(8,R)+1) + 64 + 28$$

Human Brain Microtubules 40 microns long have 65,536 Tubulin Dimers

128 - 1 micron

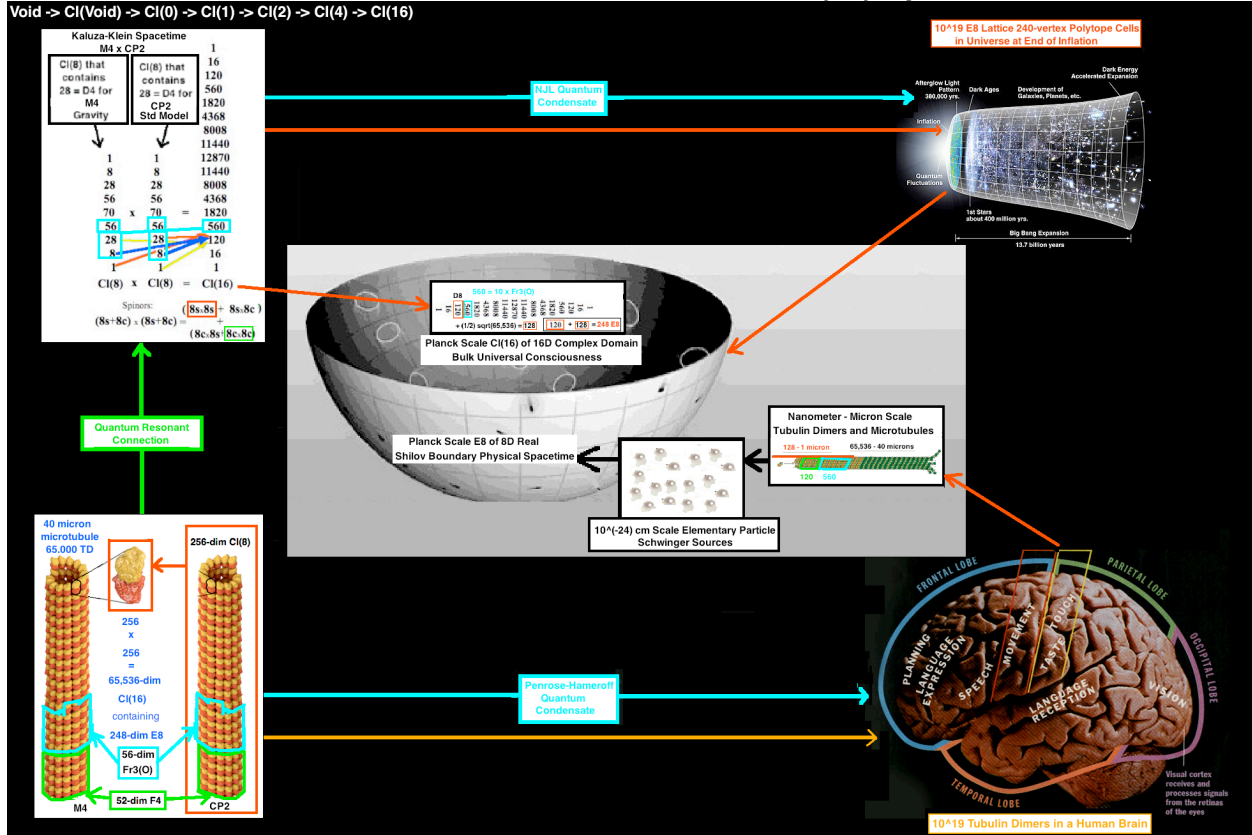
65,536 - 40 microns



(image adapted from 12biophys.blogspot.com Lecture 11)

and so

can have Bohm Quantum Resonance with Cl(16) Spacetime cells



so that at any and all Times
the State of Consciousness of a Human
is in exact resonant correspondence with
a subset of the cells of E8 Classical Lagrangian Spacetime

Therefore

E8 Classical Lagrangian Spacetime NJL Condensate is effectively the **Spirit World** in which the Human States of Consciousness = Souls exist. After the death of the Human Physical Body the Spirit World interactions with its Soul are no longer constrained by Physical World interactions with its Body so that the Spirit World can harmonize the individual Soul with the collective Universal Soul. **William Kingdon Clifford**, who invented **Real Clifford Algebras**, called them “mind-stuff”, saying: “...

When matter takes the complex form of a living human brain,
the corresponding mind-stuff takes the form of a human consciousness ...”.

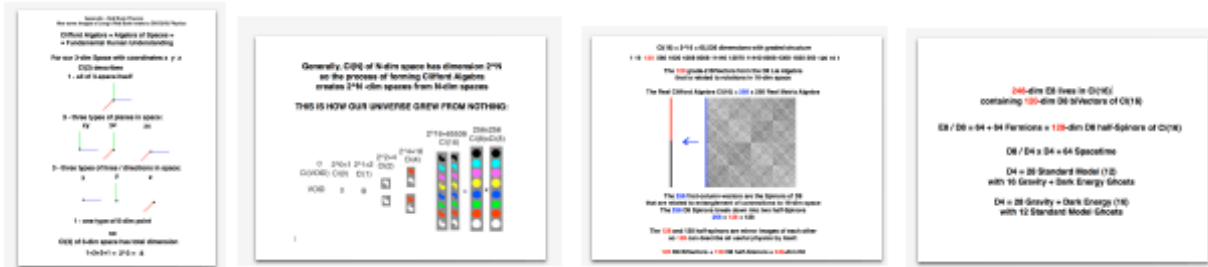
RED BOOK PHYSICS

How Jung's Red Book Archetypes connect with E8 - Cl(16) Physics

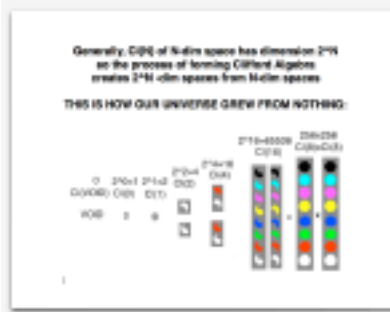
Frank Dodd (Tony) Smith, Jr. - 2018

The first five pages after the cover summarize the rest of this paper.

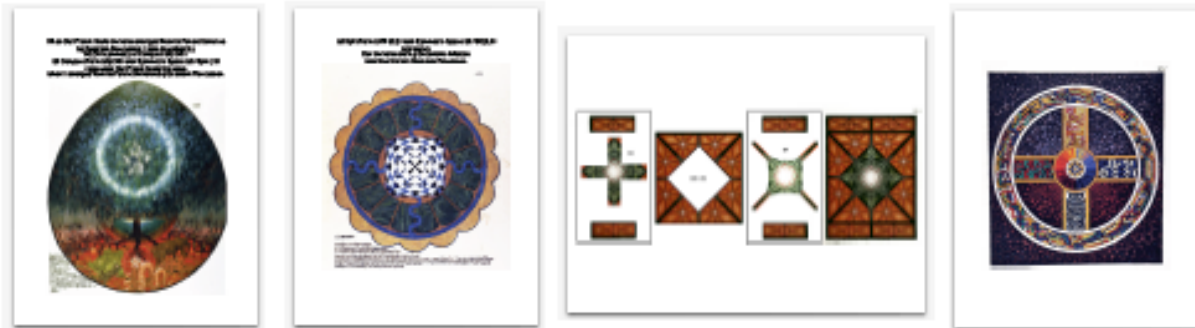
CLIFFORD ALGEBRAS to E8



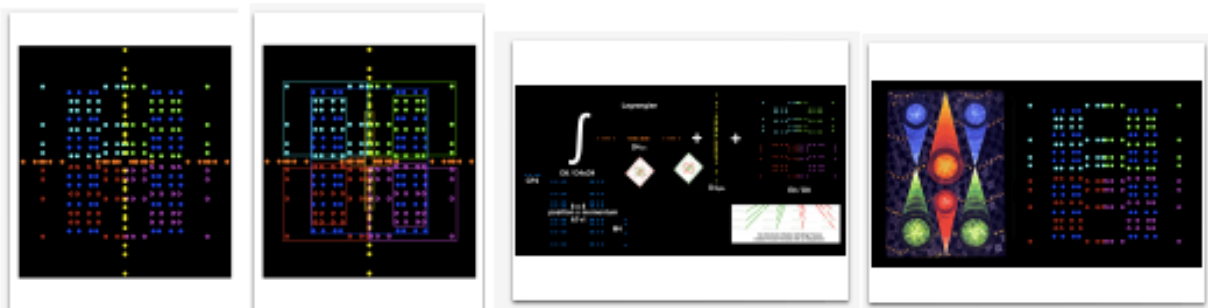
CLIFFORD EVOLUTION of OUR UNIVERSE



CREATION - OCTONIONIC NON-UNITARY INFLATION $28+64+28 = 120$ D8 = $4 \times 32 = 128$ D8 HALF-SPINOR



E8 - PARTICLES and FORCES - 8D LAGRANGIAN - TRIALITY

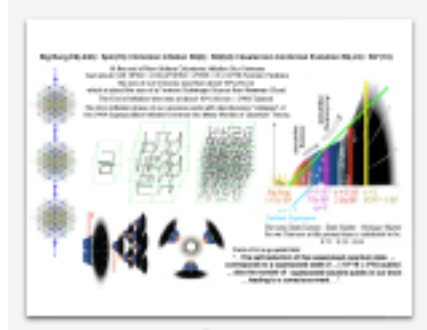


E8 HEISENBERG CREATION-ANNIHILATION - $28+64+(63+1)+64=28$

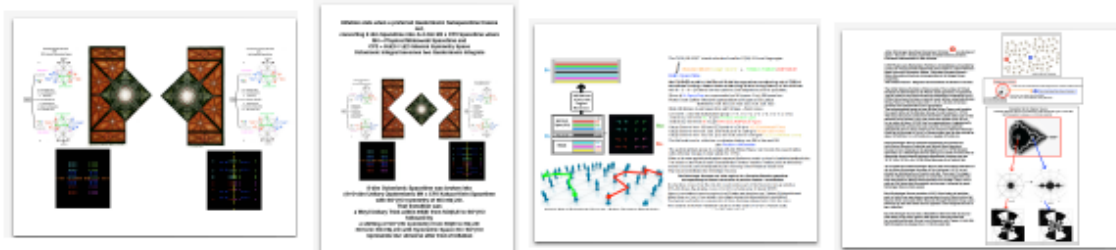


AFTER INFLATION - QUATERNIONIC UNITARY EXPANSION

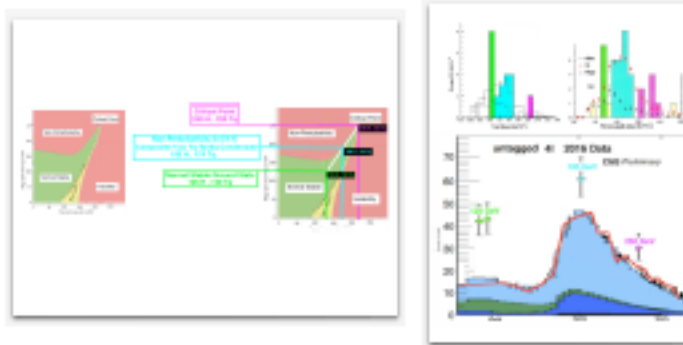
now - DE : DM : OM = 0.75 : 0.21 : 0.04



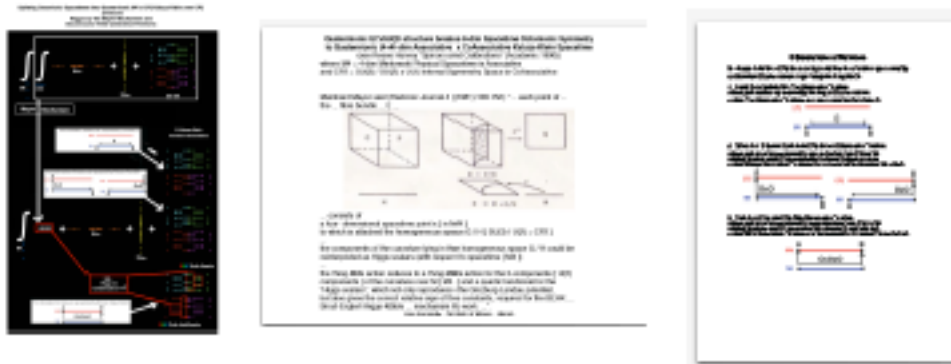
**E8 = H4 STANDARD MODEL CP2 + H4 GRAVITY+DARK ENERGY M4
STRINGS = WORLD LINES 26D STRING THEORY - SPIN-2 BOHMIONS
QUANTUM BLOCKCHAINS OF SCHWINGER SOURCES**



**HIGGS = NAMBU-JONA-LASINIO TRUTH QUARK COMPOSITE
 FERMILAB TRUTH QUARK MASSES 130 GeV - 174 GeV - 220 GeV
 CMS HIGGS MASSES 125 GeV - 195 GeV - 260 GeV**



M4xCP2 KALUZA-KLEIN - MAYER HIGGS - 3 FERMION GENERATIONS



FERMION OCTONIONIC BRAIDS - FERMION MASSES



D4 STANDARD MODEL and GRAVITY+DE GHOSTS D4 GRAVITY+DE and STANDARD MODEL GHOSTS

248-dim E8 contains 120-dim D6
 E8 / D8 = 64 + 64 Fermions
 D8 / D4 x D4 = 64 Spacetime
 D4 = 28 Standard Model (12)
 with 16 Gravity + Dark Energy Ghosts
 D4 = 28 Gravity + Dark Energy (16)
 with 12 Standard Model Ghosts

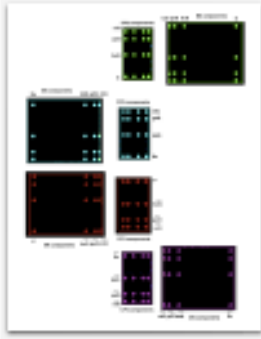
The Standard Model is a quantum field theory of particles and their interactions. It is based on the gauge theory of the Standard Model, which is a combination of the SU(3) color gauge theory and the SU(2) x U(1) electroweak gauge theory. The Standard Model is a renormalizable quantum field theory, which means that it is a consistent theory at all energy scales. The Standard Model is a theory of particles and their interactions, which is a combination of the SU(3) color gauge theory and the SU(2) x U(1) electroweak gauge theory. The Standard Model is a renormalizable quantum field theory, which means that it is a consistent theory at all energy scales.

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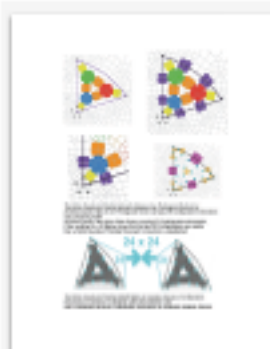
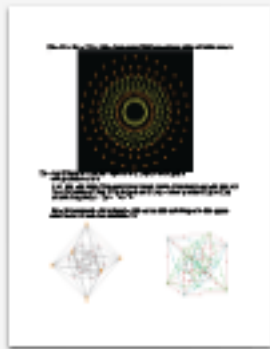
FORCE STRENGTHS - 4D LAGRANGIAN - CALCULATION RESULTS

The Standard Model is a quantum field theory of particles and their interactions. It is based on the gauge theory of the Standard Model, which is a combination of the SU(3) color gauge theory and the SU(2) x U(1) electroweak gauge theory. The Standard Model is a renormalizable quantum field theory, which means that it is a consistent theory at all energy scales. The Standard Model is a theory of particles and their interactions, which is a combination of the SU(3) color gauge theory and the SU(2) x U(1) electroweak gauge theory. The Standard Model is a renormalizable quantum field theory, which means that it is a consistent theory at all energy scales.



Force	Strength	Calculation
Gravity	10^-38	10^-38
Electromagnetism	10^-2	10^-2
Weak	10^-16	10^-16
Strong	10^-13	10^-13

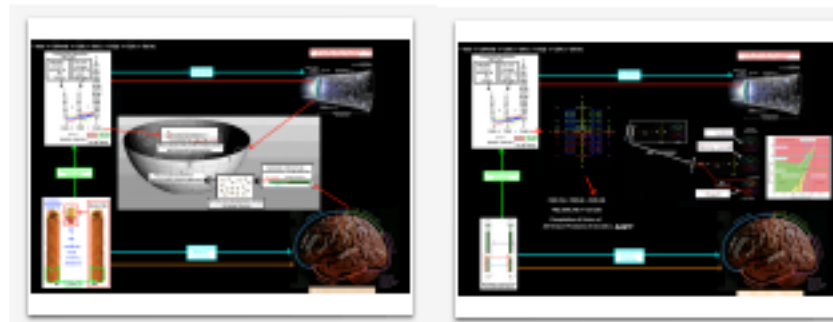
E8 - H4 - F4 - D4 - D3=A3 - H3 - H2=PENROSE STAR



CELLULAR AUTOMATA - CL(8) - CL(16) - MICROTUBULE - PYRAMIDS



SHILOV BOUNDARY HUMAN MIND COMPLEX DOMAIN UNIVERSAL CONSCIOUSNESS



William Kingdon Clifford (1845 - 1879)
described Geometry in terms of his invention: Real Clifford Algebras,
which he called “**mind-stuff**”, saying:

“... That element of which ... even the simplest feeling is a complex,
I shall call **Mind-stuff**.

A moving molecule of **inorganic matter** does not possess mind or
consciousness ; but it **possesses a small piece of mind-stuff**. ...

When molecules are ... combined together ... the elements of mind-stuff
which go along with them ... combine ... to form the ... beginnings of Sentience.

When the molecules are so combined as to form the brain and nervous system ...
the corresponding elements of mind-stuff are so combined as to form some kind
of consciousness ... changes in the complex which take place at the same time
get so linked together that the repetition of one implies the repetition of the other.

**When matter takes the complex form of a living human brain,
the corresponding mind-stuff takes the form of a human consciousness ...”.**

(Wikipedia - (1878, "On the Nature of Things-in-Themselves", Mind, Vol. 3, No. 9, pp. 57–67))

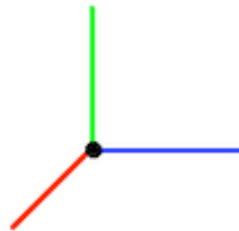
How some Images of Jung's Red Book relate to C8-Cl(16) Physics

**Clifford Algebra = Algebra of Spaces =
= Fundamental Human Understanding**

For our 3-dim Space with coordinates x y z

Cl(3) describes

1 - all of 3-space itself



3 - three types of planes in space:

xy

yz

zx



3 - three types of lines / directions in space:

x

y

z



1 - one type of 0-dim point

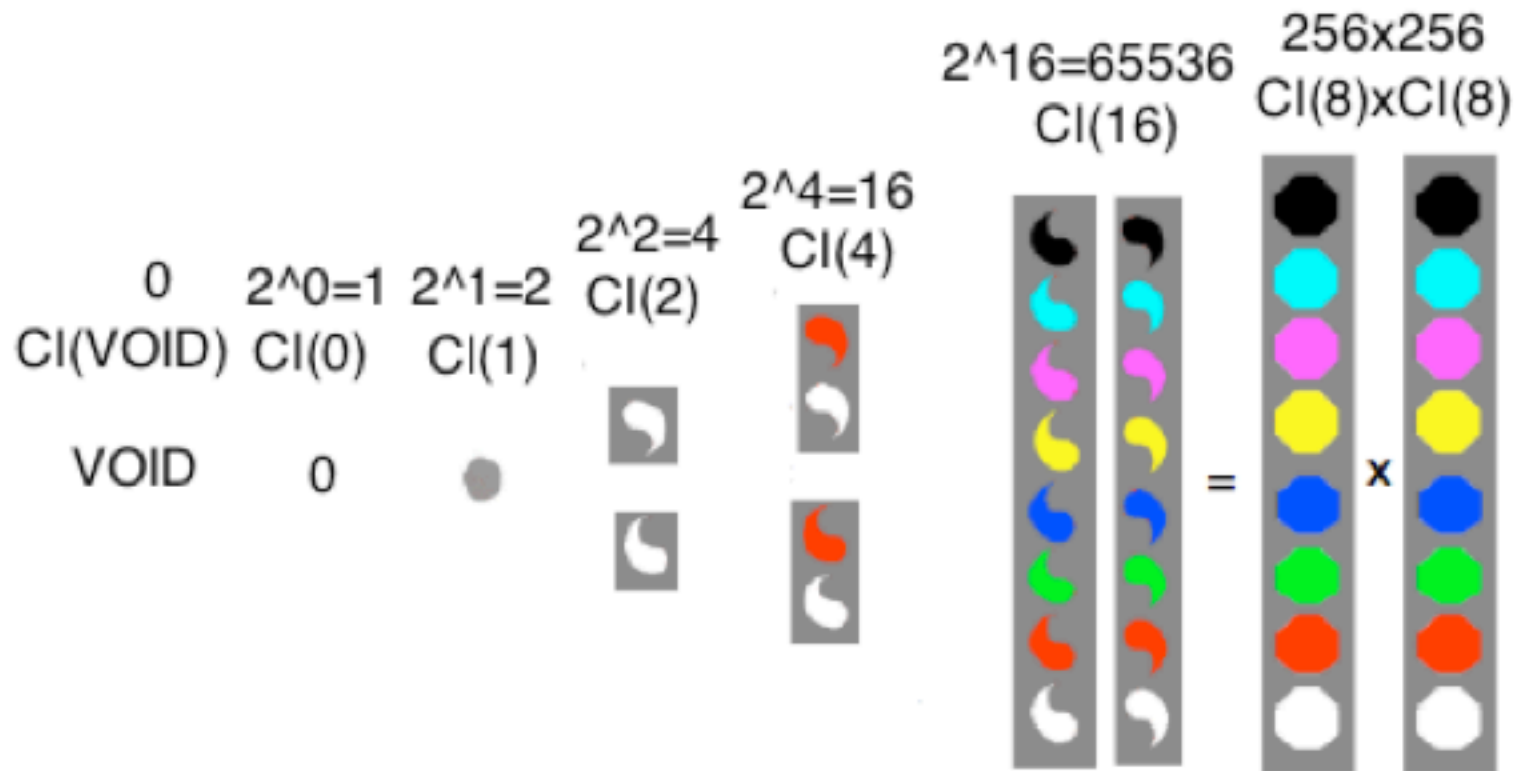
so

Cl(3) of 3-dim space has total dimension

$$1+3+3+1 = 2^3 = 8$$

**Generally, $Cl(N)$ of N -dim space has dimension 2^N
 so the process of forming Clifford Algebra
 creates 2^N -dim spaces from N -dim spaces**

THIS IS HOW OUR UNIVERSE GREW FROM NOTHING:

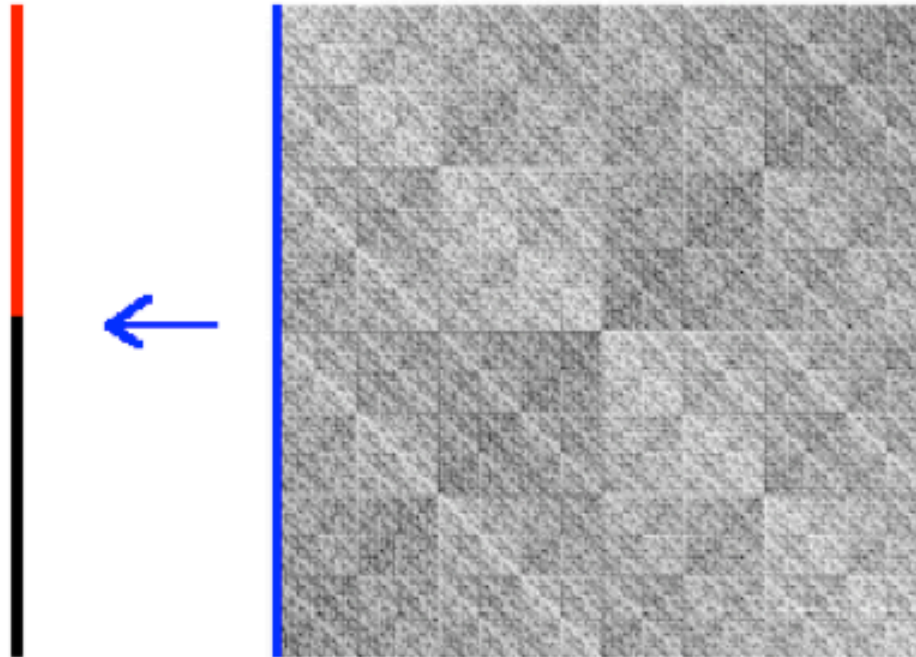


$Cl(16) = 2^{16} = 65,536$ dimensions with graded structure

1 16 **120** 560 1820 4368 8008 11440 12870 11440 8008 4368 1820 560 120 16 1

The **120** grade-2 BiVectors form the D8 Lie Algebra
that is related to rotations in 16-dim space

The Real Clifford Algebra $Cl(16) = 256 \times 256$ Real Matrix Algebra



The **256** first-column-vectors are the Spinors of D8
that are related to entanglement of connections to 16-dim space

The **256** D8 Spinors break down into two half-Spinors

$$256 = 128 + 128$$

The **128** and 128 half-spinors are mirror images of each other
so **128** can describe all useful physics by itself.

120 D8 BiVectors + **128** D8 half-Spinors = **248**-dim E8

248-dim E8 lives in Cl(16) |
containing 120-dim D8 biVectors of Cl(16)

E8 / D8 = 64 + 64 Fermions = 128-dim D8 half-Spinors of Cl(16)

D8 / D4 x D4 = 64 Spacetime

D4 = 28 Standard Model (12)
with 16 Gravity + Dark Energy Ghosts

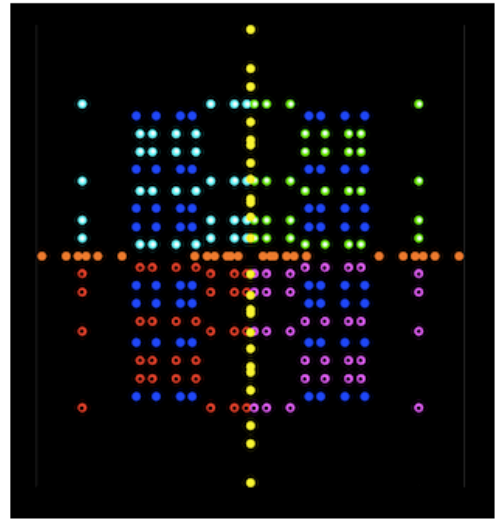
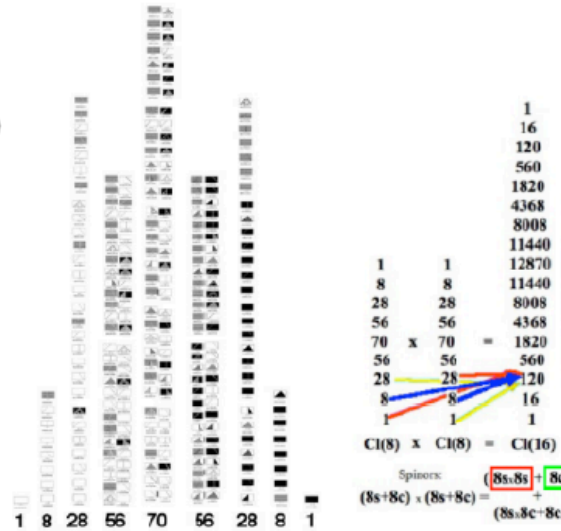
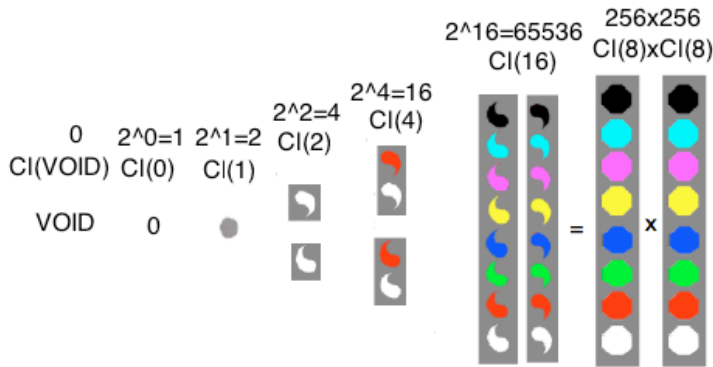
D4 = 28 Gravity + Dark Energy (16)
with 12 Standard Model Ghosts

Dimension of Clifford Algebra					
0	$2^0=1$	$2^1=2$	$2^2=4$	$2^4=16$	$2^8=256$

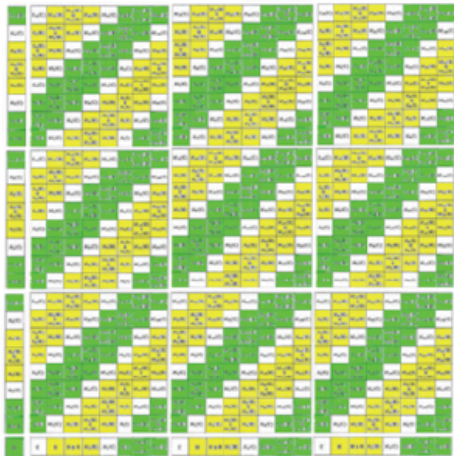
VOID \rightarrow CI(VOID) \rightarrow CI(0,0) \rightarrow CI(0,1) \rightarrow CI(0,2) \rightarrow CI(0,4) \rightarrow CI(0,16) = CI(0,8)xCI(0,8) \rightarrow CI(0,16)xCI(0,8) = CI(0,24) \rightarrow M(2,CI(0,24)) = CI(1,25) \rightarrow

\rightarrow Completion of Union of All Tensor Products of CI(1,25) = hyperfinite AQFT

CI(1,25) = CI(1,9)xCI(0,8)xCI(0,8) and CI(1,9) = CI(1,5) x CI(0,4) = CI(2,4) x CI(0,4)



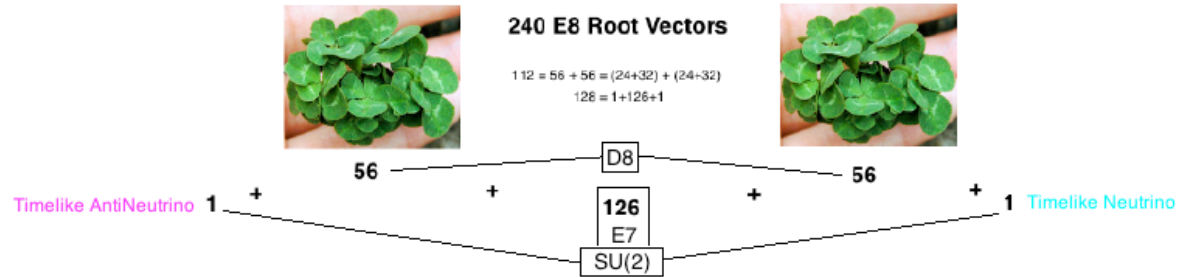
CI(16) contains $120 + 64 + 64 = 248 = E8$ with $112 + 128 = 240$ root vectors



The completion of the union of all tensor products of CI(16) = CI(8)xCI(8) produces a generalized Hyperfinite III von Neumann factor that gives the CI(16)-E8 model a natural Algebraic Quantum Field Theory

The CI(16)-E8 AQFT inherits structure from the CI(16)-E8 Local Lagrangian

The Creation-Annihilation Operator structure of CI(16)-E8 AQFT is given by the Maximal Contraction of E8 = semidirect product A7 x h92 where h92 = $92+1+92 = 185$ -dim Heisenberg algebra and A7 = 63-dim SL(8)



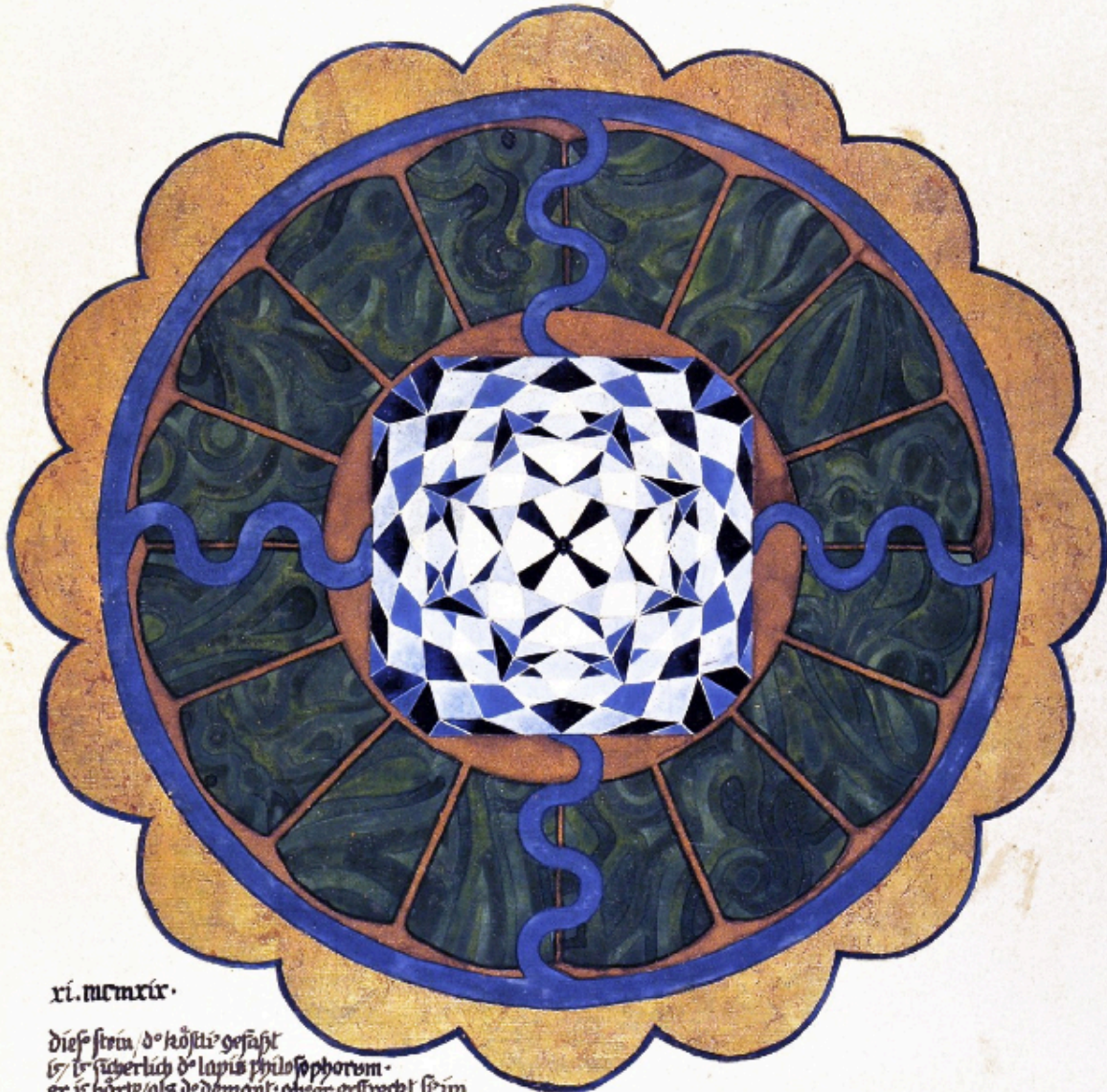
When Our Planck Scale Universe emerged from its Parent Universe by Quantum Fluctuation it was described by $SO(16)$ symmetry of Compact $E_8(-248)$. E_8 Compact Form $E_8(-248)$ with Symmetric Space $E_8 / Spin(16)$ represents Our Planck Scale Universe when it emerged from its Parent Universe by Quantum Fluctuation.



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afbe.

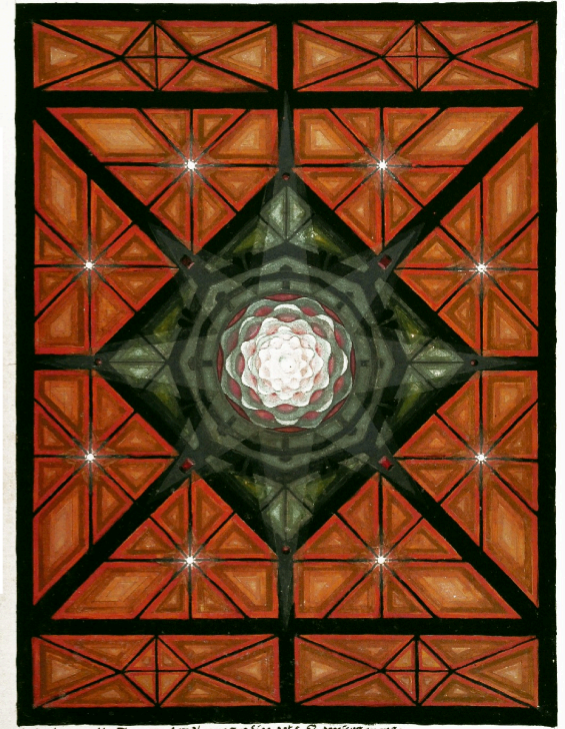
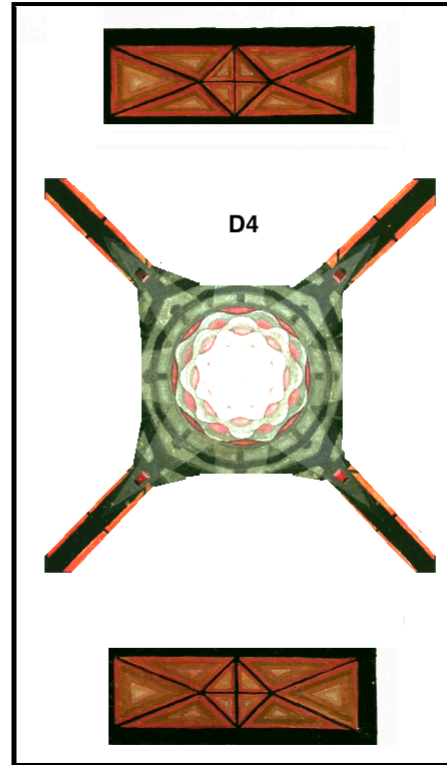
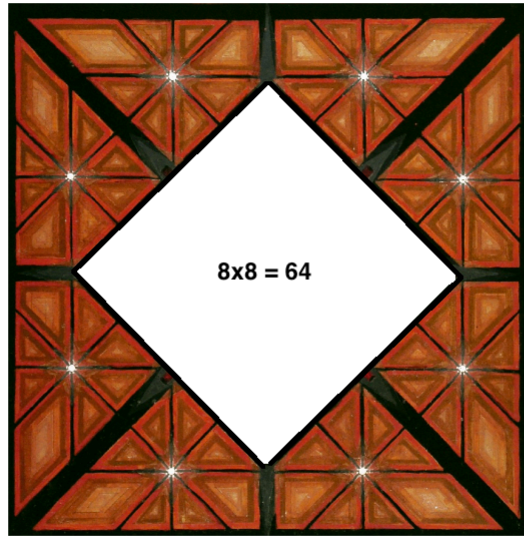
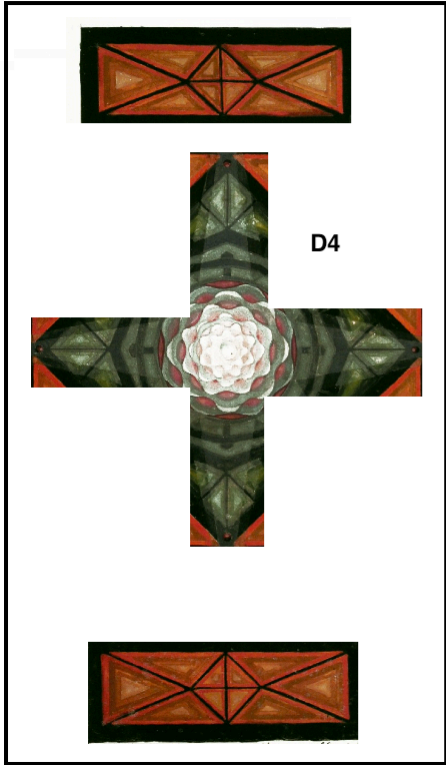
E8 Split Form EVIII E8(8) with Symmetric Space E8 / SO(8,8)
 represents
 Our Universe during Octonionic Inflation
 with Non-Unitary Quantum Processes.

121



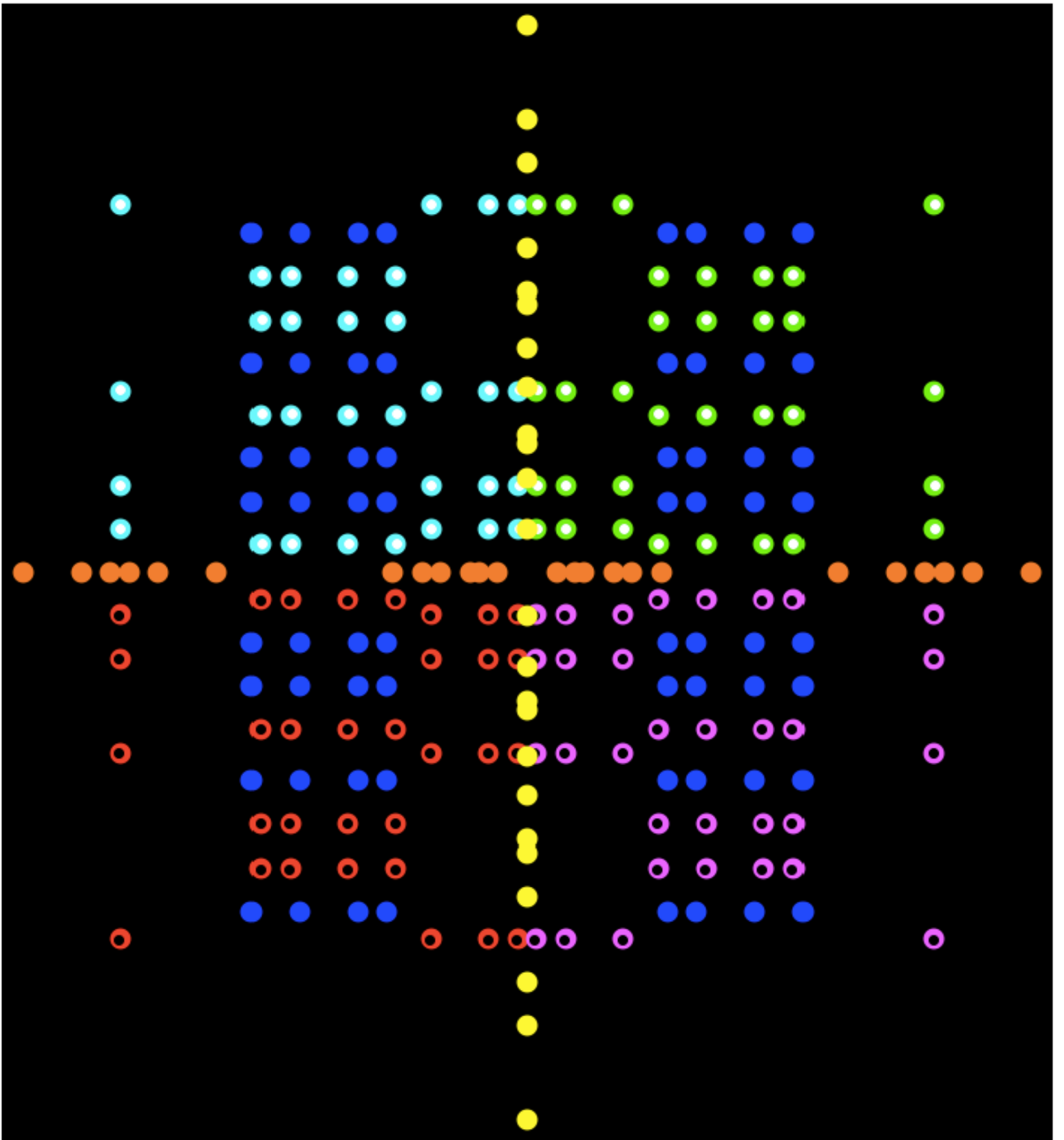
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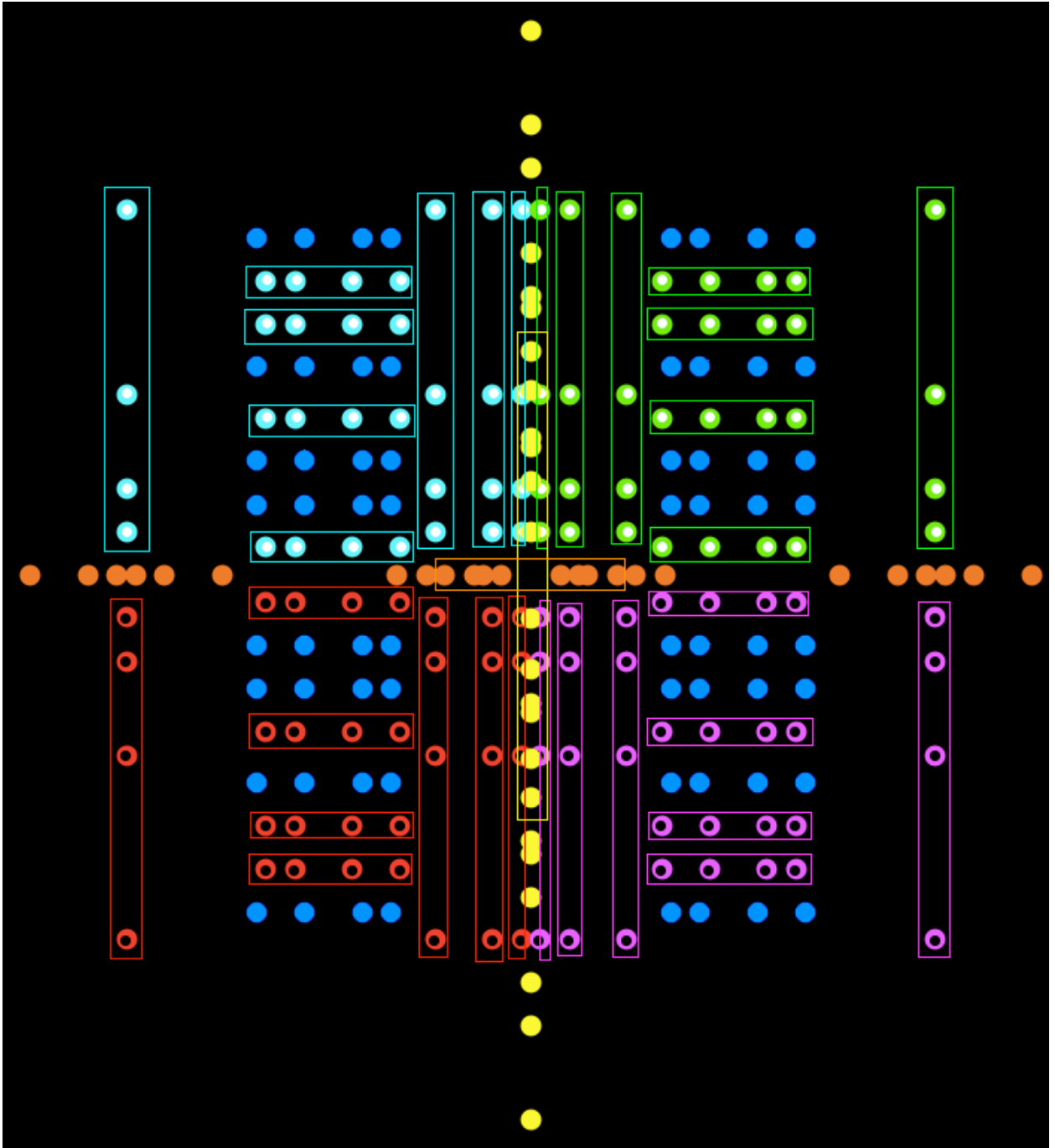
dieß stein, d' köstli' gefäht
 is' ir' sicherlich d' lapis philosophorum.
 er is' harts' als d' demant' ob' er erstreckt si' im
 raume von vier eig' schaft' nänlich d' breite/höhe/tiefe/v' d' zeit.
 er is' darvon unlosbar v' du kanst' dur' im hindur' geh' ohne es z' meck'. aus d' stein fließ' die vier aquariss' köme.
 dieß is' das unsterbliche kern' das zwöl' val' v' mult' gelegt is' v' das verhindert, das die spitz' d' beid' kegel h'
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Lagrangian

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CP2

D8 / D4xD4

D4_{sm}

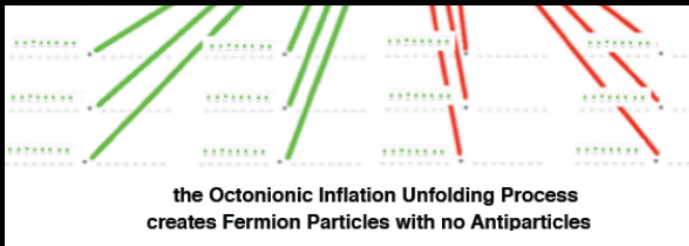
D4_{gde}

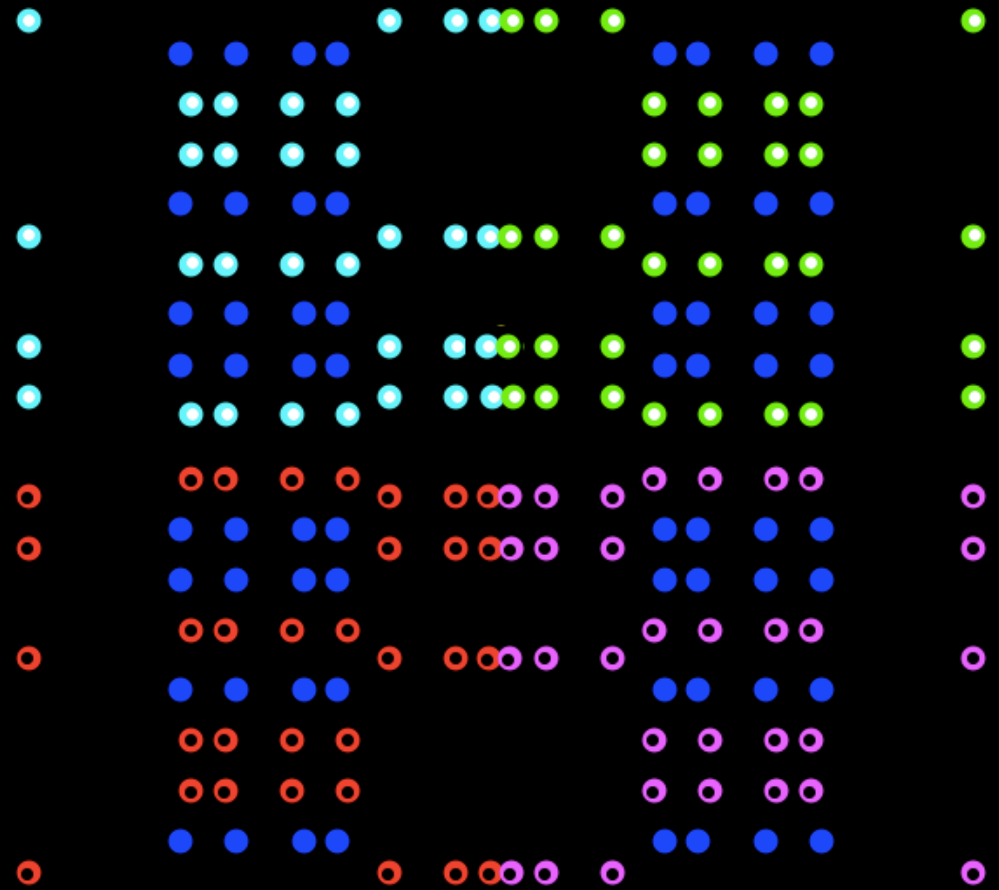
E8 / D8

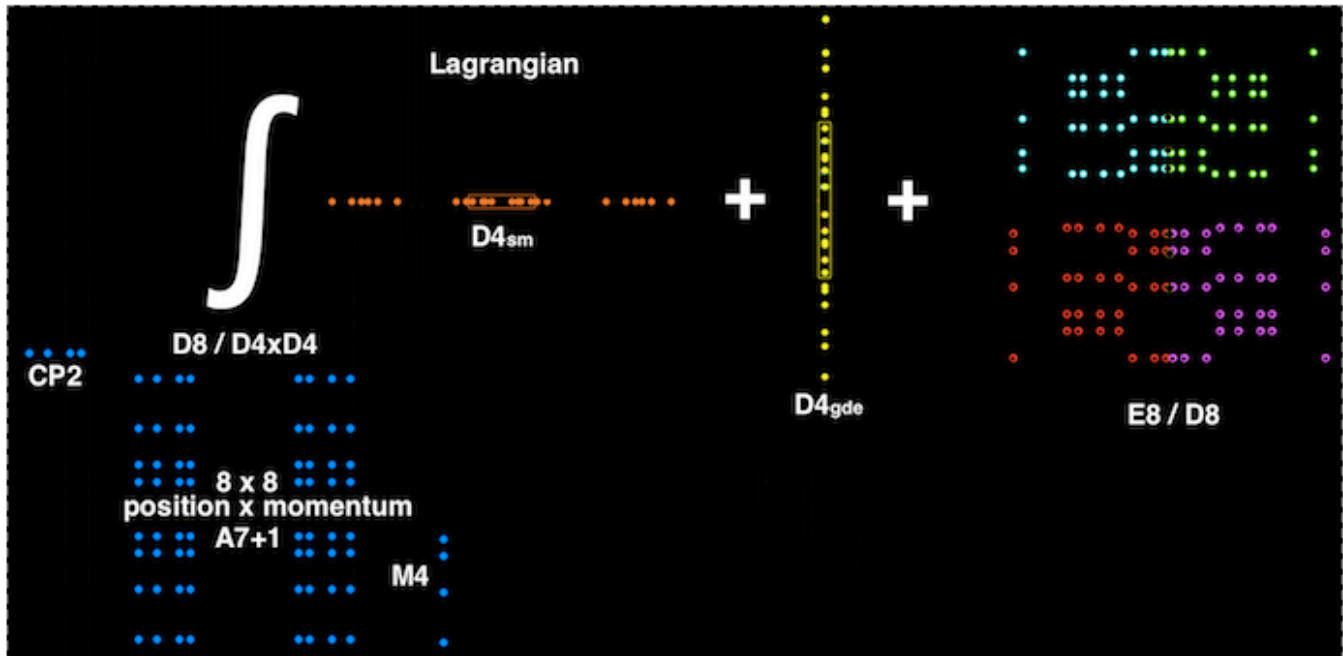
8 x 8
position x momentum

A7+1

M4





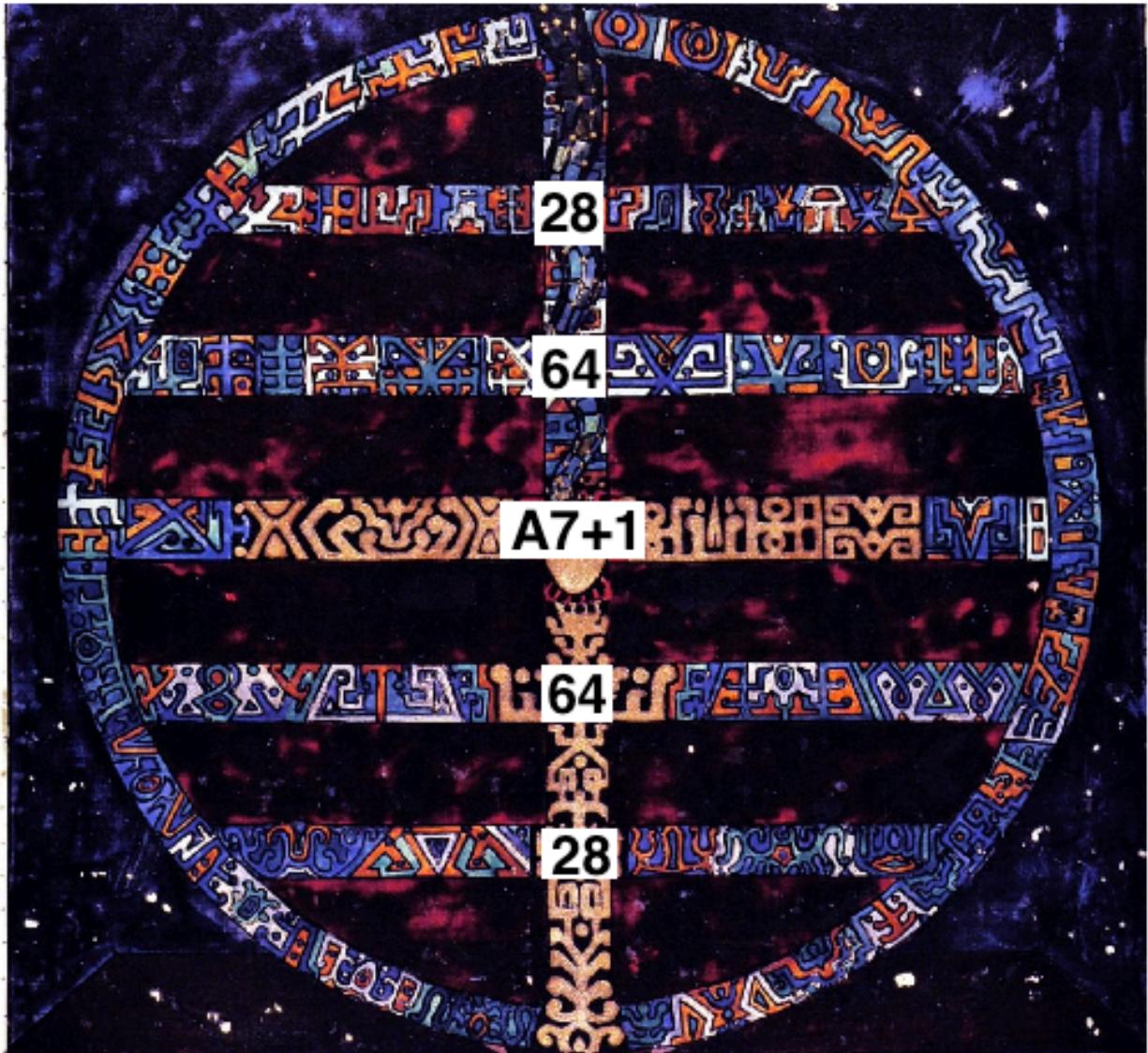


Creation-Annihilation Operators for 8 components of 8+8 Fermions
are
odd-grade-+/-1 part
of

E8 Maximal Contraction generalized Heisenberg Algebra

$$\mathfrak{h}_{92} \times \mathfrak{A}_7 = 28 + 64 + ((\mathfrak{SL}(8, \mathbb{R}) + 1) + 64 + 28)$$

(see Rutwig Campoamor-Stursberg in Acta Physica Polonica B 41 (2010) 53-77 "Contractions of Exceptional Lie Algebras and SemiDirect Products")

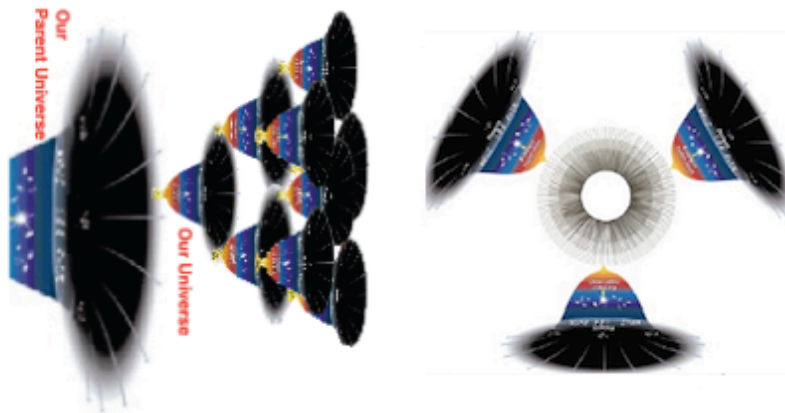
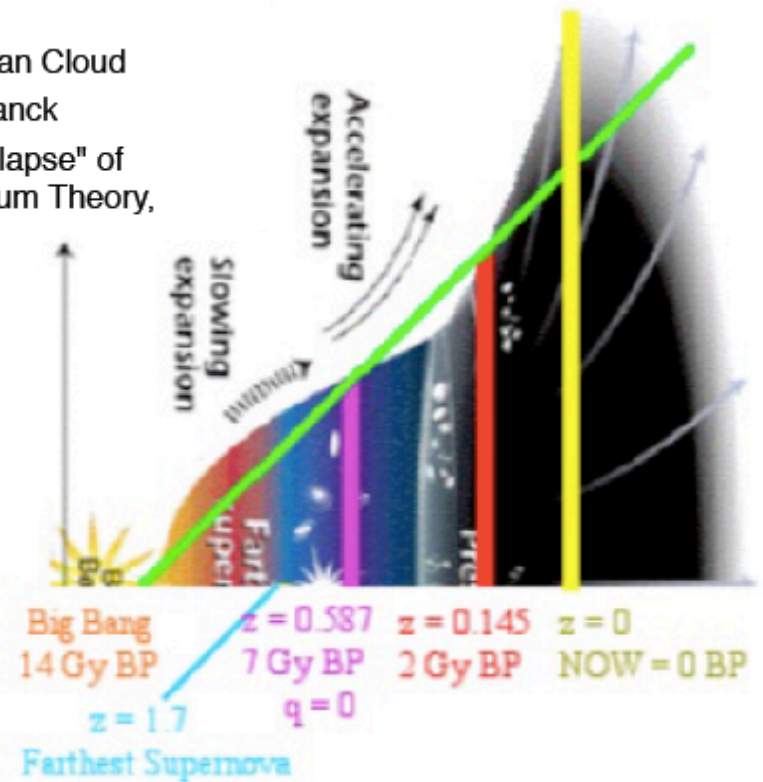
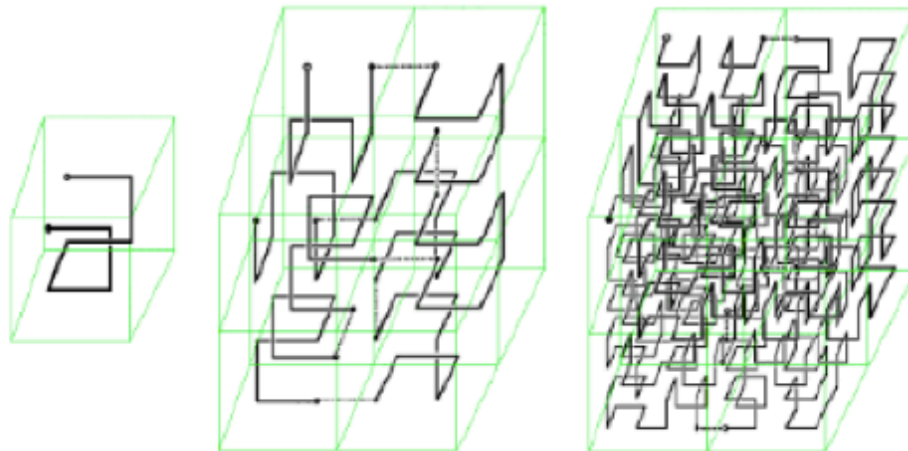
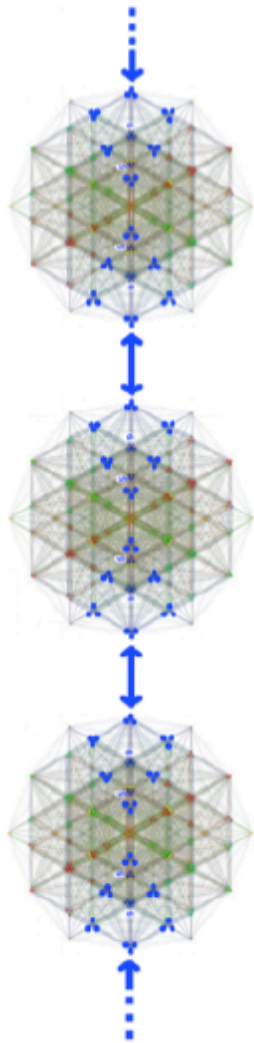


Big Bang E8(-248) : Spin(16) | Octonion Inflation E8(8) : SO(8,8) | Quaternion Conformal Evolution E8(-24) : SO*(16)

At the end of Non-Unitary Octonionic Inflation Our Universe had about $(1/2) 16^{64} = (1/2) (2^4)^{64} = 2^{255} = 6 \times 10^{76}$ Fermion Particles
 the size of our Universe was then about $10^{(-24)}$ cm
 which is about the size of a Fermion Schwinger Source Kerr-Newman Cloud

The End of Inflation time was at about $10^{(-34)}$ sec = 2^{64} Tplanck

The Zizzi Inflation phase of our universe ends with decoherence "collapse" of the 2^{64} Superposition Inflated Universe into Many Worlds of Quantum Theory,

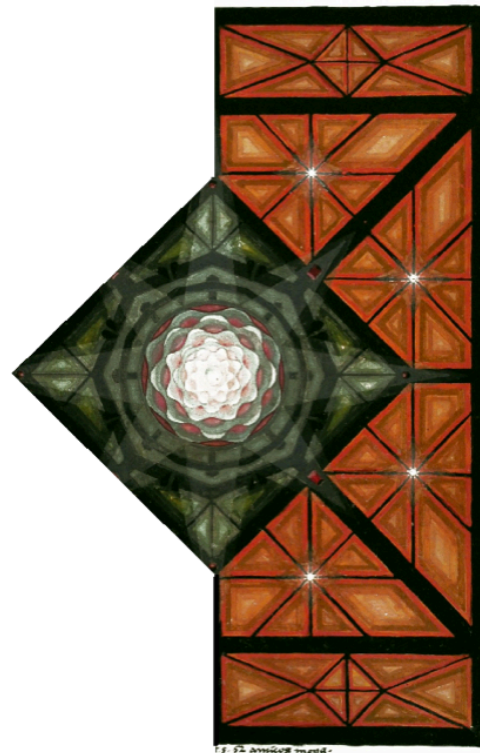
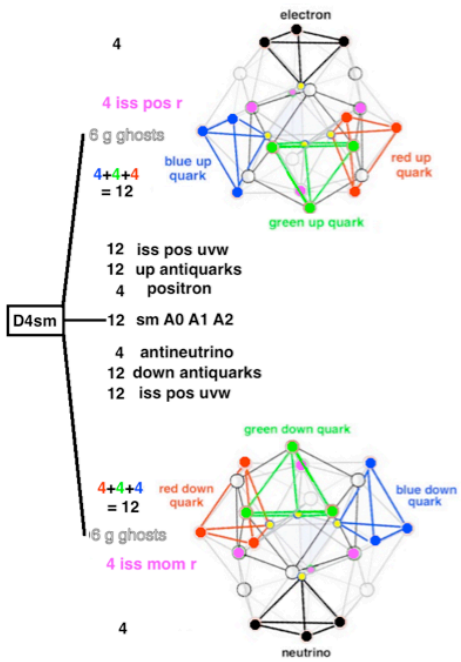


The ratio Dark Energy : Dark Matter : Ordinary Matter for our Universe at the present time is calculated to be:
 0.75 : 0.21 : 0.04

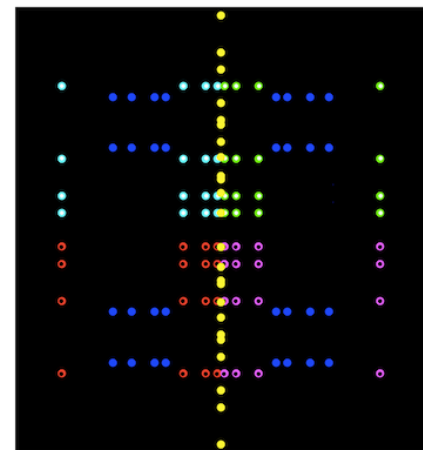
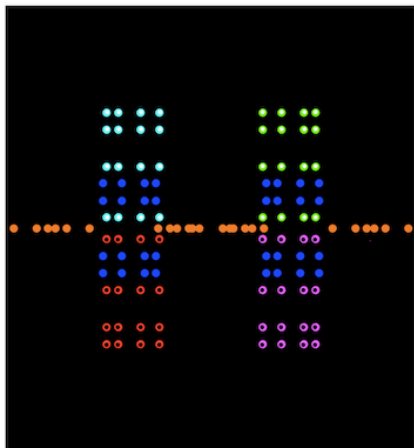
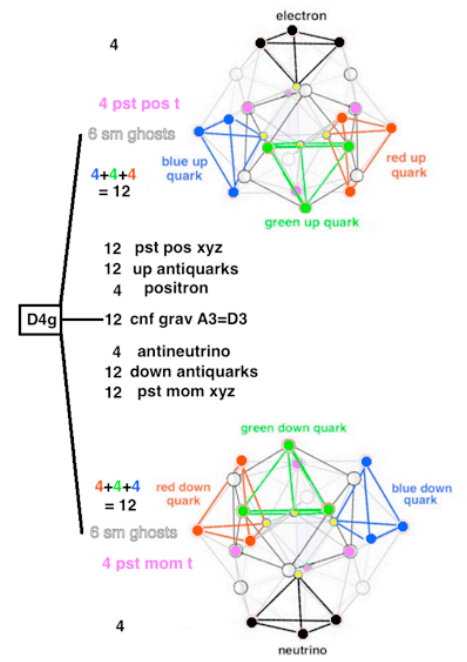
Paola Zizzi in gr-qc/0007006:

"... The self-reduction of the superposed quantum state ... corresponds to a superposed state of ... [$10^{19} = 2^{64}$ qubits] ... also the number of superposed tubulins-qubits in our brain ... leading to a conscious event. ..."

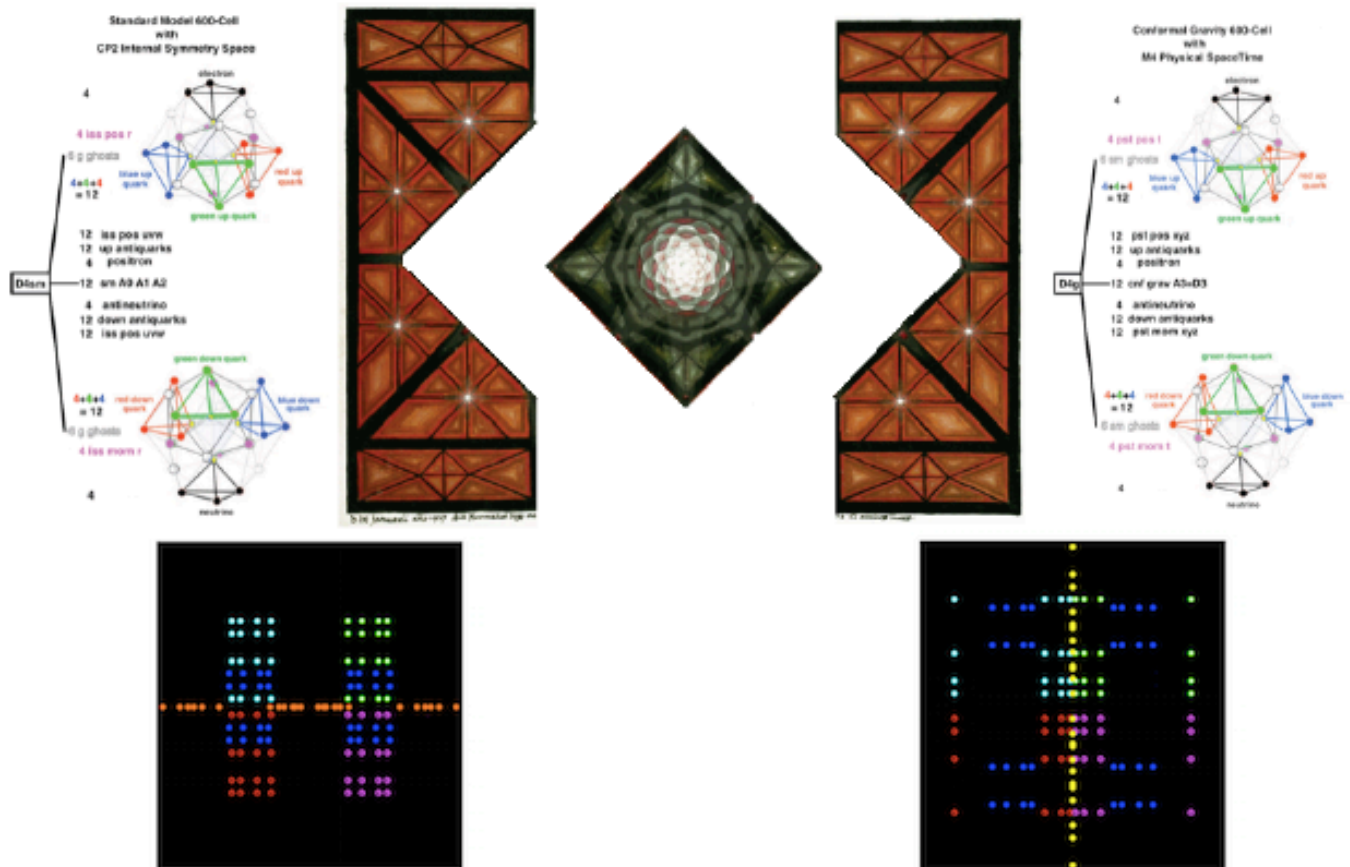
Standard Model 600-Cell
with
CP2 Internal Symmetry Space



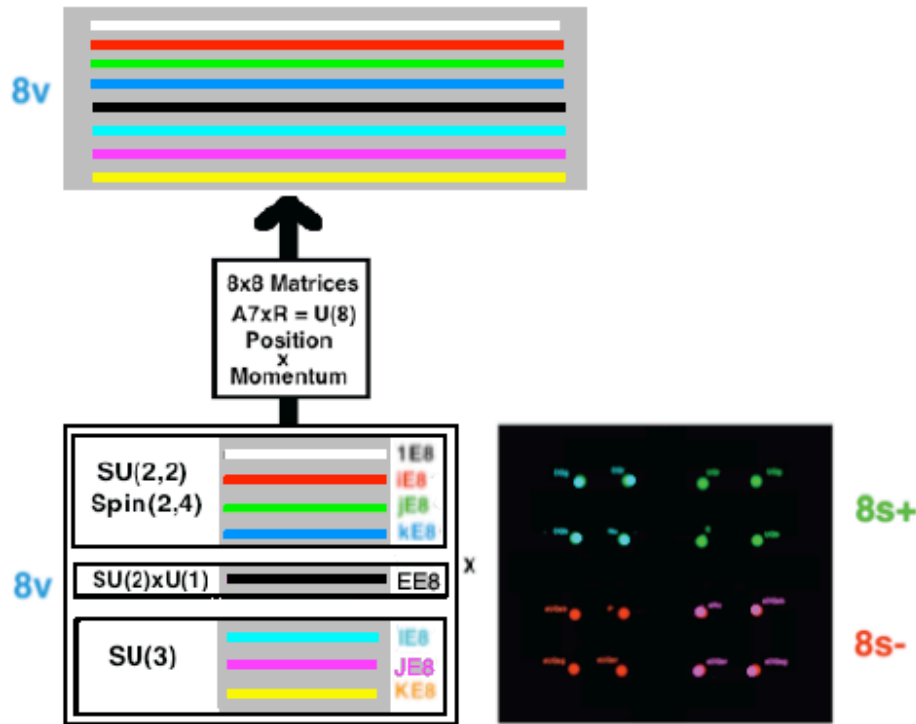
Conformal Gravity 600-Cell
with
M4 Physical SpaceTime



**Inflation ends when a preferred Quaternionic Subspacetime freezes out,
 converting 8 dim Spacetime into 4+4 dim M4 x CP2 Spacetime where
 M4 = Physical Minkowski Spacetime and
 CP2 = SU(3) / U(2) Internal Symmetry Space
 Octonionic Integral becomes two Quaternionic Integrals**



**8-dim Octonionic Spacetime was broken into
 (4+4)-dim Unitary Quaternionic M4 x CP2 Kaluza-Klein Spacetime
 with $SO^*(16)$ symmetry of EIX E8(-24).
 That transition was
 a Weyl Unitary Trick within E8(8) from $SO(8,8)$ to $SO^*(16)$
 followed by
 a shifting of $SO^*(16)$ symmetry from E8(8) to E8(-24)
 E8 form EIX E8(-24) with Symmetric Space $E8 / SO^*(16)$
 represents Our Universe after End of Inflation**



Indra's Net of Schwinger Sources - Bohm Quantum Blockchain

The Cl(16)-E8 AQFT inherits structure from the Cl(16)-E8 Local Lagrangian

$$\int \text{Standard Model Gauge Gravity} + \text{Fermion Particle-AntiParticle}$$

8-dim SpaceTime

the Cl(16)-E8 model at the Planck Scale has spacetime condensing out of Clifford structures forming a Leech lattice underlying 26-dim String Theory of World-Lines with $8 + 8 + 8 = 24$ -dim of fermion particles and antiparticles and of spacetime.

Slices of 8v SpaceTime are represented as D8 branes. Each D8 brane has Planck-Scale Lattice Structure superpositions of 8 types of E8 Lattice denoted by 1E8, iE8, jE8, kE8, EE8, IE8, JE8, KE8

Stack D8 branes to get SpaceTime with Strings = World-Lines

Let Oct16 = discrete multiplicative group $\{ +/1, +/-i, +/-j, +/-k, +/-E, +/-I, +/-J, +/-K \}$.

Orbifold by Oct16 the 8s+ to get 8 Fermion Particle Types

Orbifold by Oct16 the 8s- to get 8 Fermion AntiParticle Types

Gauge Bosons from 1E8 and EE8 parts of a D8 give U(2) Electroweak Force

Gauge Bosons from IE8, JE8, and KE8 parts of a D8 give SU(3) Color Force

Gauge Bosons from 1E8, iE8, JE8, and kE8 parts of a D8 give U(2,2) Conformal Gravity

The 8x8 matrices for collective coordinates linking one D8 to the next D8 give Position x Momentum

The automorphism group of a single 26-dim String Theory cell modulo the Leech lattice is the Monster Group of order about 8×10^{53} .


When a fermion particle/antiparticle appears Tachyons create a cloud of particles/antiparticles. The cloud is one Planck-scale Fundamental Fermion Valence Particle plus an effectively neutral cloud of particle/antiparticle pairs forming a Kerr-Newman black hole. That cloud constitutes the Schwinger Source.

The Schwinger Sources are finite regions in a Complex Domain spacetime corresponding to Green's functions of particle creation / annihilation.

Its structure comes from the 24-dim Leech lattice part of the Monster Group which is 2^{24} times the double cover of Co1, for a total order of about 10^{26} .

(Since a Leech lattice is based on copies of an E8 lattice and since there are 7 distinct E8 integral domain lattices there are 7 (or 8 if you include a non-integral domain E8 lattice) distinct Leech lattices. The physical Leech lattice is a superposition of them, effectively adding a factor of 8 to the order.)

The volume of the Kerr-Newman Cloud is on the order of 10^{27} x Planck scale, = roughly $10^{(-24)}$ cm.

Julian Schwinger describes Elementary Particles  as volumes of space - Sources - whose properties are determined by Green's Functions characteristic of the volumes.

In E8 Physics any Elementary Particle is immediately surrounded by a cloud of virtual particle-antiparticle pairs similar to a Kerr-Newman Black Hole with Symmetric Space - Bounded Complex Domain - Shilov Boundary structure corresponding to its Gauge Group properties.
The Poisson Kernel - Bergman Kernel defines the Green's Function.

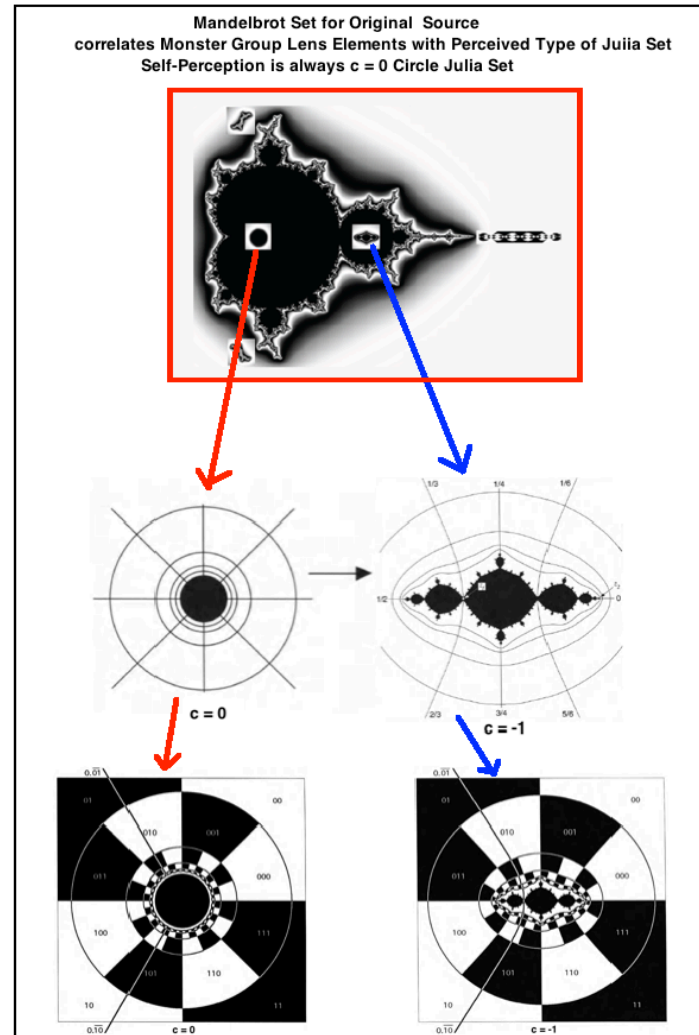
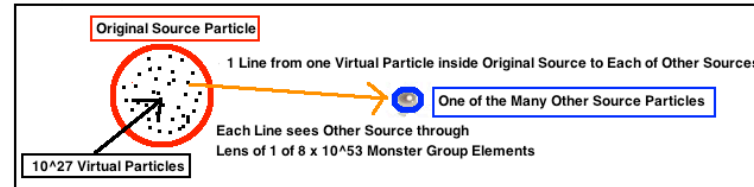
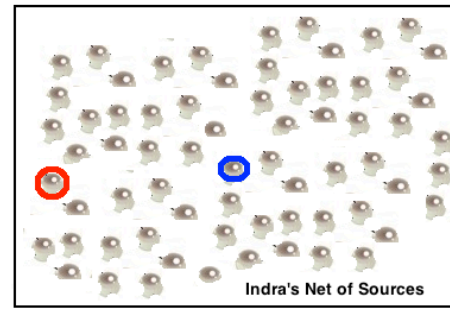
The initial Valence Particle is Planck scale. The number of Virtual Particles is determined by the Planck scale geometry of spacetime. The E8 model at the Planck Scale has spacetime condensing out of Clifford structures forming a Lorentz Leech lattice underlying 26-dim String Theory of World-Lines with $8 + 8 + 8 = 24$ -dim of fermion particles and antiparticles and of spacetime.
The automorphism group of one 26-dim String Theory cell modulo the Leech lattice is the Monster Group of order about 8×10^{53} . The Cloud structure comes from the 24-dim Leech lattice part of the Monster Group which is 2^{24} times the double cover of Co_1 , for an order of about 10^{26} . Due to superpositions of algebraically independent E8 Lattices the total number of Virtual particle/antiparticle pairs is about 10^{27} so the volume of the Kerr-Newman Cloud is on the order of 10^{27} x Planck scale, and its size should be about $10^{(27/3)} \times 1.6 \times 10^{(-33)} \text{ cm} = \text{roughly } 10^{(-24)} \text{ cm}$.

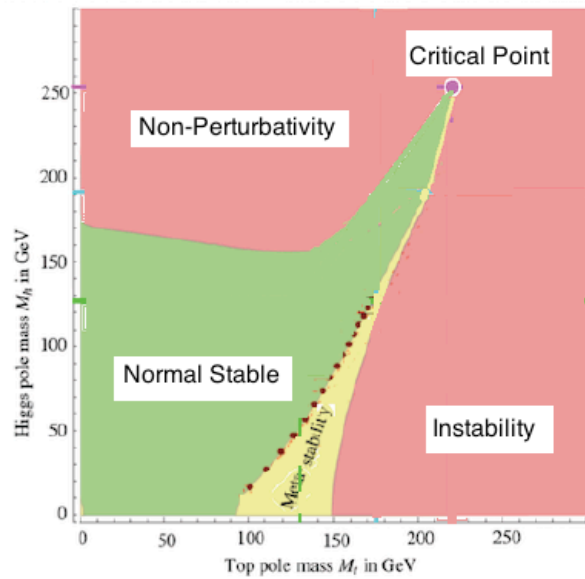
Each Schwinger Source particle-antiparticle pair should see (with Bohm Quantum Potential and Sarfatti Back-Reaction) the rest of our Universe in the perspective of 8×10^{53} Monster Symmetry so a Schwinger Source acting as a Jewel of Indra's Net of Schwinger Source Bohm Quantum Blockchain Physics can see $10^{27} \times 8 \times 10^{53} = 8 \times 10^{80}$ Other Sources of an Indra's Net.

To fit inside the initial Schwinger Source the Information Elements of all the Other Schwinger Sources of Our Universe (10^{77} or so) should be distributed as a Fractal Julia Set. There are 2^n stage-n cells in a Binary Decomposition of Julia Sets, so a stage-256 Julia level set based on Binary Decomposition has $2^{256} = \text{about } 10^{77}$ cells so Full Indra Net information can be seen / reflected by each Schwinger Source Indra Jewel.

Each Schwinger Source contains 10^{27} Virtual pairs of particles each of which can see along a connecting Line an Other Indra's Net Source which Line sees Other Sources through Monster Group Lens elements so that the Other Source appears to the Original Source to be a Julia Set.

Each Schwinger Source has a Mandelbrot Set that tells its Source what each of the many Indra's Net Source Julia set looks like by correlating Monster Group Lens Elements with Types of Julia Set. Self-Perception is always the $c = 0$ Circle Julia Set.

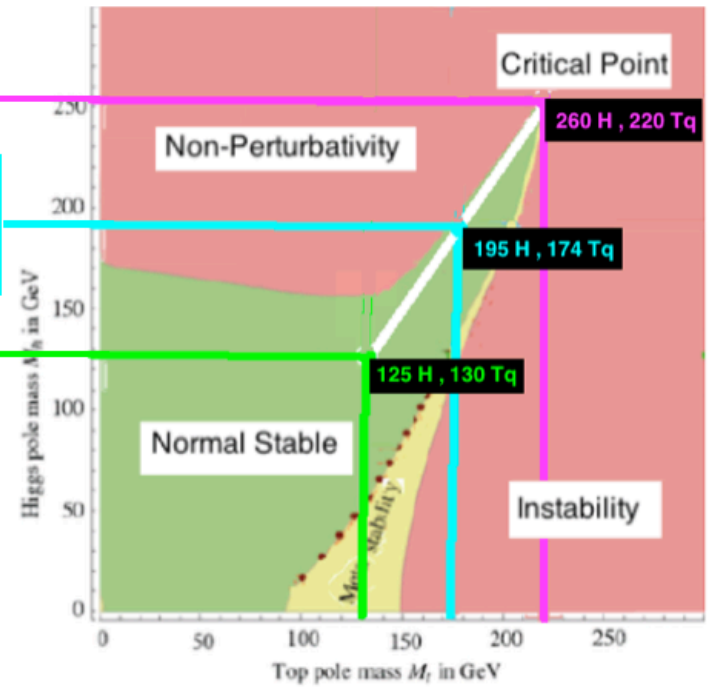


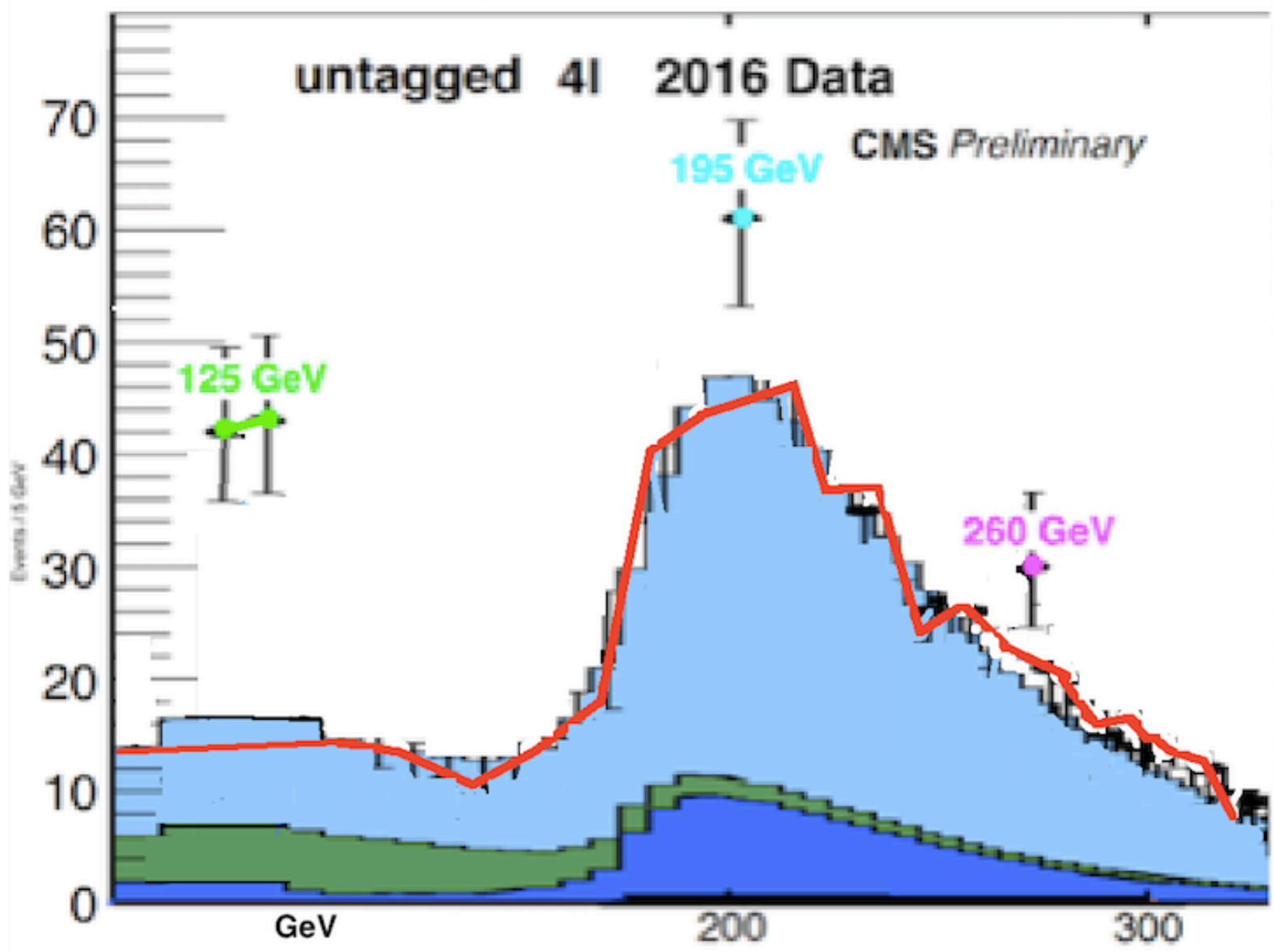
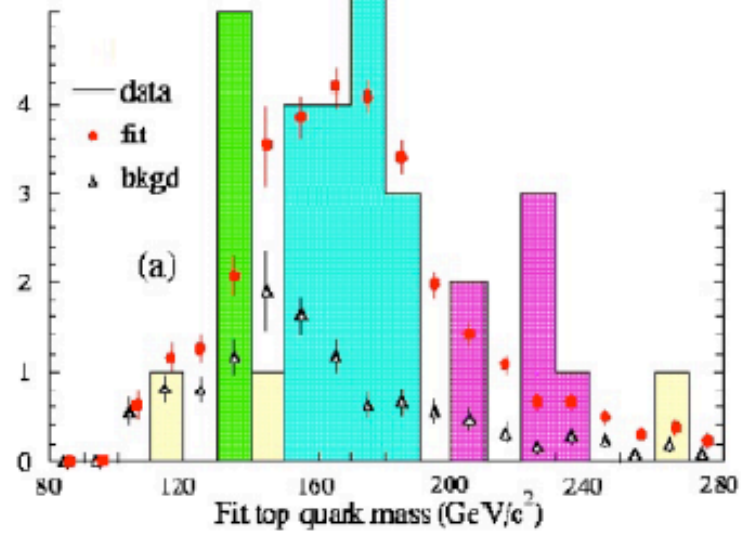
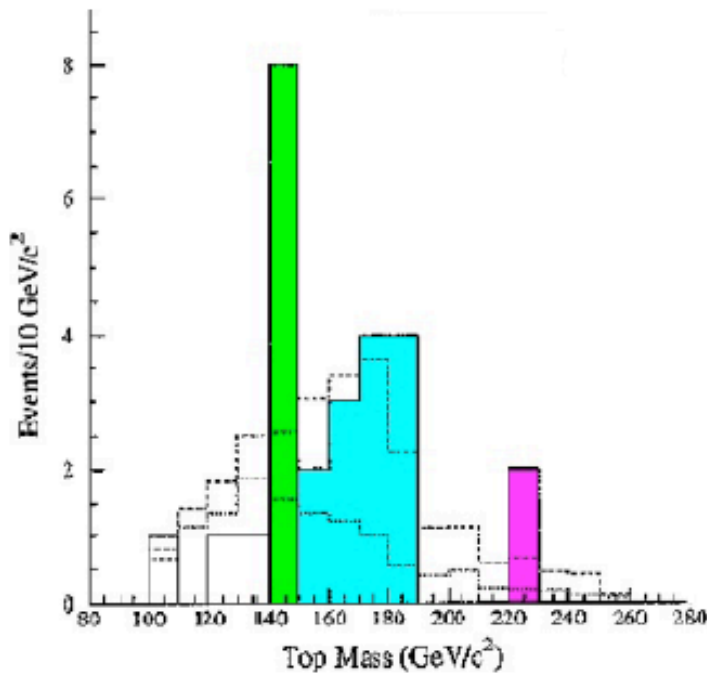


Critical Point
250 H , 220 Tq

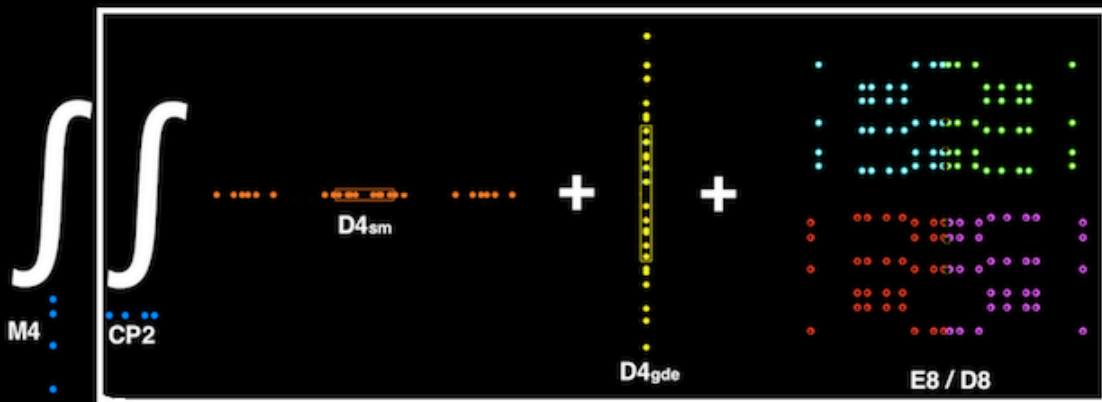
Non-Perturbativity 4+4 K-K
Composite H as Tq-Tantiq Condensate
195 H , 174 Tq

Normal Stable Ground State
125 H , 130 Tq

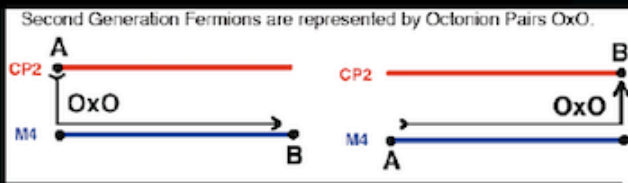
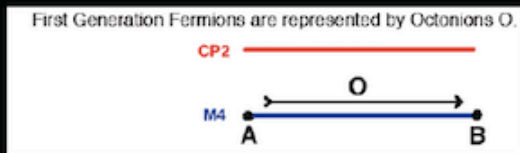




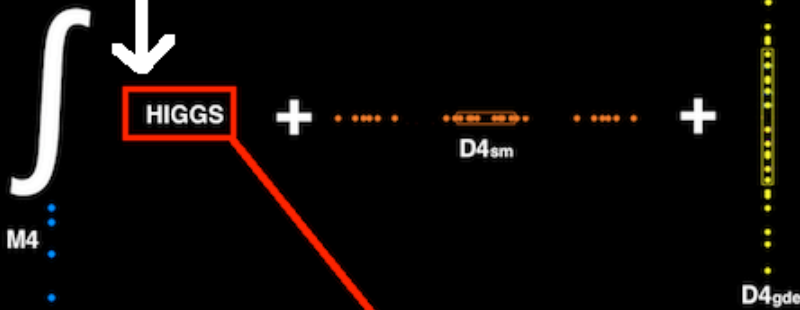
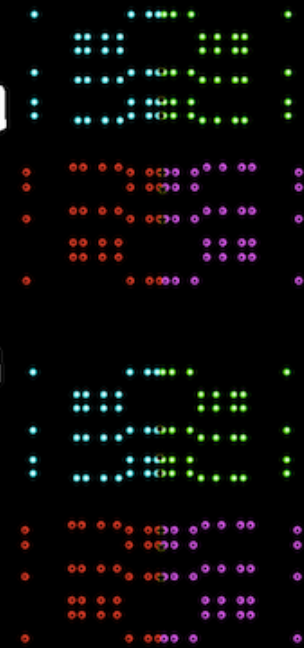
Splitting Octonionic Spacetime into Quaternionic $M4 \times CP2$ Kaluza-Klein over $CP2$ produces
Higgs by the Mayer Mechanism and
Second and Third Generation Fermions



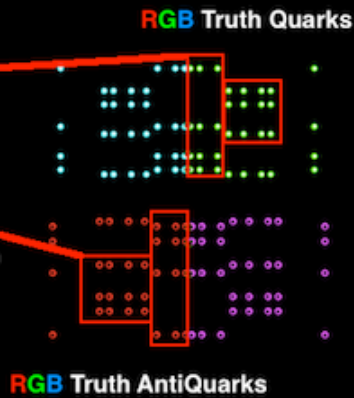
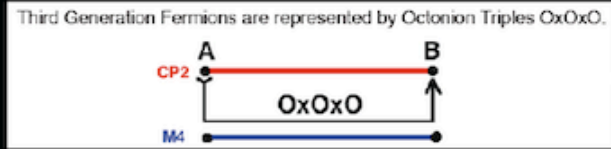
Mayer Mechanism



3 Kaluza-Klein Fermion Generations



NJL Higgs as Condensate of $T \bar{T}$



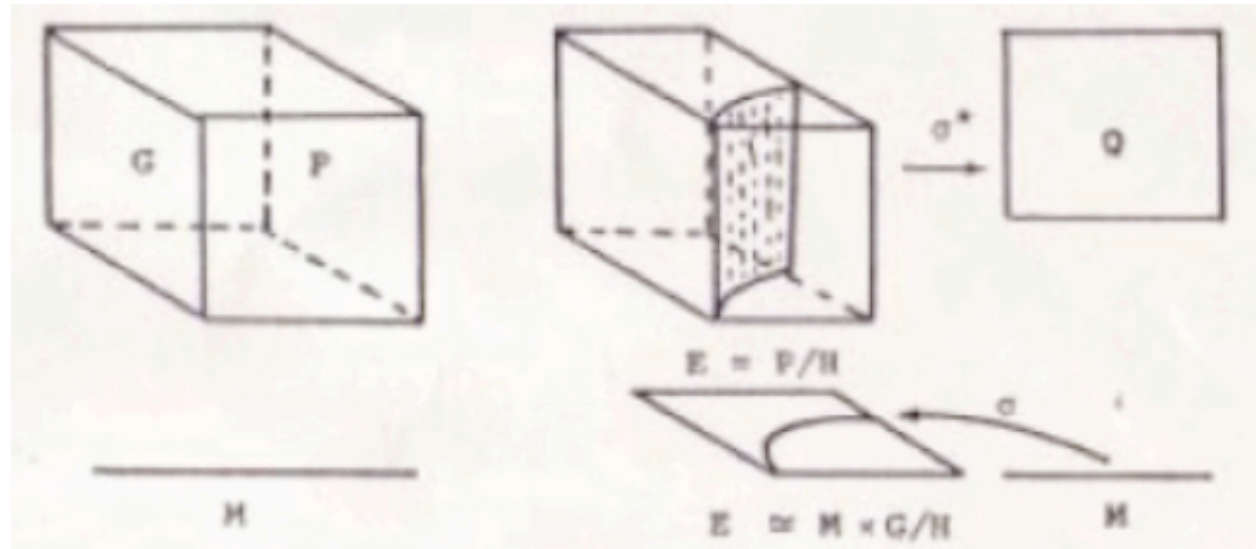
Quaternionic $E7 \times SU(2)$ structure breaks 8-dim Spacetime Octonionic Symmetry to Quaternionic (4+4)-dim Associative x CoAssociative Kaluza-Klein Spacetime

(see Reese Harvey "Spinors and Calibrations" (Academic 1990))

where $M4 = 4$ -dim Minkowski Physical Spacetime is Associative

and $CP2 = SU(3) / SU(2) \times U(1)$ Internal Symmetry Space is CoAssociative

Meinhard Mayer said (Hadronic Journal 4 (1981) 108-152): "... each point of ... the ... fibre bundle ... E ...



... consists of

a four- dimensional spacetime point x [in $M4$]

to which is attached the homogeneous space G / H [$SU(3) / U(2) = CP2$]

...

the components of the curvature lying in the homogeneous space G / H could be reinterpreted as Higgs scalars (with respect to spacetime [$M4$])

...

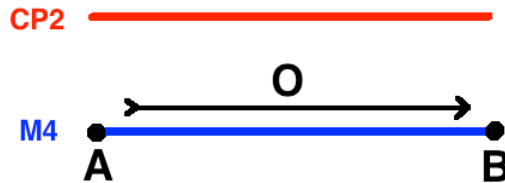
the Yang-Mills action reduces to a Yang-Mills action for the h -components [$U(2)$ components] of the curvature over M [$M4$] and a quartic functional for the "Higgs scalars", which not only reproduces the Ginzburg-Landau potential, but also gives the correct relative sign of the constants, required for the BEHK ... Brout-Englert-Higgs-Kibble ... mechanism to work. ...".

(see Appendix - Details of Mayer - Higgs)

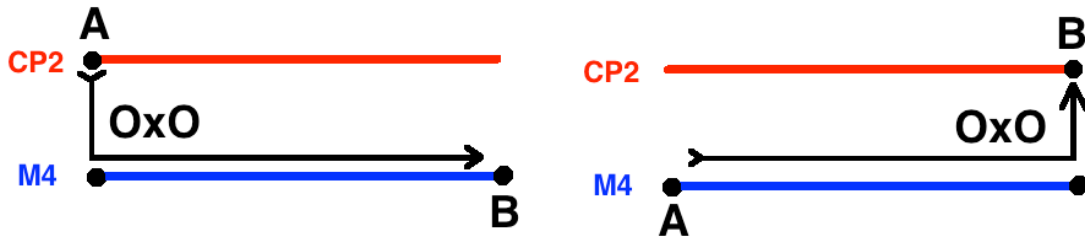
3 Generations of Fermions

In Kaluza-Klein $M4 \times CP2$ there are 3 possibilities for a fermion represented by an Octonion O basis element to go from point A to point B :

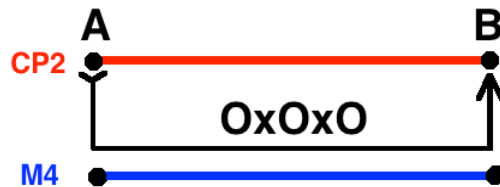
1 - A and B are both in $M4$: First Generation Fermion whose path can be represented by the single O basis element so that First Generation Fermions are represented by Octonions O .



2 - Either A or B , but not both, is in $CP2$: Second Generation Fermion whose path must be augmented by one projection from $CP2$ to $M4$, which projection can be represented by a second O basis element so that Second Generation Fermions are represented by Octonion Pairs OxO .



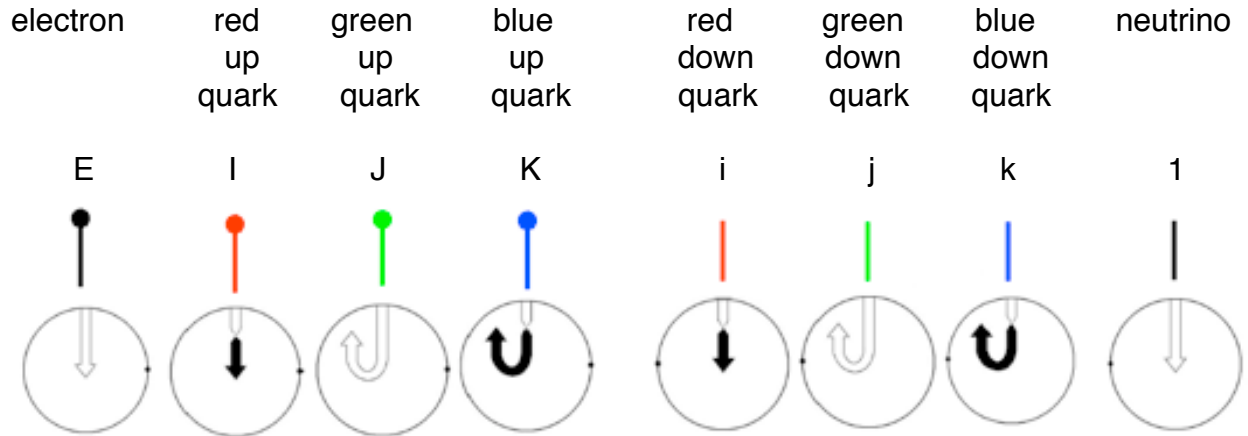
3 - Both A and B are in $CP2$: Third Generation Fermion whose path must be augmented by two projections from $CP2$ to $M4$, which projections can be represented by a second O and a third O , so that Third Generation Fermions are represented by Octonion Triples $OxOxO$.



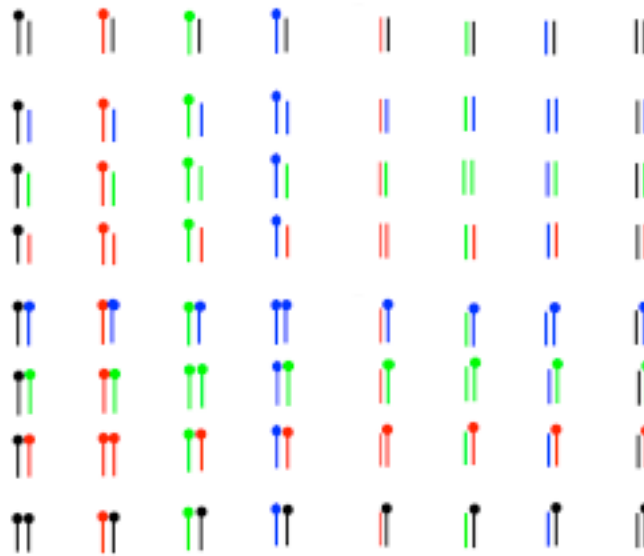
3 Generation Fermion Combinatorics

First Generation (8)

(geometric representation of Octonions is from arXiv 1010.2979)



Second Generation (64)



Mu Neutrino (1)

Rule: a Pair belongs to the Mu Neutrino if:
 All elements are Colorless (black)
 and all elements are Associative

(that is, is 1 which is the only Colorless Associative element) .

Muon (3)

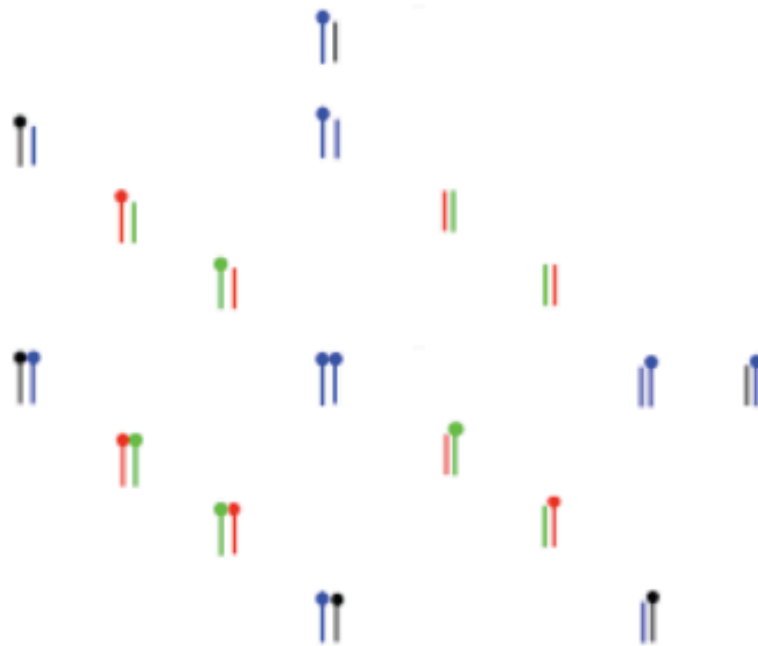
Rule: a Pair belongs to the Muon if:
All elements are Colorless (black)
and at least one element is NonAssociative
(that is, is E which is the only Colorless NonAssociative element).

Blue Strange Quark (3)

Rule: a Pair belongs to the Blue Strange Quark if:
There is at least one Blue element and the other element is Blue or Colorless (black)
and all elements are Associative (that is, is either 1 or i or j or k).

Blue Charm Quark (17)

Rules: a Pair belongs to the Blue Charm Quark if:
1 - There is at least one Blue element and the other element is Blue or Colorless (black)
and at least one element is NonAssociative (that is, is either E or I or J or K)
2 - There is one Red element and one Green element (Red x Green = Blue).



(Red and Green Strange and Charm Quarks follow similar rules)

Third Generation (512)

	Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee	
Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee	Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee	Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee
Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee	Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee	Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee
	Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee Te Te Te Te ee ee ee ee	

Tau Neutrino (1)

Rule: a Triple belongs to the Tau Neutrino if:

All elements are Colorless (black)

and all elements are Associative

(that is, is 1 which is the only Colorless Associative element)

Tauon (7)

Rule: a Triple belongs to the Tauon if:

All elements are Colorless (black)

and at least one element is NonAssociative (that is, is E which is the only Colorless NonAssociative element)

Blue Beauty Quark (7)

Rule: a Triple belongs to the Blue Beauty Quark if:

There is at least one Blue element and all other elements are Blue or Colorless (black) and all elements are Associative (that is, is either 1 or i or j or k).

Blue Truth Quark (161)

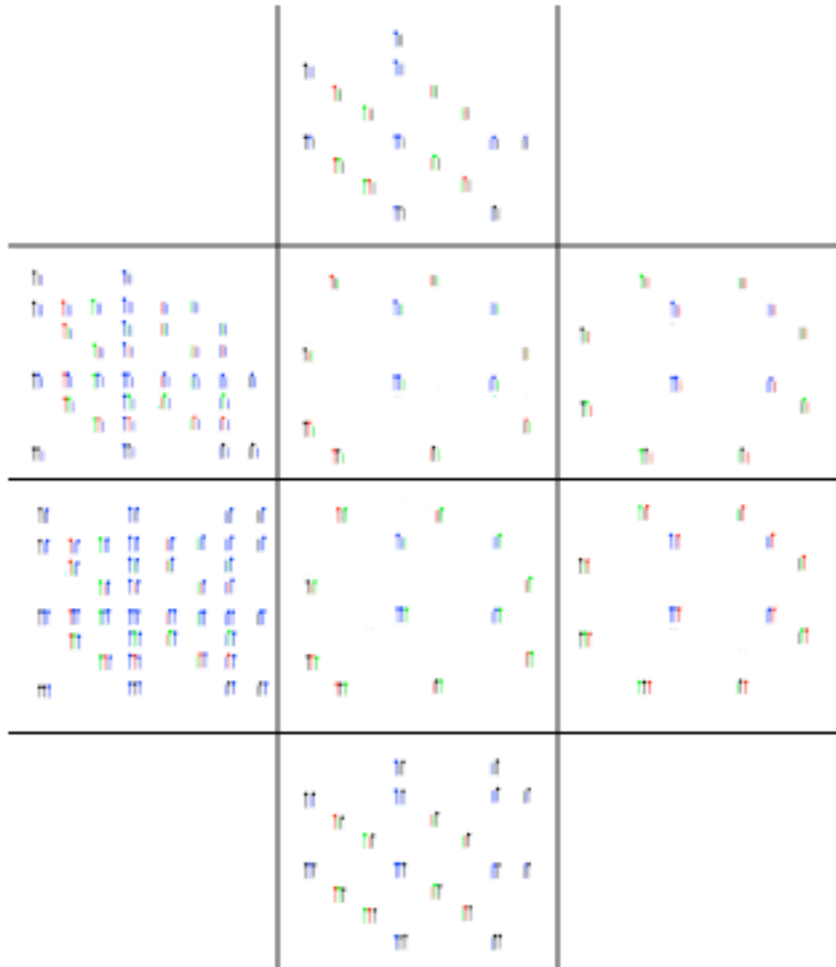
Rules: a Triple belongs to the Blue Truth Quark if:

1 - There is at least one Blue element and all other elements are Blue or Colorless (black)

and at least one element is NonAssociative (that is, is either E or I or J or K)

2 - There is one Red element and one Green element and the other element is Colorless (Red x Green = Blue)

3 - The Triple has one element each that is Red, Green, or Blue, in which case the color of the Third element (for Third Generation) is determinative and must be Blue.



(Red and Green Beauty and Truth Quarks follow similar rules)

Fermion masses are calculated as a product of four factors:

$$V(\underline{Qfermion}) \times N(\underline{Graviton}) \times N(\underline{octonion}) \times \underline{Sym}$$

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

$$V(\underline{Qdown\ quark}) / V(\underline{Qelectron}) = V(S^7 \times RP^1) / 1 = \pi^5 / 3.$$

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 first generation tree-level-massive fermions, 3 down, quarks, the 3 up quarks, and the electron,

so by the Sym factor 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 calculated at tree level as 1.877 GeV.

The beauty quark corresponds to 21 triples.

They are triples of the same form as the 7 tauon triples involving 1 and E, but for 1 and I, 1 and J, and 1 and K = red, green, and blue beauty quarks.

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

while the tauon interacts with only two.

The red beauty quark constituent mass should be the tauon mass times the third generation graviton factor $6/2 = 3$,

so the **red beauty quark mass is $m_b = 5.63111$ GeV**.

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 those $512 - 1 - 7 - 21 = 483$ 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 $m_t = 129.5155$ GeV**

248-dim E8 contains 120-dim D8

E8 / D8 = 64 + 64 Fermions

D8 / D4 x D4 = 64 Spacetime

**D4 = 28 Standard Model (12)
with 16 Gravity + Dark Energy Ghosts**

**D4 = 28 Gravity + Dark Energy (16)
with 12 Standard Model Ghosts**

The 24 Orange Root Vectors of the D4 of E8 Standard Model + Gravity Ghosts are on the Horizontal X-axis.



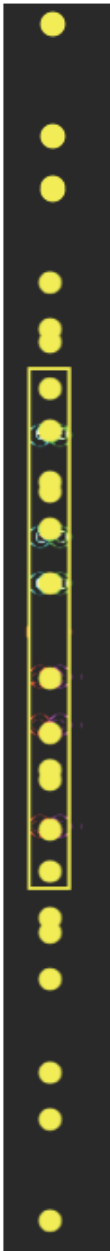
8 of them in the Orange Box represent the 8 Root Vectors of the Standard Model Gauge Groups $SU(3) SU(2) U(1)$.
 Their 4 Cartan Subalgebra elements correspond to the 4 Cartan Subalgebra elements of D4 of E8 Standard Model + Gravity Ghosts and to half of the 8 Cartan Subalgebra elements of E8.

The other $24-8 = 16$ Orange Root Vectors represent Ghosts of 16D $U(2,2)$ which contains the Conformal Group $SU(2,2) = Spin(2,4)$ that produces Gravity + Dark Energy by the MacDowell-Mansouri mechanism.

Standard Model Gauge groups come from $CP^2 = SU(3) / SU(2) \times U(1)$
 (as described by Batakis in Class. Quantum Grav. 3 (1986) L99-L105)

Electroweak $SU(2) \times U(1)$ is gauge group as isotropy group of CP^2 .

$SU(3)$ is global symmetry group of CP^2 but due to Kaluza-Klein $M_4 \times CP^2$ structure of compact CP^2 at every M_4 spacetime point, it acts as Color gauge group with respect to M_4 .



The 24 Yellow Root Vectors of the D4 of E8 Gravity + Standard Model Ghosts are on the Vertical Y-axis.

12 of them in the Yellow Box represent the 12 Root Vectors of the Conformal Gauge Group $SU(2,2) = Spin(2,4)$ of Conformal Gravity + Dark Energy.

The 4 Cartan Subalgebra elements of $SU(2,2) \times U(1) = U(2,2)$ correspond to the 4 Cartan Subalgebra elements of D4 of E8 Gravity + Standard Model Ghosts and to the other half of the 8 Cartan Subalgebra elements of E8.

The other $24 - 12 = 12$ Yellow Root Vectors represent Ghosts of 12D Standard Model whose Gauge Groups are $SU(3) SU(2) U(1)$.

Gravity and Dark Energy come from its Conformal Subgroup $SU(2,2) = Spin(2,4)$
(see Appendix - Details of Conformal Gravity and ratio DE : DM : OM)

$SU(2,2) = Spin(2,4)$ has 15 generators:

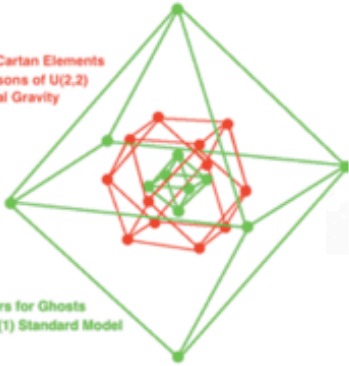
1 Dilation representing Higgs Ordinary Matter

4 Translations representing Primordial Black Hole Dark Matter

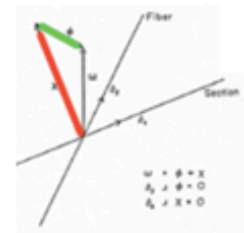
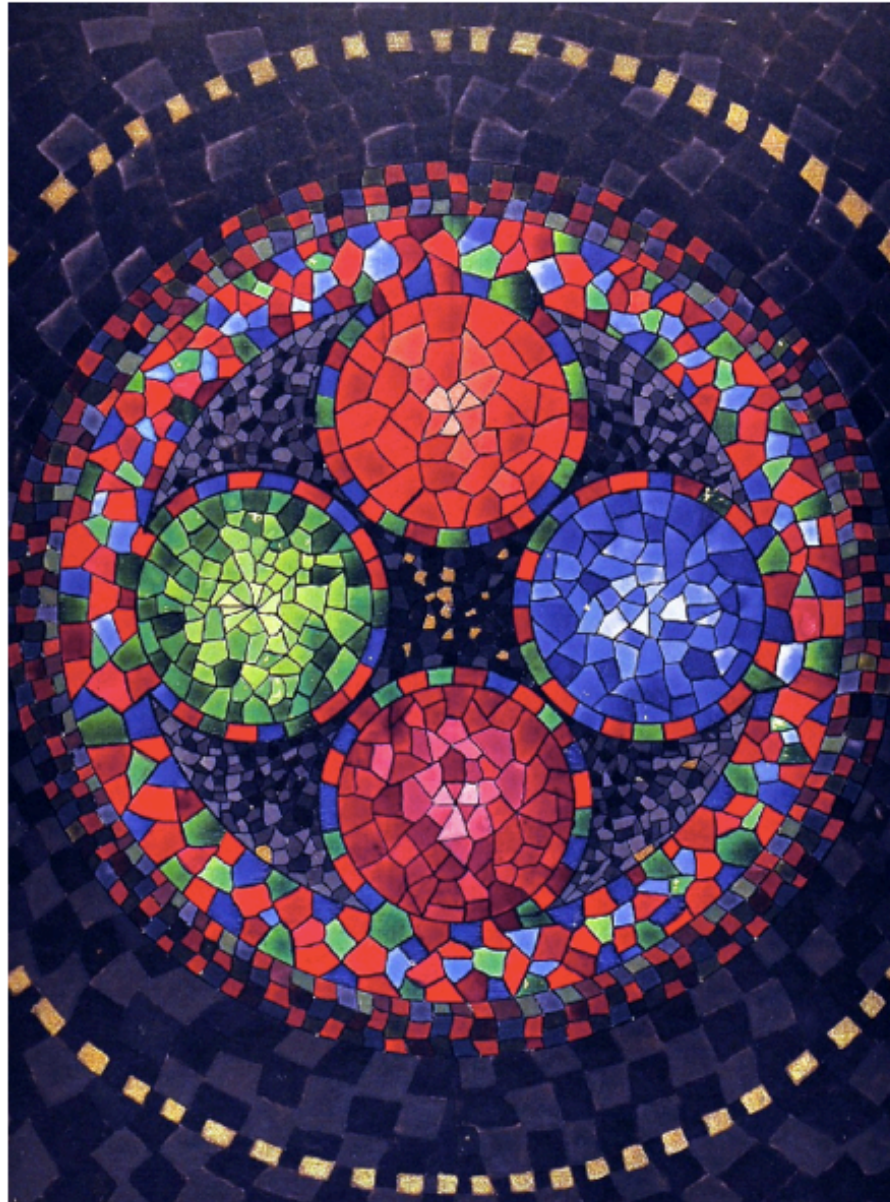
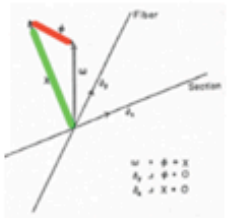
10 = 4 Special Conformal + 6 Lorentz representing Dark Energy
(see Irving Ezra Segal, "Mathematical Cosmology and Extragalactic Astronomy" (Academic 1976))

The basic ratio Dark Energy : Dark Matter : Ordinary Matter = $10:4:1 = 0.67 : 0.27 : 0.06$
When the dynamics of our expanding universe are taken into account, the ratio is calculated to be **0.75 : 0.21 : 0.04**

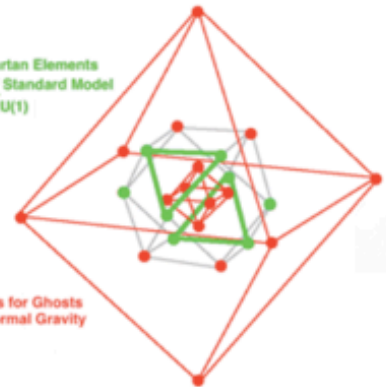
D4
 12 Root Vectors + 4 Cartan Elements
 for 16 Gauge Bosons of U(2,2)
 for Conformal Gravity



12 Root Vectors for Ghosts
 of SU(3)xSU(2)xU(1) Standard Model



D4
 8 Root Vectors + 4 Cartan Elements
 for 12 Gauge Bosons of Standard Model
 SU(3)xSU(2)xU(1)



16 Root Vectors for Ghosts
 of U(2,2) Conformal Gravity

The force strength of a given force is

$$(1 / Mforce^2) (Vol(MISforce)) (Vol(Qforce) / Vol(Dforce)^{ (1 / mforce) })$$

where:

Mforce represents the effective mass;

MISforce represents the relevant part of the target Internal Symmetry Space;

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

Qforce represents the link from the origin to the relevant target for the gauge boson;

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

$Vol(Dforce)^{ (1 / mforce) }$ 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).

Qforce, Hermitian symmetric space, Dforce, mforce, and Vol(Dforce) for four forces are:

Spin(5)	Spin(7) / Spin(5)xU(1)	IV5	4	RP ¹ xS 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 ¹ xS ²
U(1)	-	-	1	-

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

squashed S5 = Shilov boundary of complex domain of symmetric space SU(4) / SU(3) x U(1)

The relative force strengths at the characteristic energy level of each force are:

Spin(5) gravity at 10¹⁹ GeV = 1 ; GGmproton² approx 5 x 10⁻³⁹

SU(3) color at 245 MeV = 0.6286

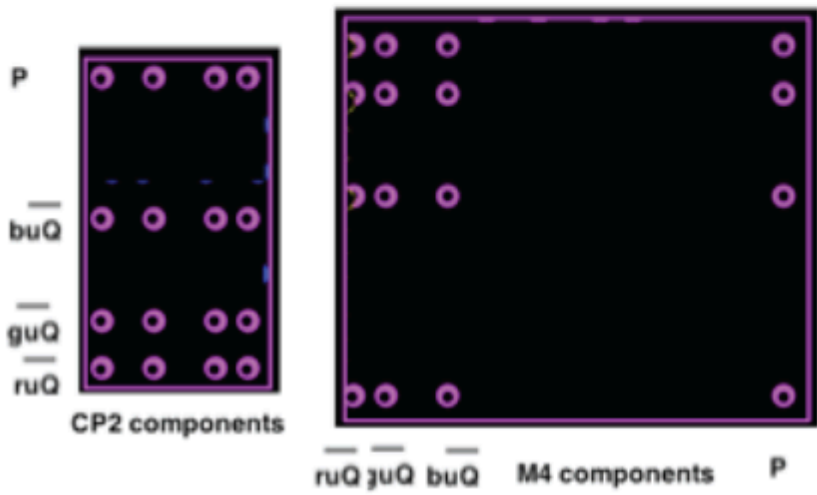
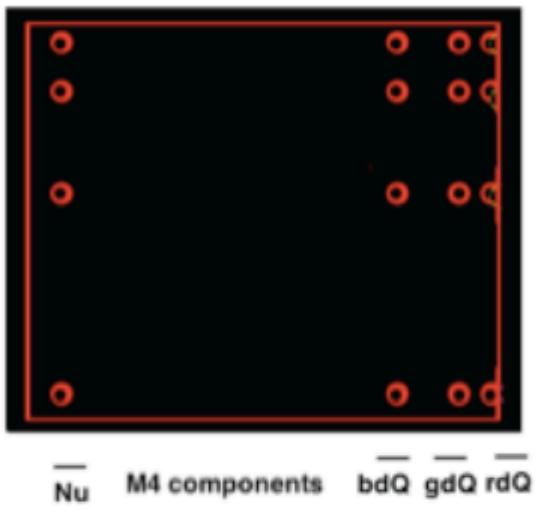
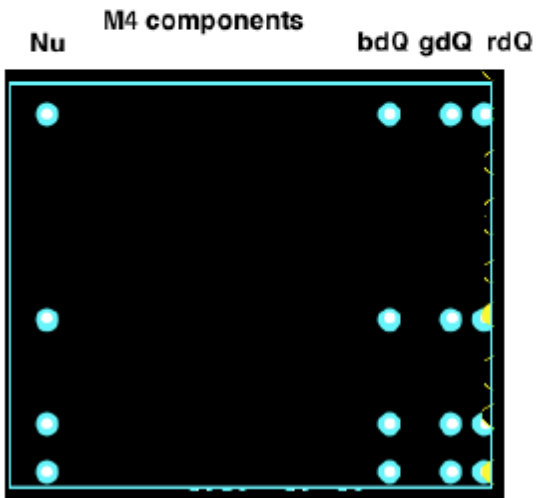
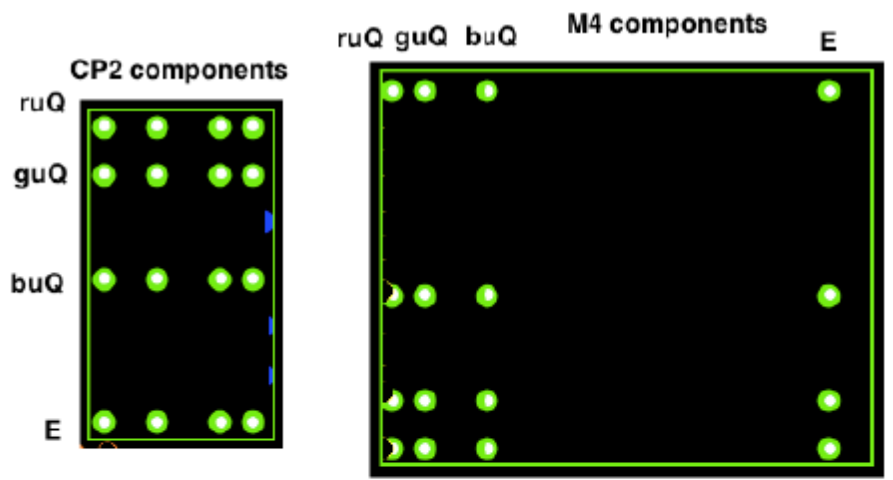
at 5.3 GeV = 0.166

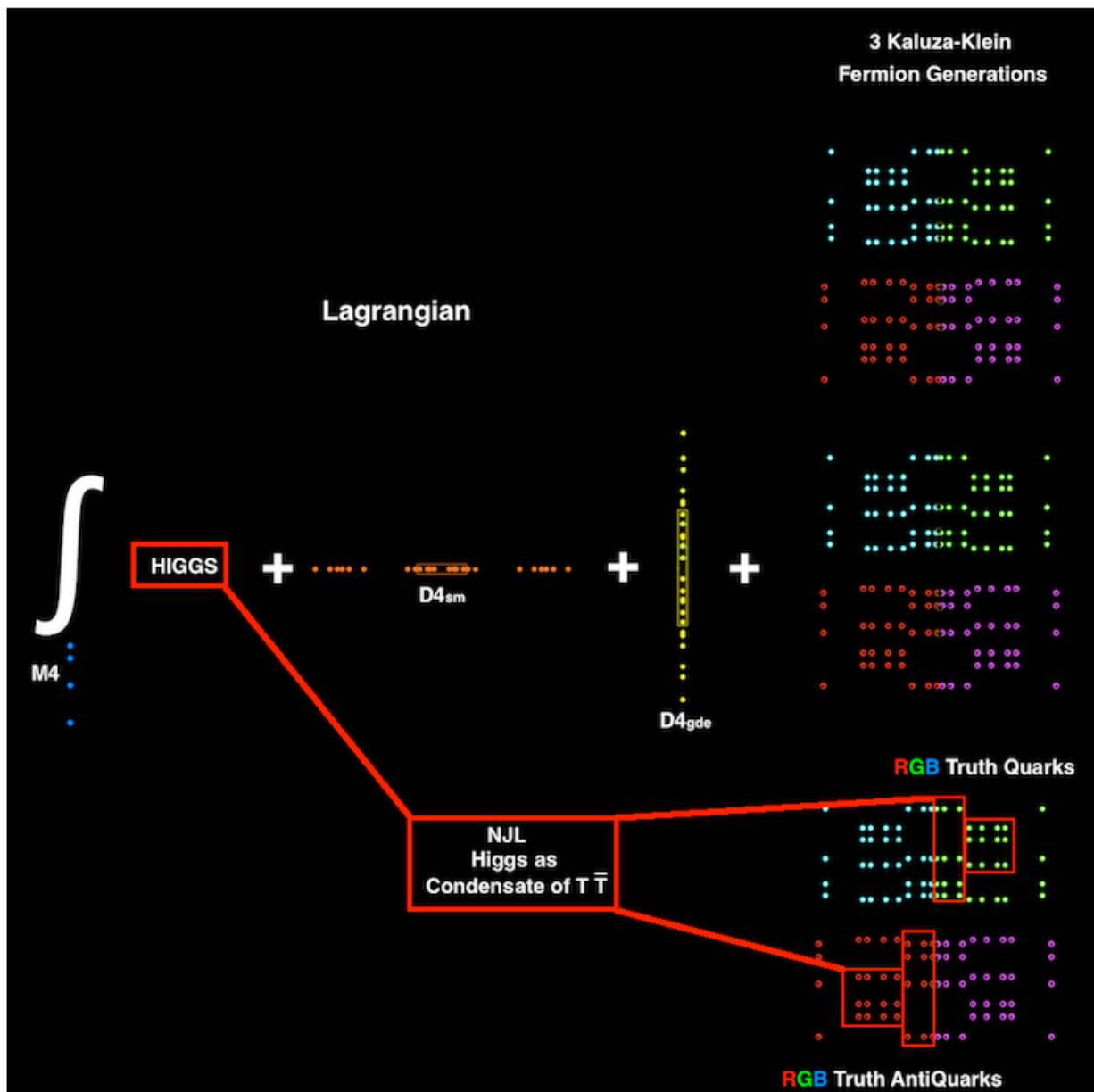
at 34 GeV = 0.121

at 91 GeV = 0.106 ; with nonperturbative effects = 0.125

SU(2) weak at 100 GeV = 0.2535 ; GWmproton² approx 1.05 x 10⁻⁵

U(1) e-mag at 4 KeV = 1/137.03608





Fermion masses are calculated as a product of four factors:

$$V(\text{Qfermion}) \times N(\text{Graviton}) \times N(\text{octonion}) \times \text{Sym}$$

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

$$V(\text{Qdown quark}) / V(\text{Qelectron}) = V(S^7 \times RP^1) / 1 = \pi^5 / 3.$$

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:

The beauty quark corresponds to 21 triples.

They are triples of the same form as the 7 tauon triples involving 1 and E, but for 1 and I, 1 and J, and 1 and K,

which correspond to the red, green, and blue beauty quarks,

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 those $512 - 1 - 7 - 21 = 483$ triples, so the

constituent mass of red truth quark is $161 / 7 = 23$ times red beauty quark

red Truth quark mass is $m_t = 129.5155 \text{ GeV}$

Here is a summary of E8 Physics model calculation results. Since ratios are calculated, values for one particle mass and one force strength are assumed. Quark masses are constituent masses. Most of the calculations are tree-level, so more detailed calculations might be even closer to observations.

Dark Energy : Dark Matter : Ordinary Matter = 0.75 : 0.21 : 0.04

Fermions as Schwinger Sources have geometry of Complex Bounded Domains with Kerr-Newman Black Hole structure size about $10^{(-24)}$ cm.

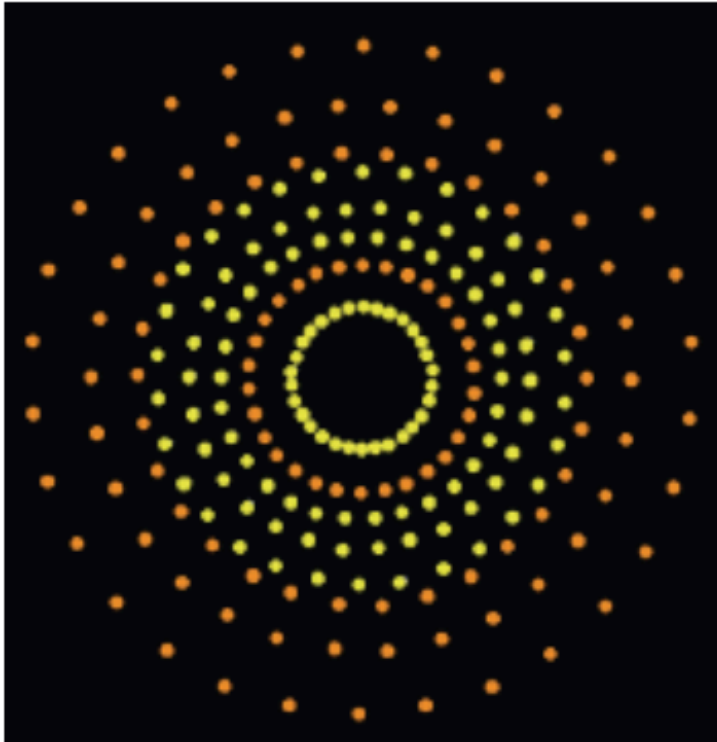
Particle/Force	Tree-Level	Higher-Order
e-neutrino	0	0 for nu_1
mu-neutrino	0	$9 \times 10^{(-3)}$ eV for nu_2
tau-neutrino	0	$5.4 \times 10^{(-2)}$ eV for nu_3
electron	0.5110 MeV	
down quark	312.8 MeV	charged pion = 139 MeV
up quark	312.8 MeV	proton = 938.25 MeV neutron - proton = 1.1 MeV
muon	104.8 MeV	106.2 MeV
strange quark	625 MeV	
charm quark	2090 MeV	
tauon	1.88 GeV	
beauty quark	5.63 GeV	
truth quark (low state)	130 GeV	(middle state) 174 GeV (high state) 218 GeV
W+	80.326 GeV	
W-	80.326 GeV	
W0	98.379 GeV	Z0 = 91.862 GeV
Mplanck	1.217×10^{19} GeV	
Higgs VEV (assumed)	252.5 GeV	
Higgs (low state)	126 GeV	(middle state) 182 GeV (high state) 239 GeV
Gravity Gg (assumed)	1	
(Gg)(Mproton ² / Mplanck ²)		$5 \times 10^{(-39)}$
EM fine structure	1/137.03608	
Weak Gw	0.2535	
Gw(Mproton ² / (Mw+ ² + Mw- ² + Mz0 ²))		$1.05 \times 10^{(-5)}$
Color Force at 0.245 GeV	0.6286	0.106 at 91 GeV

Kobayashi-Maskawa parameters for W+ and W- 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 phase angle d13 is taken to be 1 radian.

$E_8 = H_4 + H_4 = 120 + 120 = 240$ -vertex Witting polytope tiling of 8-dim space



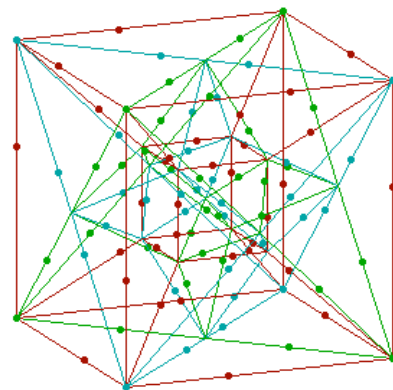
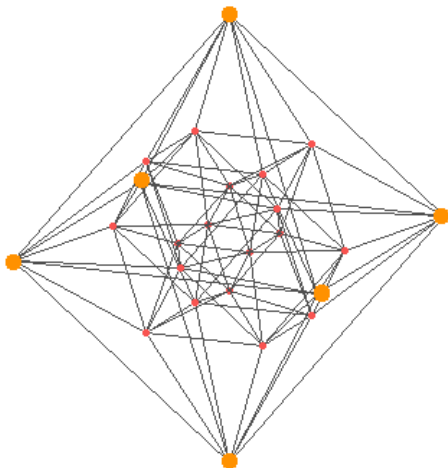
$E_8 = 120$ BiVectors + 128 half-Spinors of $Cl(16)$ Clifford Algebra
with graded structure

1 16 120 560 1820 4368 8008 11440 12870 11440 8008 4368 1820 560 120 16 1

By 8-Periodicity of Real Clifford Algebras: $Cl(16) = \text{tensor product } Cl(8) \times Cl(8)$

so with that product $E_8 = F_4 \times F_4$

$H_4 = 24$ (vertices) + 96 (edges) = 120-vertex 600-cell tiling of 4-dim space
with Coxeter Group determined by E_8

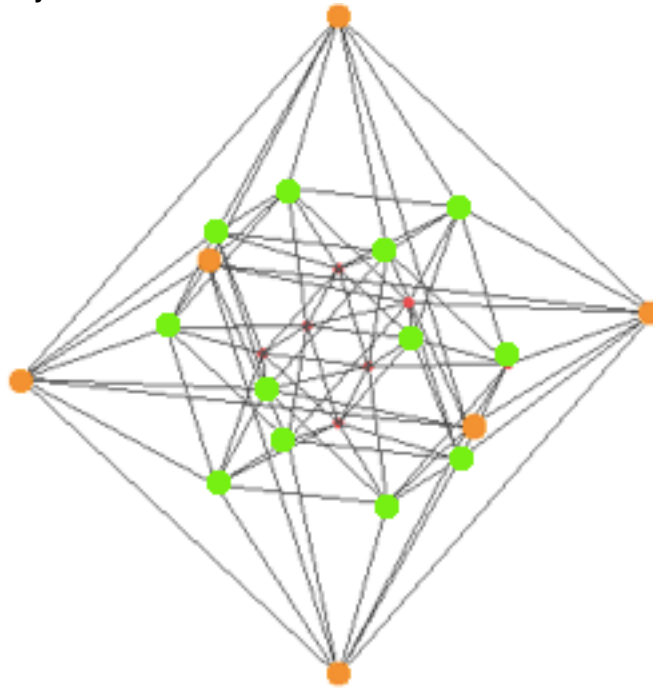


F4 = 24 cell + dual 24-cell tiling of 4-dim space

F4 = 8 Vectors + 28 BiVectors + 16 Spinors of Cl(8) Clifford Algebra
with graded structure 1 8 28 56 70 56 28 8 1
tile 4-dim space by 24-cells and their dual 24-cells

D4 24-cell tiling of 4-dim space

D4 = 28 BiVectors of Cl(8) Clifford Algebra with 24 root vectors
with graded structure 1 8 28 56 70 56 28 8 1
tile 4-dim space by 24-cells



A3 = D3 = cuboctahedral tiling of 3-dim space

A3=D3 = 15 BiVectors of Cl(6) Clifford Algebra with 12 root vectors and
with graded structure 1 6 15 20 15 6 1
tile 3-dim space by cuboctahedra
which can be seen as a central part of a 24-cell (green vertices above)

H3 = 12-Vertex Icosahedron as Jitterbug Transform of 12-Vertex Cuboctahedron
with Coxeter Group determined by D6

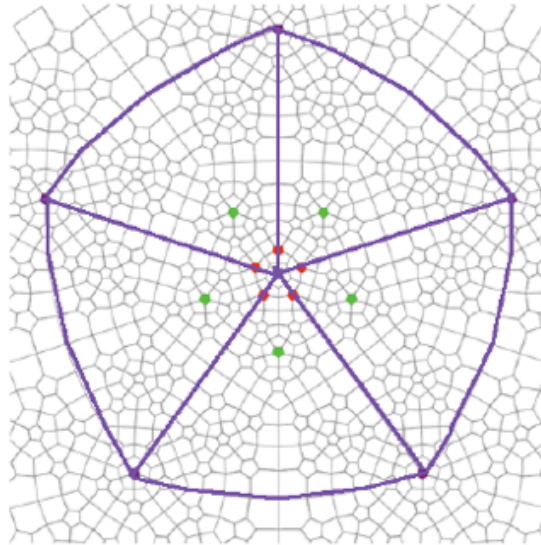


H2 Penrose STAR tilings of 2-dim space

H2 = I^5_2 = Penrose STAR tiling of 2-dim space

with Coxeter group determined by A_4 which contains A_2
and field extension $Q(\sqrt{5})$

The central part of the tiling has 5 pentagonal sectors

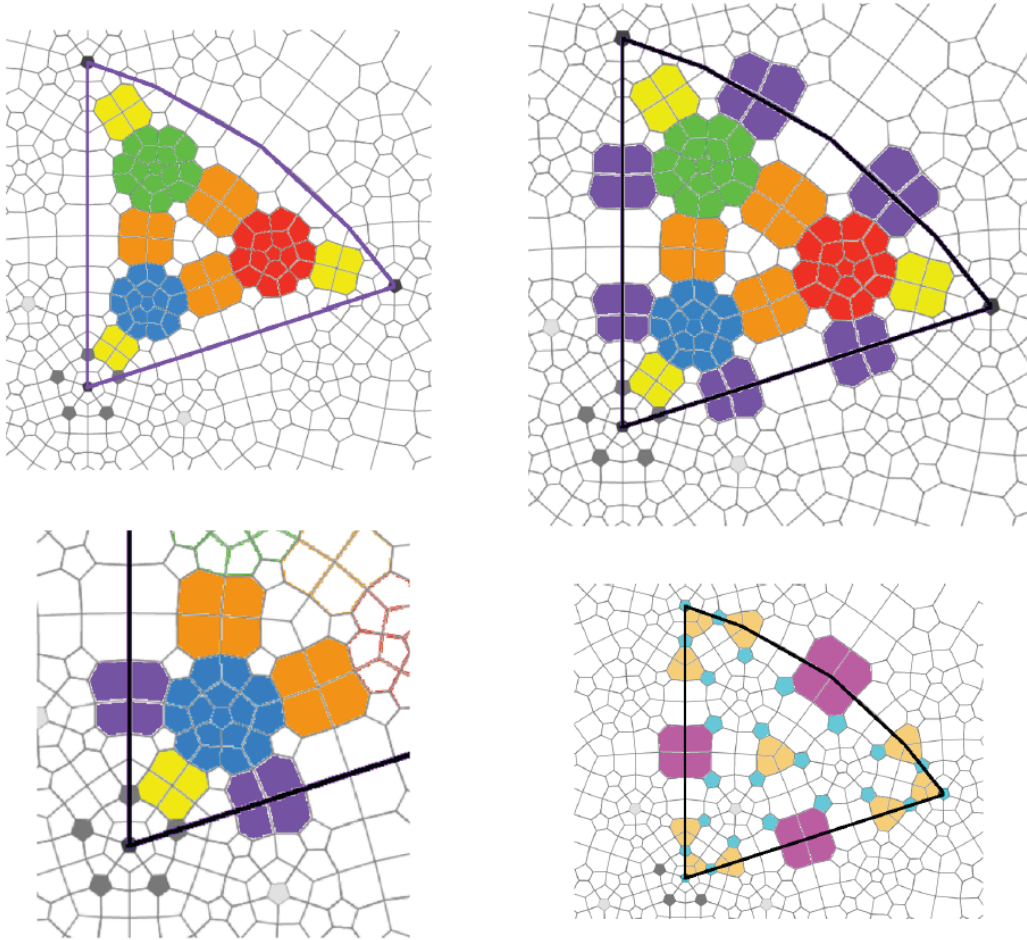


Each of the 5 pentagonal sectors of the tiling contains a 2-dim projected version of the 8-dim E_8 Root Vector structure of E_8 Physics corresponding to the Complex E_6 subalgebra of Octonionic E_8 . The outer boundary of each sector is not a straight line but is curved with Conformal Symmetry and pentagonal sectors further out are conformally curved rather than straight-line pentagons.

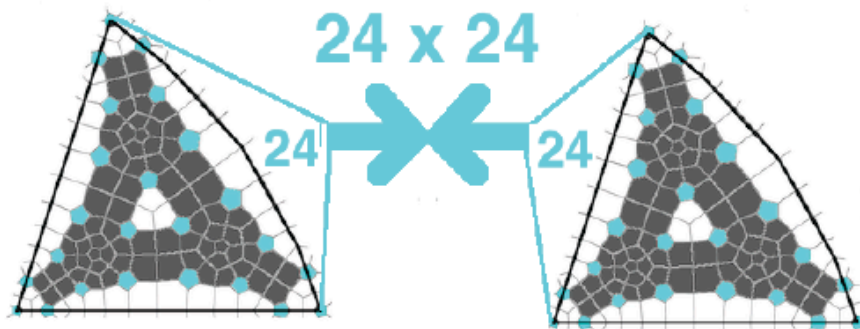
Each pentagonal sector represents the Complex part of Octonionic E_8 Physics whose 240 E_8 Root Vectors project to the 72 Root Vectors of E_6 subalgebra of E_8 which 72 E_6 Root Vectors have the following physical interpretation

16 = 2x8 of which represent Complex Fermion Particles
16 = 2x8 of which represent Complex Fermion AntiParticles
16 = 2x(4+4) of which represent Complex (4+4)-dim Kaluza-Klein SpaceTime
12 of which represent the Standard Model
12 of which represent Gravity + Dark Energy

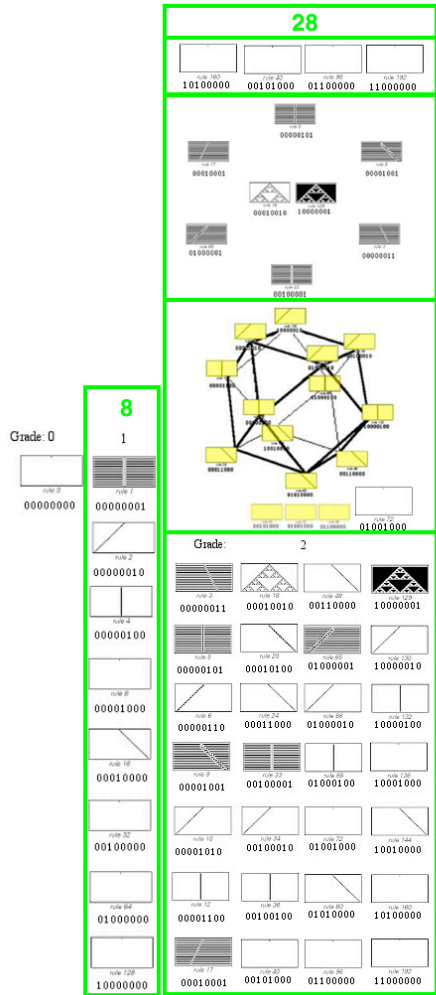
as shown in the following image of one of the pentagonal sectors:



The Bohm Quantum Potential interacts between two Pentagonal Sectors by 24 Bohm Carrier Tiles of one Pentagonal Sector carrying E8 Configuration Information and comparing it with 24 Bohm Carrier Tiles of the Other Sector carrying E8 Configuration Information. If the resulting 24 x 24 Matrix shows that the two E8 Configurations are similar, then a Bohm Quantum Potential Resonant Connection is established.



The Bohm Quantum Potential 24x24 Matrix is traceless because Configuration Resonance is sensitive to similarity rather than dilation scale and is symmetric because Configuration Resonance is symmetric between Sectors.



$$8+28+16 = 52 F4$$

256-dim Cl(8) as Cellular Automata

16

Cl(8) Primitive Idempotent has 16 Terms

$$I = (1/2)(1 + e_{1248}) (1/2)(1 + e_{2358}) (1/2)(1 + e_{3468}) (1/2)(1 + e_{4578}) =$$

$$= (1/16)(1 + e_{1248} + e_{2358} + e_{3468} + e_{4578} + e_{5618} + e_{6728} + e_{7138} - e_{3567} - e_{4671} - e_{5712} - e_{6123} - e_{7234} - e_{1345} - e_{2456} + e_J)$$

corresponding to 16 of the 256 Cellular Automata

- + e_{12345678} 11111111
- + e_{6728} + e_{3468} + e_{4578} to 11100010 10101100 11012000
- + e_{2358} + e_{1248} + e_{5618} + e_{7138} 10010110 10031011 10117001 11000101
- + 1 to 00000000
- - e_{5712} - e_{1345} - e_{6123} 01010011 00011101 00100011
- - e_{4671} - e_{7234} - e_{2456} - e_{3567} 01101001 01000110 01101101 01110100

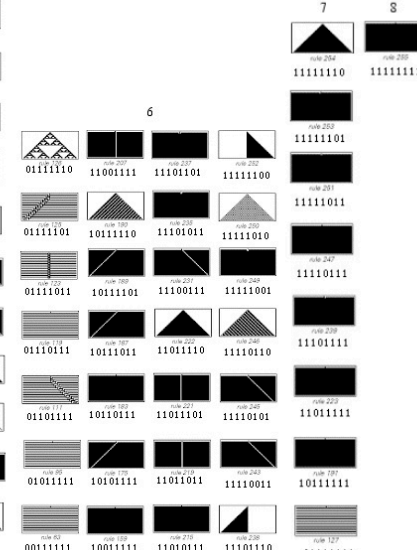
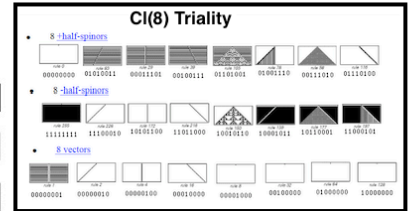
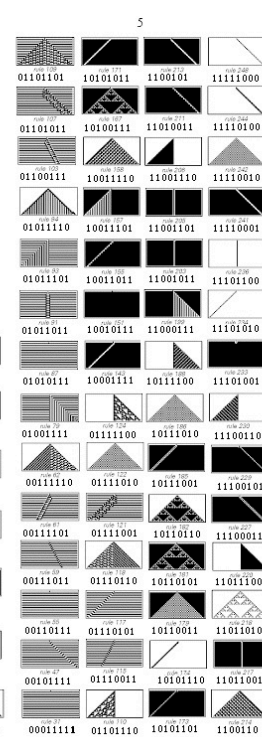
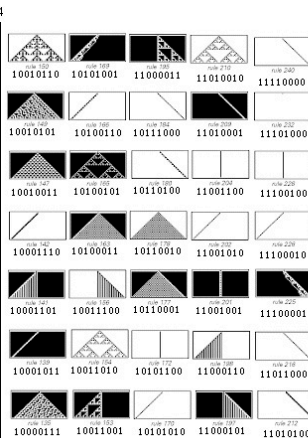
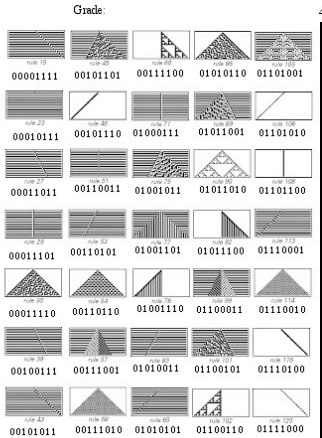
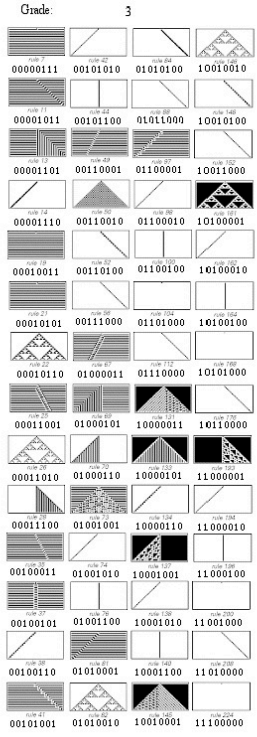
Tensor Product Cl(8) x Cl(8) = Cl(16)

$$(F4 \text{ in } Cl(8)) \times (F4 \text{ in } Cl(8)) =$$

$$= 8 \times 8 + 28 \times 1 + 1 \times 28 + 16 \times 16 =$$

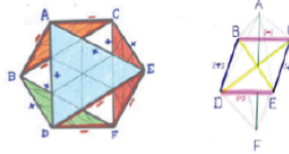
$$= 120 Cl(16) \text{ BiVectors} + (128 + 128) Cl(16) \text{ Spinors}$$

$$120 Cl(16) \text{ BiVectors} + 128 Cl(16) \text{ Half-Spinors} = E8$$

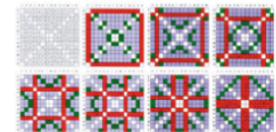


Guillermo Moreno (arXiv/math/0512517) has shown that $V(7,2) = \text{Spin}(7) / \text{Spin}(5)$ can be identified with the **Zero Divisors of Sedenions** which have $7+28 = 35$ Associative Triples and for which Zero Divisors are given by the fibration $V(7,2) \rightarrow G_2 \rightarrow S^3$ [3-sphere] and which have 4-2=2 ZD Irreducible Components and 10-dim Lie Sphere $\text{Spin}(7) / \text{Spin}(5) \times U(1)$ whose 10D correspond to $Cl(1,9) = Cl(2,8)$ Conformal over $Cl(1,7)$ that $V(15,2) = \text{Spin}(15) / \text{Spin}(13)$ is related to, but not identified with, the **Zero Divisors of 32-ons** which have $35 + 120 = 155$ Associative Triples and which have 8-2=6 ZD Irreducible Components and 26-dim Lie Sphere $\text{Spin}(15) / \text{Spin}(13) \times U(1)$ whose 26D correspond to **26D String Theory and to 26-dim traceless $J(3,0)_0$** that $V(127,2) = \text{Spin}(127) / \text{Spin}(125)$ is related to, but not identified with, the **Zero Divisors of Voudon 256-ons** corresponding to $Cl(8)$ which have $1+6+28+120+496+2016+8128=10795$ Associative Triples and which have 64-2=62 ZD Irreducible Components and 250-dim Lie Sphere $\text{Spin}(127) / \text{Spin}(125) \times U(1)$

Robert de Marrais said "... 256 ... 2^8 ions Voudons ... Moreno ... determines that the automorphism group of the ZD's of all 2^n-ions ... obey a simple pattern: for $n \geq 4$ this group has the form $G_2 \times (n-3) \times S_3$ (... order-6 permutation group on 3 elements) ... This says the automorphism group of the Sedenions' ZD's has order $14 \times 1 \times 6 = 84$... based on 7 octahedral lattices ("Box-Kites" ...

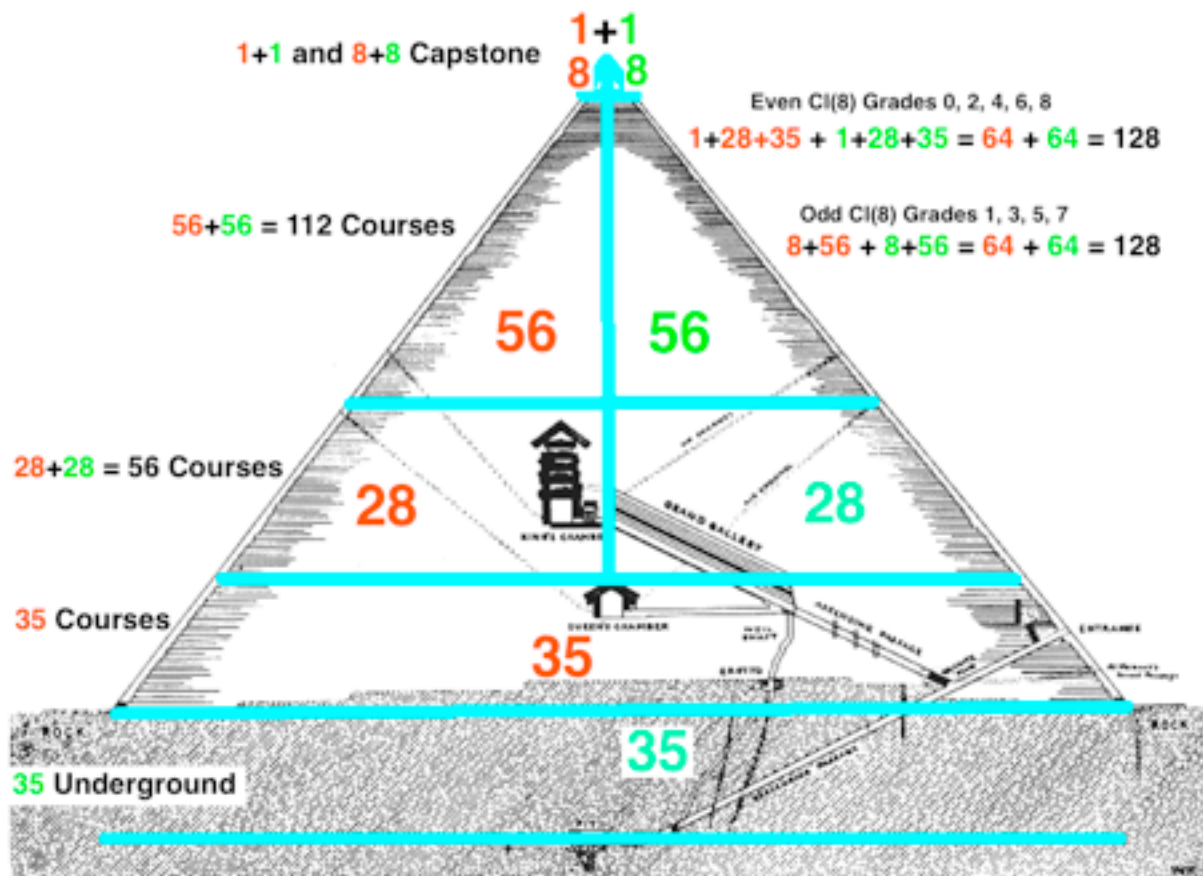


... Harmonics of Box-Kites, called here "Kite-Chain Middens," ... extend indefinitely into higher forms of 2^n -ions. All non-Midden-collected ZD diagonals in the ... 32-ons ... belong ... to a set of 15 "emanation tables," ... they house 168 ... PSL(2,7) ... cells ... 8 ... 32-ons ... ET's ... from $S = 8$ to 15 ...



[here are] ... Emanation Tables ... ET's for $S = 15, N = 5, 6, 7$... and fractal limit ...



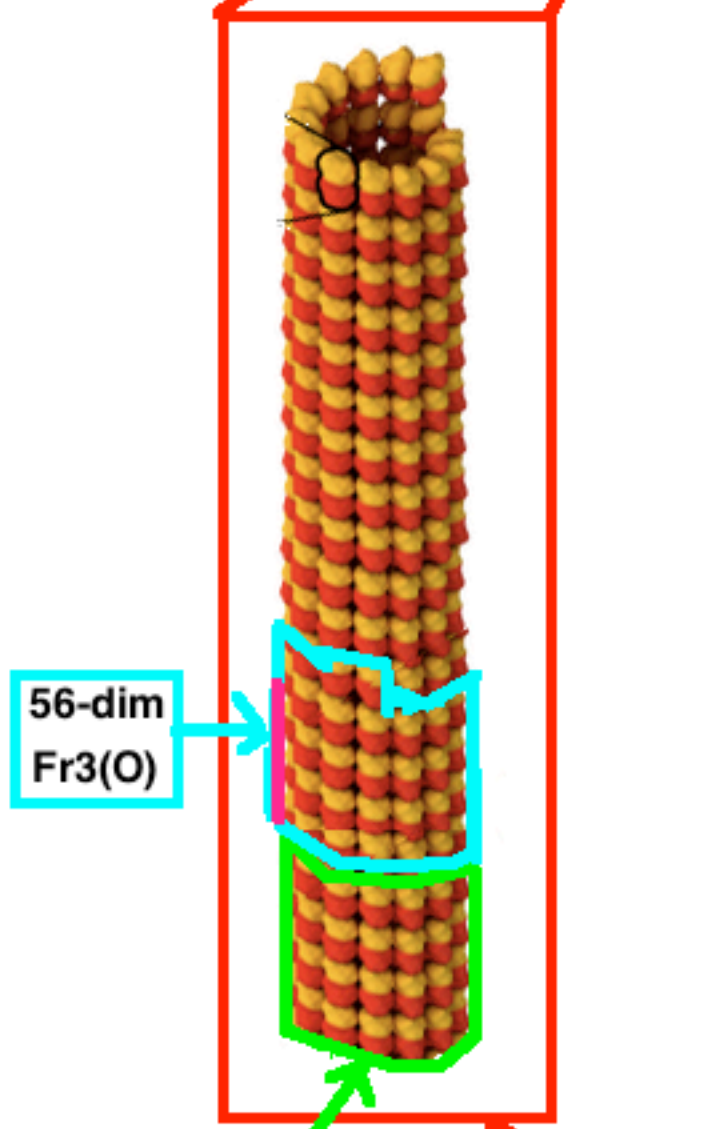
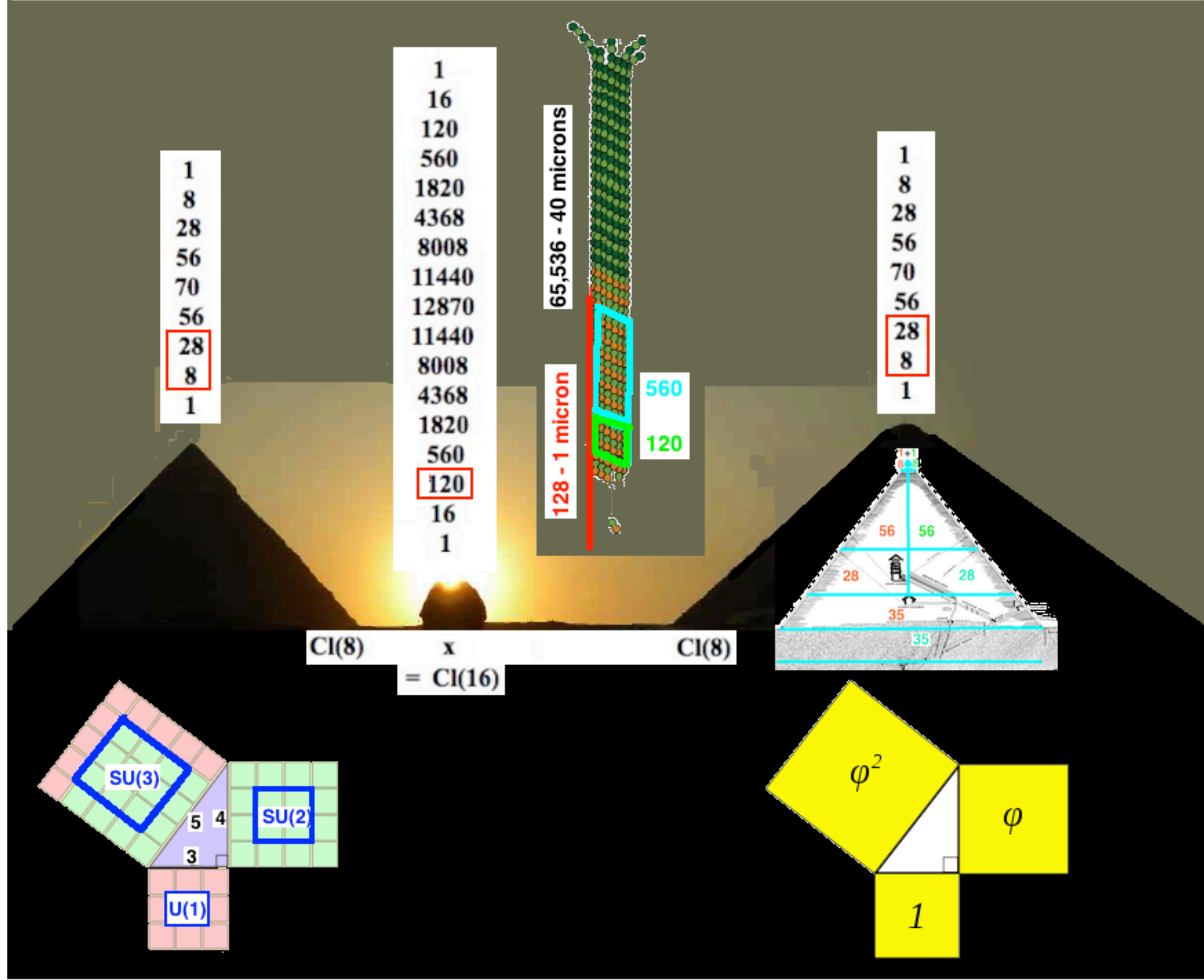


$$1 + 8 + 28 + 56 + (35 + 35) + 56 + 28 + 8 + 1$$

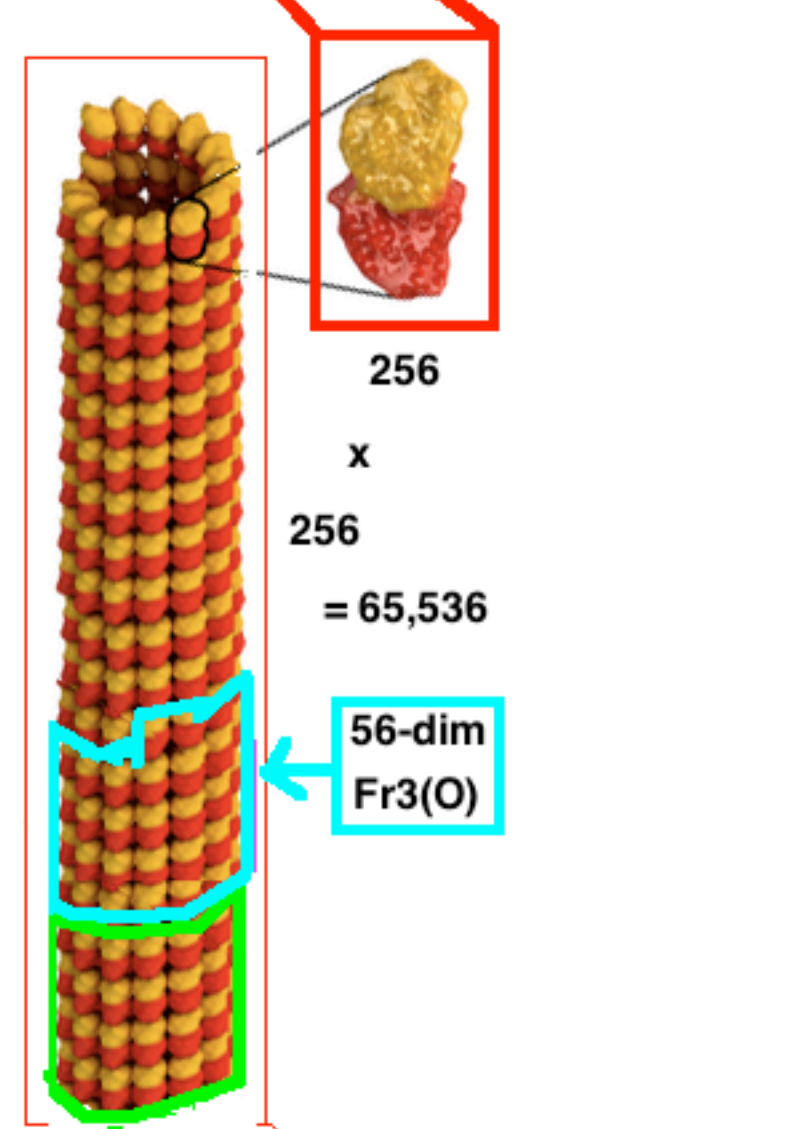
B4 **CP2** $28 + \sqrt{256} = 16 = 52 \text{ F4}$
 $8 \text{ CP2} = \text{SU}(3) / \text{SU}(2) \times \text{U}(1)$

D8 **(Cnf6 -> M4) x CP2** $120 + (1/2) \sqrt{65,536} = 128 = 248 \text{ E8}$

B4 **Cnf6 -> M4** $28 + \sqrt{256} = 16 = 52 \text{ F4}$
 8



52-dim F4 of CP2 in **256-dim Cl(8)**
 F4 / B4 = OP2 = Spinor Fermions =
 = 8 Particles + 8 AntiParticles
 B4 / D4 = 8-dim SpaceTime =
 = Kaluza-Klein M4 x CP2
 D4 = Spin(8) contains Spin(6) = SU(4)
 contains SU(3) Color Force
 SU(3) Color Force = Global Symmetry
 of CP2 = SU(3) / SU(2)xU(1)
 SU(2)xU(1) ElectroWeak Force =
 = Local Symmetry of CP2



52-dim F4 of Cnf6 -> M4 in **256-dim Cl(8)**
 $256 \times 256 = 65,536$
 F4 / B4 = OP2 = Spinor Fermions =
 = 8 Particles + 8 AntiParticles
 B4 / D4 = 8-dim SpaceTime =
 = Kaluza-Klein M4 x CP2
 D4 = Spin(4,4) contains Spin(2,4) of
 Conformal Gravity + Dark Energy



E8 Kaluza-Klein (Cnf6 -> M4) x CP2
 In (Cl(8) of CP2) x (Cl(8) of Cnf6 -> M4) = Cl(16) containing E8
 at each of the 256 points of Cl(8) of Cnf6 -> M4 there are all 256 points of Cl(8) of CP2
D8 = Cl(16) BiVectors = 120
E8 / D8 = 128-dim Fermion Spinor Space = 8 components of 8+8 Fermions
D8 / D4 x D4 = A7+1 = 64 = 8-dim position x 8-dim momentum
D4 containing D3 = Spin(2,4) = A3 = SU(2,2) for Conformal Gravity + Dark Energy
D4 containing D3 = SU(4) containing Color Force SU(3)
10xFr3(O) = Cl(16) TriVectors = 560

Void -> Cl(Void) -> Cl(0) -> Cl(1) -> Cl(2) -> Cl(4) -> Cl(16)

Kaluza-Klein Spacetime
M4 x CP2

Cl(8) that contains 28 = D4 for M4 Gravity	Cl(8) that contains 28 = D4 for CP2 Std Model	1
		16
		120
		560
		1820
		4368
		8008
		11440
		12870
		11440
		8008
		4368
		1820
		560
		120
		16
		1

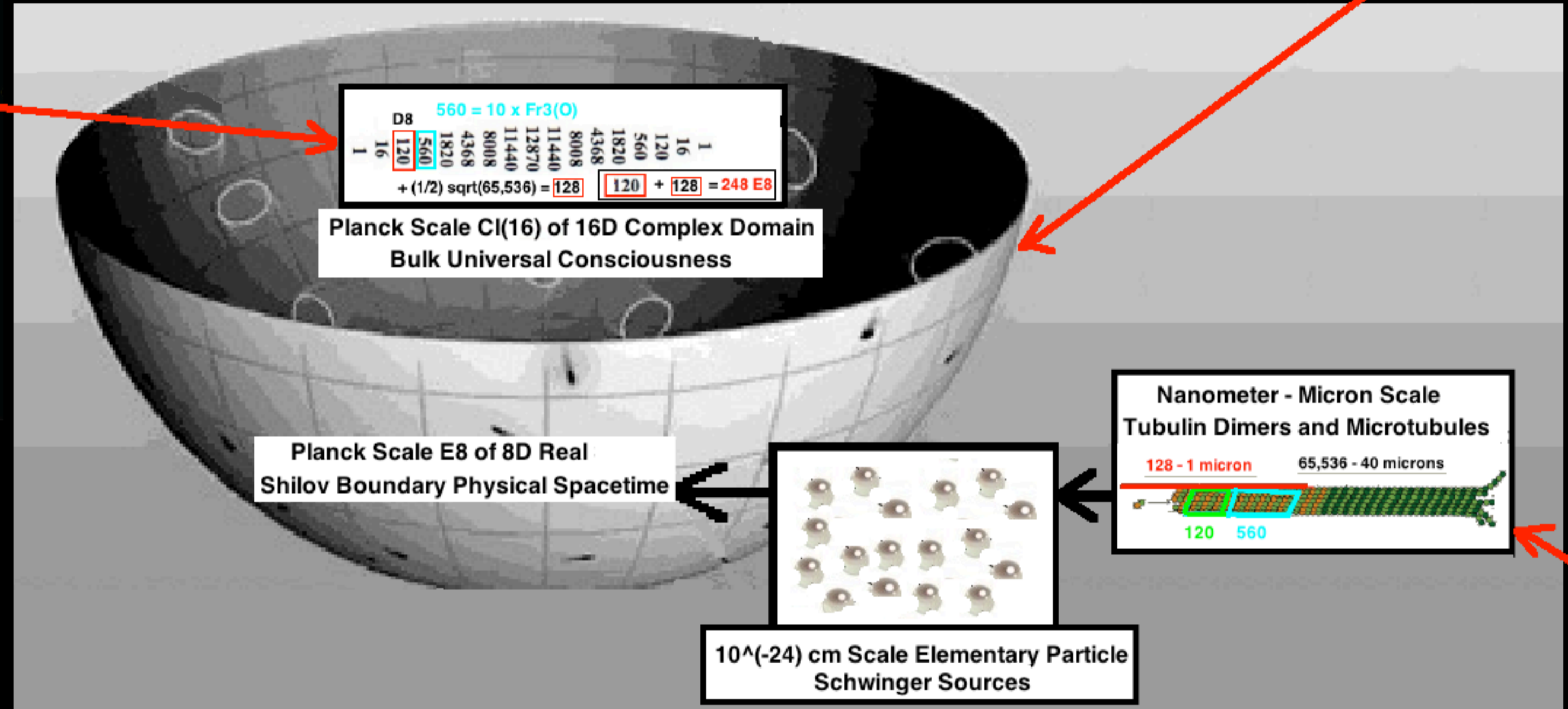
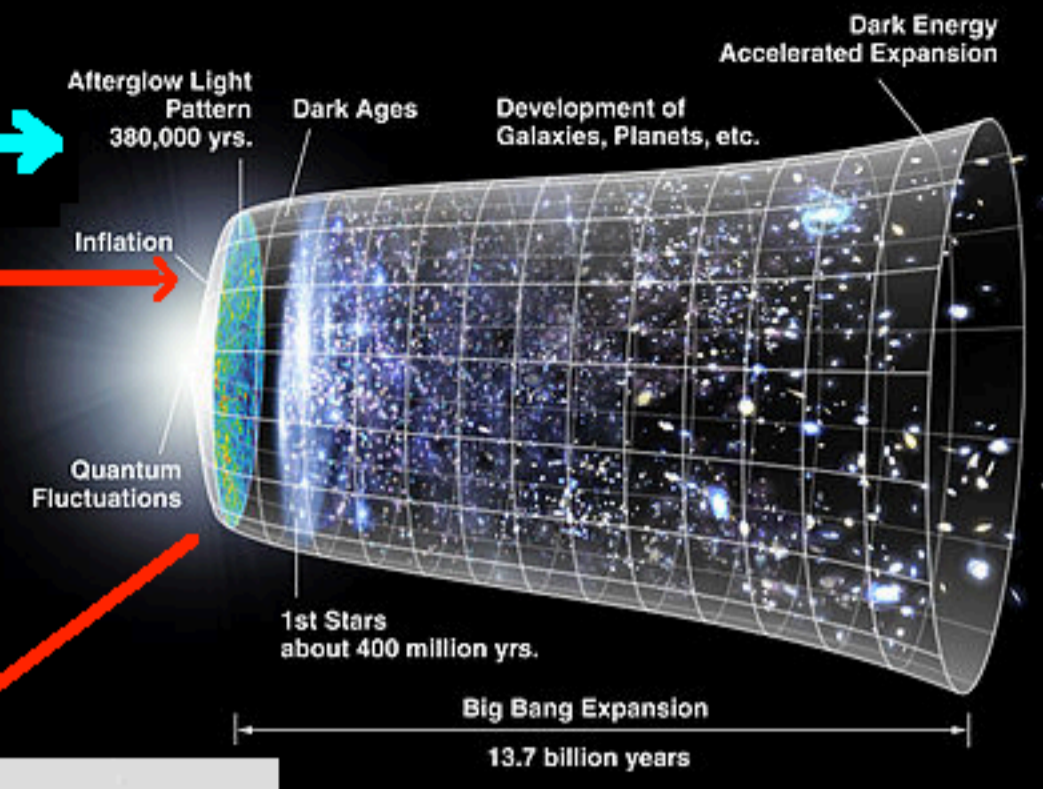
70 x 70 = 1820
56 x 56 = 560
28 x 28 = 120
8 x 8 = 16
1 x 1 = 1

$Cl(8) \times Cl(8) = Cl(16)$

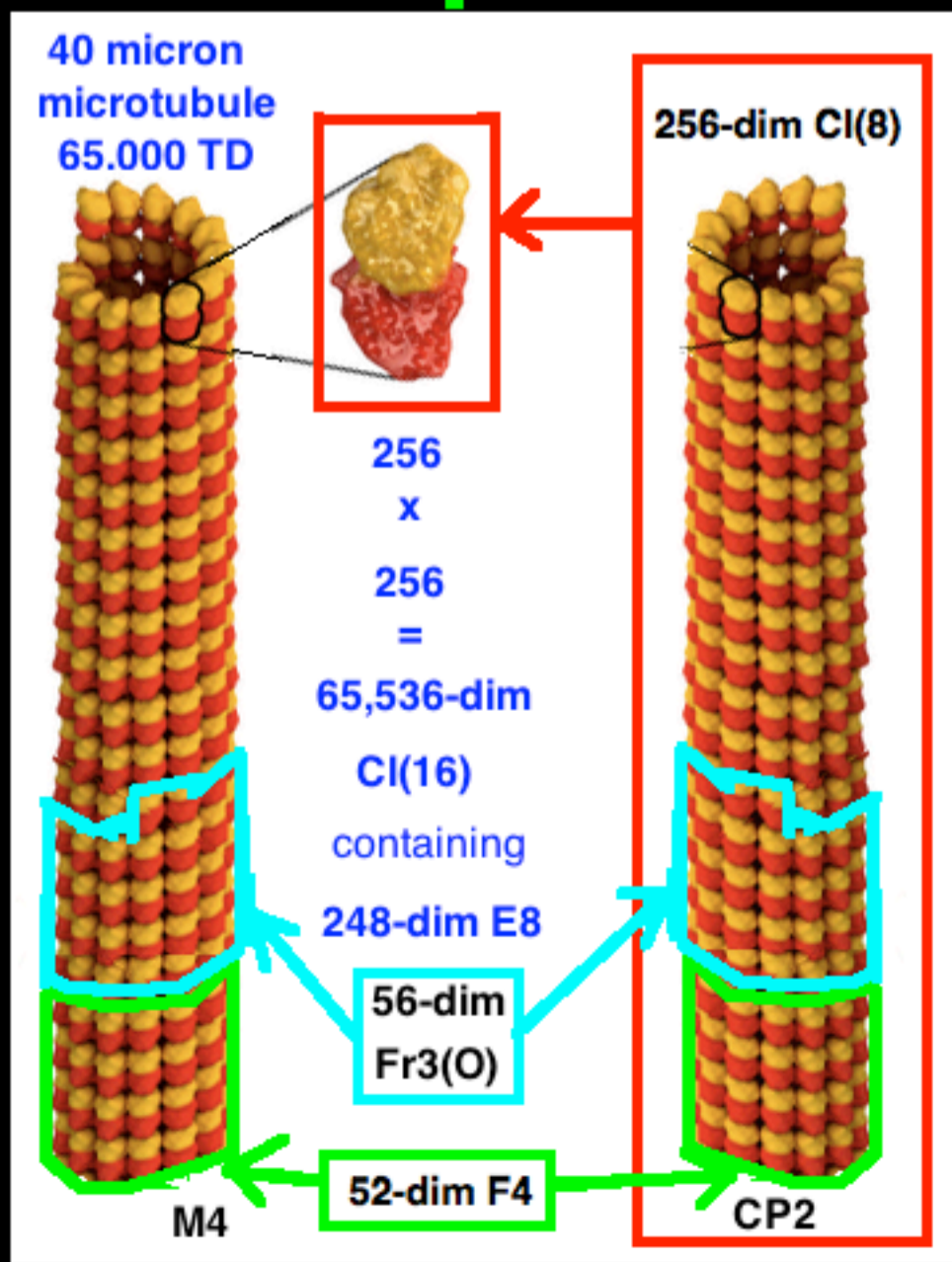
Spinors: $(8s+8c) \times (8s+8c) = (8c \times 8s + 8c \times 8c)$

NJL Quantum Condensate

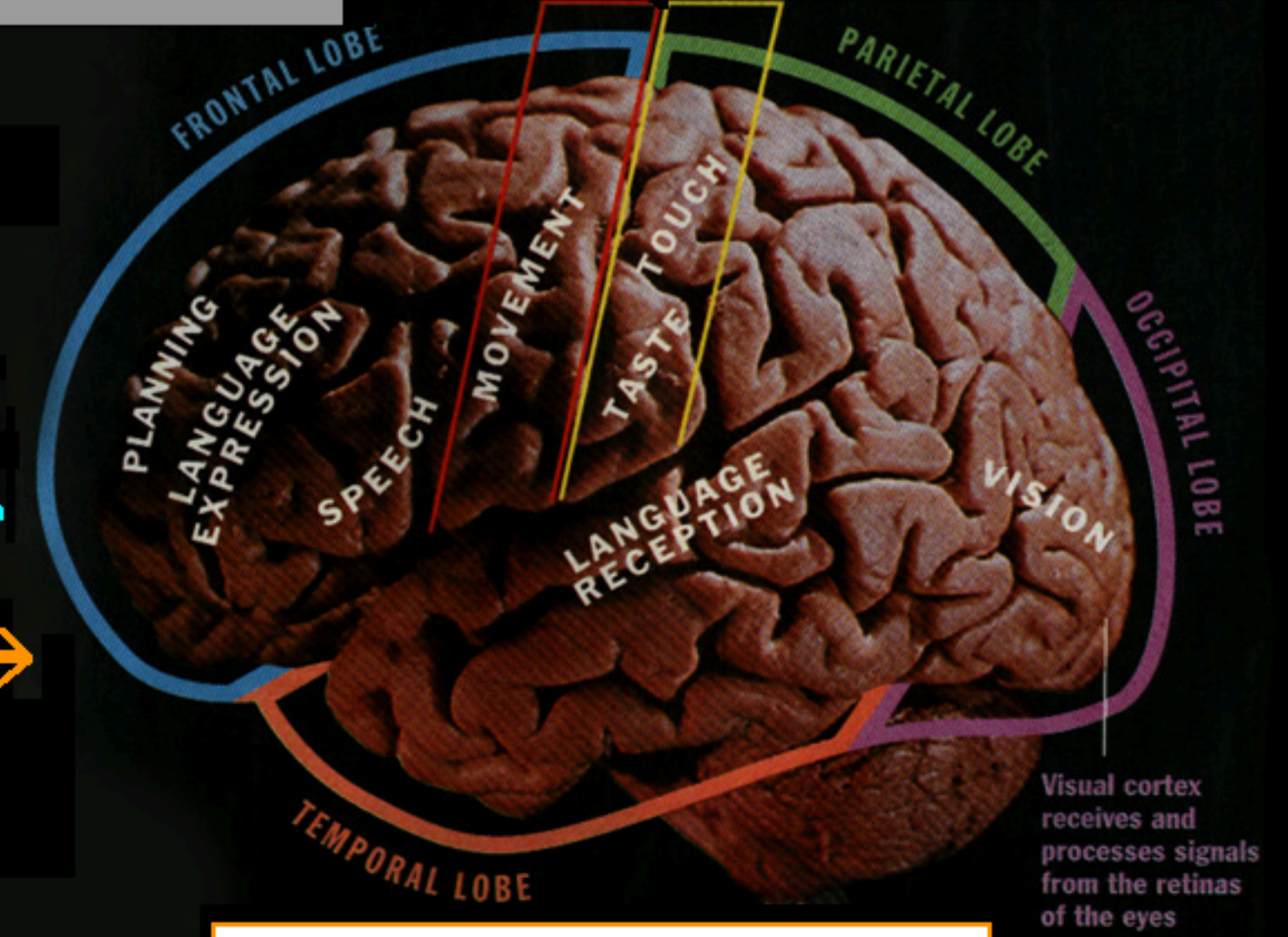
10^{19} E8 Lattice 240-vertex Polytope Cells in Universe at End of Inflation



Quantum Resonant Connection



Penrose-Hameroff Quantum Condensate



10^{19} Tubulin Dimers in a Human Brain

Void -> CI(Void) -> CI(0) -> CI(1) -> CI(2) -> CI(4) -> CI(16)

Kaluza-Klein Spacetime
M4 x CP2

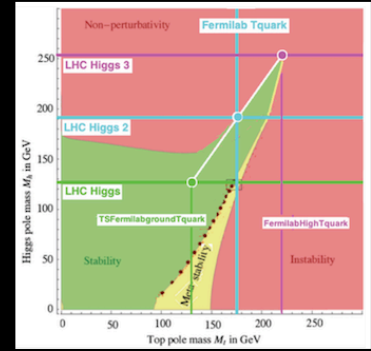
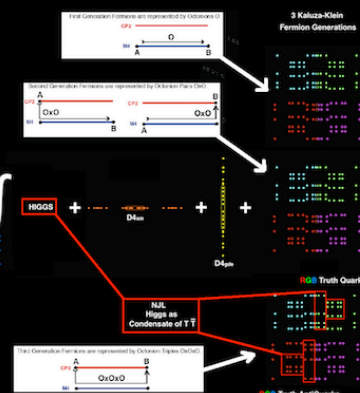
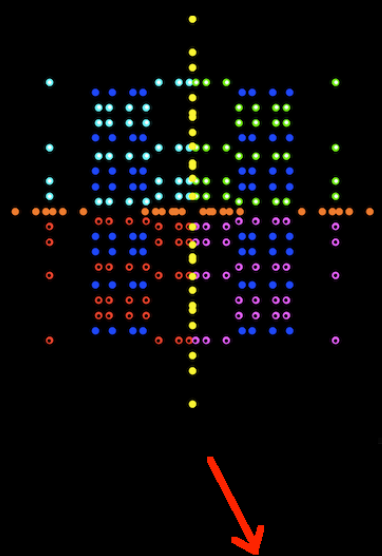
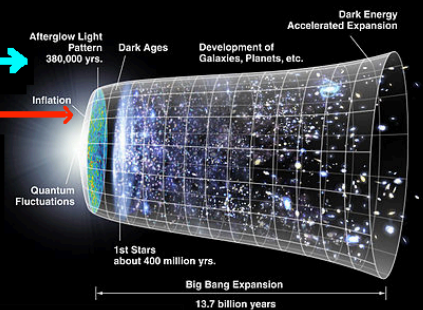
1	16
8	120
28	560
70	1820
160	4368
350	8008
700	11440
1287	12870
2520	11440
4368	8008
7000	4368
10000	1820
12000	560
11200	120
8000	16
4000	1

CI(8) x CI(8) = CI(16)

Spinors: $(8s, 8s) + (8s, 8c)$
 $(8s+8c) \times (8s+8c) = (8c, 8s + 8c, 8c)$

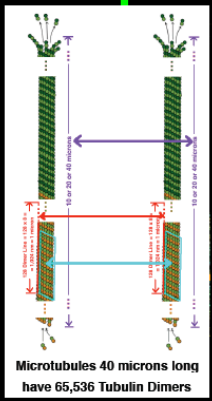
NJL Quantum Condensate

10¹⁹ E8 Lattice 240-vertex Polytope Cells in Universe at End of Inflation

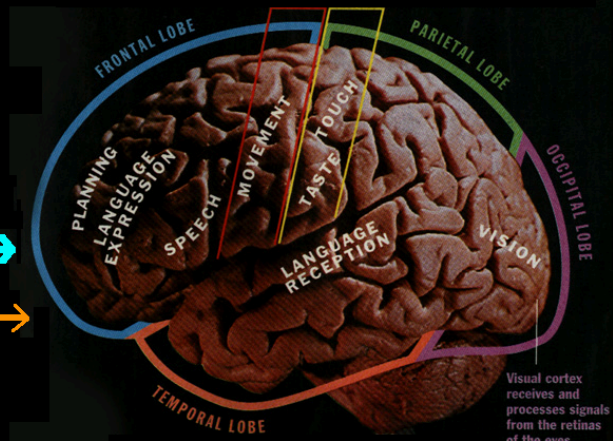


$CI(0,16) \times CI(0,8) = CI(0,24)$
 $M(2, CI(0,24)) = CI(1,25)$
 Completion of Union of All Tensor Products of $CI(1,25) = AQFT$

Quantum Resonant Connection



Penrose-Hameroff Quantum Condensate



10¹⁹ Tubulin Dimers in a Human Brain

Visual cortex receives and processes signals from the retinas of the eyes