

E8 Root Vector Geometry - AQFT - 26D String Theory - - Schwinger Sources - Quantum Consciousness

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Abstract

This paper is intended to be a only rough semi-popular overview of how the 240 Root Vectors of E8 can be used to construct a useful Lagrangian and Algebraic Quantum Field Theory (AQFT) in which the Bohm Quantum Potential emerges from a 26D String Theory with Strings = World-Lines = Path Integral Paths and the Massless Spin 2 State interpreted as the Bohm Quantum Potential. For details and references, see viXra/1602.0319.

The 240 Root Vectors of E8 represent the physical forces, particles, and spacetime that make up the construction of a realistic Lagrangian describing the Octonionic Inflation Era. The Octonionic Lagrangian can be embedded into a $Cl(1,25)$ Clifford Algebra which with 8-Periodicity gives an AQFT. The Massless Spin 2 State of 26D String Theory gives the Bohm Quantum Potential. The Quantum Code of the AQFT is the Tensor Product Quantum Reed-Muller code. A Single Cell of the 26D String Theory model has the symmetry of the Monster Group. Quantum Processes produce Schwinger Sources with size about $10^{(-24)}$ cm. Microtubule Structure related to E8 and Clifford Algebra enable Penrose-Hameroff Quantum Consciousness. E8 and $Cl(8)$ may have been encoded in the Great Pyramid. A seperate paper discusses using the Quaternionic $M4 \times CP2$ Kaluza-Klein version of the Lagrangian to produce the Higgs and 2nd and 3rd Generation Fermions and a Higgs - Truth Quark System with 3 Mass States for Higgs and Truth Quark.

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The **240 root vectors of E8** are of equal length in 8 dimensions
as they form the 240-vertex Witting-Gossett polytope

so

you can in 8 dimensions visualize how they group together

If you look at the 240 vertices as points on an 8-dim sphere
then

you can pick one point as the North Pole

and

see where the other points fall at their angle of latitude:

1 is at North Pole

**56 nearest neighbors of the North Pole
are at North Temperate Latitude**

**126 2nd nearest neighbors of the North Pole
are at the Equator**

**56 3rd nearest neighbors of the North Pole
are at South Temperate Latitude**

**1 4th nearest neighbor of the North Pole
is Anitpodal at the South Pole**

Therefore you see that the 240 break down into $1 + 56 + 126 + 56 + 1$
but
what you need to see next is which root vector corresponds to which physics thing.

Geometry of the E8 Lie Group gives you some ideas:

$56 + 56 = 112$ Temperate North and South is the $D8 = \text{Spin}(16)$ subgroup of $E8$ and they correspond to Gravity + Dark Energy and the Standard Model gauge groups and to 8-dimensional Spacetime position and momentum.

Each 56 breaks down into $24 + 32$.

North Temperate $24 = D4$ Lie Algebra = $\text{Spin}(2,6)$ which contains Conformal $\text{Spin}(2,4)$ which gives Gravity plus Conformal Dark Energy as well as Ghosts of Standard Model Gauge Bosons

South Temperate $24 = D4$ Lie Algebra = $\text{Spin}(8)$ which contains $SU(4)$ which gives $SU(3)$ of the Color Force which is the Global Group of Kaluza-Klein Internal Symmetry Space CP^2 and $CP^2 = SU(3) / SU(2) \times U(1)$ contains groups of Weak and Electromagnetic Forces as well as Ghosts of Gravity and Dark Energy

Symmetric space $D8 / D4(\text{gravity}) \times D4(\text{standard model})$ is $112 - 28 - 28 = 64$ -dim and it corresponds to $64 = 8$ -dim position \times 8 -dim momentum of 8 -dim Spacetime which
 8 -dim Spacetime reduces to $4+4$ dim $M4 \times CP^2$ Kaluza-Klein spacetime

Symmetric space $E8 / D8$ is 128 -dim Rosenfeld OctoOctonionic Projective Plane which is
 $1 + 126 + 1$ of the North Pole, Equator, and South Pole

The 128 are the 8 Spacetime components of Fermions: 8 Particles and 8 AntiParticles for $8 \times 8 = 64$ Particle components + $8 \times 8 = 64$ AntiParticle components.

1 at North Pole = time component of Neutrino

1 at South Pole = time component of AntiNeutrino

126 at Equator = other components of Leptons and Quarks = root vectors of $E7$

Symmetric space $E7 / D6 \times SU(2) = 64$ -dim Rosenfeld QuaterOctonionic Projective Plane corresponds to 8 components of (electron + rgb up quarks) = $8 \times 4 = 32$

plus 8 components of (positron + rgb up antiquarks) = $8 \times 4 = 32$

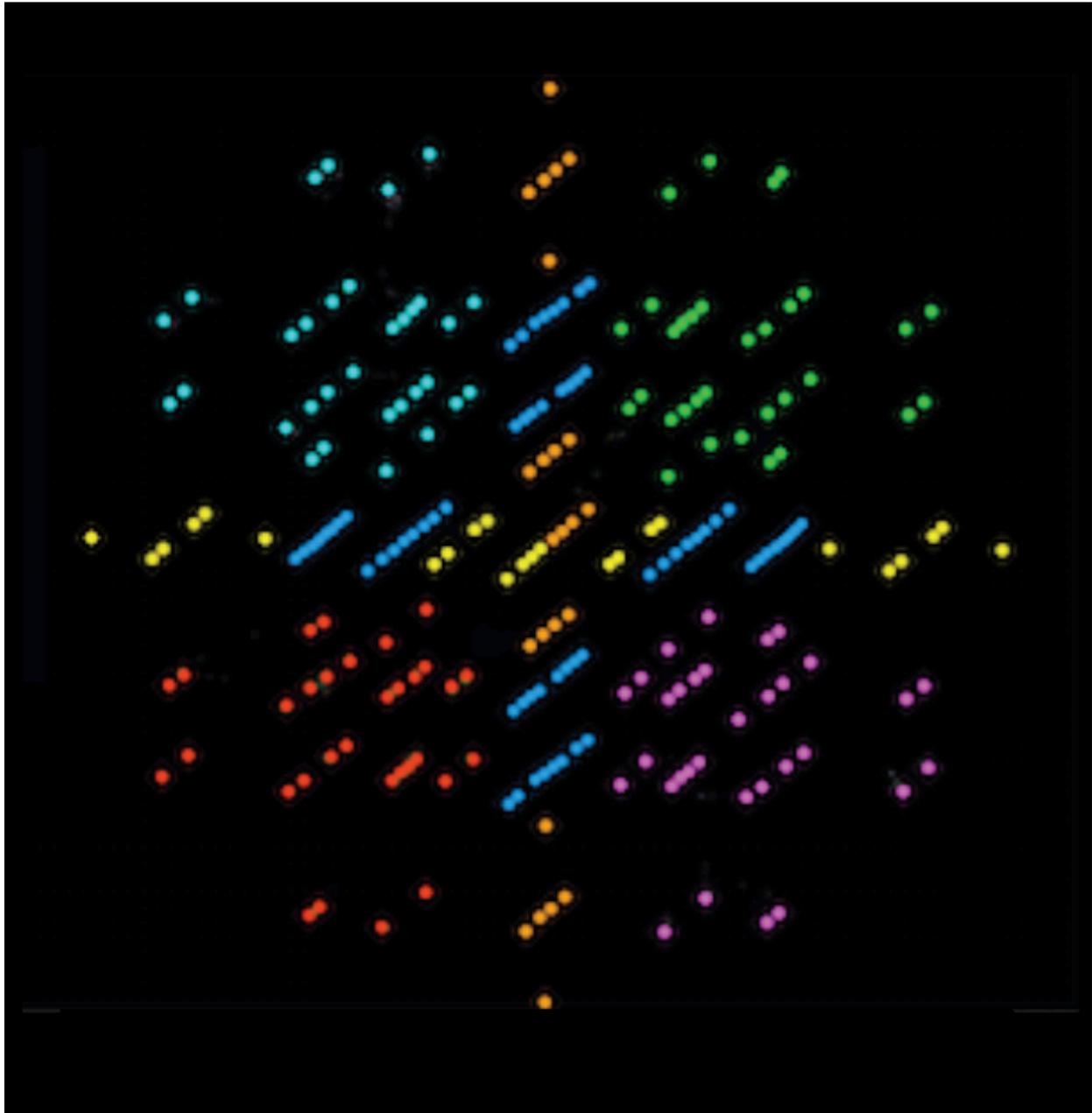
$D6 \times SU(2)$ has $60+2 = 62$ root vectors so if you add $1+1$ North and South Poles

you get 64 corresponding to 8 components of (neutrino + rgb down quarks) = $8 \times 4 = 32$

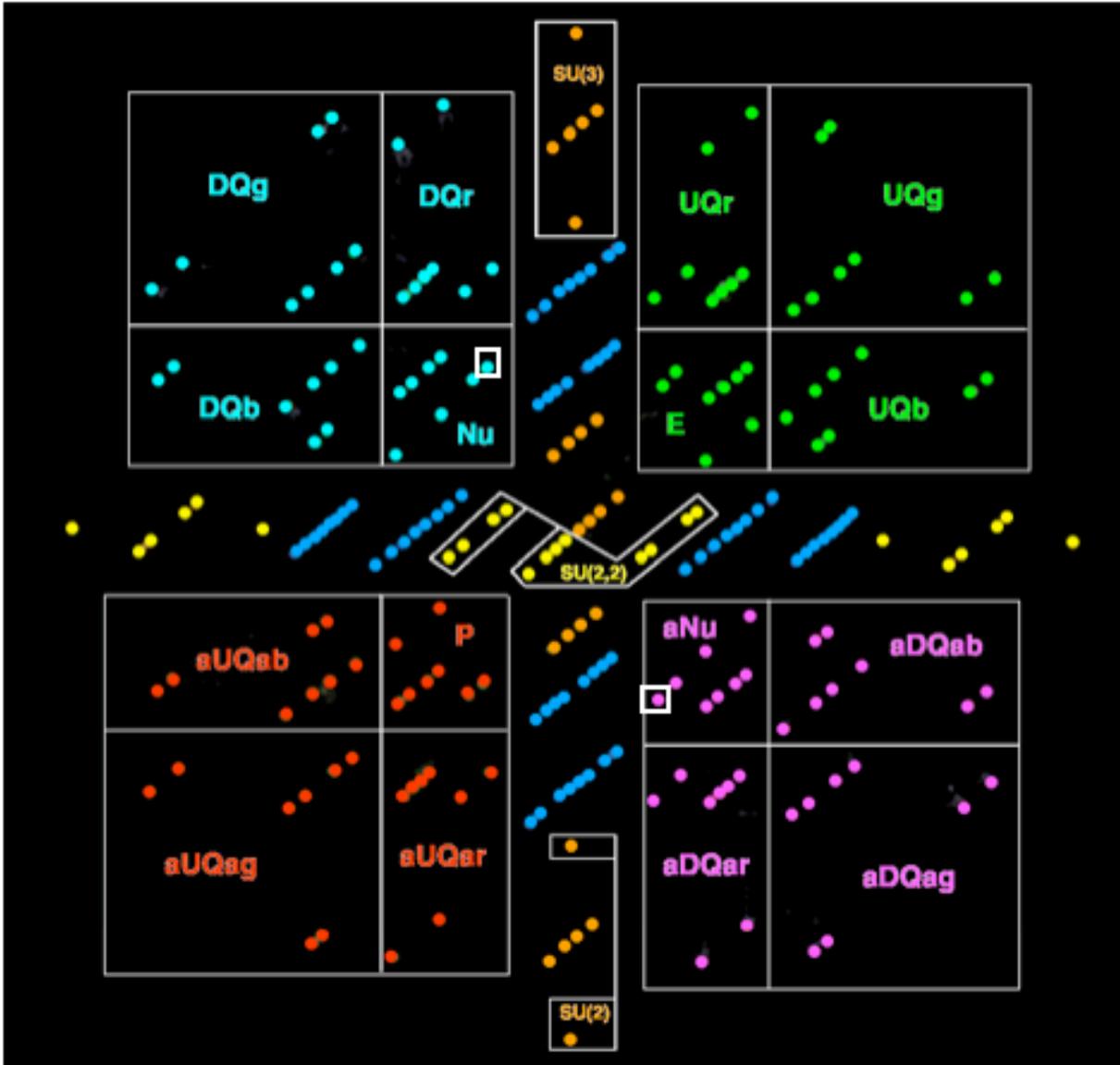
plus 8 components of (antineutrino + rgb down antiquarks) = $8 \times 4 = 32$

**2-dim projection of 240 E8 Root Vectors
gives useful visualization of
which root vector corresponds to which physics thing**

In 2-dim Projection the Root Vectors no longer have the same distance from origin



but in this particular 2-dim projection the physical interpretations of each Root Vector becomes clear:



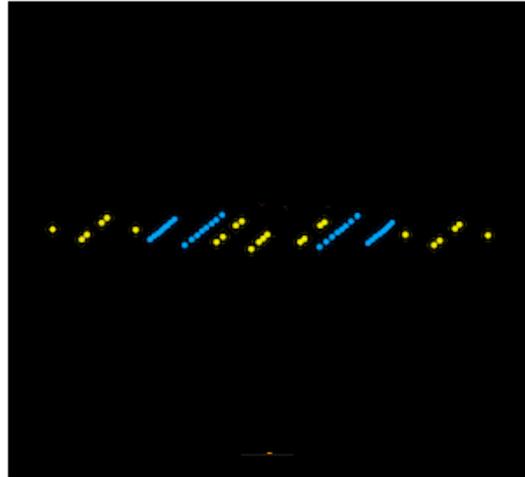
E = electron, UQr = red up quark, UQg = green up quark, UQb = blue up quark
 Nu = neutrino, DQr = red down quark, DQg = green down quark, DQb = blue down quark
 P = positron, aUQar = anti-red up antiquark,
 aUQag = anti-green up antiquark, aUQab = anti-blue up antiquark
 aNu = antineutrino, aDQar = anti-red down antiquark
 white boxes enclose time components of neutrino and antineutrino
 aDQag = anti-green down antiquark, aDQab = anti-blue down antiquark
 Each Lepton and Quark has 8 components with respect to 4+4 dim Kaluza-Klein
 6 orange SU(3) and 2 orange SU(2) represent Standard Model root vectors
 24-6-2 = 16 orange represent U(2,2) Conformal Gravity Ghosts
 12 yellow SU(2,2) represent Conformal Gravity SU(2,2) root vectors
 24-12 = 12 yellow represent Standard Model Ghosts
 32+32 = 64 blue represent 4+4 dim Kaluza-Klein spacetime position and momentum

Here is how the 2-dim physical interpretations correspond
 to the 8-dim Sphere Latitude decomposition:

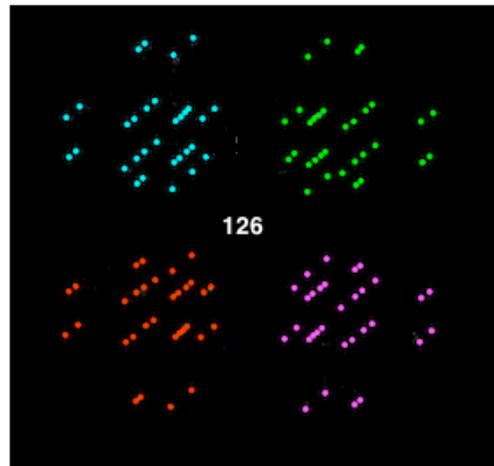
1 is at North Pole



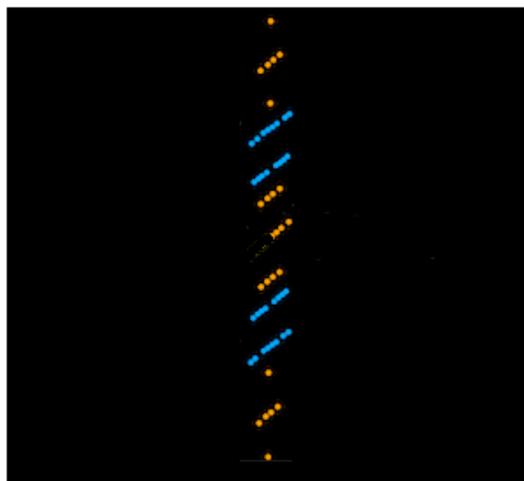
56 nearest neighbors of the North Pole
are at North Temperate Latitude



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Recipe for constructing Lagrangian from E8 Root Vectors

My favorite Fundamental Structure of Physics is the Lagrangian.
In his Dirac Lecture, Steven Weinberg says "... Lagrangian density ...
you can think of it as the density of energy.
Energy is the quantity that ... tells us how the system evolves. ...".

The Lagrangian Density contains Boson terms and Fermion terms.
To get the full Lagrangian, you integrate those terms over Spacetime.

The Code or Recipe just says:

put
the Gravity + Dark Energy Gauge Bosons and Standard Model Ghosts
and
the Standard Model Gauge Bosons and Gravity-Dark Energy Ghosts
into the Lagrangian Density Boson terms in accord with the standard way of
constructing physics boson terms

and

put
the Fermion Particles and AntiParticles
into the Lagrangian Density Fermion terms in accord with the standard way of
constructing physics fermion terms

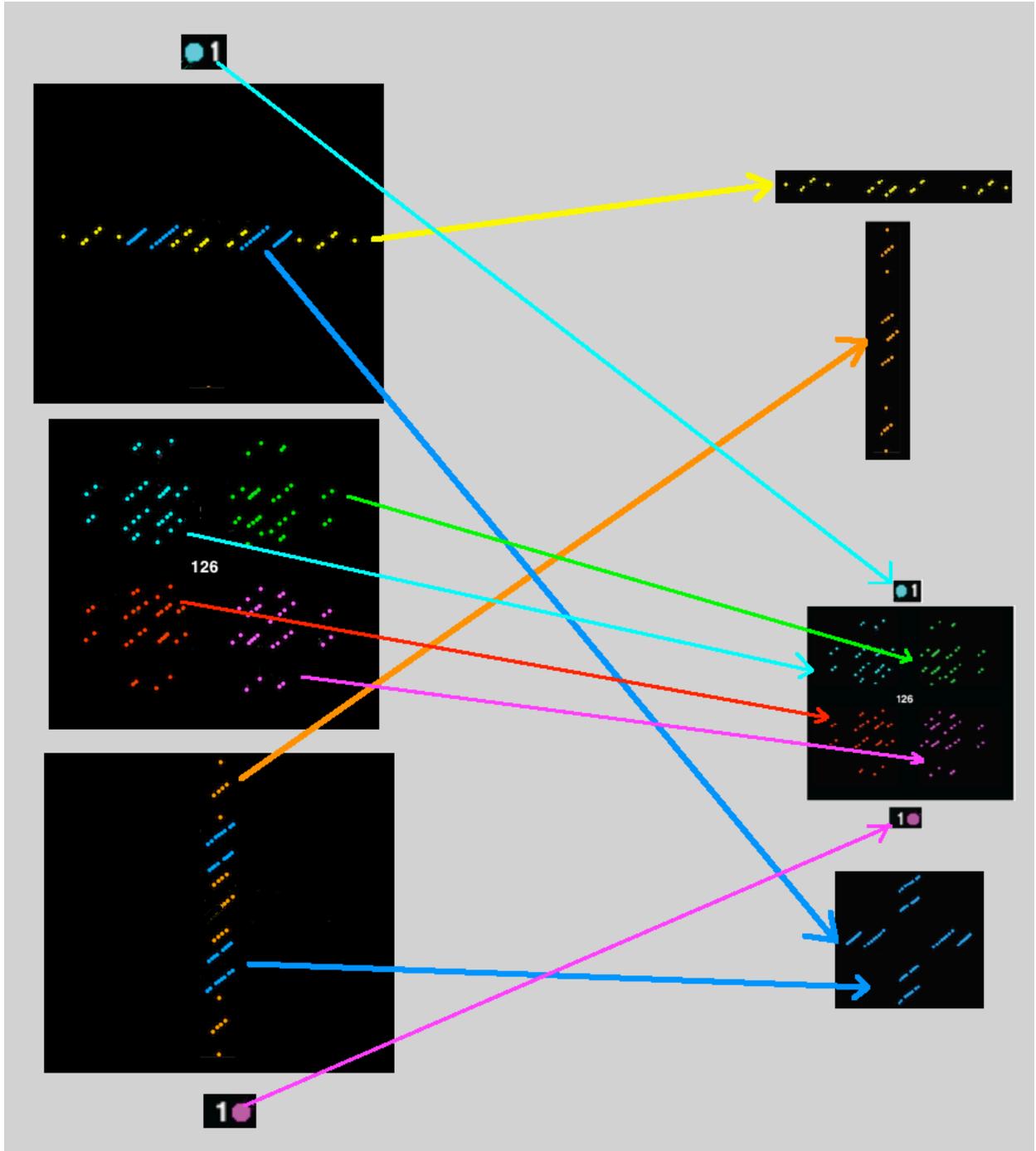
and

put the Spacetime Root Vectors
into the Spacetime Base Manifold over which the Lagrangian Density is integrated.

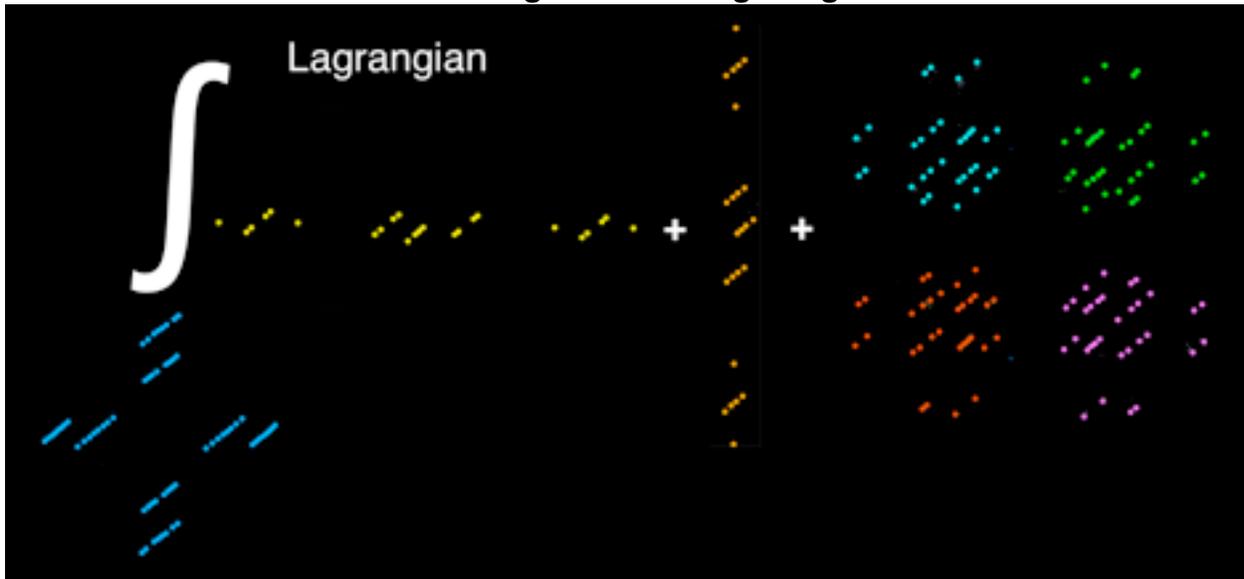
In terms of the preceding pictures of physics of E8 Root Vectors
the Code or Recipe gives a Lagrangian that is a realistic physics model.

Of course, to completely carry out the Code or Recipe you need to write out
the Lagrangian terms in the math language of conventional physics
and that is described in some of the long papers I have written
(see my web site and my viXra papers).

Here I am just trying to show the basic underlying structure of E8 Geometry
so I am not writing down the extensive details in this paper.



The fundamental Lagrangian formed by this structure is an Octonionic structure over 8-dim Spacetime and is effective during the Initial Big Bang and Inflation.



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 and the Octonionic Integral becomes two Quaternionic Integrals but

the Octonionic Lagrangian can be used as a basis for constructing an AQFT (Algebraic Quantum Field Theory)

by embedding each local E8 local classical Lagrangian into a copy of Cl(0,16)
The E8 Physics Creation Sequence begins with Spinor/Clifford Algebra Doubling

$$\mathbf{Cl(0,0) \rightarrow Cl(0,2) \rightarrow Cl(0,4) \rightarrow Cl(0,6) \rightarrow Cl(0,8) \rightarrow}$$

that goes to Cl(0,8) which has Vector - Half-Spinor Triality and is the Basic Building Block of 8-Periodicity of Real Clifford Algebras whereby the Creation Sequence continues by Tensor Product

$$\mathbf{\rightarrow Cl(0,8) \times Cl(0,8) = Cl(0,16) \rightarrow Cl(0,16) \times Cl(0,8) = Cl(0,24) \rightarrow}$$

Cl(0,16) contains the Maximal Exceptional E8 Lie Algebra

Cl(0,24) contains the Vector Space of the 24-dim Leech Lattice Λ_{24} that is 3 copies of E8 Lattices (2 being Integral Domains and 1 not Algebraically closed)

The Creation Sequence continues by constructing the Conformal Structure of 2x2 matrices with entries in Cl(0,24) = M(2,Cl(0,24))

$$\mathbf{\rightarrow M(2,Cl(0,24)) = Cl(1,25) \rightarrow}$$

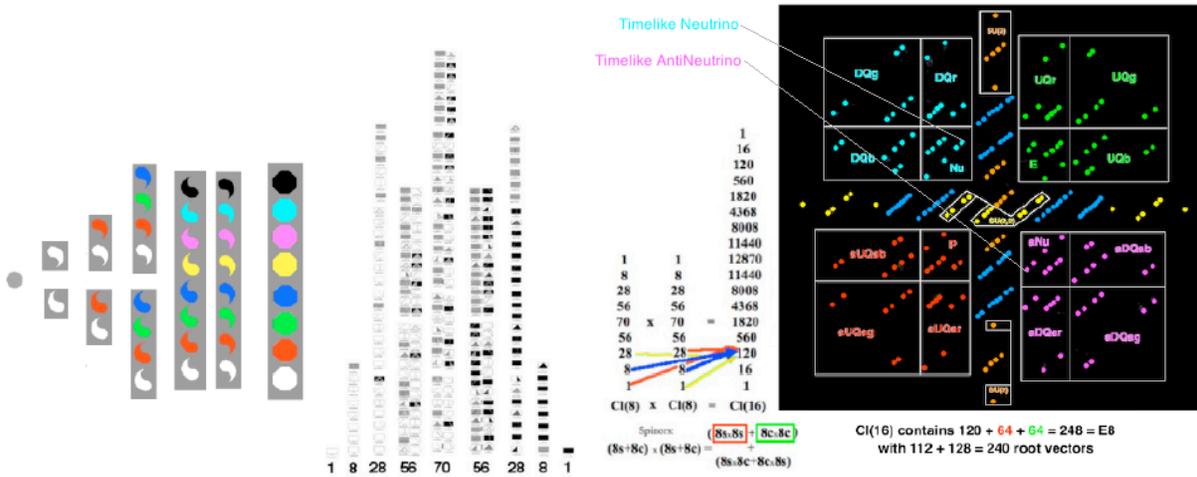
Since all the matrix entries are Cl(0,24) = tensor product of 3 copies of Cl(0,8)

8-Periodicity allows formation of the tensor products of copies of Cl(1,25)

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

(This hyperfinite algebra structure corresponds to the Universal Action Reservoir of Garrett Lisi in arXiv physics/0605068)

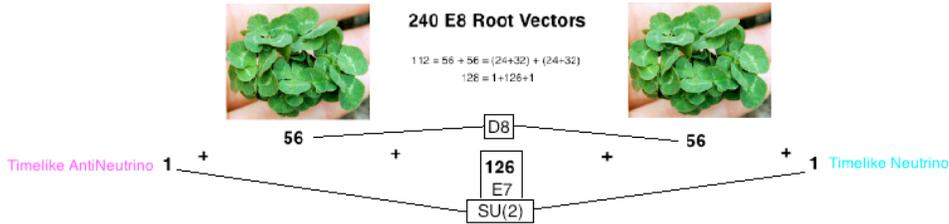
$Cl(0,0) \rightarrow Cl(0,2) \rightarrow Cl(0,4) \rightarrow Cl(0,6) \rightarrow Cl(0,8) \rightarrow Cl(0,8) \times Cl(0,8) = Cl(0,16) \rightarrow Cl(0,16) \times Cl(0,8) = Cl(0,24) \rightarrow M(2, Cl(0,24)) = Cl(1,25) \rightarrow$
 \rightarrow Completion of Union of All Tensor Products of $Cl(1,25) =$ hyperfinite AQFT
 $Cl(1,25) = Cl(1,9) \times Cl(0,8) \times Cl(0,8)$ and $Cl(1,9) = Cl(1,5) \times Cl(0,4) = Cl(2,4) \times Cl(0,4)$



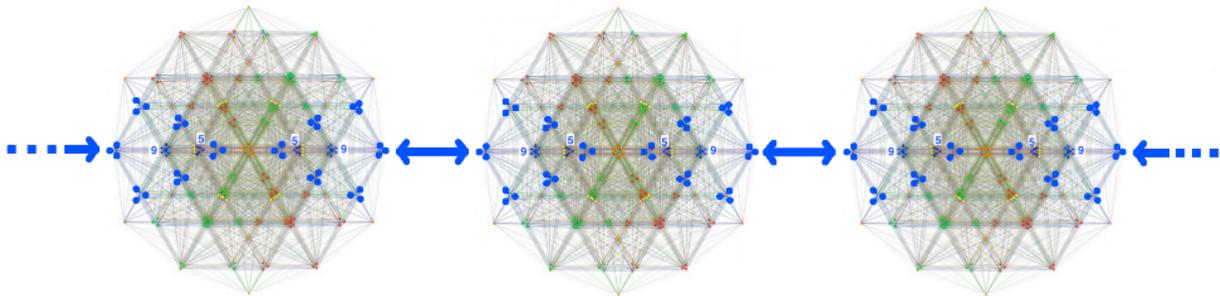
The completion of the union of all tensor products of $Cl(16) = Cl(8) \times Cl(8)$ produces a generalized Hyperfinite III von Neumann factor that gives the $Cl(16)$ -E8 model a natural Algebraic Quantum Field Theory

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

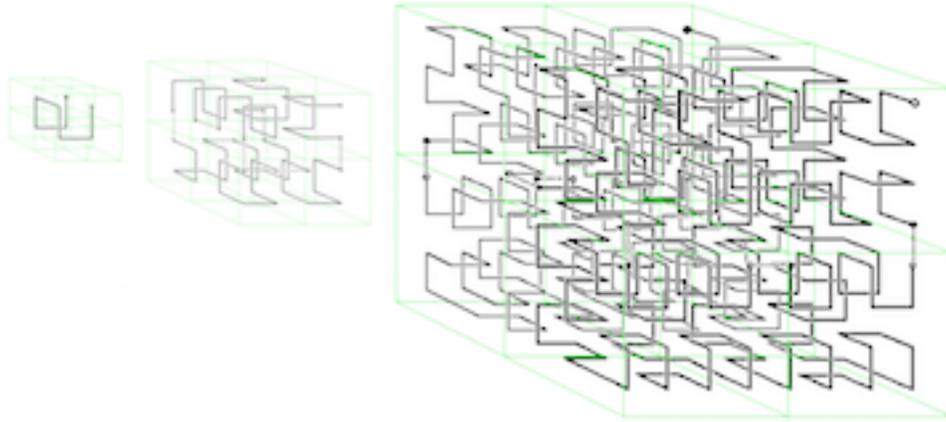
The Creation-Annihilation Operator structure of $Cl(16)$ -E8 AQFT is given by the Maximal Contraction of $E_8 =$ semidirect product $A_7 \times h_{92}$ where $h_{92} = 92+1+92 = 185$ -dim Heisenberg algebra and $A_7 = 63$ -dim $SL(8)$



One $Cl(1,25)$ containing one $Cl(0,16)$ containing one E_8 gives a Lagrangian description of one local spacetime neighborhood. To get a realistic global spacetime structure, take the tensor product $Cl(1,25) \times \dots \times Cl(1,25)$ with all E_8 local 8-dim Octonionic spacetimes consistently aligned as described by 64-dim $D_8 / D_4 \times D_4$ (blue dots) (this visualization uses a hexagonal type of projection of the 240 E_8 root vectors to 2-dim)



which then fill up spacetime according to Gray Code Hilbert's curves:



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.

The $Cl(1,25)$ E8 AQFT inherits structure from the $Cl(1,25)$ E8 Local Lagrangian

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

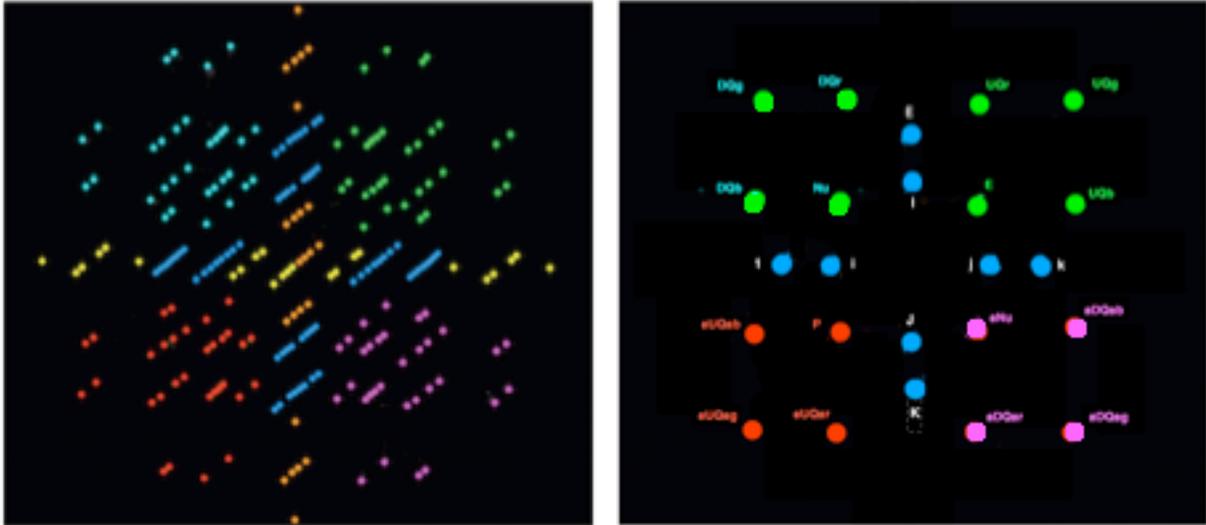
whereby World-Lines of Particles are represented by Strings moving in a space whose dimensionality includes $8v = 8\text{-dim SpaceTime Dimensions} +$
 $+ 8s+ = 8 \text{ Fermion Particle Types} + 8s- = 8 \text{ Fermion AntiParticle Types}$
 combined in the traceless part $J(3,O)_o$ of the 3×3 Octonion Hermitian Jordan Algebra
 a $8s+ 8v$

$8s+^* b 8s-$

$8v^* 8s-^* -a-b$

which has total dimension $8v + 8s+ + 8s- + 2 = 26$ and is the space of a 26D String Theory with Strings seen as World-Lines.

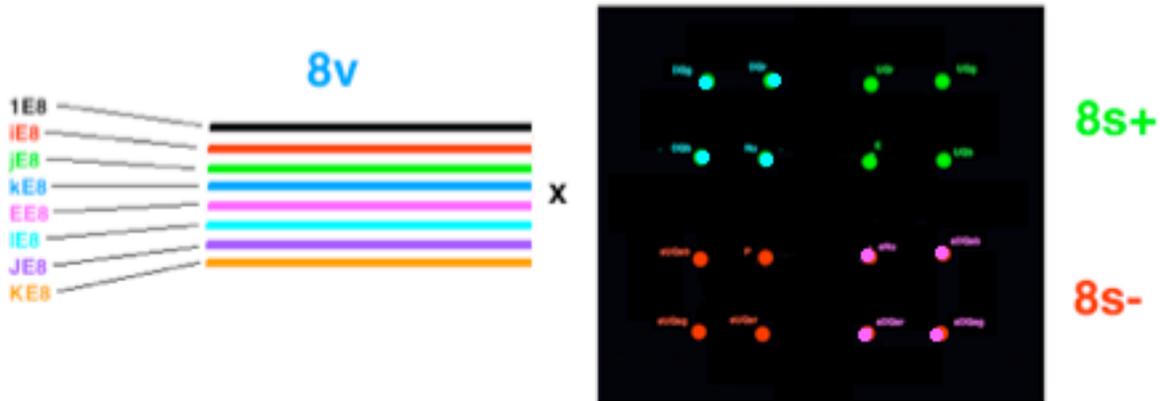
24 = 8v + 8s+ + 8s- of the 26 dimensions of 26D String Theory correspond to 24x8 = 192 of the 240 E8 Root Vectors by representing the 8v + 8s+ + 8s- as superpositions of their respective 8 components



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



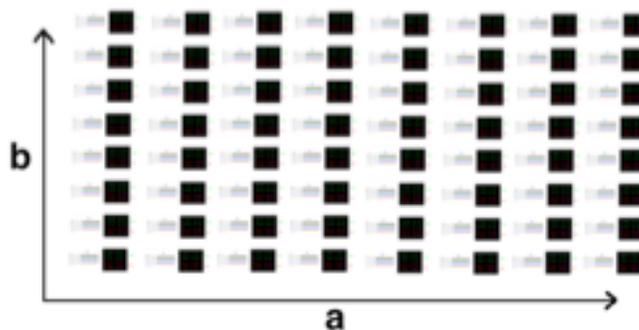
A single Snapshot of SpaceTime is represented by a D8 brane at each point of which is placed Fermion Particles or AntiParticles represented by $8+8 = 16$ orbifolded dimensions of the 26 dimensions of 26D String Theory.



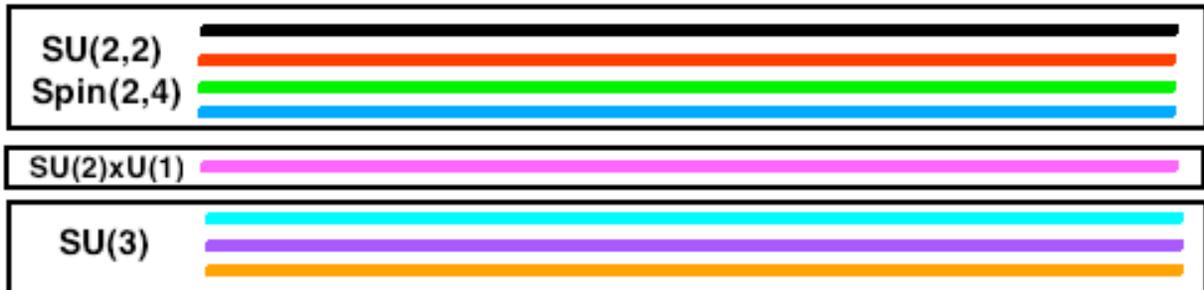
It is necessary to patch together SpaceTime Snapshots to form a Global Structure describing a Many-Worlds Global Algebraic Quantum Field Theory (AQFT) whose structure is described by Deutsch in "The Fabric of Reality" (Penguin 1997 pp. 276-283):

"... there is no fundamental demarcation between snapshots of other times and snapshots of other universes ... Other times are just special cases of other universes ... Suppose ... we toss a coin ... Each point in the diagram represents one snapshot ... in the multiverse there are far too many snapshots for clock readings alone to locate a snapshot relative to the others. To do that, we need to consider the intricate detail of which snapshots determine which others. ... in some regions of the multiverse, and in some places in space, the snapshots of some physical objects do fall, for a period, into chains, each of whose members determines all the others to a good approximation ...".

The Many-Worlds Snapshots are structured as a 26-dim Lorentz Leech Lattice of 26D String Theory parameterized by the a and b of $J(3,0)_0$ as indicated in this 64-element subset of Snapshots



The $240 - 192 = 48 = 24+24$ Root Vector Vertices of E_8 that do not represent the 8-dim D8 brane or the $8+8 = 16$ dim of Orbifolds for Fermions do represent the Gauge Bosons (and their Ghosts) of E_8 Physics:
 Gauge Bosons from $1E_8, iE_8, jE_8,$ and kE_8 parts of a D8 give $U(2,2)$ Conformal Gravity
 Gauge Bosons from EE_8 part of a D8 give $U(2)$ Electroweak Force
 Gauge Bosons from $IE_8, JE_8,$ and KE_8 parts of a D8 give $SU(3)$ Color Force



Each Deutsch chain of determination represents a World-Line of Particles / AntiParticles corresponding to a String of 26D String Theory such as the red line in this 64-element subset of Snapshots



26D String Theory is the Theory of Interactions of Strings = World-Lines = Paths
 (World-Lines = Path Integral Paths of Garrett Lisi in arXiv physics/0605068)

Interactions of World-Lines can describe Quantum Theory according to Andrew Gray (arXiv quant-ph/9712037):
 "... probabilities are ... assigned to entire fine-grained histories ... base[d] ... on the Feynman path integral formulation ...
 The formulation is fully relativistic and applicable to multi-particle systems.
 It ... makes the same experimental predictions as quantum field theory ...".

Green, Schwartz, and Witten say in their book "Superstring Theory" vol. 1 (Cambridge 1986)

"... For the ... closed ... bosonic string [26D String Theory] 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 ...".

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 (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.

**The Creation-Annihilation Operator structure
of the Bohm Quantum Potential of 26D String Theory
and
AQFT Quantum Code Information System**

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)

The Maximal E8 Contraction A7 x h92 can be written as a 5-Graded Lie Algebra
28 + 64 + (SL(8,R) + 1) + 64 + 28

Central Even Grade 0 = SL(8,R) + 1

The 1 is a scalar and SL(8,R) = Spin(8) + Traceless Symmetric 8x8 Matrices,
so SL(8,R) represents a local 8-dim SpaceTime in Polar Coordinates.

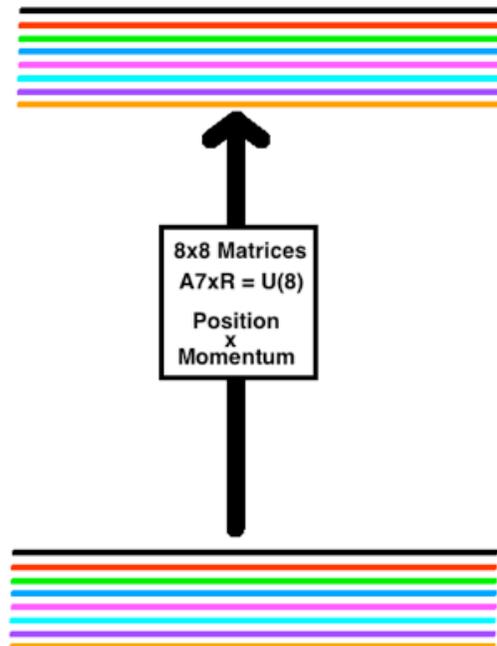
Odd Grades -1 and +1 = 64 + 64

Each = 64 = 8x8 = Creation/Annihilation Operators
for 8 components of 8 Fundamental Fermions.

Even Grades -2 and +2 = 28 + 28

Each = Creation/Annihilation Operators
for 28 Gauge Bosons of Gravity + Standard Model.

The 8x8 matrices linking one D8 to the next D8 of a World-Line String give $A7 \times R = U(8)$ representing **Position x Momentum**



Cerf and Adami in quantum-ph/9512022 describe virtual qubit-anti-qubit pairs (they call them ebit-anti-ebitpairs) that are related to negative conditional entropies for quantum entangled systems and are similar to fermion particle-antiparticle pairs. Therefore quantum information processes can be described by particle-antiparticle diagrams much like particle physics diagrams and the **Algebraic Quantum Field Theory of the $Cl(1,25)$ E8 Physics Model should have a Quantum Code Information System** that is based on structure of a unit cell in 26D String Theory represented by Real Clifford Algebra $Cl(0,8) \times Cl(0,8) \times Cl(0,8) = Cl(0,24)$

Since Quantum Reed-Muller code $[[256 , 0 , 24]]$ corresponds to Real Clifford Algebra $Cl(0,8)$

Tensor Product Quantum Reed-Muller code
 $[[256 , 0 , 24]]$ x $[[256 , 0 , 24]]$ x $[[256 , 0 , 24]]$
 corresponds to

AQFT (Algebraic Quantum Field Theory) hyperfinite von Neumann factor algebra that is Completion of the Union of All Tensor Products of $Cl(1,25)$

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
=
2⁴⁶ .3²⁰ .5⁹ .7⁶ .11² .13³ .17.19.23.29.31.41.47.59.71
or about 8 x 10⁵³.

What happens to a Fundamental Fermion Particle whose World-Line string intersects a Single Cell ?

The Fundamental Fermion Particle does not remain a single Planck-scale entity. Tachyons create clouds of particles/antiparticles as described by Bert Schroer in hep-th/9908021: "... any compactly localized operator applied to the vacuum generates clouds of pairs of particle/antiparticles ... More specifically it leads to the impossibility of having a local generation of pure one-particle vectors unless the system is interaction-free ...".

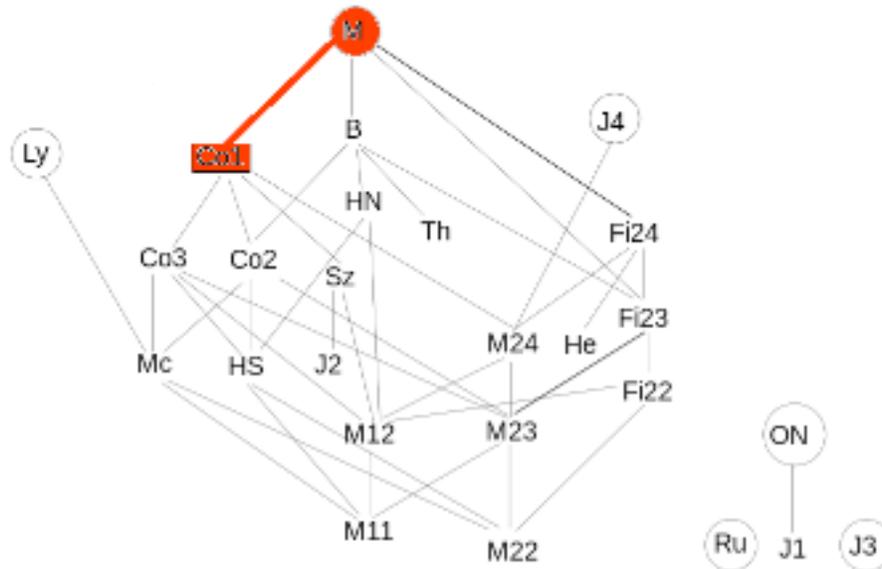
What is the structural form of the Fundamental Fermion Cloud ?

In "Kerr-Newman [Black Hole] solution as a Dirac particle", hep-th/0210103, H. I. Arcos and J. G. Pereira say: "... For $m^2 < a^2 + q^2$, with m , a , and q respectively the source mass, angular momentum per unit mass, and electric charge, the Kerr-Newman (KN) solution of Einstein's equation reduces to a naked singularity of circular shape, enclosing a disk across which the metric components fail to be smooth ... due to its topological structure, the extended KN spacetime does admit states with half-integral angular momentum. ... The state vector ... evolution is ... governed by the Dirac equation. ... for symmetry reasons, the electric dipole moment of the KN solution vanishes identically, a result that is within the limits of experimental data ... a and m are thought of as parameters of the KN solution, which only asymptotically correspond respectively to angular momentum per unit mass and mass. Near the singularity, a represents the radius of the singular ring ... With ... renormalization ... for the usual scattering energies, the resulting radius is below the experimental limit for the extendedness of the electron ...".

What is the size of the Fundamental Fermion Kerr-Newman Cloud ?

The FFKN Cloud is one Planck-scale Fundamental Fermion Valence Particle plus an effectively neutral cloud of particle/antiparticle pairs. The symmetry of the cloud is governed by the 24-dimensional Leech lattice by which the Single Cell was formed.

Here (adapted from Wikipedia) is a chart of the Monster M and its relation to other Sporadic Finite Groups and some basic facts and commentary:



The largest such subgroups of M are B, Fi24, and Co1.

B, the Baby Monster, is sort of like a downsized version of M, as B contains Co2 and Fi23 while M contains Co1 and Fi24.

Fi24 (more conventionally denoted Fi24') is of order $1255205709190661721292800 = 1.2 \times 10^{24}$. It is the centralizer of an element of order 3 in the monster group M and is a triple cover of a 3-transposition group. It may be that Fi24' symmetry has its origin in the Triality of E8 26-dim String Theory.

The order of Co1 is $2^{21} \cdot 3^9 \cdot 5^4 \cdot 7^2 \cdot 11 \cdot 13 \cdot 23$ or about 4×10^{18} .

$\text{Aut}(\text{Leech Lattice}) = \text{double cover of Co1}$.

The order of the double cover $2 \cdot \text{Co1}$ is $2^{22} \cdot 3^9 \cdot 5^4 \cdot 7^2 \cdot 11 \cdot 13 \cdot 23$ or about 0.8×10^{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 maximal subgroup of M involving Co1 is $2^{(1+24)} \cdot \text{Co1}$ of order

$139511839126336328171520000 = 1.4 \times 10^{26}$

As $2 \cdot \text{Co1}$ is the Automorphism group of the Leech Lattice modulo to which the Single Cell was formed, and as

the E8 26-dim String Theory Leech Lattice is a superposition of 8 Leech Lattices, $8 \times 2^{(1+24)} \cdot \text{Co1}$ describes the structure of the FFKN Cloud. Therefore,

the volume of the FFKN Cloud should be on the order of 10^{27} x Planck scale,

and

the FFKN Cloud should contain on the order of 10^{27} particle/antiparticle pairs

and its size should be somewhat larger than, but roughly similar to,

$10^{(27/3)} \times 1.6 \times 10^{(-33)} \text{ cm} = \text{roughly } 10^{(-24)} \text{ cm}.$

FFKN Clouds are Schwinger Sources.

Schwinger Sources, Hua Geometry, and Wyler Calculations

Fock “Fundamental of Quantum Mechanics” (1931) showed that sources require 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:

$$\begin{aligned} S^1 \times S^1 \times S^1 \times S^1 &= 4 \text{ copies of } U(1) \\ S^2 \times S^2 &= 2 \text{ copies of } SU(2) \\ CP^2 &= SU(3) / SU(2) \times U(1) \\ S^4 = Spin(5) / Spin(4) &= \text{Euclidean version of } Spin(2,3) / Spin(1,3) \end{aligned}$$

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 throughout ... 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 experimenter... must detect the particles ...[by]... collision that annihilates the particle ... the source ... can be ... an abstraction of an annihilation collision, with the source acting negatively, as a sink ... The basic things are ... the source functions ... describing the intermediate propagation of the particle ...”.

Schwinger Sources can be described by continuous manifold structures of Bounded Complex Domains and their Shilov Boundaries but

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.

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 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 Kerr-Newman cloud constitutes the E8 Physics model Schwinger Source.

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

The Cl(1,25) E8 model Lagrangian over 4-dim Minkowski SpaceTime M4 is

$$\int_{4\text{-dim M4}} GG + SM + \text{Fermion Particle-AntiParticle} + \text{Higgs}$$

Consider the **Fermion Term**.

In the conventional picture, the spinor fermion term is of the form $m S S^*$ where m is the fermion mass and S and S^* represent the given fermion.

The Higgs coupling constants are, in the conventional picture, ad hoc parameters, so that effectively the mass term is, in the conventional picture, an ad hoc inclusion.

The Cl(1,25) E8 model 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.

Fermion Schwinger Sources correspond to the Lie Sphere Symmetric space $\text{Spin}(10) / \text{Spin}(8) \times U(1)$

which has

local symmetry of the Spin(8) gauge group from which the first generation spinor fermions are formed as **+half-spinor** and **-half-spinor** spaces and Bounded Complex Domain D8 of type IV8 and Shilov Boundary Q8 = $\text{RP}^1 \times S^7$

Consider the **GG + SM** term from Gauge Gravity and Standard Model Gauge Bosons. The process of breaking Octonionic 8-dim SpaceTime down to Quaternionic (4+4)-dim $M_4 \times CP^2$ Kaluza-Klein creates differences in the way gauge bosons "see" 4-dim Physical SpaceTime. There are 4 equivalence classes of 4-dimensional Riemannian Symmetric Spaces with Quaternionic structure consistent with 4-dim Physical SpaceTime:

S^4 = 4-sphere = $Spin(5) / Spin(4)$ where $Spin(5)$ = Schwinger-Euclidean version of the Anti-DeSitter subgroup of the Conformal Group that gives **MacDowell-Mansouri Gravity**

CP^2 = complex projective 2-space = $SU(3) / U(2)$ with **the $SU(3)$ of the Color Force**

$S^2 \times S^2$ = $SU(2)/U(1) \times SU(2)/U(1)$ with two copies of **the $SU(2)$ of the Weak Force**

$S^1 \times S^1 \times S^1 \times S^1$ = $U(1) \times U(1) \times U(1) \times U(1)$ = 4 copies of **the $U(1)$ of the EM Photon** (1 copy for each of the 4 covariant components of the Photon)

The Gravity Gauge Bosons (Schwinger-Euclidean versions) live in a $Spin(5)$ subalgebra of the $Spin(6)$ Conformal subalgebra of $D_4 = Spin(8)$. They "see" M_4 Physical spacetime as the 4-sphere S^4 so that their part of the Physical Lagrangian is

\int Gravity Gauge Boson Term

S^4 .

an integral over SpaceTime S^4 .

The Schwinger Sources for GRb bosons are the Complex Bounded Domains and Shilov Boundaries for $Spin(5)$ MacDowell-Mansouri Gravity bosons.

However, due to Stabilization of Condensate SpaceTime by virtual Planck Mass Gravitational Black Holes,

for Gravity, the effective force strength that we see in our experiments is not just composed of the S^4 volume and the $Spin(5)$ Schwinger Source volume, but is suppressed by the square of the Planck Mass.

The unsuppressed Gravity force strength is the Geometric Part of the force strength.

The Standard Model SU(3) Color Force bosons 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 so that their part of the Physical Lagrangian is

\int SU(3) Color Force Gauge Boson Term
CP2 .

an integral over SpaceTime CP2.

The Schwinger Sources for SU(3) bosons are the Complex Bounded Domains and Shilov Boundaries for SU(3) Color Force bosons.

The Color Force Strength is given by the SpaceTime CP2 volume and the SU(3) Schwinger Source volume.

Note that since the Schwinger Source volume is dressed with the particle/antiparticle pair cloud, the calculated force strength is for the characteristic energy level of the Color Force (about 245 MeV).

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 so that their part of the Physical Lagrangian is

\int SU(2) Weak Force Gauge Boson Term
S2xS2 .

an integral over SpaceTime S2xS2.

The Schwinger Sources for SU(2) bosons are the Complex Bounded Domains and Shilov Boundaries for SU(2) Weak Force bosons.

However, due to the action of the Higgs mechanism, for the Weak Force, the effective force strength that we see in our experiments is not just composed of the S2xS2 volume and the SU(2) Schwinger Source volume, but is suppressed by the square of the Weak Boson masses.

The unsuppressed Weak Force strength is the Geometric Part of the force strength.

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 $S^1 \times S^1 \times S^1 \times S^1 = T^4$
 ($T^4 = 4$ -torus) so that their part of the Physical Lagrangian is

$$\int_{T^4} (\text{U(1) Electromagnetism Gauge Boson Term})$$

an integral over SpaceTime T^4 .
 The Schwinger Sources for U(1) photons are the Complex Bounded Domains and Shilov Boundaries for U(1) photons.
 The Electromagnetic Force Strength is given by the SpaceTime T^4 volume and the U(1) Schwinger Source volume.

Schwinger Sources as described above are continuous manifold structures of Bounded Complex Domains and their Shilov Boundaries but the 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.

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 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 Co_1 , for a total order of about 10^{26} .

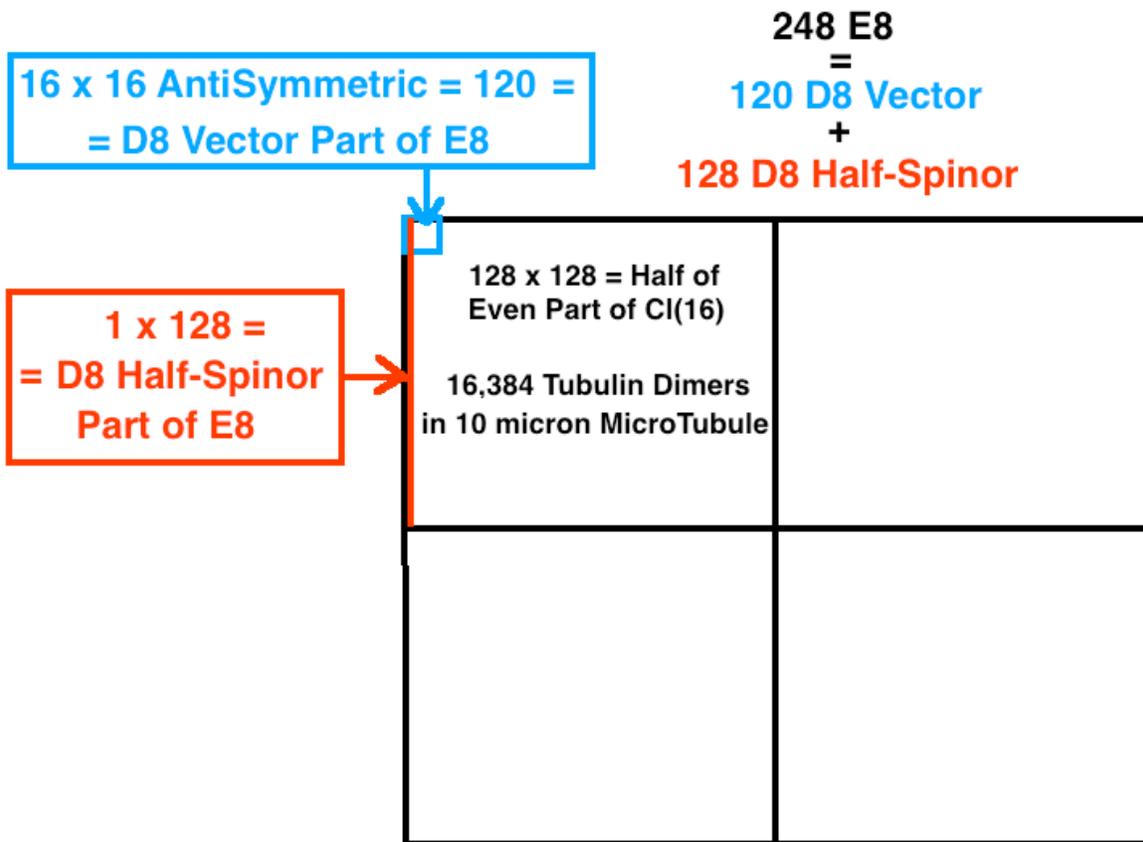
(Since a Leech lattice is based on copies of an E8 lattice and since there are 7 distinct E8 integral domain lattices there are 7 (or 8 if you include a non-integral domain E8 lattice) distinct Leech lattices. The physical Leech lattice is a superposition of them, effectively adding a factor of 8 to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

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

“... 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 ...".

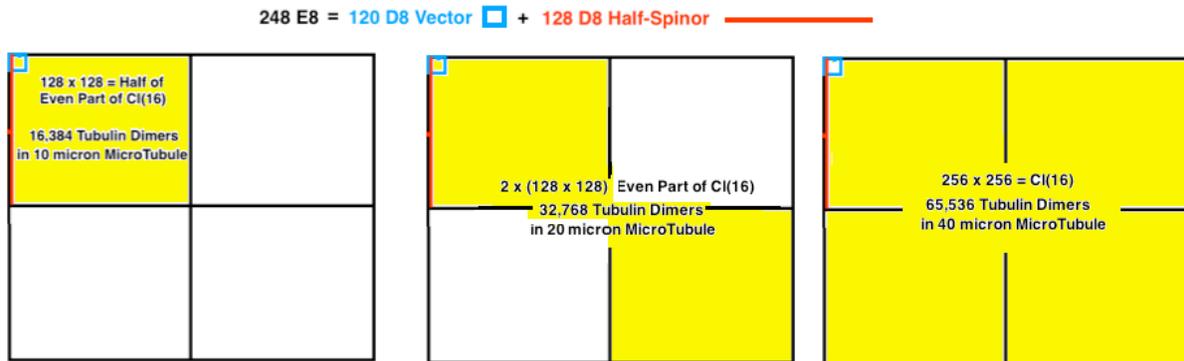
Penrose-Hameroff-type Quantum Consciousness is due to Resonant Quantum Potential Connections among Quantum State Forms. The Quantum State Form of a Conscious Brain is determined by the configuration of a subset of its 10^{18} to 10^{19} Tubulin Dimers with math description in terms of a large Real Clifford Algebra.

Microtubule binary math / code system corresponds to Clifford Algebras $Cl(8)$ and $Cl(8) \times Cl(8) = Cl(16)$ containing E_8
 A 40 micron Microtubule contains Dimers representing the 65,536 elements of $Cl(16)$ which contains the 248 elements of Lie Algebra E_8 that defines E_8 Physics Lagrangian.



E_8 lives in only half of the block diagonal Even Part half of $Cl(16)$ so that E_8 of E_8 Physics can be represented by the 16,384 Dimers of a 10 micron Microtubule.

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 Cl(16) (10 microns)



or as the Even Part (half) of Cl(16) (20 microns) or as full Cl(16) (40 microns).

In a given Microtubule the 128 D8 Half-Spinor part is represented by a line of 128 Dimers in its stable GTP region and

the 120 D8 Vector part by a 12 x 10 block of Dimers in its stable GTP region
(image adapted from 12biophys.blogspot.com Lecture 11)

How do the Microtubules communicate with each other ?

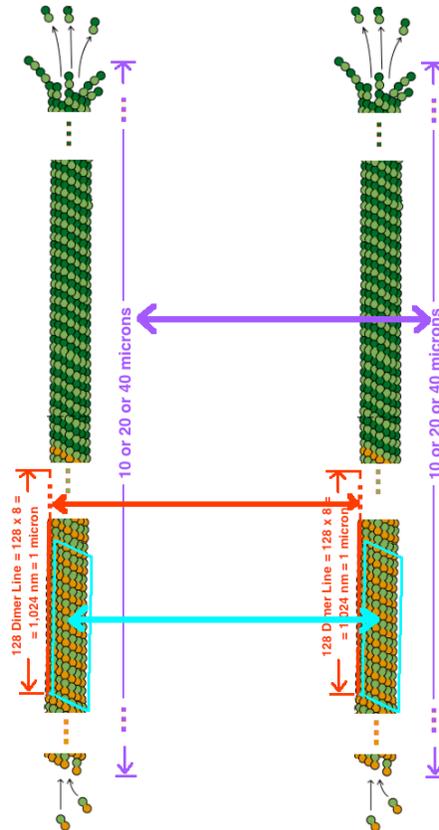
Consider the Superposition of States State 0 and State 1 involving one Tubulin Dimer with Conformation Electron mass m and State1 / State 0 position separation a .

The Superposition Separation Energy Difference is the internal energy

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

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 (purple arrow) with the correspondence being based on connection between respective E8 subsets, the 128 D8 Half-Spinors (red arrow) and the 120 D8 BiVectors (cyan arrow)



How is information encoded in the Microtubules ?

Each Microtubule contains E8, allowing Microtubules to be correlated with each other. The parts of the Microtubule beyond E8 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 $[[256 , 0 , 24]]$

For a 40-micron Microtubule there are, outside the 248-E8 part, about 65,000 TD Qubits available to describe one Quantum Thought State among about $2^{65,000}$ possibilities.

65,536-dimensional Cl(16) not only contains the E8 of E8 Physics and the information content of Microtubules but also contains the information content of DNA chromosome condensation and the information content of mRNA triple - amino acid transformations.

In “Living Matter: Algebra of Molecules” (CRC Press 2016) Valery V. Stcherbic and Leonid P. Buchatsky say: “... DNA structure contains four nucleotides: adenine A, guanine G, cytosine C and thymine T. ...

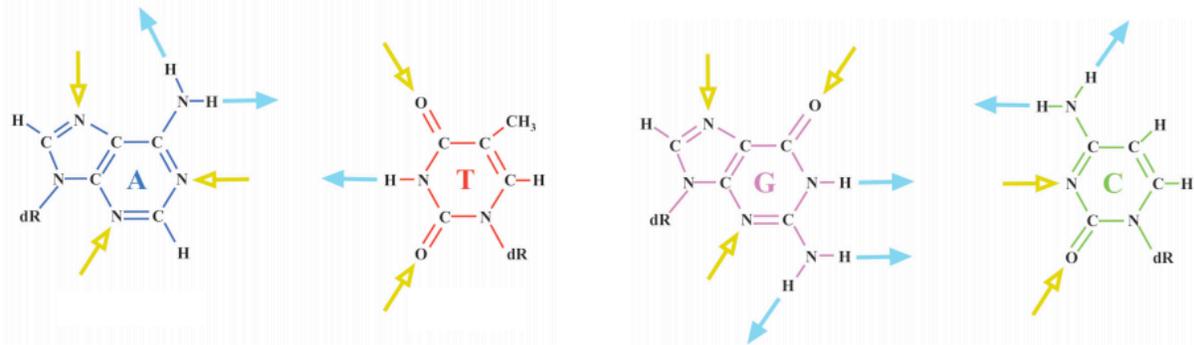


Figure 1.4 Potential vectors of hydrogen bond of DNA nucleotides. Yellow arrows—acceptors, blue arrows—donors of hydrogen.

The space of DNA nucleotide states contains $T^2 \otimes C^2 \otimes A^2 \otimes G^2 = 2^{18}$ elements of Clifford algebras. This space reduction to four nucleotides means compression of DNA information by a factor of $2^{18} / 4 = 65536$. Reduction of the nucleotide state space leads to DNA compactization and chromosome condensation. ...”.

Information lost by condensing DNA is stored in Microtubules through Anaphase after which it has been restored to the new Duplicated DNA

The DNA information condensation factor of 65,536 is the dimension of Cl(16) which is the Real Clifford Algebra containing 248-dim E8 of E8 Physics as 120-dim bivector D8 plus 128-dim D8 half-spinor and is also the Clifford Algebra of Microtubule information in Quantum Consciousness.

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

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

The decoherence time for the system of N Tubulin Electrons is

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

so we have the following rough approximate Decoherence Times T_N

Number of Involved Tubulin Dimers	Time T_N	
$10^{(11+9)} = 10^{20}$	$10^{(-33 + 26)} = 10^{(-7)}$ sec	10^{11} neurons x 10^9 TD / neuron = 10^{20} Tubulin Dimers in Human Brain
10^{16}	$10^{(-27 + 26)} = 10^{(-1)}$ sec - 10 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 $10^{16} \times 10 \text{ nm} / c = (10^{16} \times 10^{(-6)}) \text{ cm} / c = 10^{10} \text{ cm} / c = 0.3$ sec

Condensate Structure of Higgs and Spacetime

“... The Nambu Jona-Lasinio model ...
is a theory of Dirac particles with a local 4-fermion interaction and, as such, it belongs to
the same class of effective theories as the BCS theory of superconducting metals ...
the Nambu Jona-Lasinio model has very recently been applied to the standard model.
In this application the Higgs meson is a $t\bar{t}$ top quark mass excitation ...”.

(from Nambu Jona-Lasinio Models Applied to Dense Hadronic Matter, by Georges Ripka,
in a Workshop on Nuclear Physics, Iguazu Falls, 28 Aug - 1 Sep 1989)

As to the Higgs in the E8 physics model (viXra 1602.0319),
consider a generalized Nambu Jona-Lasinio model in which
the Higgs is a Fermion-AntiFermion condensate. As the most massive fermion,
the Truth Quark - AntiQuark pairs would be so dominant that the Higgs could be
effectively considered as a condensate of Truth Quark - Truth AntiQuark pairs
but the detailed picture would be as a condensate of Fermion - Anti-Fermion pairs
where there are 24 types of Fermions, each Quark coming in color R, G, or B:

E-Neutrino and Electron
Down Quark (R, G, B) and Up Quark (R, G, B)
M-Neutrino and Muon
Strange Quark (R, G, B) and Charm Quark (R, G, B)
T-Neutrino and Tauon
Beauty Quark (R, G, B) and Truth Quark (R, G, B)

so that there are $24 \times 24 = 576$ Fermion-AntiFermion pairs for each Higgs and each
Higgs can be in Bohm Quantum Resonance with 24×24 Bohm Quantum String states:
dilaton; antisymmetric Planck-cell group; and symmetric Bohm Quantum Potential.

As to Spacetime in the E8 physics model (viXra 1602.0319),
consider a generalized Nambu Jona-Lasinio model in which
8-dim Classical Lagrangian Spacetime is a condensate of Geoffrey Dixon's
64-dim Particle spinor $T = RxCxHxO = \text{Real} \times \text{Complex} \times \text{Quaternion} \times \text{Octonion}$
and its corresponding 64-dim AntiParticle spinor $Tbar$.

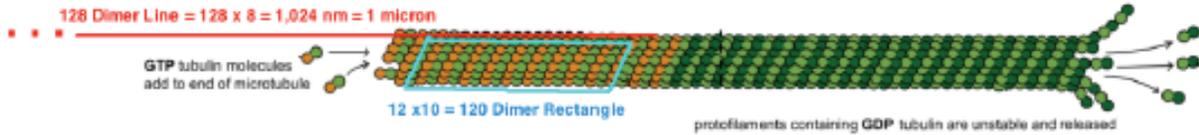
The T - Tbar pairs of the condensate form the 128-dim part of E8
that lives in the $Cl(16)$ Real Clifford Algebra as

$$\mathbf{248\text{-dim E8} = 120\text{-dim bivector D8} + 128\text{-dim half-spinor D8}$$

By Triality, the $D8 / D4 \times D4 = 64\text{-dim}$ part of E8 representing Spacetime is equivalent
to T and Tbar, with T representing Fermions and Tbar representing AntiFermions.

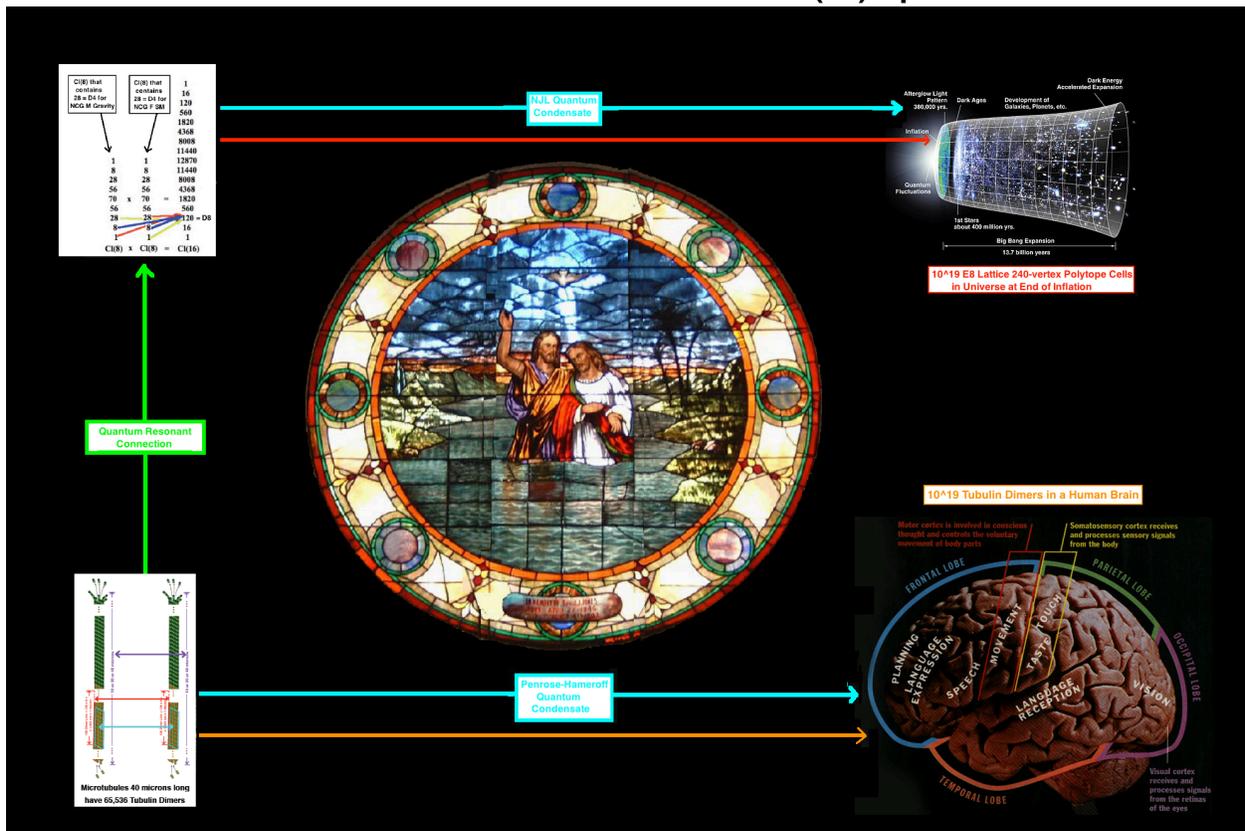
Each cell of E8 Classical Lagrangian Spacetime corresponds to 65,536-dim CI(16) which contains 248-dim E8 = 120-dim D8 bivectors +128-dim D8 half-spinors

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 CI(16) Spacetime cells



(image from Wikipedia and Time)

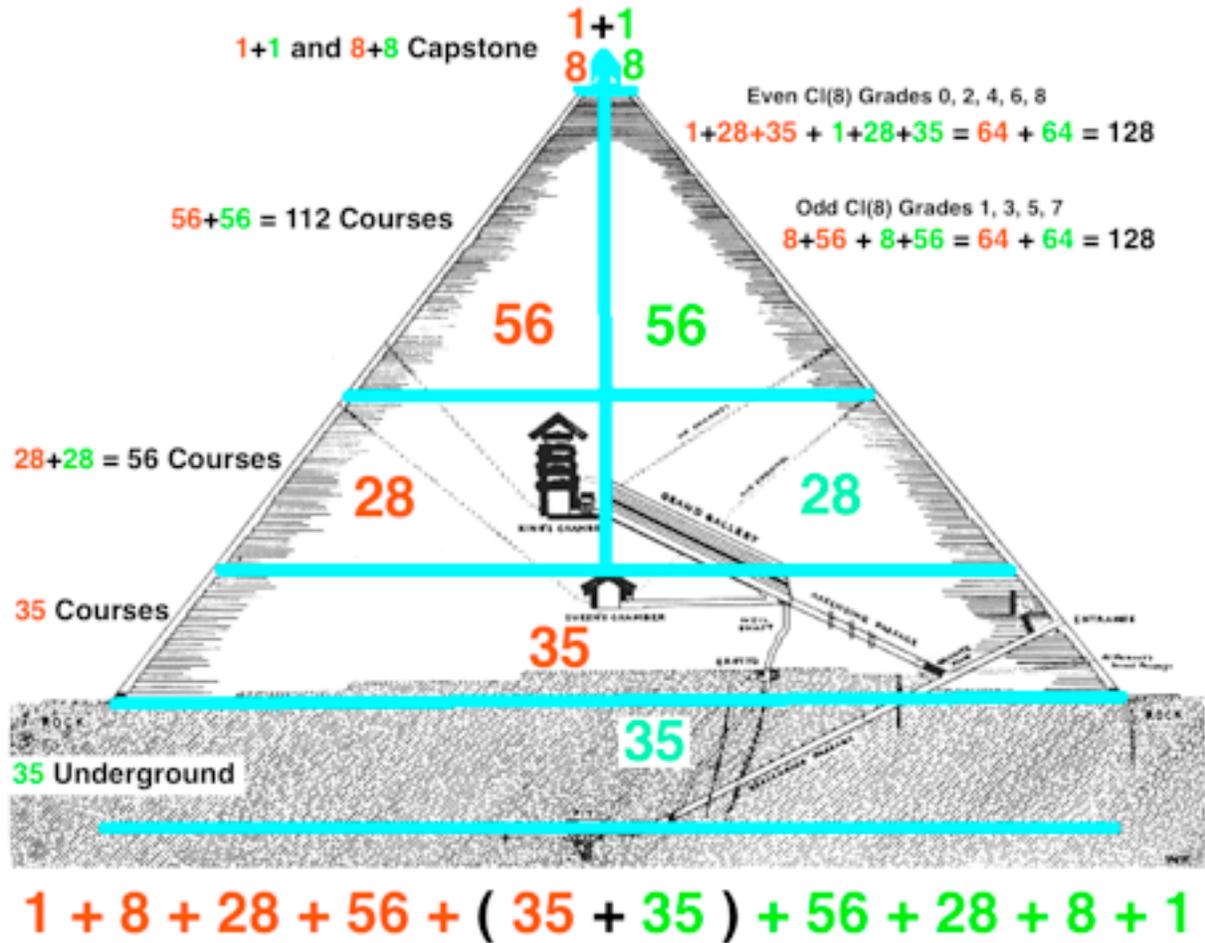
so that at any and all Times
the **State of Consciousness of a Human**
is in exact resonant correspondence with
a subset of the cells of E8 Classical Lagrangian Spacetime

Therefore

E8 Classical Lagrangian Spacetime NJL Condensate is effectively the **Spirit World** in which the **Human States of Consciousness = Souls** exist.

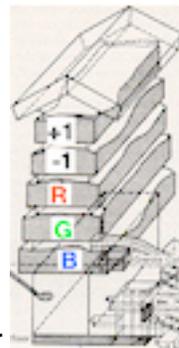
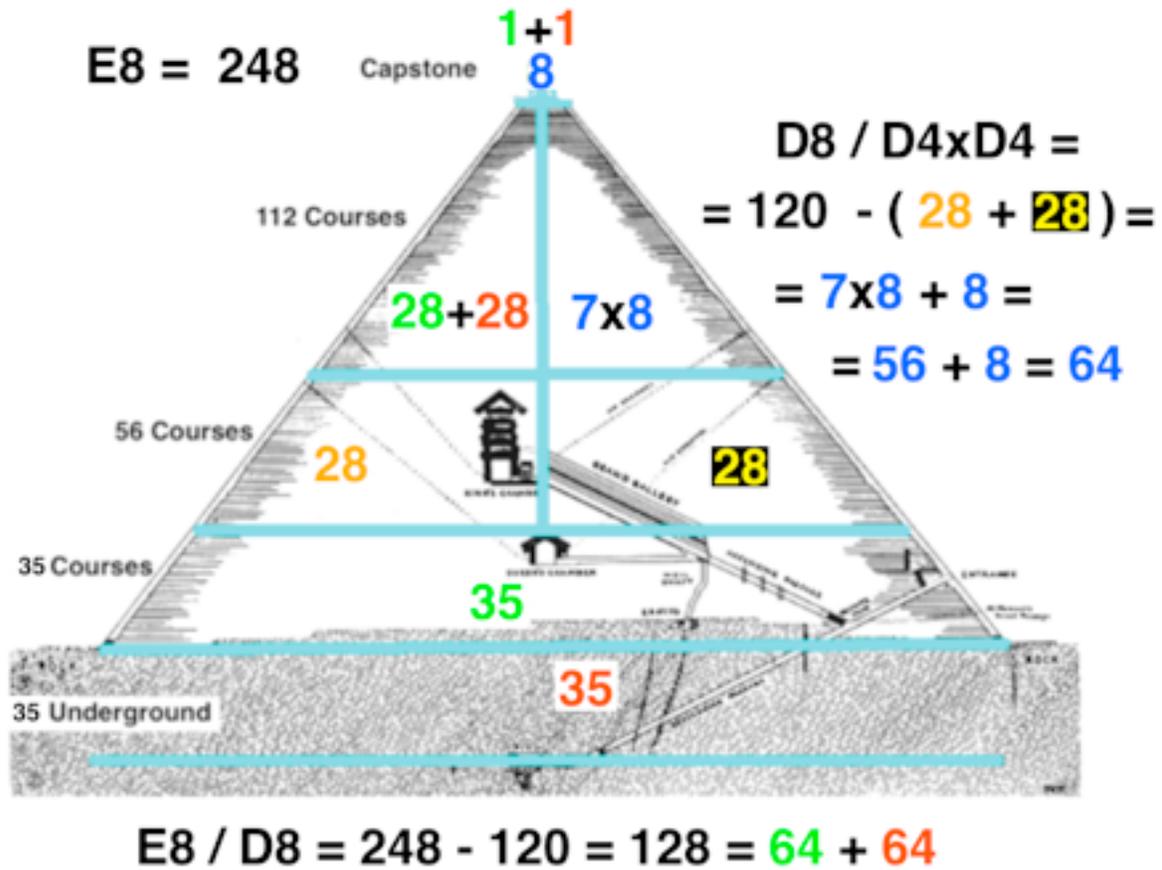
After the death of the Human Physical Body the Spirit World interactions with its Soul are no longer constrained by Physical World interactions with its Body so that the Spirit World can harmonize the individual Soul with the collective Universal Soul by the process of Gehinnom whereby the Soul is prepared for Gan Eden.

Clifford Algebras were not known to European mathematicians until Clifford in the 19th century and not known to European physicists until Dirac in the 20th century but it seems to me that their structure was known to Africans in ancient times. For example, the courses of the Great Pyramid of Giza correspond to the graded structure of $Cl(8)$:

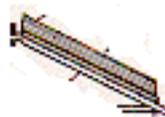


(image adapted from David Davidson image - for larger size see tony5m17h.net/GreatPyrCl8.png)

248-dim E8 (like 256-dim Cl(8)) can also be seen in terms of the Great Pyramid (the 8-dim difference is related to the Cl(8) Primitive Idempotent and the Higgs).



The **28** is in the area of the Upper Chamber which has 5 slabs that represent the 5 charges (+1,-1 electric and R,G,B color) of the Standard Model.



The **28** is in the area of the Grand Gallery which rises at a slope of about 26 degrees, or about half of the Golden Ratio slope of the Great Pyramid which is $\arccosine(1 / ((1 + \sqrt{5})/2)) = 51.8$ degrees.

The Grand Gallery could represent a segment of a space-time path (World-Line) in the context of Conformal Gravity