Schwinger Sources: Visualization and Explanation

Frank Dodd (Tony) Smith, Jr. - 2018

Abstract

In E8-Cl(16) Physics, elementary particles are not point particles in or with smooth manifold structures but are finite Schwinger Source regions with size scale from Planck 10^(-33) cm to Source Region Boundaries at scale 10^(-24) cm.

At scales larger than 10^(-24) cm spacetime and other relevant structures can be usefully and accurately considered to be smooth manifolds,
thus permitting use of Armand Wyler's methods of calculating force strengths, particle masses, etc.

At Schwinger Source scales Planck 10^(-33) cm to scale 10^(-24) cm
the internal structure of Schwinger Sources is QuasiCrystal Lattice
derived from E8 Lattices, permitting Indra's Net BlockChain Physics
of Schwinger Source Indra Jewels.

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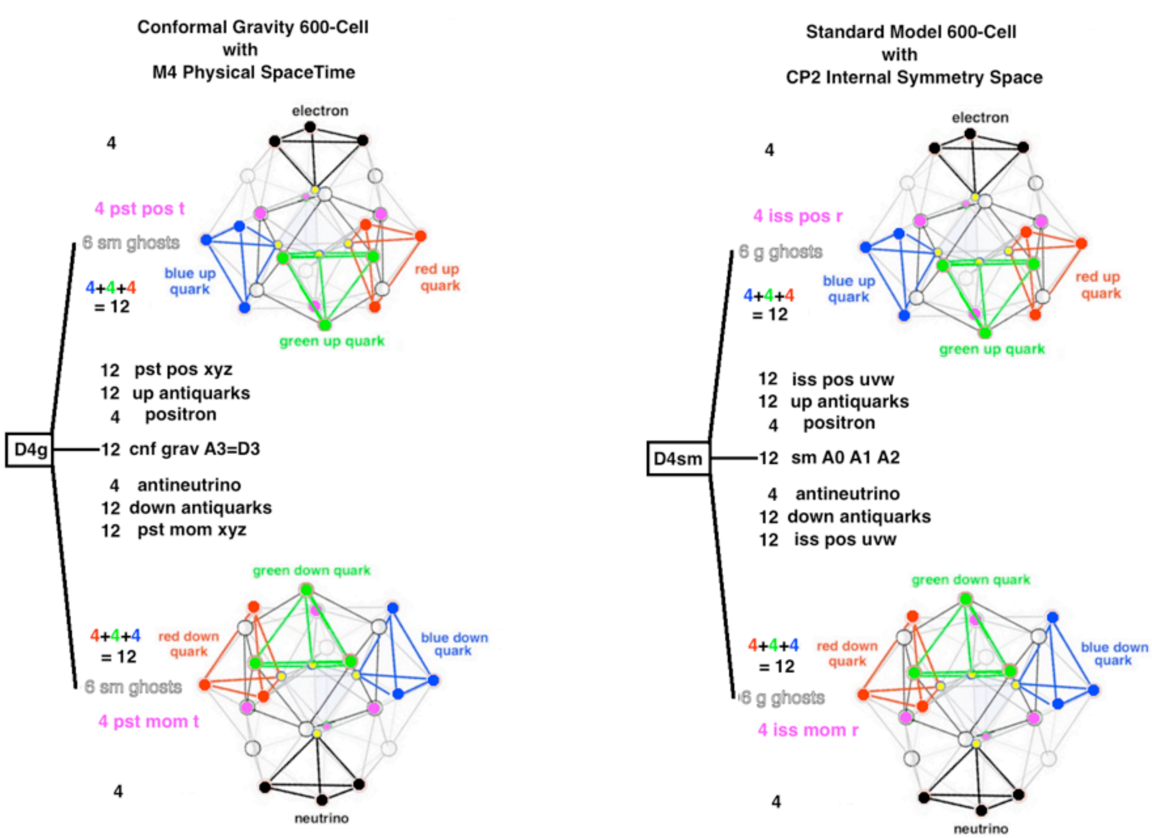
Visualization of Schwinger Sources
with Root Vectors and Weyl Chambers
(Explanation of this Visualization is given in Part II of this paper)

E8 Root Vectors represent Valence Fermions of the Schwinger Source Cloud.
E8 is two 600-cells, each with 120 vertices:
H4 M4 representing Conformal Gravity and the M4 part of M4 x CP2 Kaluza-Klein
where M4 = 4D Minkowski Physical Spacetime
and
H4 CP2 representing the Standard Model and the CP2 part of M4 x CP2
where CP2 = SU(3) / SU(2) x U(1) Internal Symmetry Space

The H4 M4 600-cell is larger than the H4 CP2 600-cell by the Golden Ratio

E8 240 Root Vectors =

= H4M4 120 **+** **H4CP2 120**



Each First-Generation Fermion is represented by a 4-vertex Tetrahedron
in the H4 M4 600-cell and in the H4 CP2 600-cell.

The Valence Fermion is represented as
the corresponding two Tetrahedra being activated.

Weyl Chambers are formed by
Reflection Hyperplanes perpendicular to Root Vectors

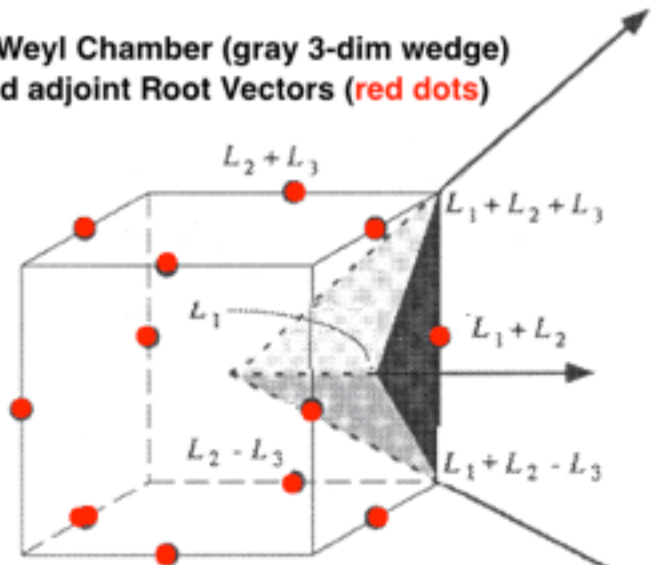
240 E8 Root Vector Hyperplances intersect to form
128 x 8! x 27 x 5 = 696,729,600 Weyl Chambers
that are 8-dim bounded by 7-dim faces

120 H4 Root Vector Hyperplances intersect to form
8 x 4! x 3 x 25 = 14,400 Weyl Chambers
that are 4-dim bounded by 3-dim faces

Use D3 as simple example
to understand Root Vectors and Weyl Chambers:

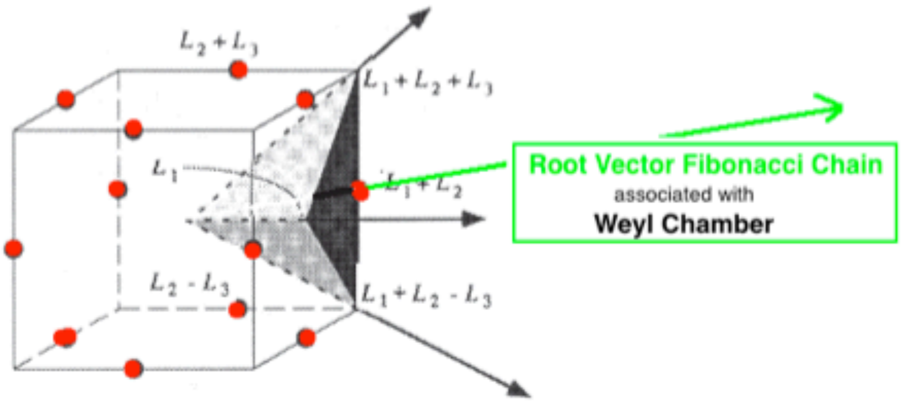
12 D3 Root Vector Hyperplances intersect to form
4 x 3! = 24 Weyl Chambers
that are 3-dim bounded by 2-dim faces

D3 Weyl Chamber (gray 3-dim wedge)
and adjoint Root Vectors (red dots)



D3 Lie Algebra comes from
Reflections of Root Vectors through
Hyperplanes of Surfaces of Weyl Chambers

At each Lattice Vertex
D3 has 12 Root Vectors and 24 Weyl Chambers
Each Root Vector is in 2 Weyl Chambers
Each Weyl Chamber includes a Root Vector
from which it inherits Fibonacci Chain Structure



If the Root Vector is a seed of a Schwinger Source
then the Schwinger Source fills the Weyl Chamber
up to 10^(-24) cm with virtual particles/antiparticles
in QuasiCrystal Structure of the Fibonacci Chain

For an E8 Lattice, at each Vertex is 240 Root Vectors
(240 half-lines from vertex, 120 full lines through vertex)
and 696,729,600 = 2^7 x 8! x 27 x 5 Weyl Chambers

For an H4 Lattice, at each Vertex is 120 Root Vectors
(120 half-lines from vertex, 60 full lines through vertex)
and 14,400 = 2^3 x 4! x 3 x 25 Weyl Chambers

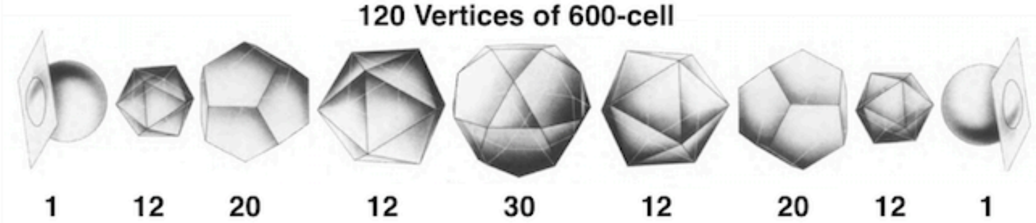
For H4 and E8 each Weyl Chamber does not include a Root Vector
but it does include Vectors closely related to Root Vectors
so that each Weyl Chamber does inherit Fibonacci Chain Structure

Our Universe has 8-dim Octonionic E8 Spacetime
only through the Inflation Era
After Inflation it has M4 x CP2 Kaluza-Klein Quaternionic Spacetime

Octonionic E8 breaks down into two copies of Quaternionic H4
one for Gravity and M4 Spacetime part of Kaluza-Klein
the other for Standard Model and CP2 part of Kaluza-Klein

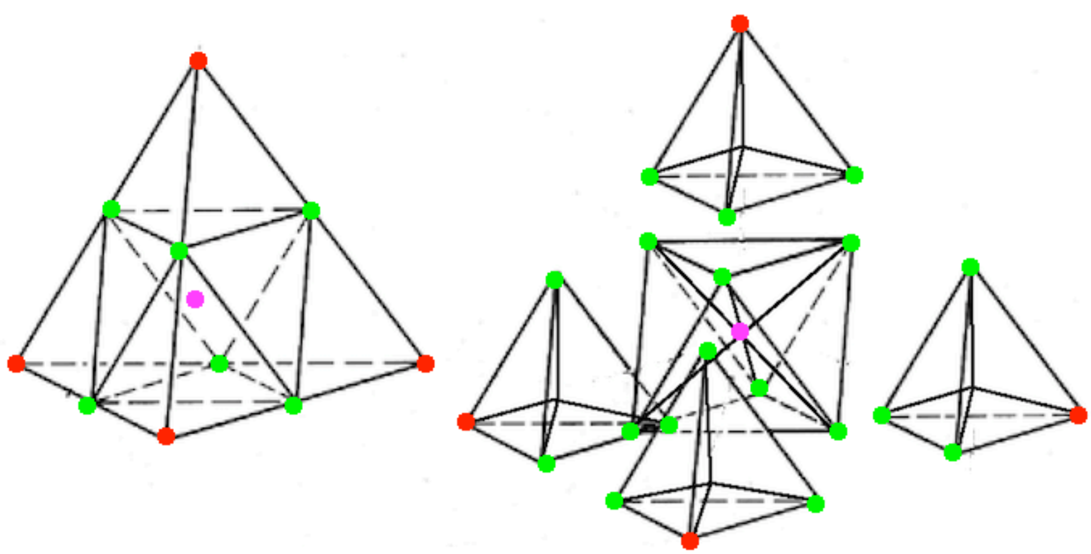
For the H4 of M4 Spacetime with 600-cell symmetry,
at each Vertex is 120 Root Vectors
(120-half-lines from Vertex, 60 full lines through Vertex)
and 14,400 = 2^3 x 4! x3 x 5^2 = 24 x 600 Weyl Chambers

120 Vertices of 600-cell



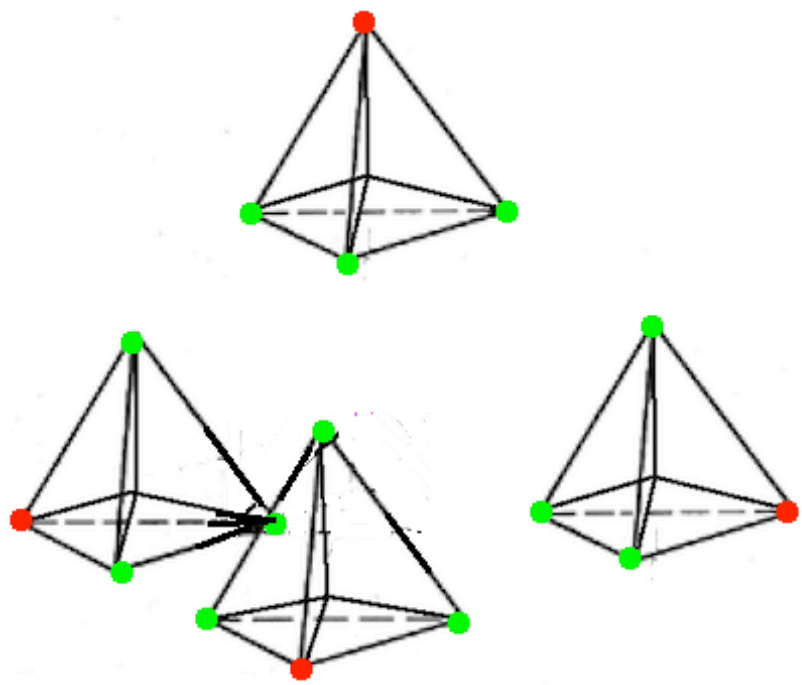
Each of the 600 Tetrahedra of the H4 600-cell
forms a cone Chamber over the center of the 600-cell
with 4 Fibonacci Chain edges from center to a Root Vector

Each of the 600 Tetrahedra can be decomposed into
4 Tetrahedra plus 1 Octahedron which in turn
can be decomposed into
4x4 Tetrahedra plus 1x8 Tetrahedra = 24 Tetrahedra

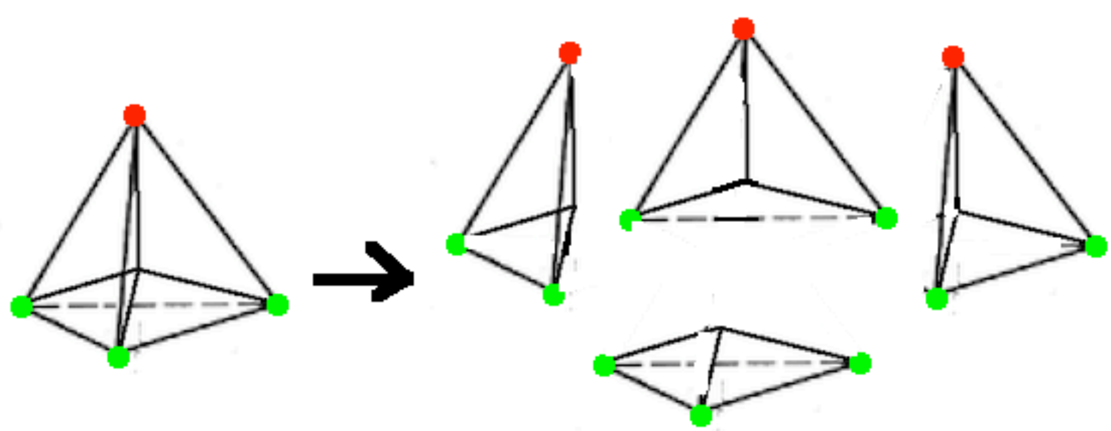


Red Dots = Root Vectors with Fibonacci Chains
Green Dots = MidPoints of Root Vector Pairs - inherited Fibonacci
Magenta Dot - Center of 600-cell Tetrahedron and of Octahedron

For each of the 600 Tetrahedra
each of the 4 decomposition Tetrahedra



decomposes into 4 Weyl Chamber Tetrahedra

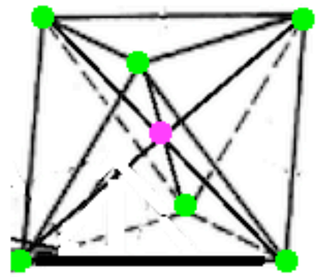


with 3 of the 4 containing 1 Root Vector Fibonacci Chain
for QuasiCrystal Schwinger Sources
and 2 MidPoints of Root Vector Pairs
therefore inheriting Fibonacci structure for QuasiCrystal Schwinger Sources

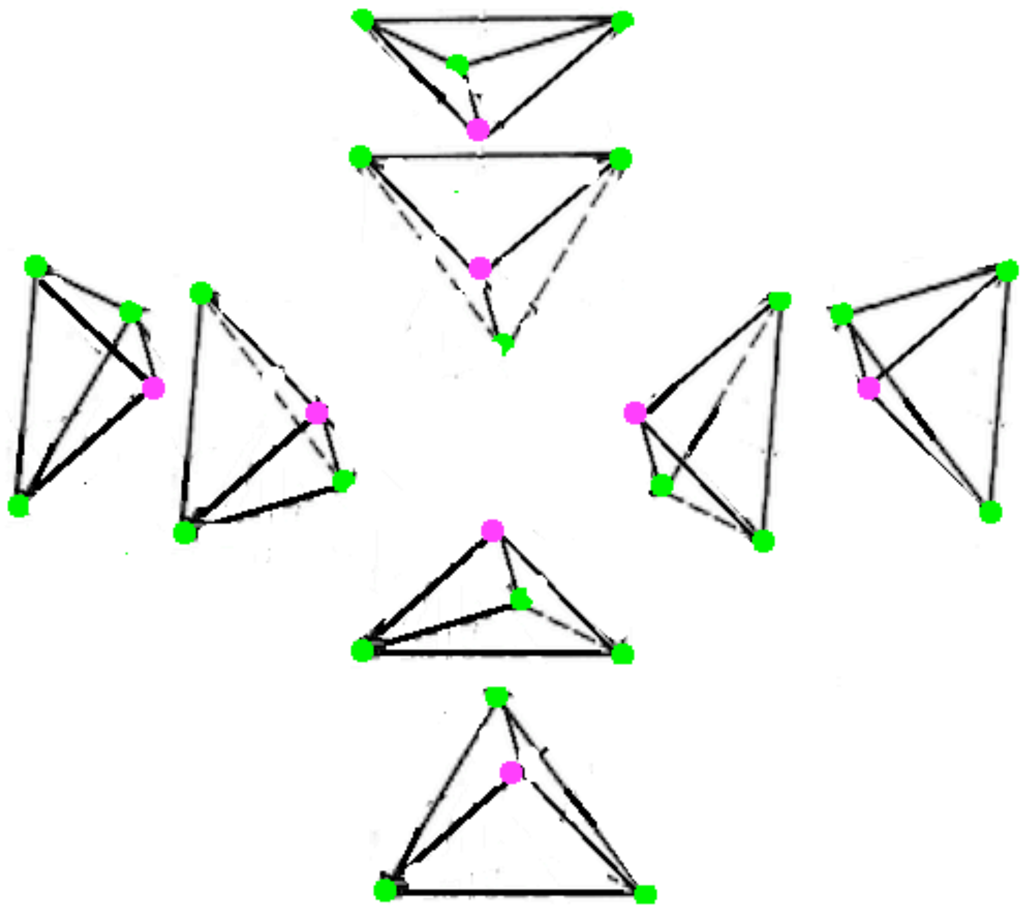
and 1of the 4 containing 3 MidPoints of Root Vector pairs
therefore inheriting Fibonacci structure for QuasiCrystal Schwinger Sources

and

the decomposition Octahedron

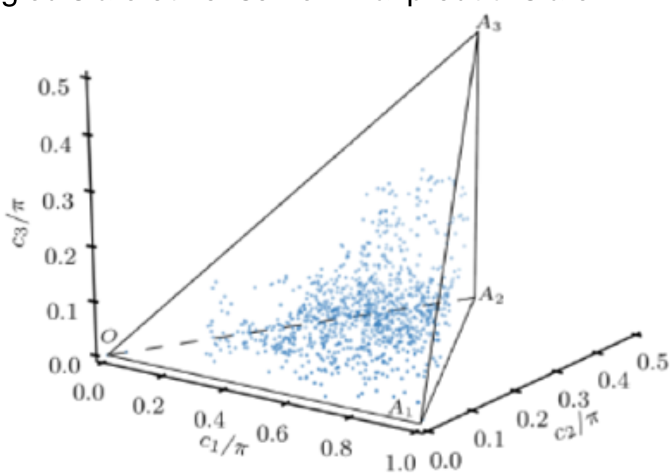


decomposes into 8 Weyl Chamber Tetrahedra
each of whch contains 3 MidPoints of Root Vector Pairs
and so inheriting Fibonacci structure for QuasiCrystal Schwinger Sources



Therefore H4 has 600 Tetrahedral Cells
each of which has 4x4 + 8 = 24 Weyl Chambers
for a total of 600x24 = 14,400 Weyl Chambers
with each Weyl Chamber having
Fibonacci structure for QuasiCrystal Schwinger Sources

Filling of the Weyl Chamber has been discussed for the D3 Lie Group in the context of Quantum Computing by Watts, Vala, Mueller, Calarco, Whaley, Reich, Goerz, and Koch in arXiv 1412.7347
where they say:
"... The **geometric theory of** ...[A3 Lie Group SU(4) = **D3 Lie Group** Spin(6)]... provides a very useful classification of two-qubit operations ...
Perfect entanglers (PEs) are non-local two-qubit operations that are capable of creating a maximally-entangled state out of some initial product state. ...



Sampling of reachable points in the Weyl chamber ... **for ... full set of 15 generators** in the [A3 = D3] Lie algebra ... **every point in the Weyl chamber can be reached** ...".

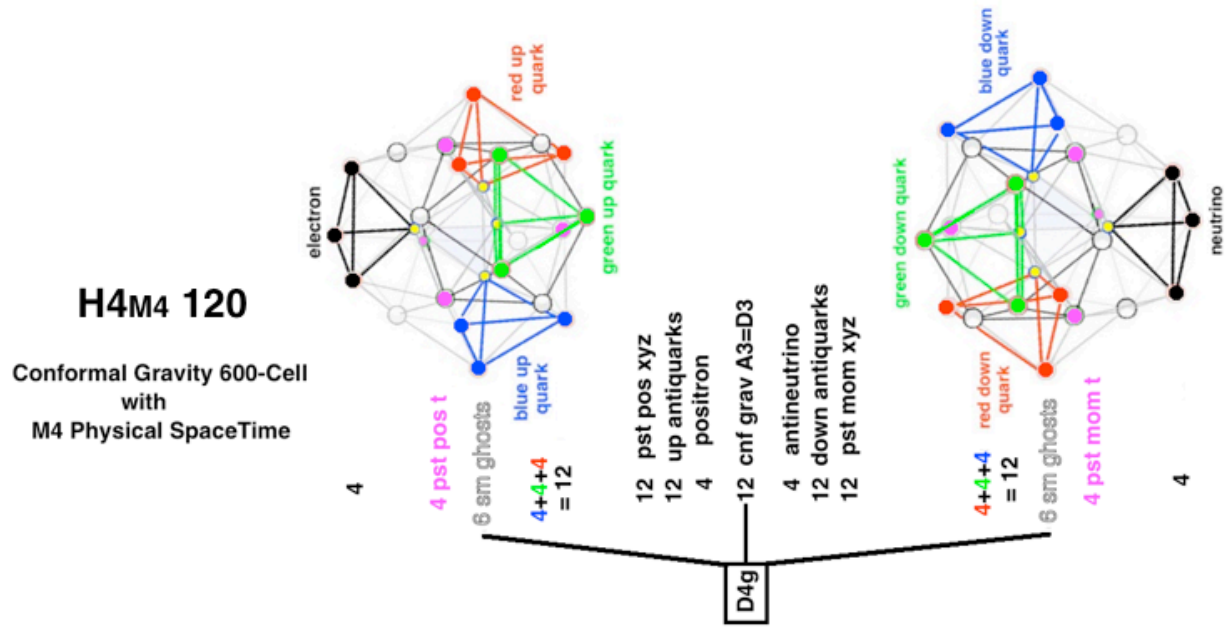
The Quantum Computing Point of View is useful in working with

the Schwinger Source BlockChain Indra's Net

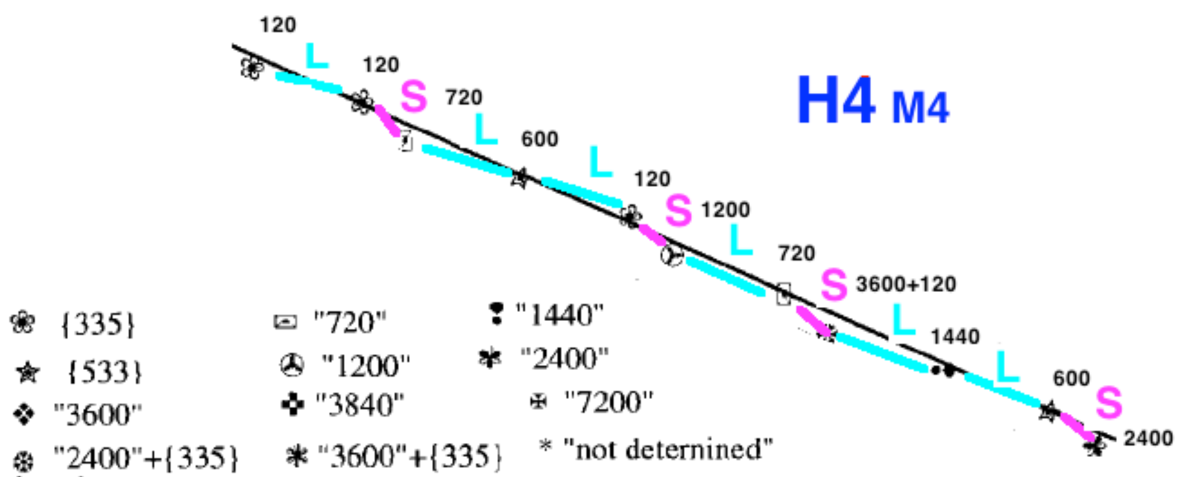
The Fibonacci Structure is useful in working with

Schwinger Source QuasiCrystal Structure
and with
the Finite Sized Schwinger Source Weyl Chamber Cloud
being the Empire of the Valence Fermion

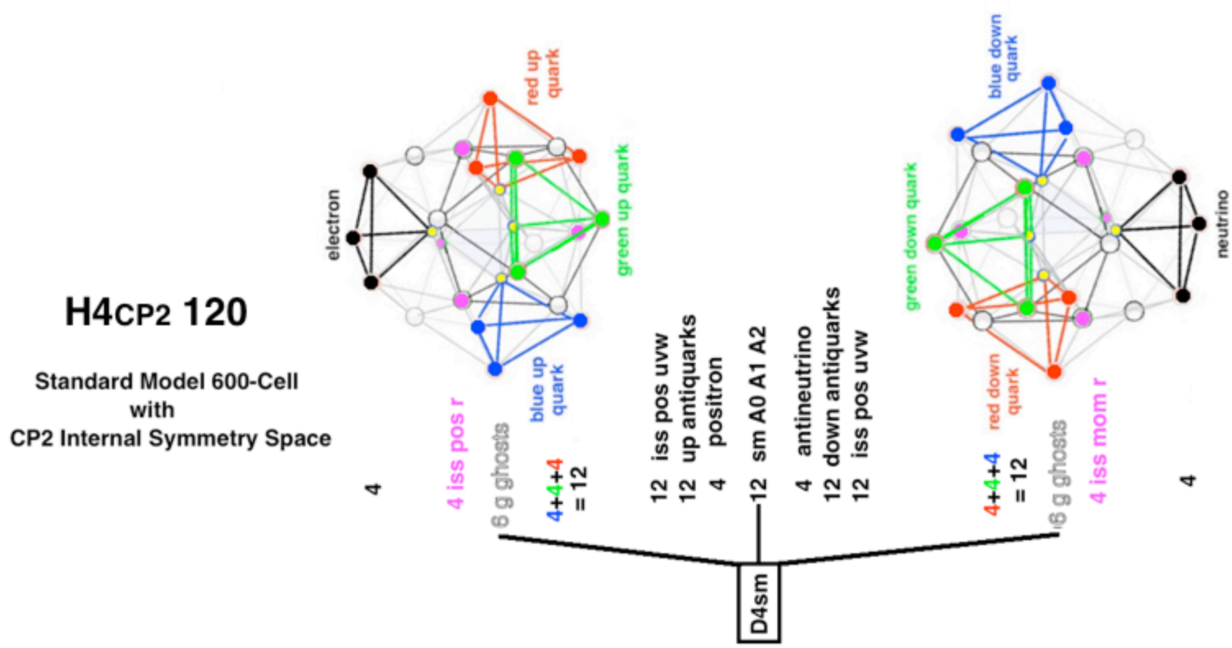
Now, look only at the H4 M4 600-cell to see how the Valence Fermion looks in M4 Minkowski Physical Spacetime:



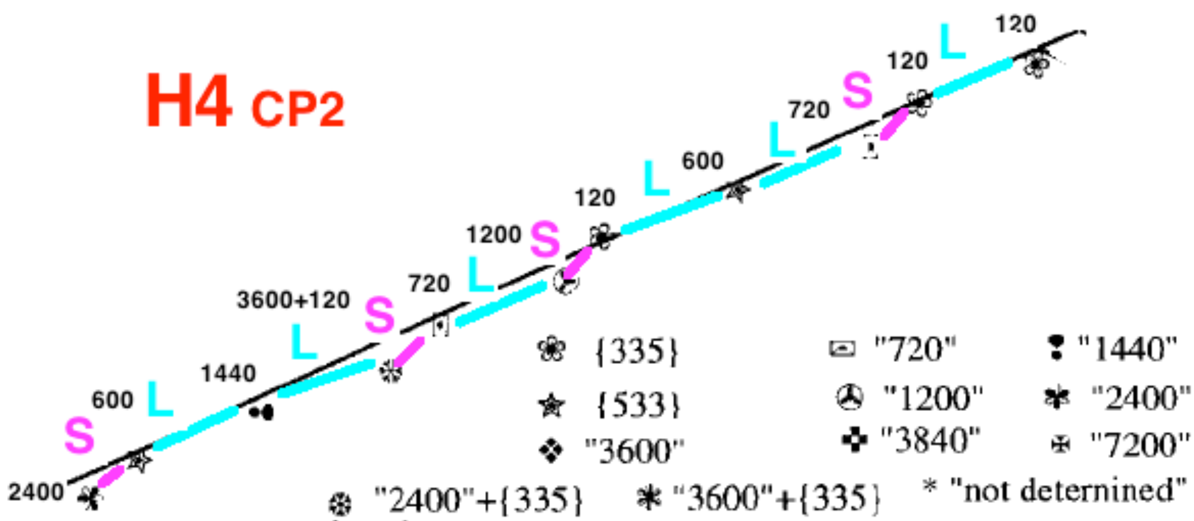
and look at the Fibonacci Shell Structure of the M4 part of the Schwinger Source Cloud



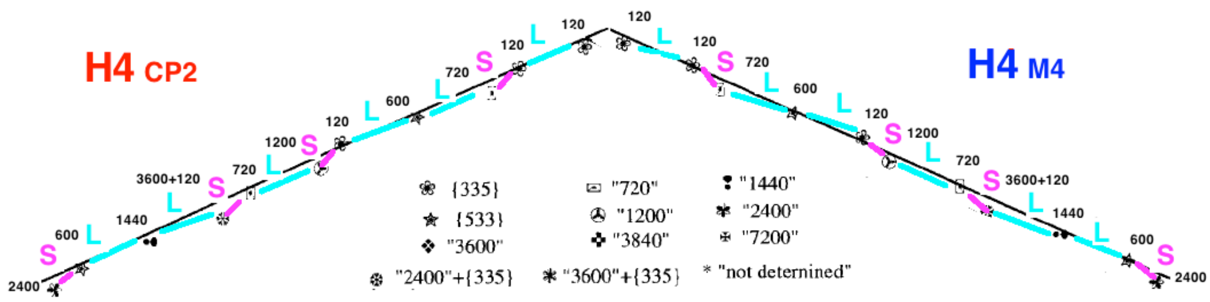
Then look only at the H4 CP2 600-cell to see how the Valence Fermion looks in CP2 Internal Symmetry Space:



and
look at the Fibonacci Shell Structure of the CP2 part of the Schwinger Source Cloud

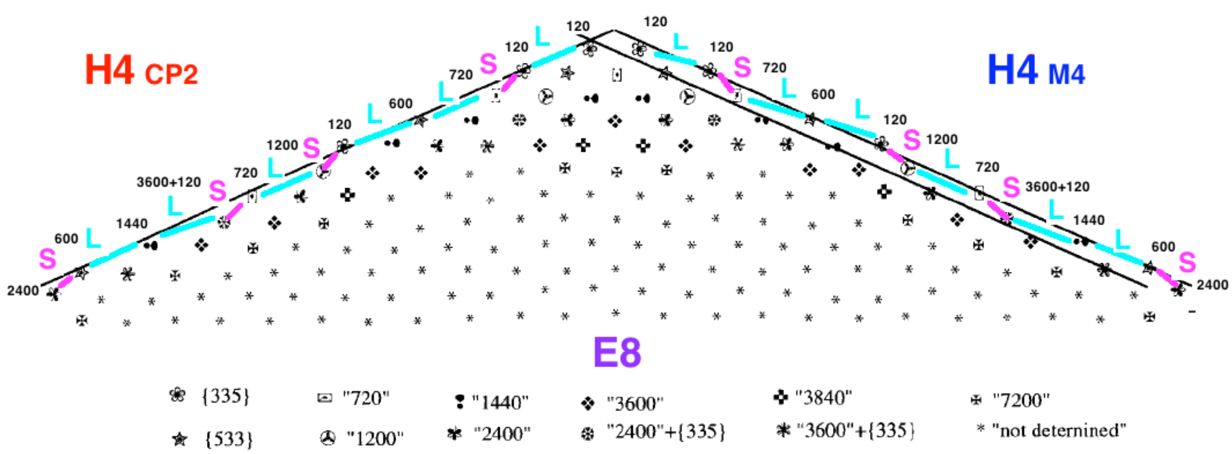


Then look at the combined Shell Structures of H4 M4 and H4 CP2:



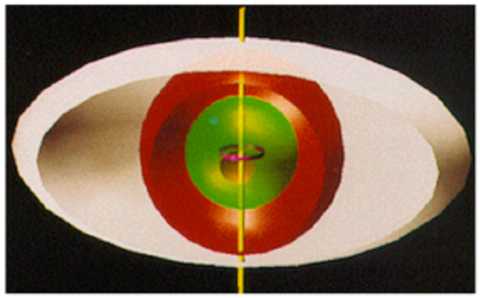
At this stage, you see the M4 and CP2 parts of the Schwinger Source Cloud
but
you have not yet seen the full E8 Schwinger Source Cloud.
For that, you need to go to the 7th Step:

Finally,
combine the H4 M4 and H4 CP2 parts to form the full E8 Schwinger Source:



How does the Schwinger Source look on larger scales ?

In the 4D M4 MInkowski Physical Spacetime part of M4 x CP2 Kaluza-Klein
it looks like a Gravitational Black Hole.



Ergosphere (white), Outer Event Horizon (red), Inner Event Horizon (green), and Ring Singularity (purple)
from Black Holes - A Traveller's Guide, by Clifford Pickover (Wiley 1996).

David Finkelstein invented the one-way membrane of the Black Hole.
David's Black Hole can be generalized to deal with Spin
and the. (-1 +1) Charge of the U(2) ElectroWeak Force

The generalization is called a Kerr-Newman Black Hole,

The Zeldovich-Hawking Process,
in which a Virtual Particle-AntiParticle Pair near the Event Horizon can be separated
with one of the Virtual Pair going into the Black Hole
and
the other going into External Spacetime,

can be applied to Quark-AntiQuark Virtual Pairs showing that

a Black Hole can carry Color Charge of the SU(3) Color Force.

What is the Geometrical Symmetry Structure
of each type of Schwinger Source?

Neutrino:

Volume in 4D Minkowski M4 is Complex Bounded Domain type IV4
with Symmetric Space Spin(6) / Spin(4)xU(1) Lie Ball
and Shilov Boundary RP1 x S3 Lie Sphere

Volume in 8D is Complex Bounded Domain type IV8
with Symmetric Space Spin(10) / Spin(8)xU(1) Lie Ball
and Shilov Boundary RP1 x S7 Lie Sphere

By Triality the 8D M4 Spacetime Shilov Boundary LIe Sphere
is isomorphic to the 8D CP2 Fermion Particle Symmetry Space
Lie Sphere RP1 x S7 Shilov Boundary
with basis {1,i,j,k,E,I,J,K} = {Nu,rDQ,gDQ,bDq,E,rUQ,gUQ,bUQ}
and
to the corresponding
8D CP2 Fermion AntiParticle Symmetry Space

Conformal Gravity has 15 generators.
1 is the Dilaton corresponding to the Higgs
4 are Special Conformal corresponding to Dark Energy
10 are anti-deSitter for Einstein-Hilbert Gravity
2 of the 10 are Cartan Subalgebra
8 of the 10 can carry Charges
6 of the 8 carry SU(3) Color Charge (R G B)
2 of the 8 can carry U(2) ElectroWeak Charge (-1 +1)
1 of the 2 carries Charge 0 of the Neutrino
which gives the Neutrino mass formula a Graviton factor of 0
so that the tree-level Neutrino mass is Zero.

The Neutrino is only related to the RP1 of S^7 x RP^1
because the Neutrino carries only no Charge
so
the Neutrino should have at tree level
a spinor manifold volume factor V(Qneutrino) of unit volume of Zero.

Electron:

Volume in 4D Minkowski M4 is Complex Bounded Domain type IV4
with Symmetric Space Spin(6) / Spin(4)xU(1) Lie Ball
and Shilov Boundary RP1 x S3 Lie Sphere

Volume in 8D is Complex Bounded Domain type IV8
with Symmetric Space Spin(10) / Spin(8)xU(1) Lie Ball
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2 of the 10 are Cartan Subalgebra
8 of the 10 can carry Charges
6 of the 8 carry SU(3) Color Charge (R G B)
2 of the 8 can carry U(2) ElectroWeak Charge (-1 +1)
1 of the 2 carries Charge +1 of the Electron
which gives the Electron mass formula a Graviton factor of 1.

The Electron is only related to the equatorial S1 = U(1) of the S7 of S^7 x RP^1
because the Electron carries only U(1) ElectroWeak Charge
so
the Electron should have
a spinor manifold volume factor V(Qelectron) of unit volume of S1 = U(1).

Down Quark (either Red, Green, or Blue):

Volume in 4D Minkowski M4 is Complex Bounded Domain type IV4
with Symmetric Space Spin(6) / Spin(4)xU(1) Lie Ball
and Shilov Boundary RP1 x S3 Lie Sphere

Volume in 8D is Complex Bounded Domain type IV8
with Symmetric Space Spin(10) / Spin(8)xU(1) Lie Ball
and Shilov Boundary RP1 x S7 Lie Sphere

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10 are anti-deSitter for Einstein-Hilbert Gravity
2 of the 10 are Cartan Subalgebra
8 of the 10 can carry Charges
6 of the 8 carry SU(3) Color Charge (R G B)
which gives the Down Quark mass formula a Graviton factor of 6.

The Down Quarks correspond to Octonions i, j, k
which, by gluon interactions, can be taken into each other.
By also using weak boson interactions,
they can also be taken into I, J, and K, the red, blue, and green Up Quarks.
Given the Up and Down quarks, Pions can be formed from quark-antiquark pairs,
and the Pions can decay to produce electrons and neutrinos.
Therefore the Down Quarks are related to all parts of S^7 x RP^1,
the compact manifold corresponding to { 1, i, j, k, E, I, J, K }
and therefore a Down Quark should have
a spinor manifold volume factor V(Qdown quark) of the volume of S^7 x RP^1.
The ratio of the Down Quark spinor manifold volume factor
to the Electron spinor manifold volume factor is
V(Qdown quark) / V(Qelectron) = V(S^7x RP^1)/1 = pi^5 / 3.
Since the first generation graviton factor is 6 for Down Quarks and 1 for Electron
md / me = 6 V(S^7 x RP^1) = 2 pi^5 = 612.03937

Up Quark (either Red, Green, or Blue):

Volume in 4D Minkowski M4 is Complex Bounded Domain type IV4
with Symmetric Space Spin(6) / Spin(4)xU(1) Lie Ball
and Shilov Boundary RP1 x S3 Lie Sphere

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with Symmetric Space Spin(10) / Spin(8)xU(1) Lie Ball
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Lie Sphere RP1 x S7 Shilov Boundary
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1 is the Dilaton corresponding to the Higgs
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2 of the 10 are Cartan Subalgebra
8 of the 10 can carry Charges
6 of the 8 carry SU(3) Color Charge (R G B)
which gives the Up Quark mass formula a Graviton factor of 6.

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

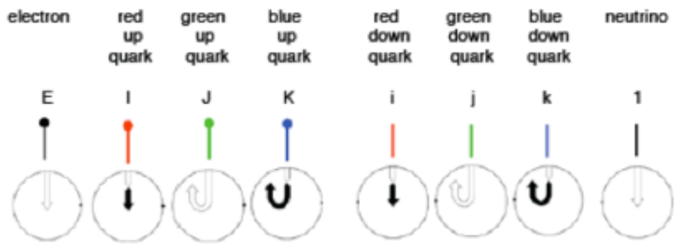
Antiparticles have the same mass as the corresponding particles.

Since the model only gives ratios of masses,
the mass scale is fixed so that the electron mass me = 0.5110 MeV.
Then, the constituent mass of the down quark is md = 312.75 MeV,
and the constituent mass for the up quark is mu = 312.75 MeV.
These results when added up give a total mass of first generation fermion particles:
Sigmaf1 = 1.877 GeV

The proton mass is taken to be
the sum of the constituent masses of its constituent quarks
so
mproton = mu + mu + md = 938.25 MeV
which is close to the experimental value of 938.27 MeV.

Second and Third Generation Fermions:

First Generation Fermions are represented by Octonions
with 8 basis elements { 1, i, j, k, E, I, J, K }



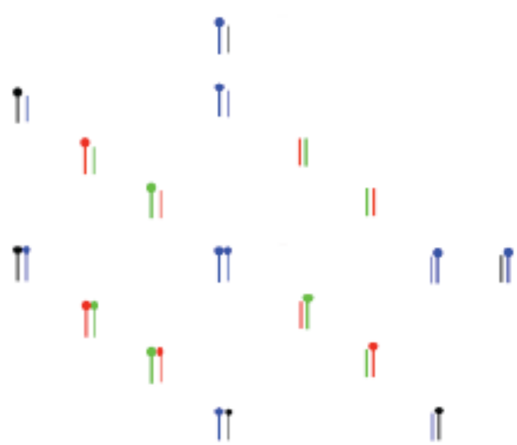
1 = 1 = Neutrino
1 = E = electron
3 = i, j, k = Down Quarks (r,g,b = 3)
3 = I, J, K = Up Quarks (r,g,b = 3)

Second Generation Fermions are represented by Pairs of Octonions
with 8x8 = 64 basis elements

1 = {11}= Mu Neutrino
3 = 2+1 = {1E,E1,EE} = Muon
9 = 3x3 = {1r,r1,rr or 1g,g1,gg or 1b,b1,bb} = Strange Quarks (r,g,b = 3)
51 = 17x3 = Charm Quarks (r,g,b = 3)

Example: Blue Charm Quark

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).

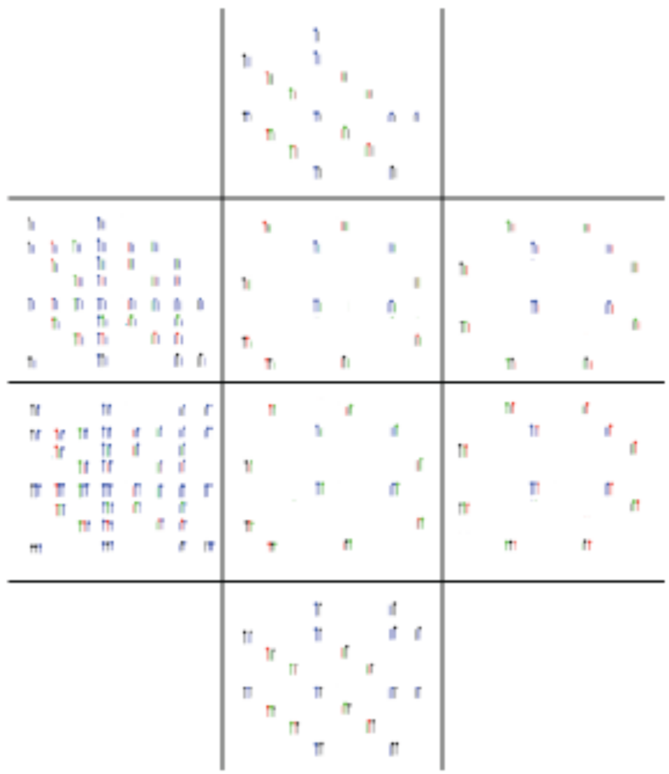


Third Generation Fermions are represented by Triples of Octonions
with 8x8x8 = 512 basis elements

1 = {111} = Tau Neutrino
7 = 3+3+1 = { 11E,1E1,E11,EE1,E1E,1EE,EEE} = Tauon
21 = 7x3 = Beauty Quarks (r,g,b = 3)
483 = 161x3 = 23x7x3 = Truth Quarks (r,g,b = 3)

Example: Blue Truth Quark

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.



Photon

The Standard Model U(1) Electromagnetic Force bosons (photons) live in
a U(1) subalgebra of the U(2) local group of CP2 = SU(3) / U(2)
They "see" M4 Physical spacetime as four 1-sphere circles S1xS1xS1xS1 = T4
(T4 = 4-torus) each of whose dimension is 1 and has volume 2 pi

Their part of the Physical Lagrangian is

$$\int_{T4} \text{(U(1) Electromagnetism Gauge Boson Term}$$

an integral over SpaceTime T4.

Schwinger Source for U(1) photons that carry no charge,
so the Complex Bounded Domains and Shilov Boundaries can be set equal to 1
and the Electromagnetic Force Strength is given by
the SpaceTime T4 volume.

One fourth of the Electromagnetic Force Strength is give by 2 pi.

The total Electromagnetic Force Strength
relative to the geometric strength of Einstein-Hilbert Gravity is 1/137.03608

The force strength is given at the characteristic energy level
of the generalized Bohr radius which for U(1) Electromagnetism is about 4KeV.

Weak Boson

The Standard Model SU(2) Weak Force bosons live in
a SU(2) subalgebra of the U(2) local group of CP2 = SU(3) / U(2)
They "see" M4 Physical spacetime as two 2-spheres S2 x S2
each of whose dimension is 2 and each of whose volume is 4 pi

Their part of the Physical Lagrangian is

$$\int_{S2xS2} \text{SU(2) Weak Force Gauge Boson Term}$$

an integral over SpaceTime S2 x S2.

Schwinger Source for SU(2) Weak Force bosons is
the Complex Bounded Domain is two copies of IV3 Lie Ball
each with Symmetric Space Lie Sphere Spin(5) / Spin(3)xU(1)
and volume pi^3 / 24
and Shilov Boundary RP1 x S2 with volume 4 pi^2

Due to the action of the Higgs mechanism,
for the Weak Force, the effective force strength that we see in our experiments
is suppressed by the Weak Boson masses squared (1 / (MW+^2 + MW-^2 + MWo^2).
The unsuppressed Weak Force strength is the Geometric Part of the force strength.

One half of the Geometric Weak Force Strength is given by
(4 pi) (4 pi^2) / (pi^3 / 24)^(1 / 2))

(pi^3 / 24)^(1 / 2)) = (Vol(IV3))^(1 / 2)) is a dimensional normalization factor
to reconcile the dimensionality of the Internal Symmetry Space Bounded Domain
with the dimensionality of Spacetime Lagrangian Base Manifold.

The geometric force strength,
relative to the geometric strength of Einstein-Hilbert Gravity,
of the Weak Force is 0.2535

The total force strength of the SU(2) Weak Force,
including the suppression factor of the Weak Boson masses squared, is given by

Gw x Mproton^2 = about 1.05 x 10^(-5)

Note that MWo is the mass of the SU(2) Wo Weak boson that combines with the U(1) boson
by the Higgs mechanism to form the Zo Weak boson and the Photon.
MWo is about 98 GeV, MW+ = MW- is about 80 GeV, MZo is about 92 GeV, and the Photon is massless.

Gluon

The Standard Model SU(3) Color Force bosons (gluons) live in
a SU(3) subalgebra of the SU(4) subalgebra of D4 = Spin(8).
They "see" M4 Physical spacetime as the complex projective plane CP2
whose dimension is 4 and whose volume is 8 pi^2 / 3

Their part of the Physical Lagrangian is

$$\int_{CP2} \text{SU(3) Color Force Gauge Boson Term}$$

an integral over SpaceTime CP2.

Schwinger Source for SU(3) Color Force bosons (gluons) is
the Complex Bounded Domain B6 (ball) with Symmetric Space SU(4) / SU(3)xU(1)
and volume pi^3 / 6
and Shilov Boundary S5 with volume 4 pi^3

The Color Force Strength is given by
(Vol(CP2)) (Vol(S5) / Vol(B6)^(1 / 4))

Vol(B6)^(1 / 4) is a dimensional normalization factor
to reconcile the dimensionality of the Internal Symmetry Space Bounded Domain
with the dimensionality of Spacetime Lagrangian Base Manifold.

The force strength, relative to the geometric strength of Einstein-Hilbert Gravity,
of the SU(3) Color Force is 0.6286
at the characteristic energy level of the Color Force (about 245 MeV).

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

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

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

Note (thanks to Carlos Castro for noticing these) that the volume listed for S5 is for a squashed S5, a Shilov boundary of the complex domain corresponding to the symmetric space SU(4) / SU(3) x U(1) and also that the volume listed for CP2 is unconventional, but physically justified by noting that S4 and CP2 can be seen as having the same physical volume, with the only difference being structure at infinity.

Conformal Graviton

The Gravity Gauge Bosons (Schwinger-Euclidean versions) live in
a Spin(5) subalgebra of the Spin(6) Conformal subalgebra of D4 = Spin(8).
They "see" M4 Physical spacetime as the 4-sphere S4
whose dimension is 4 and whose volume is 8 pi^2 / 3

Their part of the Physical Lagrangian is

$$\int_{S4} \text{Gravity Gauge Boson Term} \; .$$

an integral over SpaceTime S4.

Schwinger Source for Spin(5) MacDowell-Mansouri Gravity bosons is
the Complex Bounded Domain IV5 Lie Ball
with Symmetric Space Lie Sphere Spin(7) / Spin(5)xU(1)
and volume pi^5 / 2^4 5!
and Shilov Boundary RP1 x S4 with volume 8 pi^3 / 3

Due to Stabilization of Condensate SpaceTime
by virtual Planck Mass Gravitational Black Holes,
the effective force strength of Gravity that we see in our experiments
is suppressed by the square of the Planck Mass (1 / Mplanck^2).
The unsuppressed Gravity force strength is the Geometric Part of the force strength.

The Geometric Einstein-Hilbert Gravity Strength is given by
(Vol(S4)) (Vol(IV5) / Vol(RP1xS4)^(1 / 4))

Vol(RP1xS4)^(1 / 4) is a dimensional normalization factor
to reconcile the dimensionality of the Internal Symmetry Space Bounded Domain
with the dimensionality of Spacetime Lagrangian Base Manifold.

The geometric force strength,
relative to the geometric strength of Einstein-Hilbert Gravity,
of Spin(5) MacDowell-Mansouri Gravity is obviously 1.

The total force strength Ggrav of Spin(5) MacDowell-Mansouri Gravity,
including the Planck Mass squared suppression factor, is given by

Ggrav x Mproton^2 = about 5 x 10^(-39)

Higgs

Higgs = Fermion Particle-AntiParticle Condensate,
especially Truth Quark - Truth AntiQuark

Quantum Bohmion

Quantum Bohmion = spin-2 traceless of 26D World-Line-String Theory

Quantum Kernel Functions and Schwinger Source Green's Functions

Fock "Fundamental of Quantum Mechanics" (1931) showed that it requires
Linear Operators "... represented by a definite integral [of a]... kernel ... function ...".

Hua "Harmonic Analysis of Functions of Several Complex Variables in the Classical Domains" (1958) showed Kernel Functions for Complex Classical Domains.

Schwinger (1951 - see Schweber, PNAS 102, 7783-7788) "... introduced a description in terms of Green's functions, what Feynman had called propagators ... The Green's functions are vacuum expectation values of time-ordered Heisenberg operators, and the field theory can be defined non-perturbatively in terms of these functions ...[which]... gave deep structural insights into QFTs; in particular ... the structure of the Green's functions when their variables are analytically continued to complex values ...".

Wolf (J. Math. Mech 14 (1965) 1033-1047) showed that the Classical Domains
(complete simply connected Riemannian symmetric spaces)
representing 4-dim Spacetime with Quaternionic Structure are:

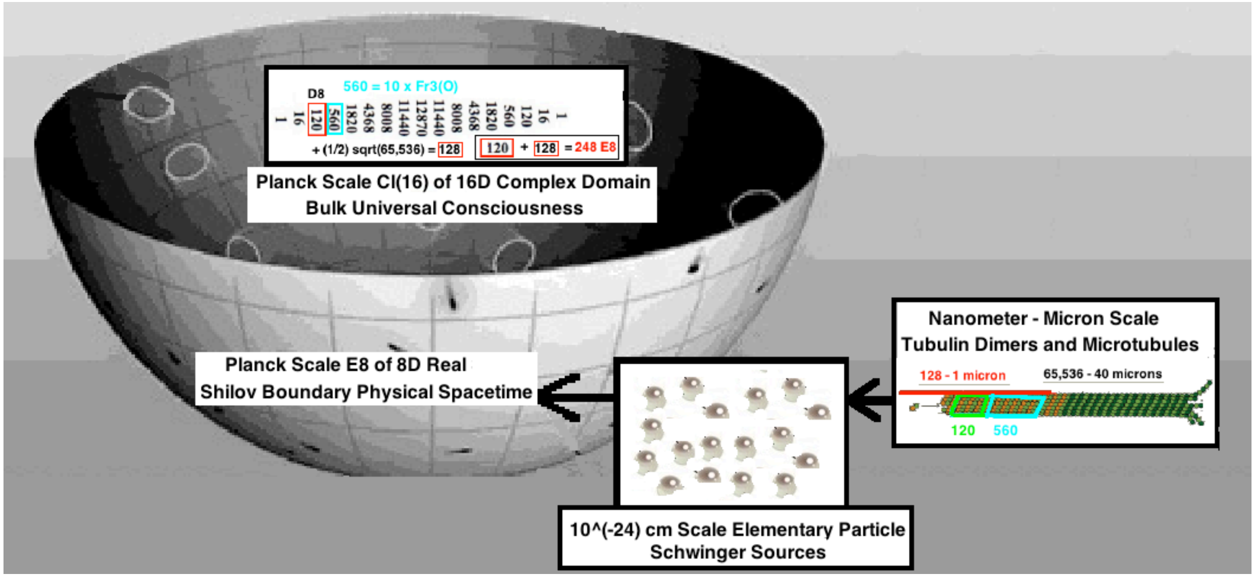
S1 x S1 x S1 x S1 = 4 copies of U(1)
S2 x S2 = 2 copies of SU(2)
CP2 = SU(3) / SU(2)xU(1)
S4 = Spin(5) / Spin(4) = Euclidean version of Spin(2,3) / Spin(1,3)

Armand Wyler (1971 - C. R. Acad. Sc. Paris, t. 271, 186-188) showed how to use **Green's Functions = Kernel Functions** of Classical Domain structures characterizing **Sources = Leptons, Quarks, and Gauge Bosons,
to calculate Particle Masses and Force Strengths**

Schwinger (1969 - see physics/0610054) said: "... operator field theory ... replace[s] the particle with ... properties ... distributed througout ... small volumes of three-dimensional space ... particles ... must be created ... even though we vary a number of experimental parameters ... The properties of the particle ... remain the same ... We introduce a quantitative description of the particle source in terms of a source function ...
we do not have to claim that we can make the source arbitrarily small ...
the experimeter... must detect the particles ...[by]... collision that annihilates the particle ... the source ... can be ... an abstraction of an annilhilation collision, with the source acting negatively, as a sink ... The basic things are ... the source functions ... describing the intermediate propagation of the particle ...".

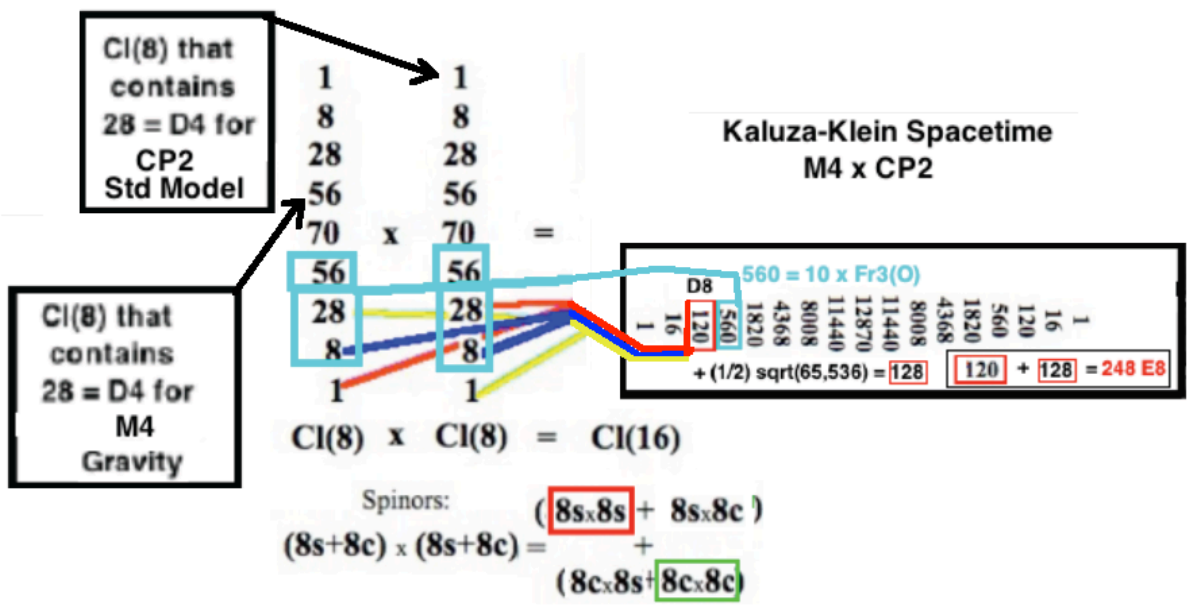
Creation and Annihilation operators indicate a Clifford Algebra, and 8-Periodicity shows that the basic Clifford Algebra is formed by tensor products of 256-dim Cl(8) such as Cl(8) x Cl(8) = Cl(16) containing 248-dim E8 = 120-dim D8 + 128-dim D8 half-spinor whose maximal contraction is a realistic generalized Heisenberg Algebra

h92 x A7 = 5-graded 28 + 64 + ((SL(8,R)+1) + 64 + 28



In E8-Cl(16) Physics **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 and has 56 TriVectors for the Fr3(O) Freudenthal Algebra of World-Line String Theory.

Cl(16) has 120 BiVectors, and 128 Half-Spinors with 120+128 = 248 = E8 Lie Algebra, and has 560 TriVectors for 10 copies of Fr3(O).

The 248 E8 elements of Cl(16) define a Lagrangian
for the Standard Model and for Gravity - Dark Energy
so that 65,536 - 248 - 560 = 64,728 elements of Cl(16) can carry Bits of Information.

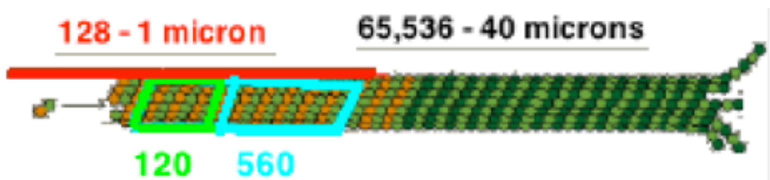
The Complex Bulk Space Cl(16) contains the Maximal Contraction of E8
which is H92 + A7
a generalized Heisenberg Algebra of Quantum Creation-Annihilation Operators with graded structure

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

We live in the Physical Minkowski M4 part of Kaluza-Klein M4 x CP2 structure
of RP1 x S7 **Boundary**.

(where CP2 = SU(3) / SU(2)xU(1) is Internal Symmetry Space
of Standard Model gauge groups)

Our Consciousness is based on Binary States of Tubulin Dimers (each 4x4x8 nm size) in Microtubules.



MIcrotubules are cylinders of sets of 13 Dimers with maximal length about 40,000 nm so that
each Microtubule can contain about 13 x 40,000 / 8 = 65,000 Bits of Information.
The Physical Boundary in which we live is a Real Shilov Boundary in which E8 is manifested
as Lagrangian Structure of Real Forms of E8 with Lagrangian Symmetric Space structure:

E8 / D8 = (OxO)P2 for 8 First-Generation Fermion Particles and
8 First-Generation Fermion AntiParticles (8 components of each)
D8 / D4 x D4 for 8-dim spacetime paths, one for each of 8 Fermion Types
D4 for Standard Model Gauge Bosons and Gravity - Dark Energy Ghosts
D4 for Gravity - Dark Energy Gauge Bosons, Propagator Phase,
and Standard Model Ghosts

Microtubule Information in the Physical Shilov Boundary has Resonant Connection to Cl(16) Information in Bulk Complex Domain Spacenby the spin-2 Bohm Quantum Potential with Sarfatti Back-Reaction of 26D String Theory of World-Lines consistent with Poisson Kernel as derivative of Green's function.

The Bulk Space Complex Domain Type IV8 corresponds to
the Symmetric Space Spin(10) / Spin(8)xU(1)
and is a Lie Ball whose Shilov Boundary RP1 x S7 is a Lie Sphere 8-dim Spacetime.
It is related to the Stiefel Manifold V(10,2) = Spin(10) / Spin(8) of dimension 20-3 = 17 by the fibration

Spin(10) / Spin(8)xU(1) -> V(10,2) -> U(1)

It can also be seen as a tube z = x + iy whose imaginary part is physically inverse momentum so that its points give both position and momentum
(see R. **Coquereaux** Nuc. Phys. B. 18B (1990) 48-52) "Lie Balls and Relativistic Quantum Fields").

In “Harmonic Analysis of Functions of Several Complex Variables in the Classical Domains” L. K. H**ua** said: “... Editor’s Foreword ... M. I. Graev ...

Poisson kernel can be defined in group-theoretic terms. Let $\mathfrak{R}$ be one of the domains considered in the book, and $\mathfrak{C}$ its characteristic manifold. Let z be a point in $\mathfrak{R}$ and C_z the group of those analytic automorphisms of $\mathfrak{R}$ which leave z invariant. It can be shown that the group C_z is transitive on $\mathfrak{C}$, i.e., transforms any point of $\mathfrak{C}$ into any other point. The measure on $\mathfrak{C}$ which is invariant under the transformations in C_z is then simply equal to the Poisson kernel.

...[Characteristic Manifold = Shilov Boundary]...

In 1935, E. Cartan [1] proved that there exist only six types of irreducible homogeneous bounded symmetric domains. Beside the four types, RI, RII, RIII, RIV there exist only two; their dimensions are 16 and 27.
[16-Complex-Dimensional E6 / Spin(10)xU(1) = (CxO)P2
27-Complex-Dimensional E7 / E6xU(1) = J(3,(CxO))]

The domain $\mathfrak{R}_{\mathrm{IV}}$ of n-dimensional $(n>2)$ vectors

$$z=(z_1, z_2, \cdots, z_n)$$

(z_k are complex numbers) satisfying the conditions

$$|zz'|^2+1-2\bar{z}z'>0, \qquad |zz'|<1.$$

The complex dimension of the four domains is mn, $n(n+1)/2$, $n(n-1)/2$, n.

The author has shown (cf. L. K. Hua [3]) that $\mathfrak{R}_{\mathrm{IV}}$ can also be regarded as a homogeneous space of $2\times n$ real matrices. Therefore, the study of all these domains can be reduced to a study of the geometry of matrices.

The manifolds $\mathfrak{C}_{\mathrm{I}}$, $\mathfrak{C}_{\mathrm{II}}$, $\mathfrak{C}_{\mathrm{III}}$ and $\mathfrak{C}_{\mathrm{IV}}$ have real dimension $m(2n-m)$, $n(n+1)/2$, $n(n-1)/2+(1+(-1)^n)(n-1)/2$ and n, respectively.

The characteristic manifold of the domain $\mathfrak{R}_{\mathrm{IV}}$ consists of vectors of the form $e^{i\theta}x$, where $0\leqq\theta\leqq\pi$, and $x=(x_1, \cdots, x_n)$ is a real vector which satisfies the condition $xx'=1$.

$$H(z,\ \theta,\ x)=\frac{1}{V(\mathfrak{C}_{\mathrm{IV}})\,[(x-e^{-i\theta}z)\,(x-e^{-i\theta}z)']^{n/2}},$$

the magnitude of the volume $V(\mathfrak{C}_{\mathrm{IV}})$: $\quad V(\mathfrak{C}_{\mathrm{IV}})=\dfrac{2\pi^{\frac{n}{2}+1}}{\Gamma\left(\frac{n}{2}\right)}$.

The Bergman kernel of the domain $\mathfrak{R}_{\mathrm{IV}}$ *is*

$$\frac{1}{V(\mathfrak{R}_{\mathrm{IV}})}(1+|zz'|^2-2\bar{z}\bar{z}')^{-n},$$

$$\textit{where,} \quad V(\mathfrak{R}_{\mathrm{IV}})=\frac{\pi^n}{2^{n-1}\cdot n!}.$$

THE POISSON KERNEL For $\mathfrak{R}_{\mathrm{IV}}$

$$P(z,\xi)=\frac{1}{V(\mathfrak{C}_{\mathrm{IV}})}\cdot\frac{(1+|zz'|^2-2\bar{z}z')^{\frac{n}{2}}}{|(z-\xi)(z-\xi)'|^n},$$

where $\xi\in\mathfrak{C}_{\mathrm{IV}}$.

HARMONIC ANALYSIS ON LIE SPHERES

$$\int_{\mathfrak{R}_{\mathrm{IV}}}|zz'|^{2l}\,\Phi_{f-2l}(z,\bar{z})\,\dot{z}$$

$$=(N_{f-2l}-N_{f-2l-2})\frac{l!\,\Gamma(n)\,\Gamma\left(\frac{n}{2}+1\right)\Gamma\left(f+\frac{n}{2}-l\right)}{2\pi^{\frac{n}{2}}\,\Gamma\left(l+\frac{n}{2}+1\right)\Gamma(f+n-l)}\,V(\mathfrak{R}_{\mathrm{IV}}).$$

...".

In Annals of Mathematics 55 (1952) 19-33 P. R. **Garabedian** said "...

we turn here to a more direct development of the theory of boundary value problems associated with the Cauchy-Riemann equations for analytic functions of several complex variables. This boundary value problem is solved by means of a Dirichlet principle, and we introduce a Green's function in terms of which the solution can be expressed as a boundary integral. A formula giving the Bergman kernel function for several variables [1] in terms of this Green's function is obtained, and we thus generalize known theorems from the theory of functions of one complex variable

for analytic functions of several complex variables.

Bergman [1] defines a kernel function $k(z, t)$, analytic in z and $\bar{t}$ for $z, t \in D$

THEOREM 3. *The analytic kernel function* $k(z, t)$ *with*

$$g(t) = \int_D g(z)\, \overline{k(z, t)}\, d\tau$$

for each analytic function g *in* D *has the representation*

$k(z, t) = \Delta_z \theta(z, t)$ *in terms of the Green's function* $\theta(z, t)$.

...".

E8 Physics constructs the **Lagrangian** integral such that the **mass m emerges as the integral over the Schwinger Source spacetime region** of its Kerr-Newman cloud of virtual particle/antiparticle pairs plus the Valence Fermion so that the volume of the Schwinger Source fermion defines its mass, which, being dressed with the particle/antiparticle pair cloud, gives **quark mass as constituent mass**.

Armand Wyler used Harmonic Geometry to calculate:

Fermion masses as a product of four factors:

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

V(Qfermion) is the volume of the part of the half-spinor fermion particle manifold S^7 x RP^1 related to the fermion particle by photon, weak boson, or gluon interactions.
N(Graviton) is the number of types of Spin(0,5) graviton related to the fermion.
N(octonion) is an octonion number factor relating up-type quark masses to down-type quark masses in each generation.
Sym is an internal symmetry factor, relating 2nd and 3rd generation massive leptons to first generation fermions. It is not used in first-generation calculations.

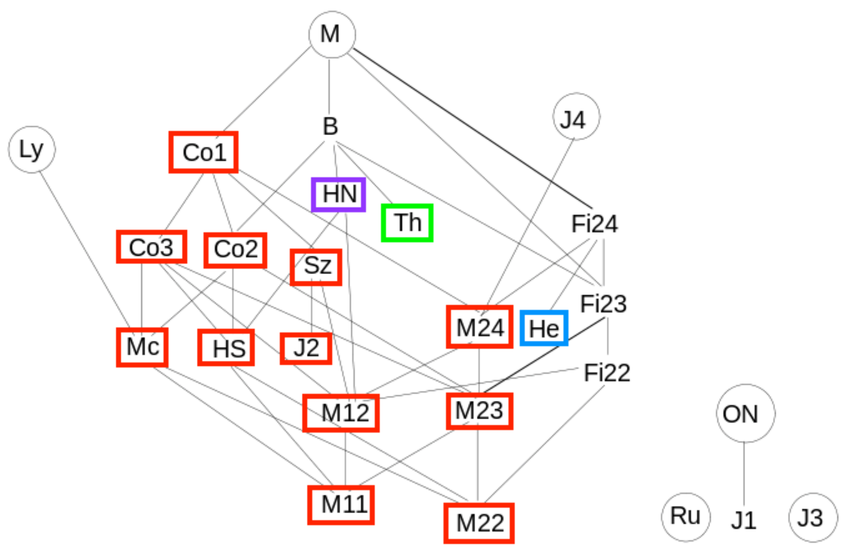
Force Strengths are made up of two parts:

the relevant spacetime manifold of gauge group global action
the U(1) photon sees 4-dim spacetime as T^4 = S1 x S1 X S1 x S1
the SU(2) weak boson sees 4-dim spacetime as S2 x S2
the SU(3) weak boson sees 4-dim spacetime as CP2
the Spin(5) of gravity sees 4-dim spacetime as S4
and
the volume of the Shilov boundary corresponding to the symmetric space with local symmetry of the gauge boson. The nontrivial Shilov boundaries are:
for SU(2) Shilov = RP^1xS^2
for SU(3) Shilov = S^5
for Spin(5) Shilov = RP^1xS^4

Schwinger Sources as described above are continuous manifold structures of Bounded Complex Domains and their Shilov Boundaries but the E8-Cl(16) 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 a single 26-dim String Theory cell modulo the Leech lattice is the Monster Group of order about 8 x 10^53.

The Monster Group is of order
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

This chart (from Wikipedia) shows the Monster M and other Sporadic Finite Groups



The order of Co1 is 2^21.3^9.5^4.7^2.11.13.23 or about 4 x 10^18.
Aut(Leech Lattice) = double cover of Co1.
The order of the double cover 2.Co1 is 2^22.3^9.5^4.7^2.11.13.23 or about 0.8 x 10^19.
Taking into account the non-sporadic part of the Leech Lattice symmetry
according to the ATLAS at brauer.maths.qmul.ac.uk/Atlas/v3/spor/M/
the Schwinger Source Kerr-Newman Cloud Symmetry s 2^(1+24).Co1
of order 139511839126336328171520000 = 1.4 x 10^26

Co1 and its subgroups account for 12 of the 19 subgroups of the Monster M.
Of the remaining 7 subgroups, Th and He are independent of the Co1 related
subgroups and HN has substantial independent structure.

Th = Thompson Group. Wikipedia says "... Th ... was ... constructed ... as the
automorphism group of a certain lattice in the 248-dimensional Lie algebra of E8.
It does not preserve the Lie bracket of this lattice, but
does preserve the Lie bracket mod 3, so is a subgroup of the Chevalley group E8(3).
The subgroup preserving the Lie bracket (over the integers) is a maximal
subgroup of the Thompson group called the Dempwolff group (which unlike the
Thompson group is a subgroup of the compact Lie group E8) ...
the Thompson group acts on a vertex operator algebra over the field with 3 elements.
This vertex operator algebra contains the E8 Lie algebra over **F**3,
giving the embedding of Th into E8(3) ...
The Schur multiplier and the outer automorphism group of ... Th ... are both trivial.
Th is a sporadic simple group of order 215 · 310 · 53 · 72 · 13 · 19 · 31
= 90745943887872000 ≈ 9 x 10^16 ...".

He = Held Group. Wikipedia says "... The smallest faithful complex representation has
dimension 51; there are two such representations that are duals of each other.
It centralizes an element of order 7 in the Monster group. ...
the prime 7 plays a special role in the theory of the group ...
the smallest representation of the Held group over any field is
the 50 dimensional representation over the field with 7 elements ...
He ... acts naturally on a vertex operator algebra over the field with 7 elements ...
The outer automorphism group has order 2 and the Schur multiplier is trivial. ...
He is a sporadic simple group of order 210 · 33 · 52 · 73 · 17
= 4030387200 ≈ 4 x 10^9 ...".

HN = Harada-Norton Group. Wikipedia says "... The prime 5 plays a special role ...
it centralizes an element of order 5 in ... the Monster group ...and as a result acts
naturally on a vertex operator algebra over the field with 5 elements ... it acts on
a 133 dimensional algebra over $\mathbf{F}_5$ with a commutative but nonassociative product ...
Its Schur multiplier is trivial and its outer automorphism group has order 2 ...
HN is a sporadic simple group of order $2^{14} \cdot 3^6 \cdot 5^6 \cdot 7 \cdot 11 \cdot 19$
= 273030912000000 ≈ 3 × 10^14 ...

HN has an involution whose cenrtralizer is of the form 2.HS.2, where HS is the Higman-Sims group ... of order $2^9 \cdot 3^2 \cdot 5^3 \cdot 7 \cdot 11 = 44352000 \approx 4 \times 10^7$ ...[whose] Schur multiplier has order 2 ...[and whose] outer automorphism group has order 2 ...
HS is ... a subgroup of ... the Conway groups Co0, Co2 and Co3 ...".

Co1 x Th x He x HN / HS together have order about 4 x 9 x 4 x 10^(18+16+9+7)
= about 10^52 which is close to the order of M = about 10^54.

The components of the Monster Group describe the composition of Schwinger Sources:

Co1 gives the number of particles in the Schwinger Source Kerr-Newman Cloud emanating from a Valence particle in a Planck-scale cell of E8 Physics SpaceTime.

Th gives the 3-fold E8 Triality structure relating 8-dim SpaceTime to
First-Generation Fermion Particles and AntiParticles.

He gives the 7-fold algebraically independent Octonion Imaginary E8 Integral Domains that make up 7 of the 8 components of Octonion Superposition E8 SpaceTime.

HN / HS gives the 5-fold symmetry of 120-element Binary Icosahedral E8 McKay Group beyond the 24-element Binary Tetrahedral E6 McKay Group at which level
the Shilov Boundaries of Bounded Complex Domains emerge to describe SpaceTime and Force Strengths and Particle Masses.

W**hen a fermion particle/antiparticle appears in E8 spacetime** it does not remain a single Planck-scale entity because **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**.
Its **structure comes from the 24-dim Leech lattice part of the Monster Group which is**

2^(1+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.

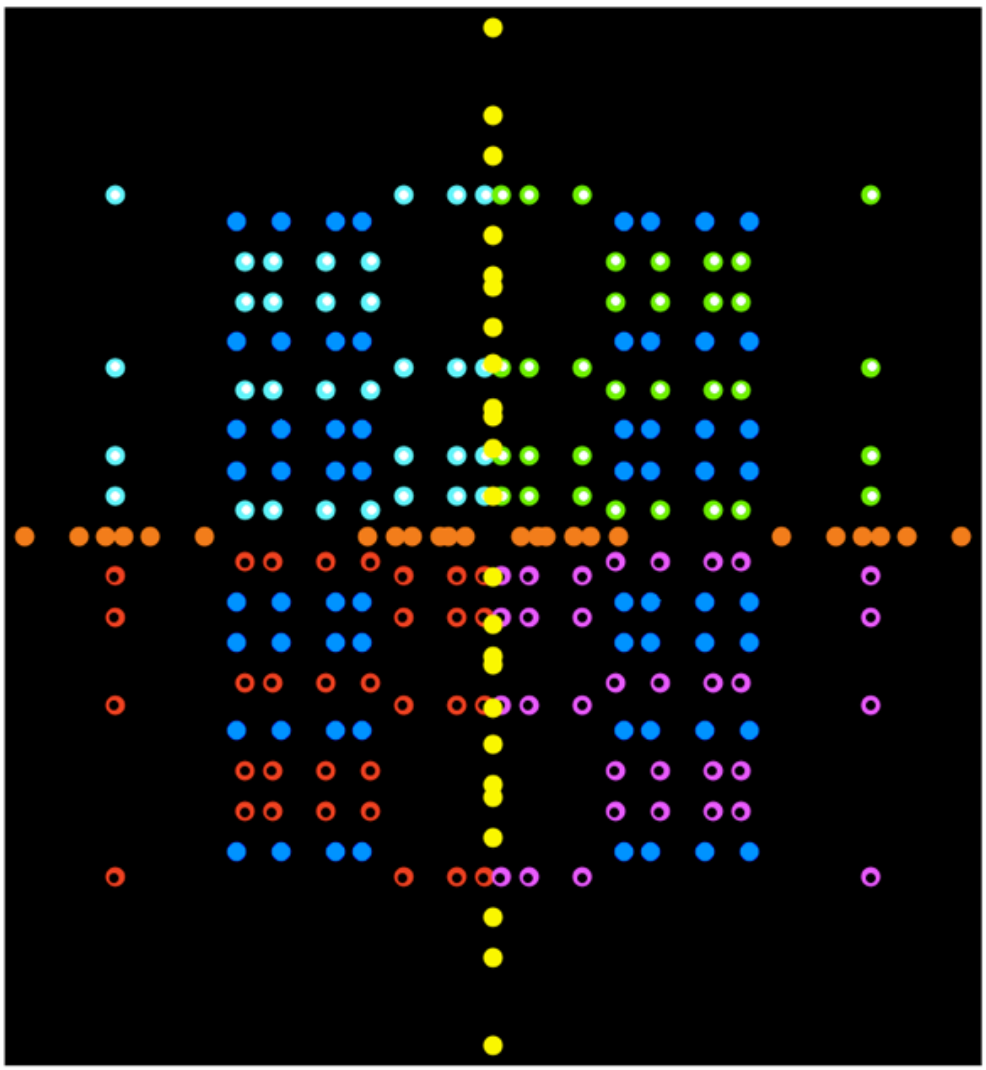
The volume of the Kerr-Newman Cloud is on the order of 10^27 x Planck scale, so the Kerr-Newman Cloud **Source should contain about 10^27 particle/antiparticle pairs and its size should be about** 10^(27/3) x 1.6 x 10^(-33) cm = roughly **10^(-24) cm**.

Schwinger Source QuasiCrystal Internal Structure

Above the scale of Schwinger Sources (10^(-24) cm) E8-Cl(16) Physics structures such as Spacetime, Symmetric Spaces, and Bounded Complex Domains and their Shilov Boundaries, are well approximated by smooth manifolds so that the geometric techniques of Amand Wyler give good results for force strengths, particle masses, etc.

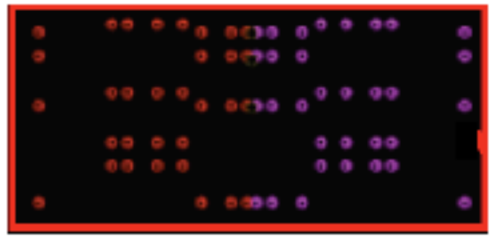
Below the scale of Schwinger Sources (10^(-24) cm down to Planck 10^(-33) cm) the fundamental structures are E8 lattices and QuasiCrystals derived therefrom.
Planck Scale is about 10^(-33) cm. Schwinger Souce Scale is about 10^(-24) cm, a scale about 10^9 larger than the Planck Scale.

The 240 E8 Root Vector Vertices of each cell of 8D E8-Cl(16) Physics Spacetime can be represented in 2D as done by Ray Aschheim



The E8-Cl(16) Physical interpretation of the 240 E8 Root Vectors is

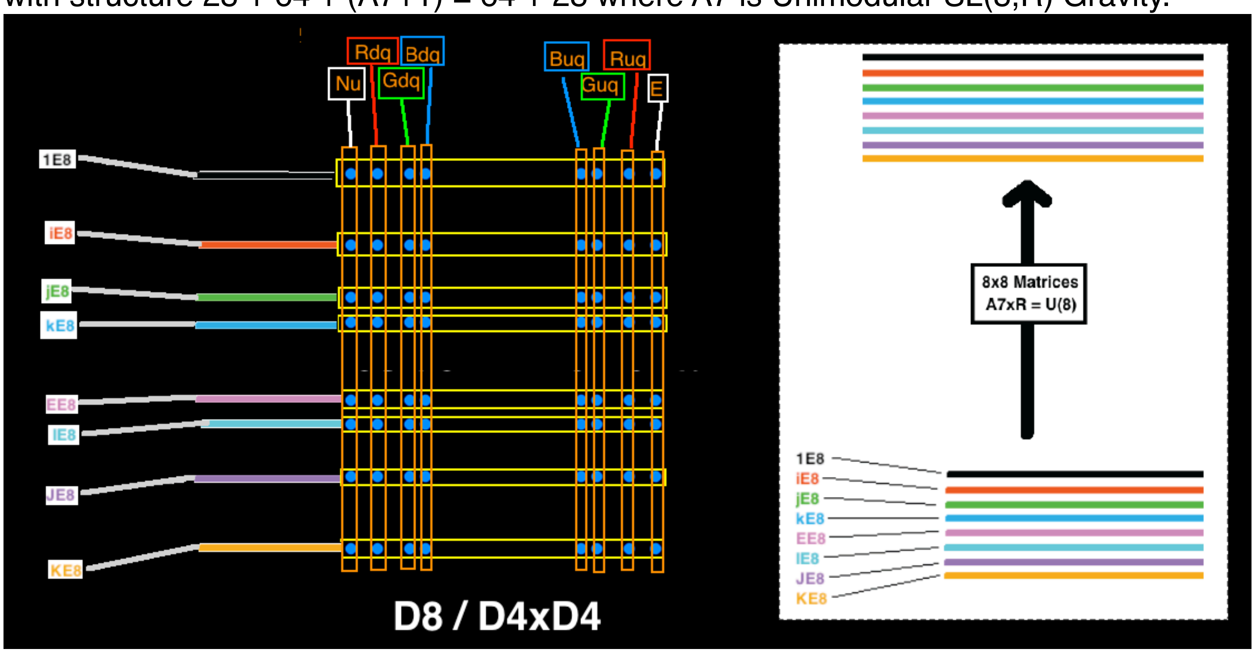
E8 / D8 for 8-dim Spacetime components of 8+8 First-Generation Fermions



Green and Cyan dots with white centers (32+32 = 8x8 dots)
for Fermion Particles
and
Red and Magenta dots with black centers (32+32 = 8x8 dots)
for Fermion AntiParticles

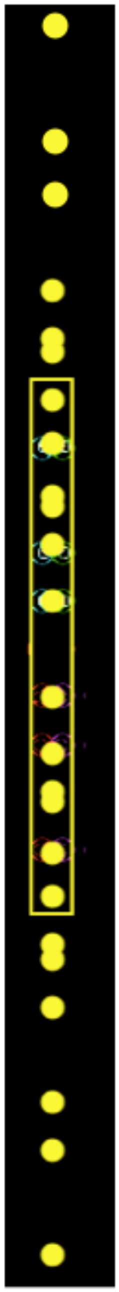
D8 / D4 x D4 for Spacetime Superposition of 8 types of E8 Lattice

The 64 generators (8x8 = 64 blue dots) correspond to an 8-dim base manifold of an E8 Lagrangian in which Spacetime 8V of 26D String Theory is represented by 8-branes whose Planck-Scale Lattice Structure is that of a superposition of 8 types of E8 Lattice: 7 E8 Integral Domains corresponding to the 7 Imaginary Octonion Basis Elements and 1 E8 Lattice (not an Integral Domain - Kirmse's Mistake) corresponding to the Octonion Real Axis. The 64 Blue Root Vectors of the space D8 / D4 x D4 also represent the A7+1 = SL(8,R)+1 in the Maximal Contraction Heisenberg Algebra of E8 with structure 28 + 64 + (A7+1) = 64 + 28 where A7 is Unimodular SL(8,R) Gravity.



The map from one 8-brane superposition to the next is by 8x8 Matrices representing the central grade-0 part A7+1 of the Heisenberg Maximal Contraction Algebra of E8,

D4 for Gravity - Dark Energy Gauge Bosons and Standard Model Ghosts



The 24 Yellow Root Vectors of the D4 of E8 Gravity + Standard Model Ghosts are on the Vertical Y-axis.
12 of them in theYellow 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)xU(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**

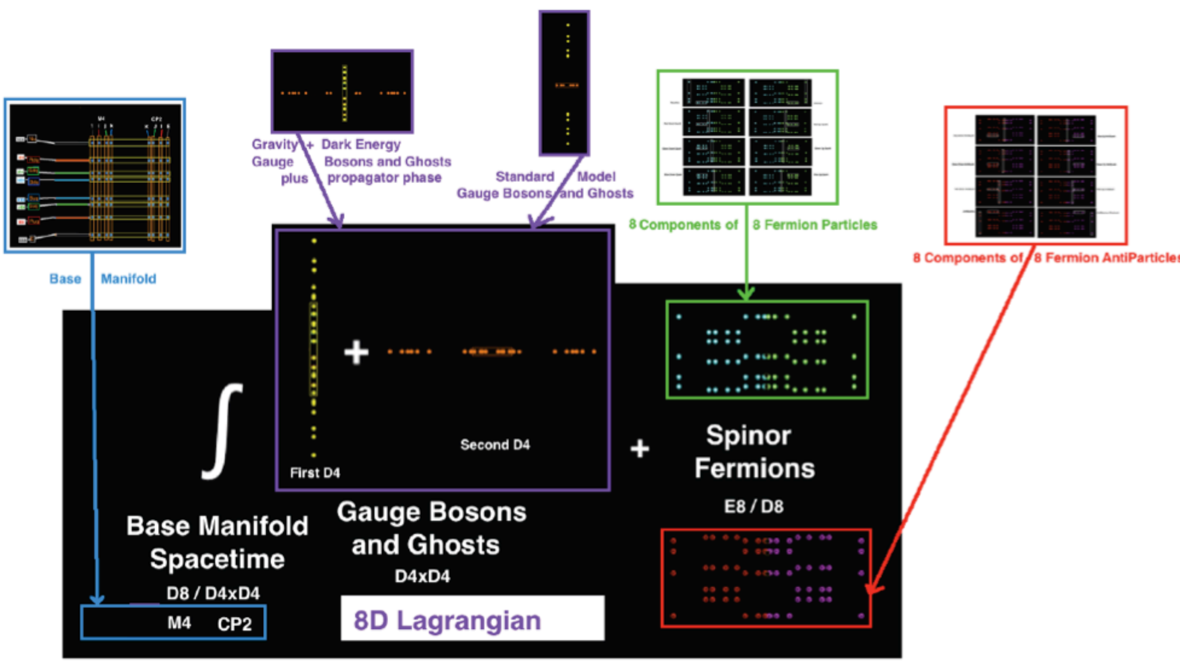
The U(1) of SU(2,2)xU(1) = U(2,2) represents the Propagator Phase Internal Clock

D4 for Standard Model Gauge Bosons and Gravity - Dark Energy Ghosts

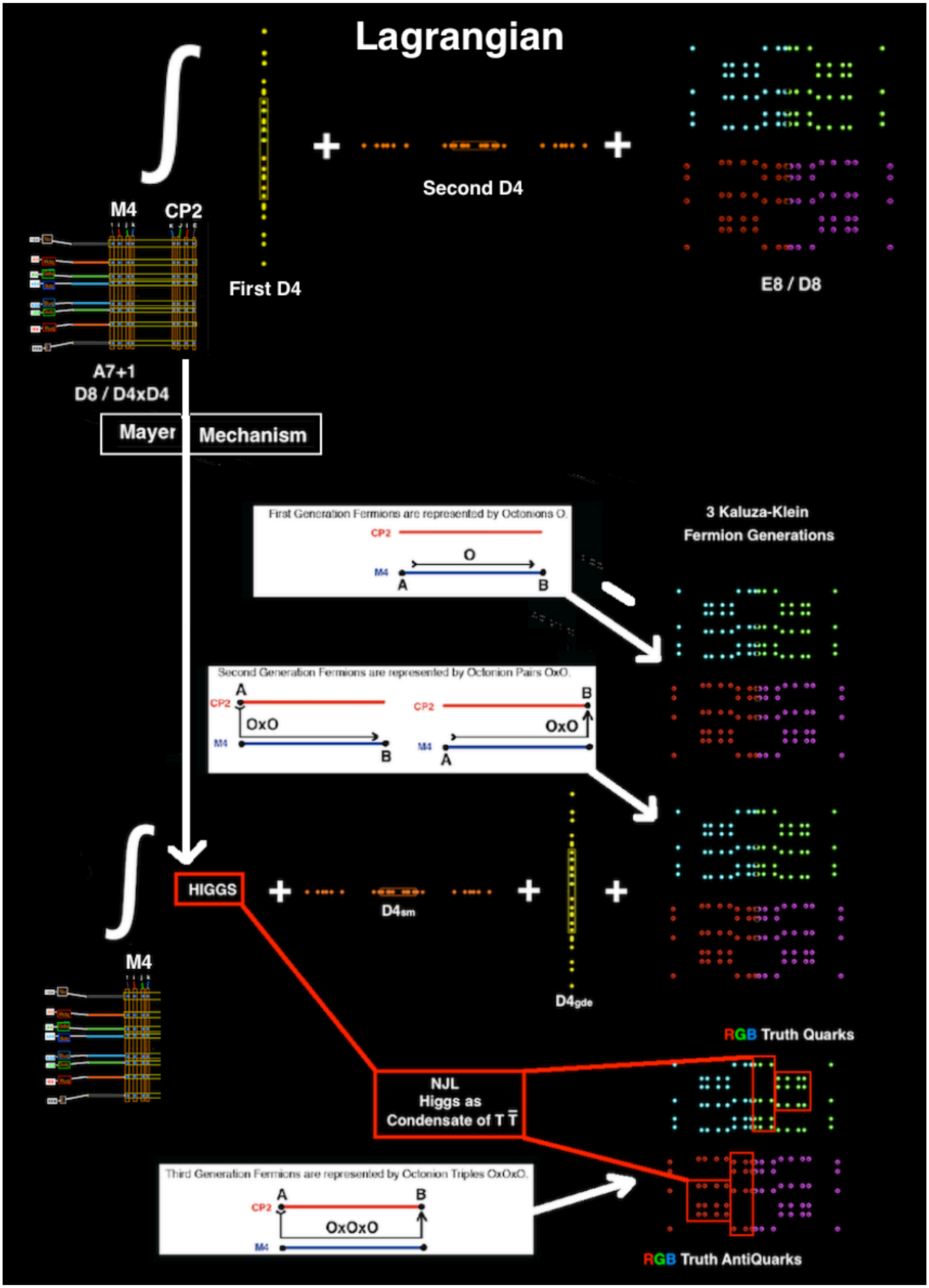
The 24 Orange Root Vectors of the D4 of E8 Standard Model + Gravity Ghosts
are on the Horizontal X-axis.

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 CP2 = SU(3) / SU(2) x U(1)
(as described by Batakis in Class. Quantum Grav. 3 (1986) L99-L105)
Electroweak SU(2) x U(1) is gauge group as isotropy group of CP2.
SU(3) is global symmetry group of CP2 but due to Kaluza-Klein M4 x CP2 structure of
compact CP2 at every M4 spacetime point,
it acts as Color gauge group with respect to M4.

Here is how the 240 E8 Root Vectors define an 8D Lagrangian:

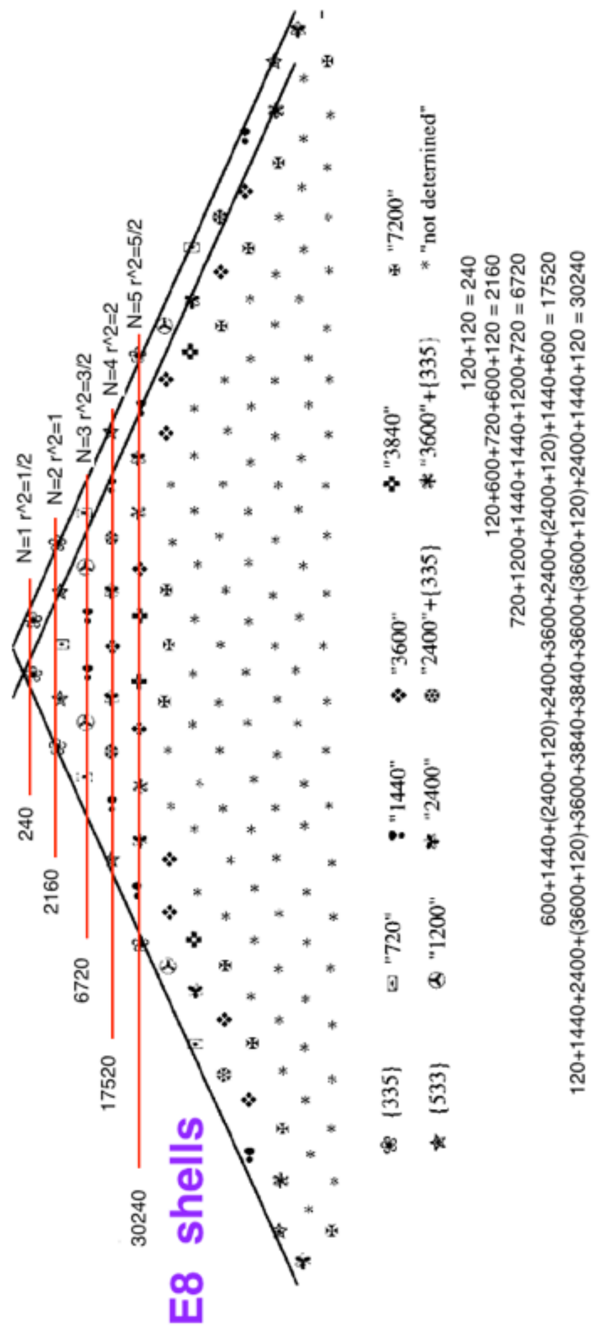


Here is how the 8D Lagrangian goes to 4D Lagrangian of M4 x CP2 Kaluza-Klein so that the Higgs and Fermion Generations 2 and 3 emerge:



Lagrangian
M4
CP2
First D4
Second D4
E8 / D8
A7+1
D8 / D4xD4
Mayer Mechanism
First Generation Fermions are represented by Octonions O.
CP2
O
M4
A
B
3 Kaluza-Klein
Fermion Generations
Second Generation Fermions are represented by Octonion Pairs OxO.
A
CP2
OxO
M4
B
CP2
B
OxO
M4
A
HIGGS
D4sm
D4gde
M4
RGB Truth Quarks
NJL
Higgs as
Condensate of T T̄
Third Generation Fermions are represented by Octonion Triples OxOxO.
A
B
CP2
OxOxO
M4
RGB Truth AntiQuarks

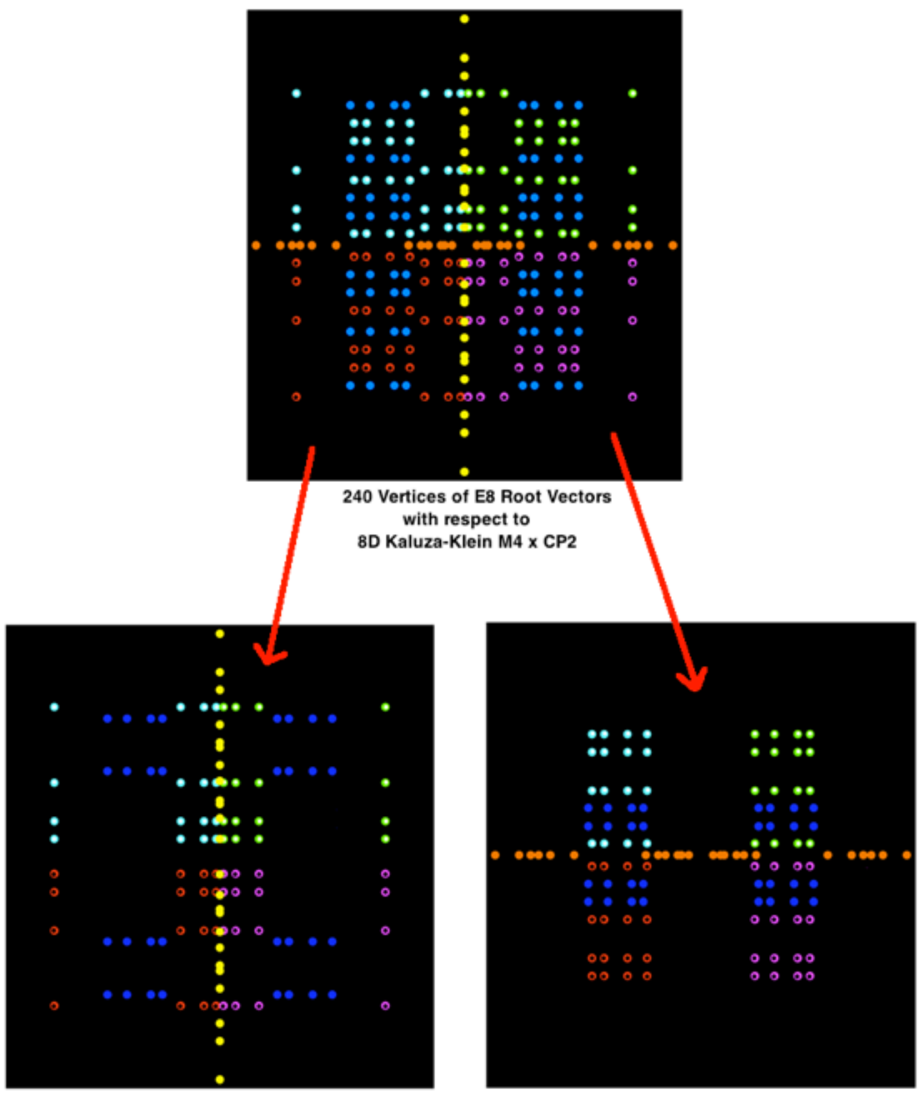
This mapping of the shell structure of a full E8 Lattice
is adapted from the book “Geometrical Frustration” by Sadoc and Mosseri



If you consider only the Root Vectors neighboring the Origin of the Lattices,
that is, only the first Lattice shell, then you see that
the 240 Root Vectors of E8 are made up of two copies of the 120 Root Vectors of H4

One H4 describes the Standard Model and is related to CP2 of M4 x CP2 Kaluza-Klein.

The other describes Conformal Gravity + Dark Energy and U(1) Propagator Phase
and is related to M4 of M4 x CP2 Kaluza-Klein.



240 Vertices of E8 Root Vectors
with respect to
8D Kaluza-Klein M4 x CP2

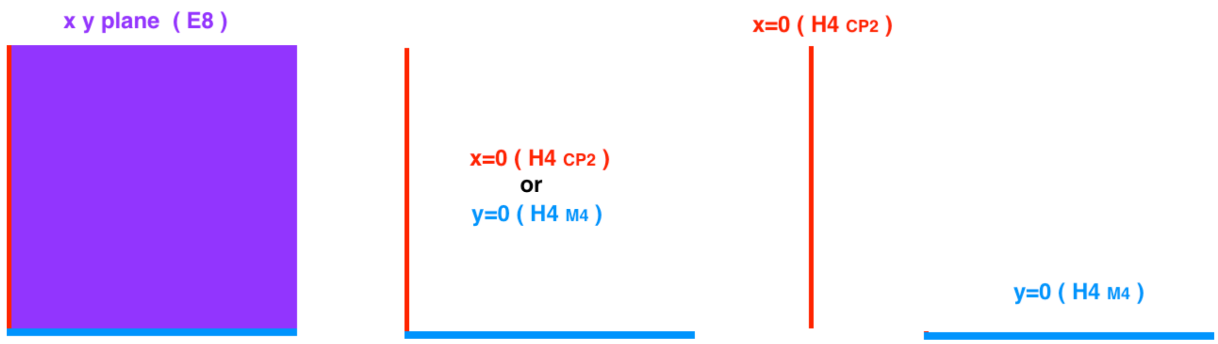
120 E8 Root Vectors for M4
and Conformal Gravity + Dark Energy

120 E8 Root Vectors for CP2 = SU(3) / SU(2)xU(1)
and Standard Model

The 120 Root Vectors for H4 tiling of M4 Minkowski Physical Spacetime (H4 M4)
and
the 120 Root Vectors for H4 tiling of CP2 Internal Symmetry Space (H4 CP2)
form two 600-cells, one with Golden Ratio edge length (define it to be for M4)
and the other with Unit edge length (define it to be for CP2)

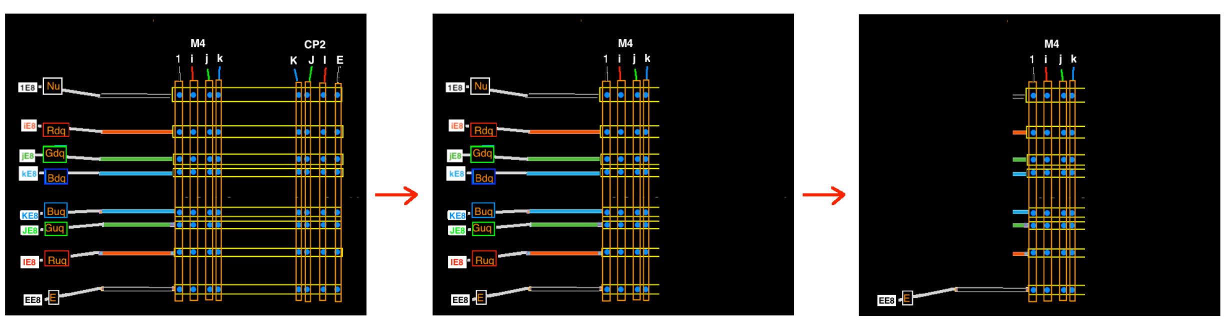
To see the internal structure of a Schwinger Source look at the M4 part
of M4 x CP2 Kaluza-Klein Spacetime and choose a Fermion Type
whose Schwinger Source structure you want to see (for example, Electron).

First, chose only those E8 Lattice vertices with CP2 coordinates = zero
so that you have only M4 coordinates being non-zero.
Here is a schematic diagram of how E8 Lattice breaks down
into H4 CP2 Lattoice and H4 M4 Lattice



Then project from 8D E8 Lattice space to 4D H4 Lattice space for M4
in which each 4D H4 Lattice vertex is surrounded by 120 vertices
at Golden Ratio distance from the origin point.

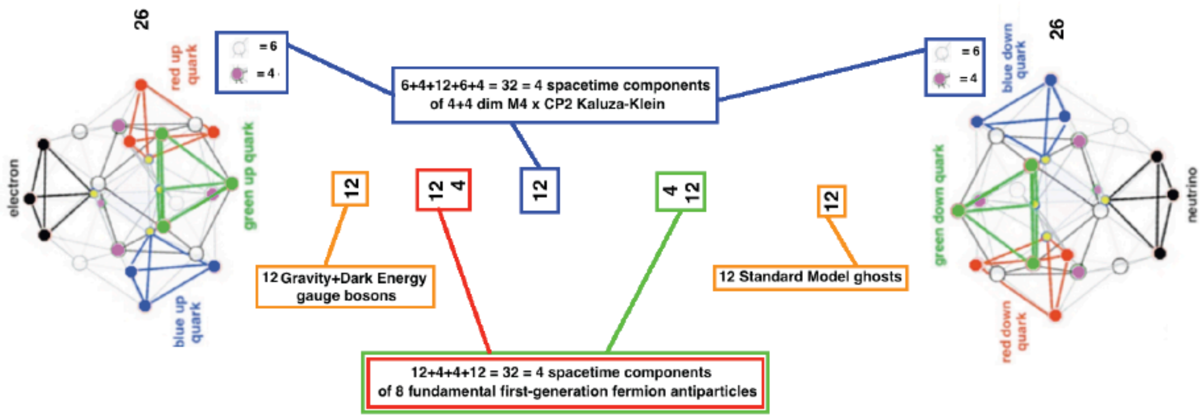
Then select the Fermion (Electron in this example) that is located
at the M4 coordinates of the origin point.



The image on the far right is the representation of

a Valence Electron at the M4 coordinates of the origin point

which is surrounded by its 120 nearest-neighbor vertices
which are all at Golden Ratio distance and which form a 600-cell



in which the Electron and its M4 coordinates are represented by the Tetrahedron
of 4 vertices at the top (far left) of the 600-cell.

A more detailed view how full E8 Lattice breaks down
into full H4 CP2 QiasiCrystal Lattice and full H4 M4 QuasiCrystal Lattice
is shown on the following page,
where you can see some interesting phenomena, such as:

The E8 lattice (interior of the diagram) is periodic,
a property inherited from its 8-dimensional structure.

Both the H4 M4 and H4 CP2 Lattices are Fibonacci-type QuasiCrystals
with chain structure L S L L S L S L L S ...
inherited from the fact that some E8 lattice lines are longer than the preceding line by 2
and others are longer by 4.

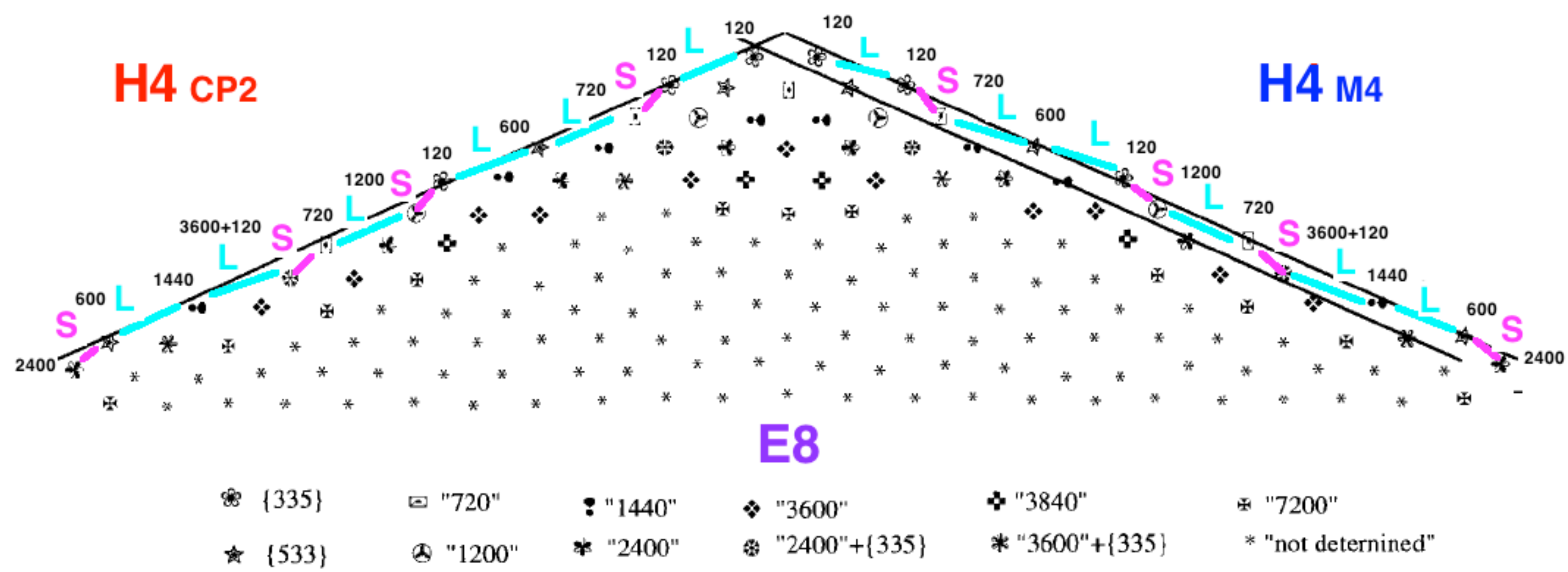
All the things in the H4 M4 Fibonacci Chain are Golden Ratio larger
than the corresponding things in the H4 CP2 Fibonacci Chain.

The H4 CP2 QuasiCrystal determines the Standard Model Internal Symmetry
of its Schwinger Source through CP2 = SU(3) / SU(2)xU(1).

The H4 M4 QuasiCrystal determines the Spacetime Properties,
including filling the volume,
of the Schwinger Source through the Conformal U(2,2) symmetry.

The size and volume of the Schwinger Source (10^(-24) cm and 10^27 particle-antiarticle pairs)
is imposed on the H4 M4 QuasiCrystal by the Monster symmetry of Lattice Spacetime at the
Planck scale, and then imposed on the H4 CP2 QuasiCrystal by symmetry with H4 M4.

The Indra Net mirroring ability of each of the 10^27 virtual elements of a Schwinger Source
is of the order of the Monster Group of the Spacetime Lattice Cell of the Valence H4 M4 600-cell
which is on the order of 10^53, so that the total mirroring capacity of a single Schwinger Source
is 10^27 x 10^53 = 10^80 which is enough mirroring capacity to maintain
an Indra's Net BlockChain System of all the particles in Our Universe.



H4 CP2
H4 M4
E8
2400
600
1440
3600+120
720
1200
120
S
L
{335}
{533}
"720"
"1200"
"1440"
"2400"
"3600"
"2400"+{335}
"3840"
"3600"+{335}
"7200"
"not determined"

Indra’s Net of Schwinger Sources

Each Schwinger Source particle-antiparticle pair should see (with Bohm Potential) the rest of our Universe in the perspective of 8 x 10^53 Monster Symmetry so **a Schwinger Source acting as a Jewel of Indra’s Net** of Schwinger Source Bohm Quantum Blockchain Physics (viXra 1801.0086)
can see / reflect 10^27 x 8 x 10^53 = 8 x 10^80 Other Schwinger Source Jewels of Indra’s Net.

How many Schwinger Sources are in the Indra’s Net of Our Universe ?

Based on gr-qc/0007006 by Paola Zizzi, the Inflation Era of Our Universe ended with Quantum Decoherence when its number of qubits reached 2^64 for Cl(64) = Cl(8)^8 self-reflexivity whereby each Cl(8) 8-Periodicity component corresponded to each basis element of the Cl(8) Vector Space.

At the End of Inflation, each of the 2^64 qubits transforms into 2^64 elementary first-generation fermion particle-antiparticle pairs. The resulting 2^64 x 2^64 pairs constitute a Zizzi Quantum Register of order 2^64 x 2^64 = 2^128 .

At Reheating time Tn = (n+1) TPlanck the Register has (n+1)^2 qubits so at Reheating Our Universe has (2^128)^2 = 2^256 = 10^77 qubits and since each qubit corresponds to fermion partiilce-antiparticle pairs that average about 0.66 GeV so
the number of particles in our Universe at Reheating is about 10^77 nucleons which, being less than 10^80, can be reflected by Schwinger Source Indra Jewels.

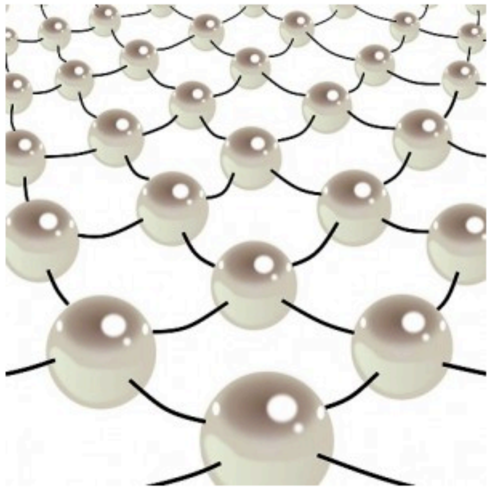
The Reheating process raises the energy/temperature at Reheating to Ereh = 10^14 GeV, the geometric mean of the Eplanck = 10^19 GeV and Edecoh = 10^10 GeV.

After Reheating, our Universe enters the Radiation-Dominated Era, and, since there is no continuous creation, particle production stops, so the
10^77 nucleon Baryonic Mass of our Universe has been mostly constant since Reheating

Indra’s Net

“... "Indra's net" is the net of the Vedic deva Indra, whose net hangs over his palace on Mount Meru, the axis mundi of Buddhist and Hindu cosmology. In this metaphor, Indra's net has a multifaceted jewel at each vertex,
and each jewel is reflected in all of the other jewels ...
the image of "Indra's net" is used to describe the interconnectedness of the universe ...
Francis H Cook describes Indra's net thus:
“Far away in the heavenly abode of the great god Indra, there is a wonderful net ...
a single glittering jewel in each "eye" of the net ... in ... each of the jewels ...
its polished surface ... reflect[s] all the other jewels in the net ... Not only that, but each of the jewels reflected in this one jewel is also reflecting all the other jewels ...” “.

Image from https://brightwayzen.org/meetings-placeholder/indras-net-honoring-interdependence-scales/ :

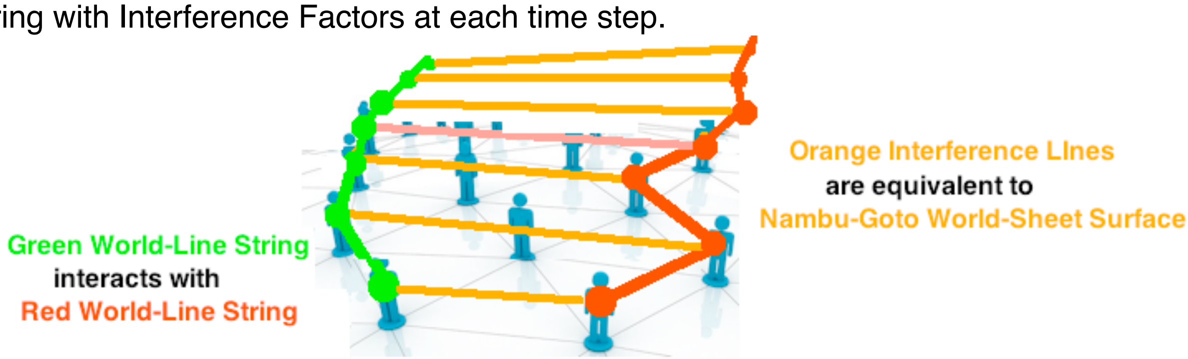


In E8-Cl(16) Physics e**ach Indra Jewel is a Schwinger Source**.

26D Freudenthal Fr3(O) String Theory - Bohm Quantum Potential
To understand **Schwinger Sources of E8 Physics start with 26D String Theory**:
interpret **Strings as World-Lines** of Particles and
spin-2 String Theory 24x24 symmetric matrices
as carriers of Bohm Quantum Potential (not gravitons).

Luis E. Ibanez and Angel M. Uranga in “String Theory and Particle Physics” said:
“... String theory proposes ... small one-dimensional extended objects, strings, of typical size Ls = 1/ Ms, with Ms known as the string scale ...
As a string evolves in time, it sweeps out a two-dimensional surface in spacetime, known as the worldsheet, which is the analog of the ... worldline of a point particle ... for the bosonic string theory ... the classical string action is the total area spanned by the worldsheet ... This is the ... Nambu– Goto action ...”.

Consider the Gray Fine-Grained History (quant-ph/9712037v2) to be a World-Line String with Interference Factors at each time step.



The Gray Fine-Grained History Quantum Theory is
equivalent to the Nambu-Goto action of 26D String Theory.
Nambu-Goto 24x24 traceless spin-2 particle is
Quantum Bohmion carrier of Bohm Quantum Potential

Further, Ibanez and Uranga also said:
"... The string ground state corresponds to a 26d spacetime tachyonic scalar field T(x).
This tachyon ... is ... unstable
...
The massless two-index tensor splits into irreducible representations of SO(24) ...
Its trace corresponds to a scalar field, the dilaton **ϕ**, whose vev fixes the string interaction coupling constant gs
...
the antisymmetric part is the 26d 2-form field BMN
...
The symmetric traceless part is the 26d graviton GMN ...".

My interpretation of the symmetric traceless part
differs from that of Ibanez and Uranga in that it
is the carrier of the Bohm Quantum Potential.

Closed string tachyons localized at orbifolds of fermions produce virtual clouds of particles / antiparticles that dress fermions.

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

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

Joe Polchinski in "String Theory, Volume 1, An Introduction to the Bosonic String" said:
"... we find at m^2 = - 4 / alpha' the tachyon,
and at m^2 = 0 the 24 x 24 states of the graviton, dilaton, and antisymmetric tensor ...".
My interpretation of what Polchinski describes as the graviton
differs from that of Polchinski in that it
is the carrier of the Bohm Quantum Potential.

The 24x24 Real Symmetric Matrices form the Jordan Algebra J(24,R).
24-Real-dim space has a natural Octonionic structure of 3-Octonionic-dim space.
The corresponding Jordan Algebra is J(3,O) = 3x3 Hermitian Octonion matrices.
Their 26-dim traceless part J(3,O)o describes the 26-dim Bosonic String Theory and the algebra of its Quantum States, so that
the 24x24 traceless symmetric spin-2 particle is the Quantum Bohmion
that carries the Bohm Quantum Potential
for interactions among Strings = World-Line Histories of Schwinger Sources.

Blockchain Structure of Bohm Quantum Potential

Andrew Gray in arXiv quant-ph/9712037 said:

"... probabilites are ... assigned to entire fine-grained histories ... base[d] ... on the Feynman path integral formulation ..."
so **in E8 Physics the Indra's Net of Schwinger Source Jewels**
would not have Bohm Quantum Potential interactions between two Jewels,
rather **the interactions would be between the two entire World-Line History Strings**

(image adapted from http://www.blockchaintechnologies.com/)

According to https://hbr.org/2017/01/the-truth-about-blockchain "... **How Blockchain Works ...**

1. Distributed Database
Each party on a blockchain has access to the entire database and its complete history. No single party controls the data or the information. Every party can verify the records of its transaction partners directly, without an intermediary.

2. Peer-to-Peer Transmission
Communication occurs directly between peers instead of through a central node.
Each node stores and forwards information to all other nodes.

3. Transparency with Pseudonymity
Every transaction and its associated value are visible to anyone with access to the system. Each node, or user, on a blockchain has a unique 30-pluscharacter
alphanumeric address that identifies it. Users can choose to remain anonymous or provide proof of their identity to others. Transactions occur between blockchain addresses.

4. Irreversibility of Records
Once a transaction is entered in the database and the accounts are updated, the records cannot be altered, because they're linked to every transaction record that came
before them (hence the term "chain"). Various computational algorithms and approaches are deployed to ensure that the recording on the database is permanent, chronologically ordered, and available to all others on the network.

5. Computational Logic

The digital nature of the ledger means that blockchain transactions can be tied to computational logic and in essence programmed. So users can set up algorithms and rules that automatically trigger transactions between nodes. ...".

With respect to Bohm Quantum Potential of E8 Physics Schwinger Sources there is no Human directly controlling any Event / Interaction / Transaction, as they are all completely controlled by the Laws of Physics which define "algorithms and rules that automatically trigger transactions between nodes" .

Each Node is a Schwinger Source that is connected by Bohm Quantum Potential to all other Schwinger Source Nodes in our Universe and governed by the "algorithms and rules" of the E8 Physics Lagrangian and the Algebraic Quantum Field Theory arising from the completion of the union of all tensor products of copies of Cl(16) each copy of Cl(16) containing E8 and the E8 Lagrangian.

Acording to http://www.blockchaintechnologies.com/ "... A blockchain is a type of distributed ledger, comprised of unchangable, digitally recorded data in packages called *blocks*. These digitally recorded "blocks" of data is stored in a linear *chain ...*

... A distributed ledger is a consensus of replicated, shared, and synchronized digital data geographically spread across multiple sites, countries, and/or institutions ..."

or, in the case of the E8 Physics Indra's Net of Schwinger Source Jewels, spread across the entirety of our Universe.

The idea of Schwinger Sources as more than mere points is in David Finkelstein's Space-Time Code 1968 in which David said "... "... What is too simple about general relativity is the space-time point ... each point of space-time is some kind of assembly of some kind of thing ... Each point, as Feynman once put it, has to remember with precision the values of indefinitely many fields describing many elementary particles; has to have data inputs and outputs connected to neighboring points; has to have a little arithmetic element to satisfy the field equations; and all in all might just as well be a complete computer ...".

Results of E8 Physics Calculations:

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.

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

(**for calculation details see viXra 1804.0121**)

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

Particle/Force	Tree-Level	Higher-Order
e-neutrino	0	0 for nu_1
mu-neutrino	0	9 x 10^(-3) eV for nu_2
tau-neutrino	0	5.4 x 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	1.217x10^19 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 x 10^(-39)
EM fine structure	1/137.03608	
Weak Gw	0.2535	
Gw(Mproton^2 / (Mw+^2 + Mw-^2 + Mz0^2))		1.05 x 10^(-5)
Color Force at 0.245 GeV	0.6286	0.106 at 91 GeV

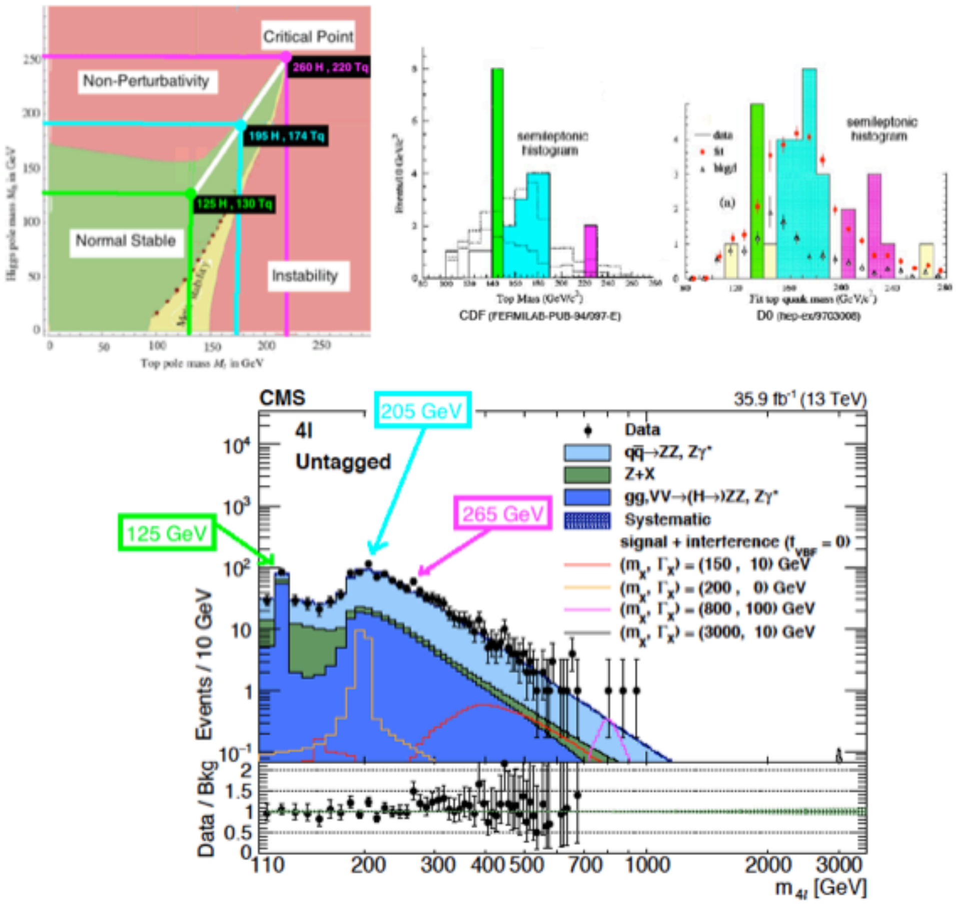
Kobayashi-Maskawa parameters for W+ and W- processes are:

	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.

E8 Physics:
Higgs and Truth Quark = 3-Mass-State Nambu-Jona-Lasinio System:

Higgs at 125 GeV and Truth Quark at 130 GeV
Higgs at 200 GeV and Truth Quark at 174 GeV
Higgs at 250 GeV and Truth Quark at 220 GeV



Upper Left = Higgs-Truth Quark mass state phase diagram

Upper Center = CDF semileptonic histogram of 3 Truth Quark Mass States
FERMILAB-PUB-94/097E

Upper Right = D0 semileptonic histogram of 3 Truth Quark Mass States
hep-ex/9703008

Lower = CMS H -> ZZ* -> 4l histogram of 3 Higgs Mass States
arXiv 1804.01939