

E8 Physics: Results and Origins

Frank Dodd (Tony) Smith, Jr. - 2018

Abstract:

**My view of the Origins of E8 Physics is
that its basic structure of Real Clifford Algebras
was known in Ancient Africa
and reflected in the Giza Pyramids as of 36,000 years ago,
and
that is only very recently have understanding of Math and Experiment
advanced far enough
to rediscover the Algebraic Quantum Field Theory of E8 Physics.**

**This is an outline of my view of the Results of E8 Physics calculations
of Force Strengths, Particle Masses, ... etc
and my view of the Origins of its ideas.**

It is 115 pdf pages that are intended to be presented as a slide show.

For details, see viXra 1804.0121.

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African Origin, Cellular Automata, Giza Pyramids and Sphinx ... pages 4-23

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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.

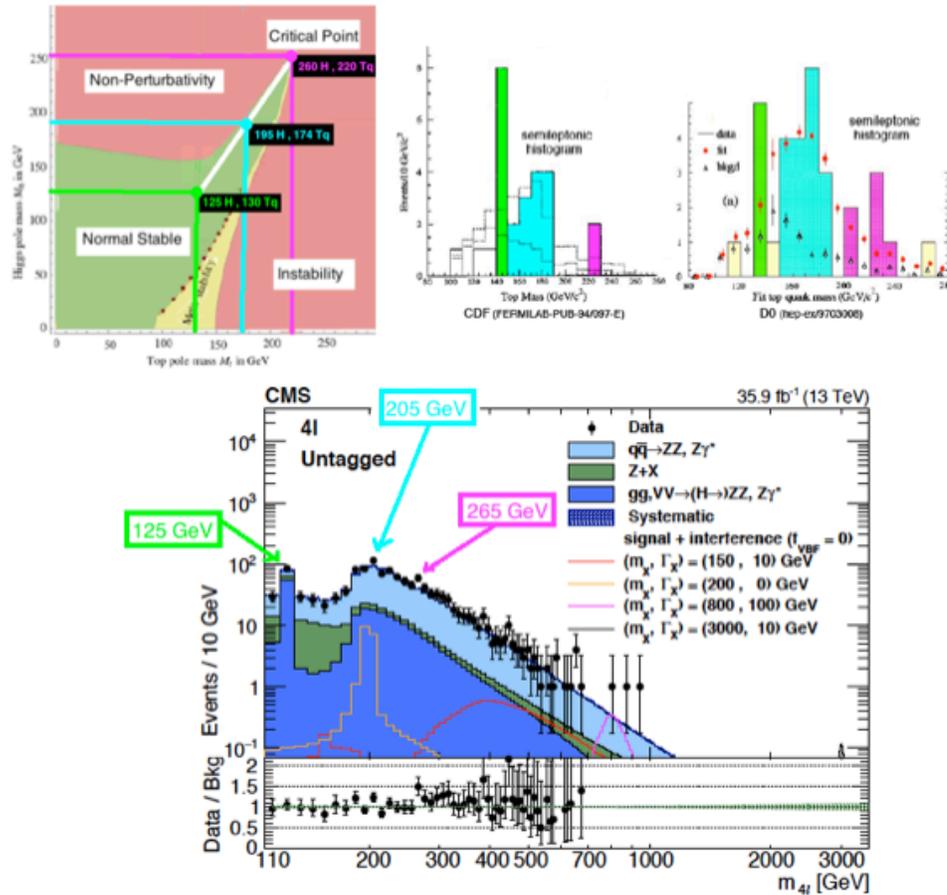
E8 Physics:

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

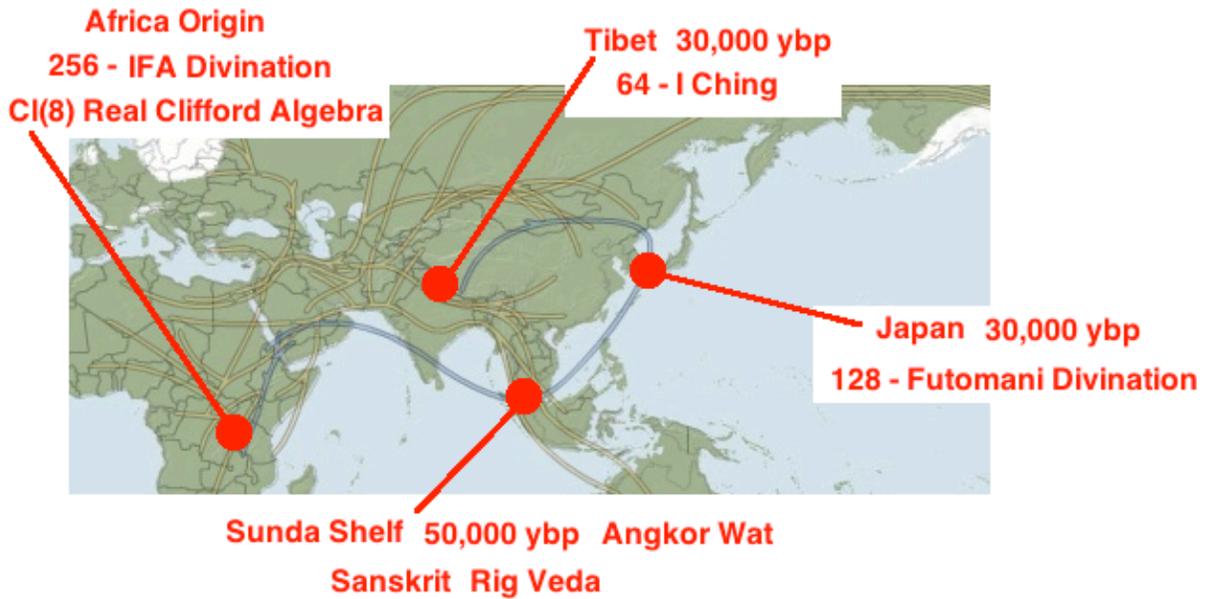


Upper Left = Higgs-Truth Quark mass state phase diagram

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

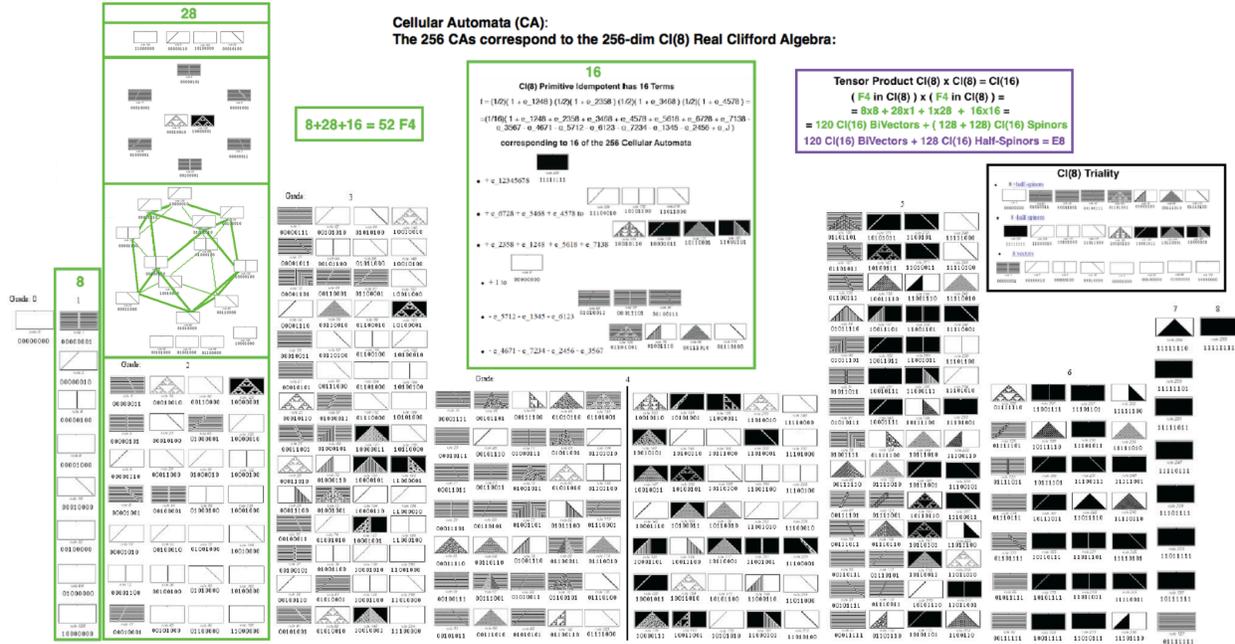
Lower = CMS $H \rightarrow ZZ^* \rightarrow 4l$ histogram of 3 Higgs Mass States
arXiv 1804.01939



The first richa of the first sukt of the Rig Veda has 24 syllables plus 24 gaps\
(if you include a silent gap to close the first sukt into a circle)
Those 24 gaps are made relevant by being elaborated by the following 8 richas
of the first sukt, which have $64 \times 3 = 192$ syllables
so that the total number of relevant entities in the first sukt
is $24 + 24 + 192 = 240 = \text{Off-Diagonal Elements of CI}(8) = 16 \times 16 \text{ Real Matrices}$

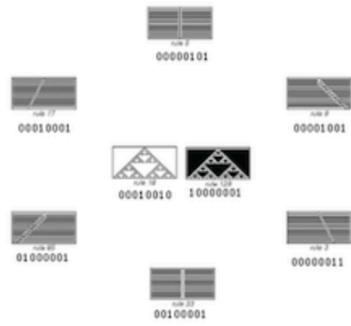
**African IFA Divination is based on a $2^4 = 16$ Tetragrams
and
a 16×16 Matrix of Tetragram Pairs = 256 Odu (Verses)
with 16 Diagonal Odu and 240 Off-Diagonal Odu
corresponding to
the $2^8 = 256$ elements of the Real Clifford Algebra CI(8)
The 240 Off-Diagonal Odu correspond to the Rig Veda**

Cellular Automata (CA): The 256 CAs correspond to the 256-dim $Cl(8)$ Real Clifford Algebra:



Cellular Automata (CA): The 256 CAs correspond to the 256-dim Cl(8) Real Clifford Algebra:

28



8+28+16 = 52 F4

16

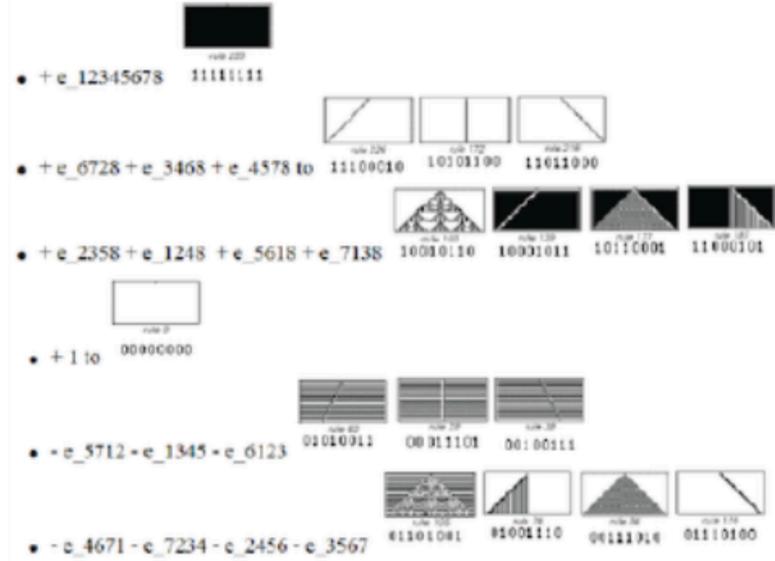
Cl(8) Primitive Idempotent has 16 Terms

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

$$= (1/16)(1 + e_{1248} + e_{2358} + e_{3468} + e_{4578} + e_{5618} + e_{6728} + e_{7138} -$$

$$e_{3567} - e_{4671} - e_{5712} - e_{6123} - e_{7234} - e_{1345} - e_{2456} + e_J)$$

corresponding to 16 of the 256 Cellular Automata



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

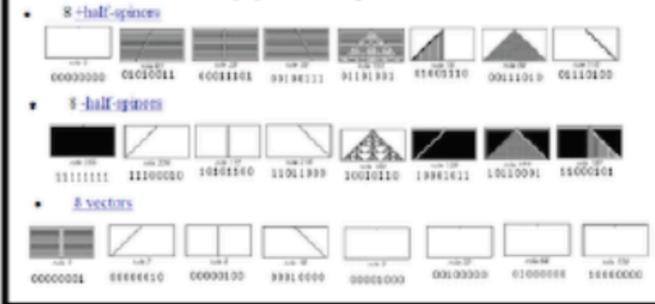
(F4 in Cl(8)) x (F4 in Cl(8)) =

$$= 8x8 + 28x1 + 1x28 + 16x16 =$$

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

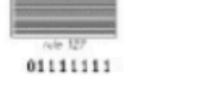
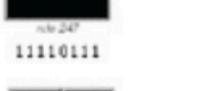
$$120 \text{ Cl(16) BiVectors} + 128 \text{ Cl(16) Half-Spinors} = E8$$

Cl(8) Triality

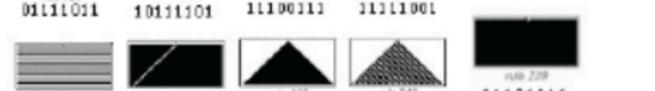


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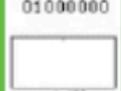
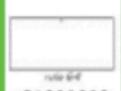
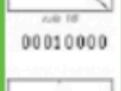
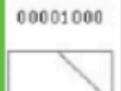
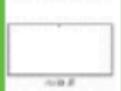
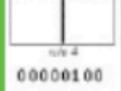
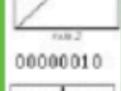
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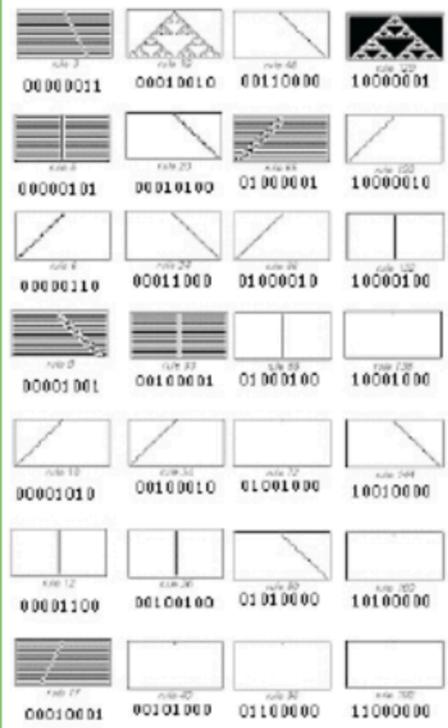
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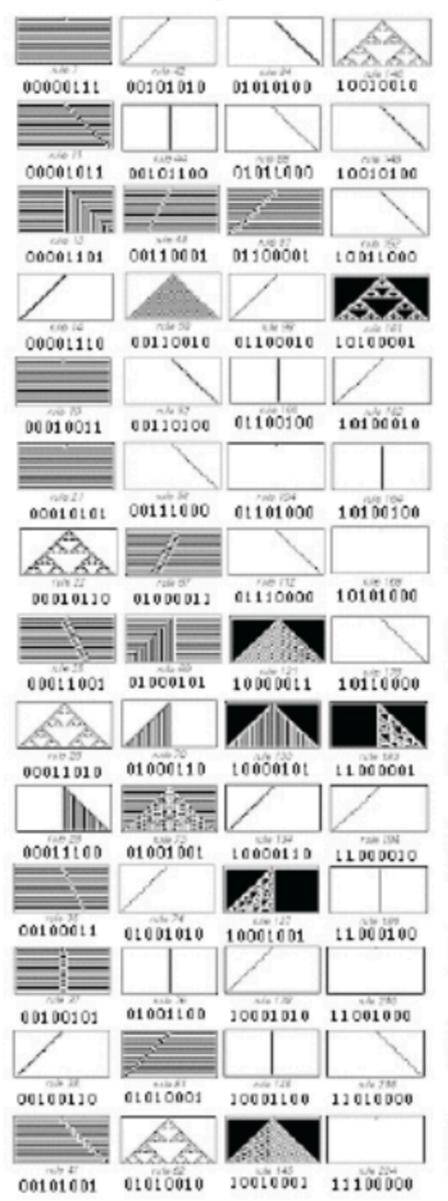
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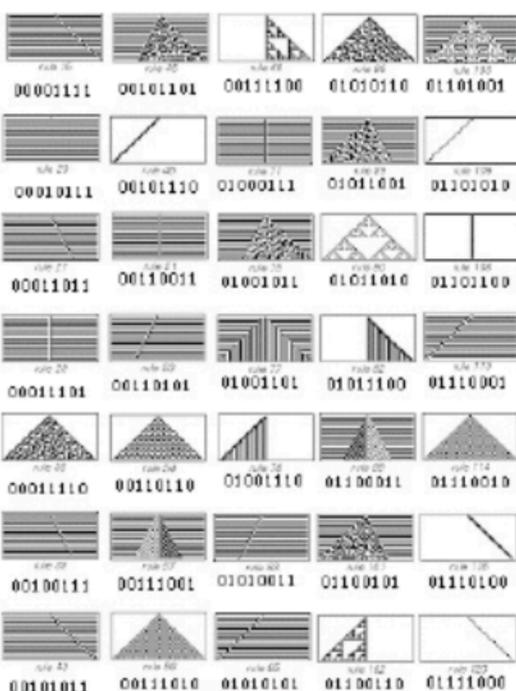
Grade: 2



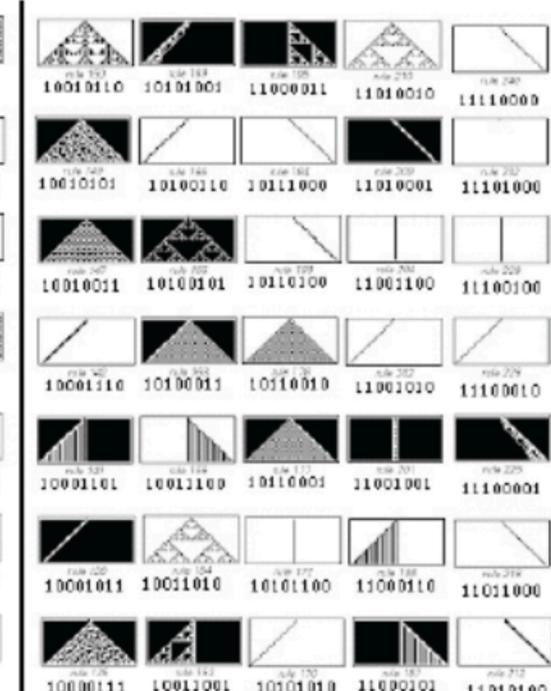
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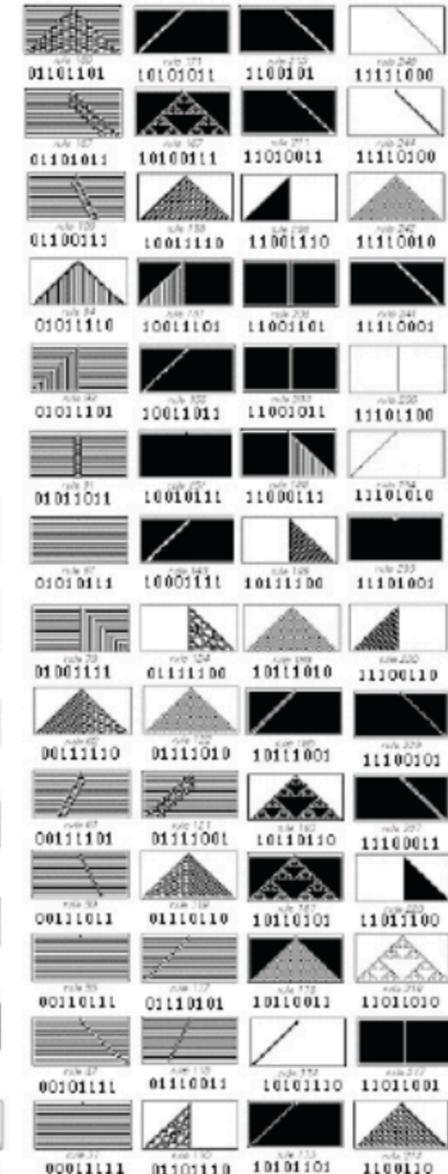
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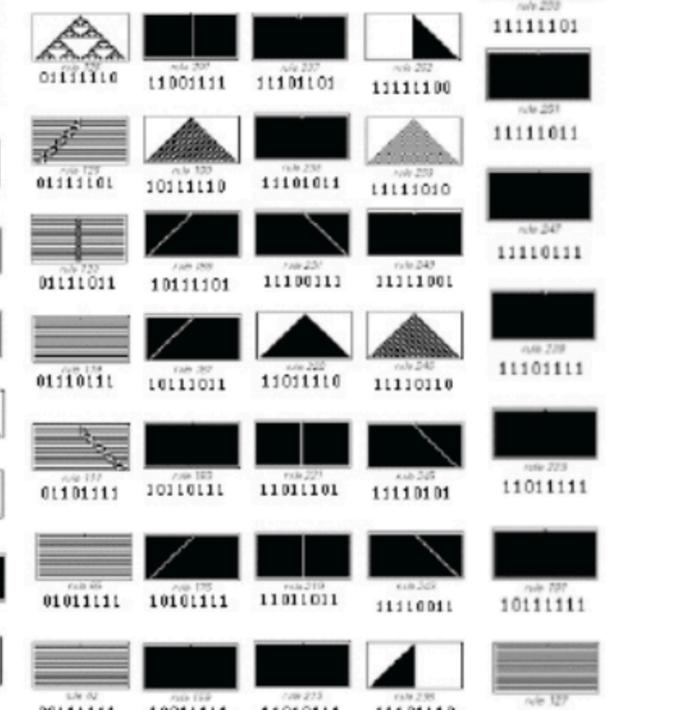
Grade: 5



Grade: 6



Grade: 7

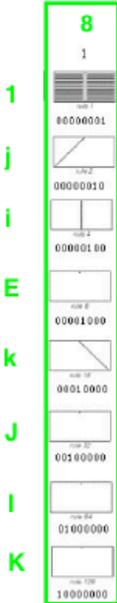


Grade: 8



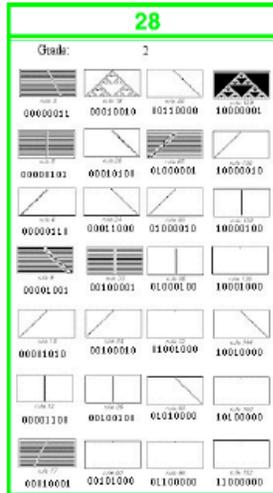
**8 Vectors, 28 BiVectors, and 16 Spinors of Cl(8)
form the 52-dim F4 Lie Algebra:**

8 = Vectors
SpaceTime



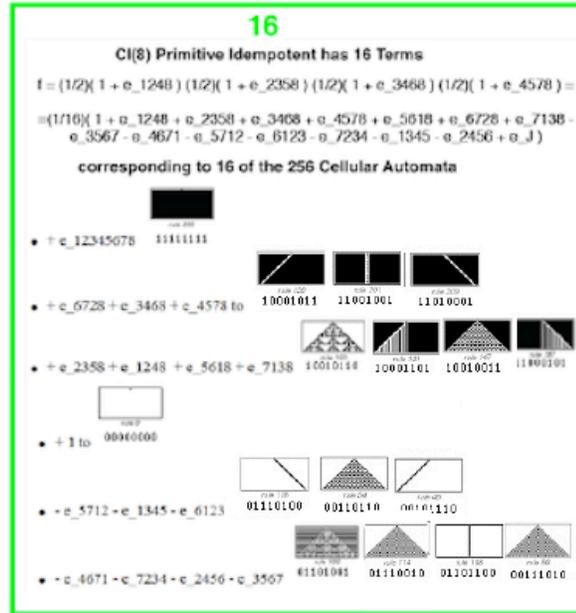
$$8+28+16 = 52 \text{ F4}$$

28 = D4 BiVectors



16 = Spinors

(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)
(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

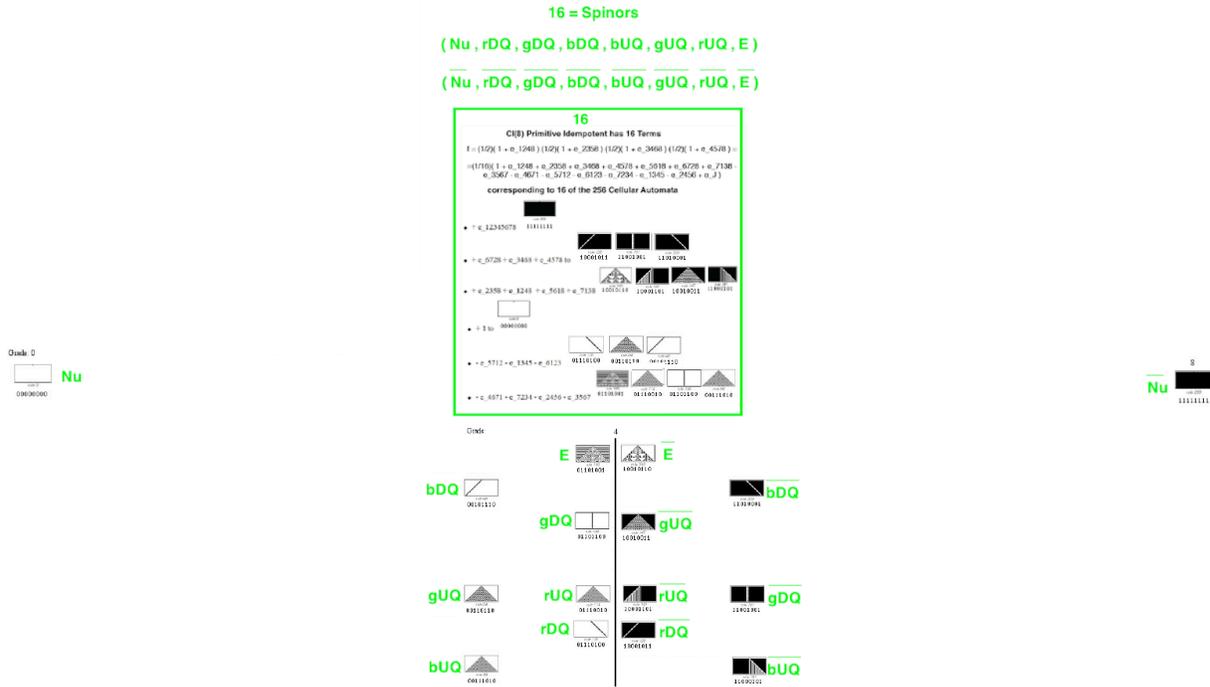


8 Vectors correspond to 8-dim Spacetime (M4 x CP2 Kaluza-Klein)

28 BiVectors correspond to D4 Gauge Bosons and Ghosts

**16 = 8L + 8R Spinors correspond to first-generation Fermions
(8L left-handed Particles + 8R right-handed AntiParticles)**

**16 = 8L + 8R Spinors correspond to first-generation Fermions
(8L left-handed Particles + 8R right-handed AntiParticles)**



**Pierre Ramond has shown in hep-th/0112261 that
the Spinor part of F4 need not be written as Commutators
but can also be written as Fermionic AntiCommutators**

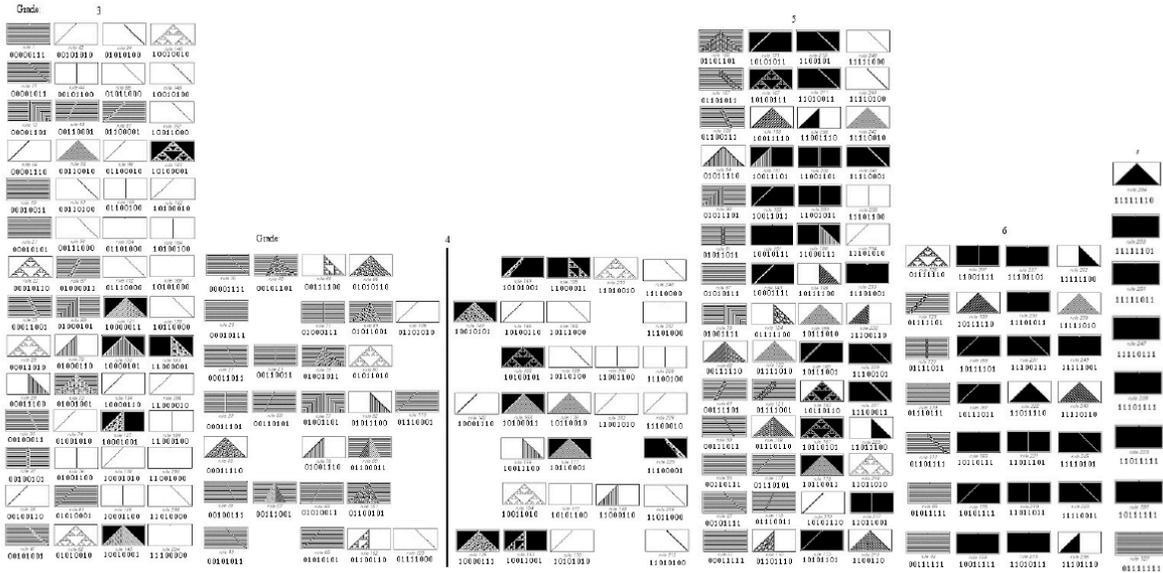
so

F4 Spinors can physically represent Fermions.

**Since the Cl(16) Half-Spinors of E8
come from the tensor product Cl(16) = Cl(8)xCl(8)
and
each copy of Cl(8) contains an F4
with the E8 Half-Spinors being based on F4 Spinors**

**the E8 Half-Spinors can be written as Fermionic AntiCommutators
and can physically represent Fermions**

As to the $256 - 52 = 204$ elements of $Cl(8)$ that are not in F_4



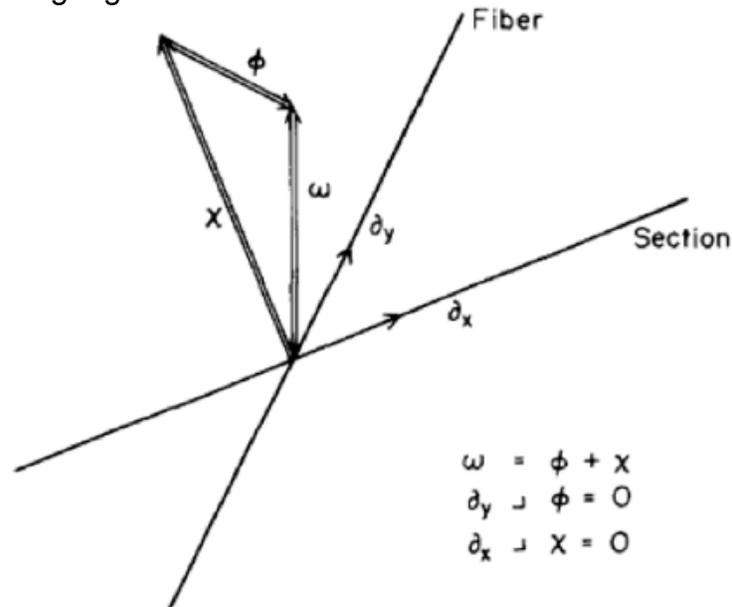
William Kingdon Clifford who invented Real Clifford Algebras called them “mind-stuff”, saying: “... mind-stuff takes the form of a human consciousness ...”.

The 52 F_4 elements of $Cl(8)$ describe the Natural Laws of Physics so the other 204 elements of $Cl(8)$ can carry the Information of Conscious Thought.

The 28 D4 elements of BiVectors of Cl(8) can be either Gauge Bosons or Ghosts.

Jean Thierry-Mieg in J. Math. Phys. 21 (1980) 2834-2838 said:

“... The ghost and the gauge field:



The single lines represent a local coordinate system of a principal fiber bundle of base space-time. The double lines are 1 forms. The connection of the principle bundle ω is assumed to be vertical. Its contravariant components ϕ and χ are recognized, respectively, as the Yang-Mills gauge field and the Faddeev-Popov ghost form ...”.

Steven Weinberg in The Quantum Theory of Fields Volume II Section 15.7 said:

“... there is a beautiful geometric interpretation of the ghosts and the BRST symmetry ...

The gauge fields A_a^μ may be written as one-forms $A_a = A_{a\mu} dx^\mu$,

where dx^μ are a set of anticommuting c-numbers. ... This can be combined with the ghost to compose a one-form $A_a = A_a + w_a$ in an extended space.

Also, the ordinary exterior derivative $d = dx^\mu d/dx^\mu$ may be combined with the BRST operator s to form an exterior derivative $D = d + s$ in this space,

which is nilpotent because $s^2 = d^2 = sd + ds = 0$...”.

**16 of the 28 D4 elements represent
16-dim U(2,2) of Conformal Gravity+Dark Energy**

They can be either Gauge Bosons or Ghosts.

If they are Gauge Bosons in a D4, the other 28-16 = 12 are Ghosts.

If they are Ghosts in a D4, the other 28-16 = 12 are Gauge Bosons.

**The 28-16 = 12 D4 elements represent
12-dim Standard Model SU(3)xSU(2)xU(1)**

There are two ways that 28 BiVectors of $Cl(8)$ can form Gauge Bosons and Ghosts

so

there are two ways F_4 can sit inside $Cl(8)$

First:

16 of the 28 D_4 elements represent 16-dim $U(2,2)$ of Conformal Gravity+Dark Energy (plus a $U(1)$ for propagator phase)

12 of the 28 D_4 elements represent 12-dim Standard Model $SU(3) \times SU(2) \times U(1)$

16 $U(2,2)$ Gauge Bosons of First D_4 in First F_4 represent Conformal Gravity + Dark Energy and Propagator Phase

8 = Vectors SpaceTime

8

1

j

i

E

k

J

I

K

16 $U(2,2) + 12$ Ghosts

$8 + (16 + 12) + 16 = 52 F_4$

16 = Spinors

(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

16

Cl(8) Primitive Idempotent has 16 Terms

$f = (1/2)(1 + e_{1248})(1/2)(1 + e_{2358})(1/2)(1 + e_{3468})(1/2)(1 + e_{4578}) =$
 $= (1/16)(1 + e_{1248} + e_{2358} + e_{3468} + e_{4578} + e_{5618} + e_{6728} + e_{7138} -$
 $- e_{3567} - e_{4671} - e_{5712} - e_{6123} - e_{7234} - e_{1345} - e_{2456} + e_{J})$

corresponding to 16 of the 256 Cellular Automata

↑

28-16 = 12 Ghosts of First D_4 in First F_4 correspond to the 12 Standard Model Gauge Bosons that live in Second D_4

Second:

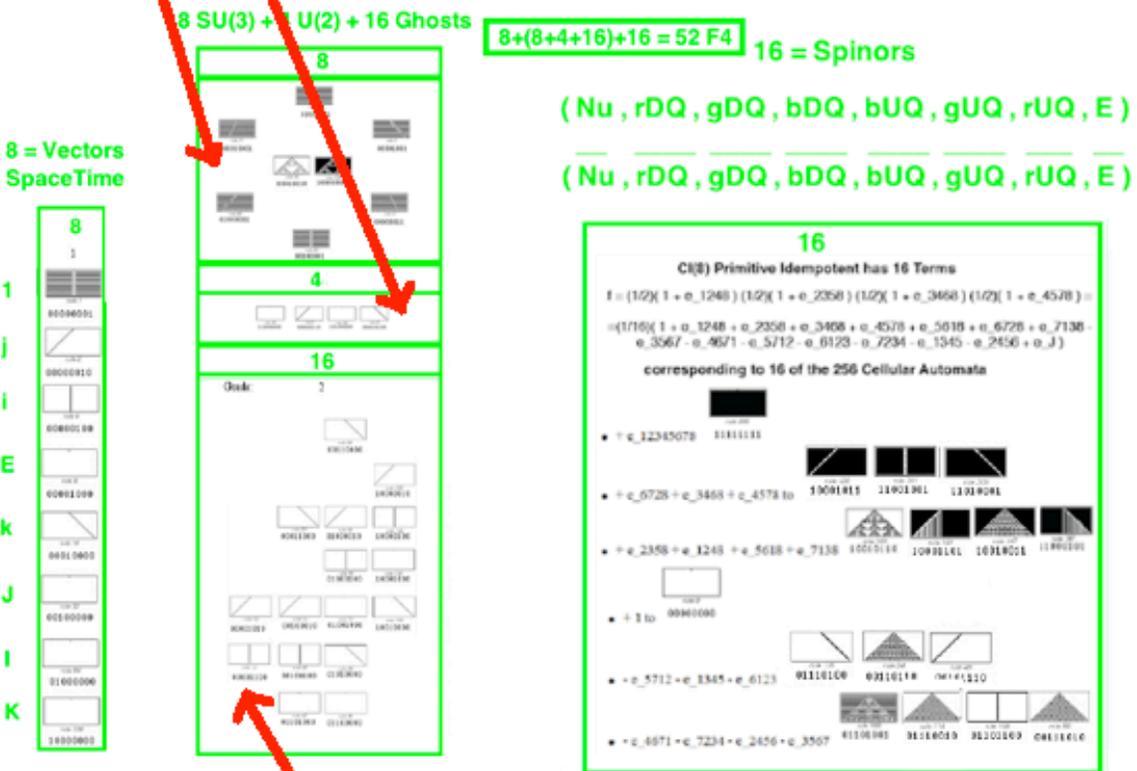
12 of the 28 D4 elements represent Standard Model SU(3)xSU(2)xU(1) Gauge Bosons
 16 of the 28 D4 elements represent U(2,2) Ghosts

8 + 4 = 12 Gauge Bosons of Second D4 in Second F4 represent Standard Model SU(3)xSU(2)xU(1)

SU(3) as subgroup of SU(4) subgroup of D4 and SU(2)xU(1) as little group of CP2 = SU(3) / SU(2)xU(1)

where CP2 = Internal Symmetry Space of Kaluza-Klein M4 x CP2
 SO

Second F4 describing the Standard Model has 16 Spinors = 8L (left-handed) + 8R (right-handed)



28-12 = 16 Ghosts of First D4 in First F4 correspond to the 16 Gravity+Dark Energy plus Propagator Phase Gauge Bosons which Gauge Bosons live in the First D4

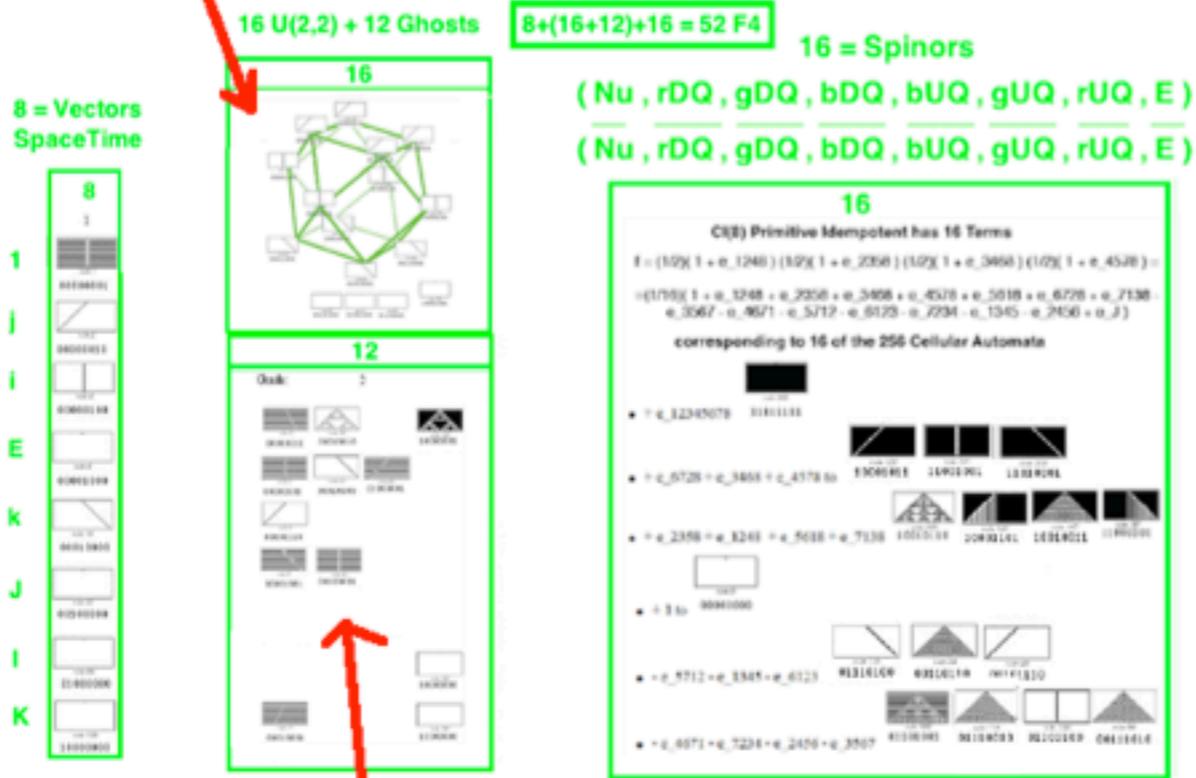
First CI(8) x Second CI(8) = CI(16)
(tensor product)

CI(16) contains E8

E8 contains and **First D4** x **Second D4**
plus **First F4** plus **Second F4**

First F4 of First D4 in First CI(8)

16 U(2,2) Gauge Bosons of First D4 in First F4 represent Conformal Gravity + Dark Energy and Propagator Phase



28-16 = 12 Ghosts of First D4 in First F4 correspond to the 12 Standard Model Gauge Bosons that live in Second D4

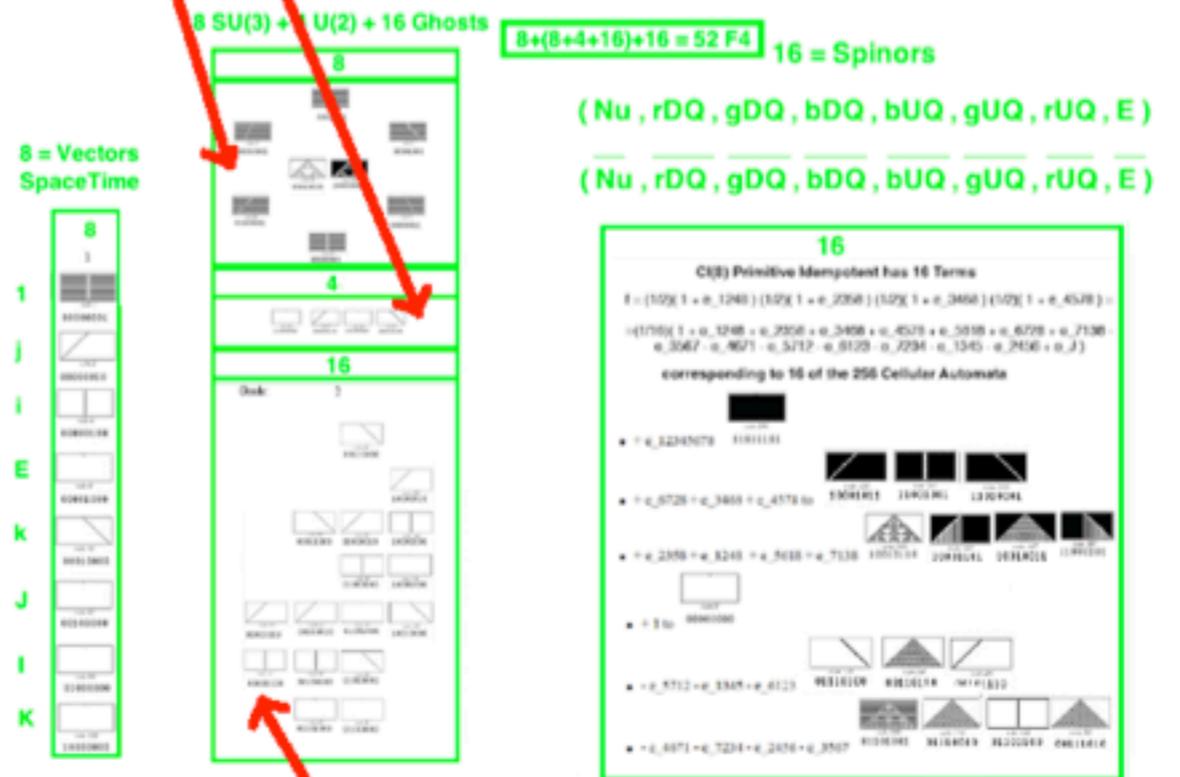
Second F4 of Second D4 in Second CI(8)

8 + 4 = 12 Gauge Bosons of Second D4 in Second F4 represent Standard Model SU(3)xSU(2)xU(1)

SU(3) as subgroup of SU(4) subgroup of D4 and SU(2)xU(1) as little group of CP2 = SU(3) / SU(2)xU(1)

where CP2 = Internal Symmetry Space of Kaluza-Klein M4 x CP2 SO

Second F4 describing the Standard Model has 16 Spinors = 8L (left-handed) + 8R (right-handed)



28-12 = 16 Ghosts of First D4 in First F4 correspond to the 16 Gravity+Dark Energy plus Propagator Phase Gauge Bosons which Gauge Bosons live in the First D4

**36,000 Years Ago - National Geographic Genographic YDNA -
Humans follow North Star Vega
up the Nile to Giza and Mediterranean**



Egyptian History according to Manetho:

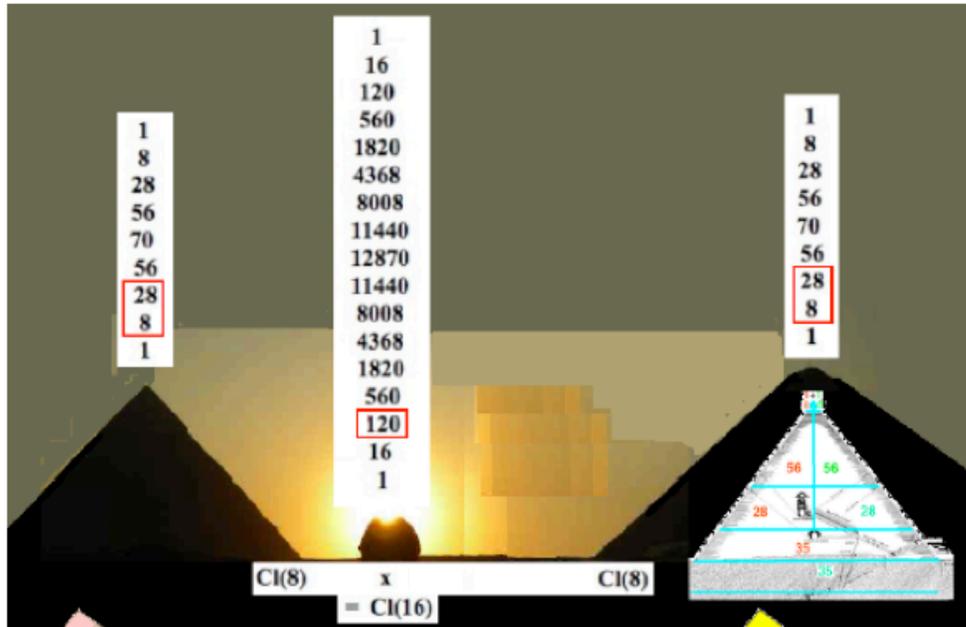
**36,525 years ago - Rule of Gods - North Star Vega -
Geminga Shock Wave - Glaciation**

22,625 years ago - Rule of Demigods - last Glacial Maximum

**17,413 years ago - Rule of Spirits of the Dead -
end of last Glacial Maximum**

**11,600 years ago - Rule of Mortal Humans - North Star Vega -
Vela X - end of Ice Age**

When Humans reached Giza they built two large Pyramids - one for First F4 and one for Second F4 - and the Sphinx



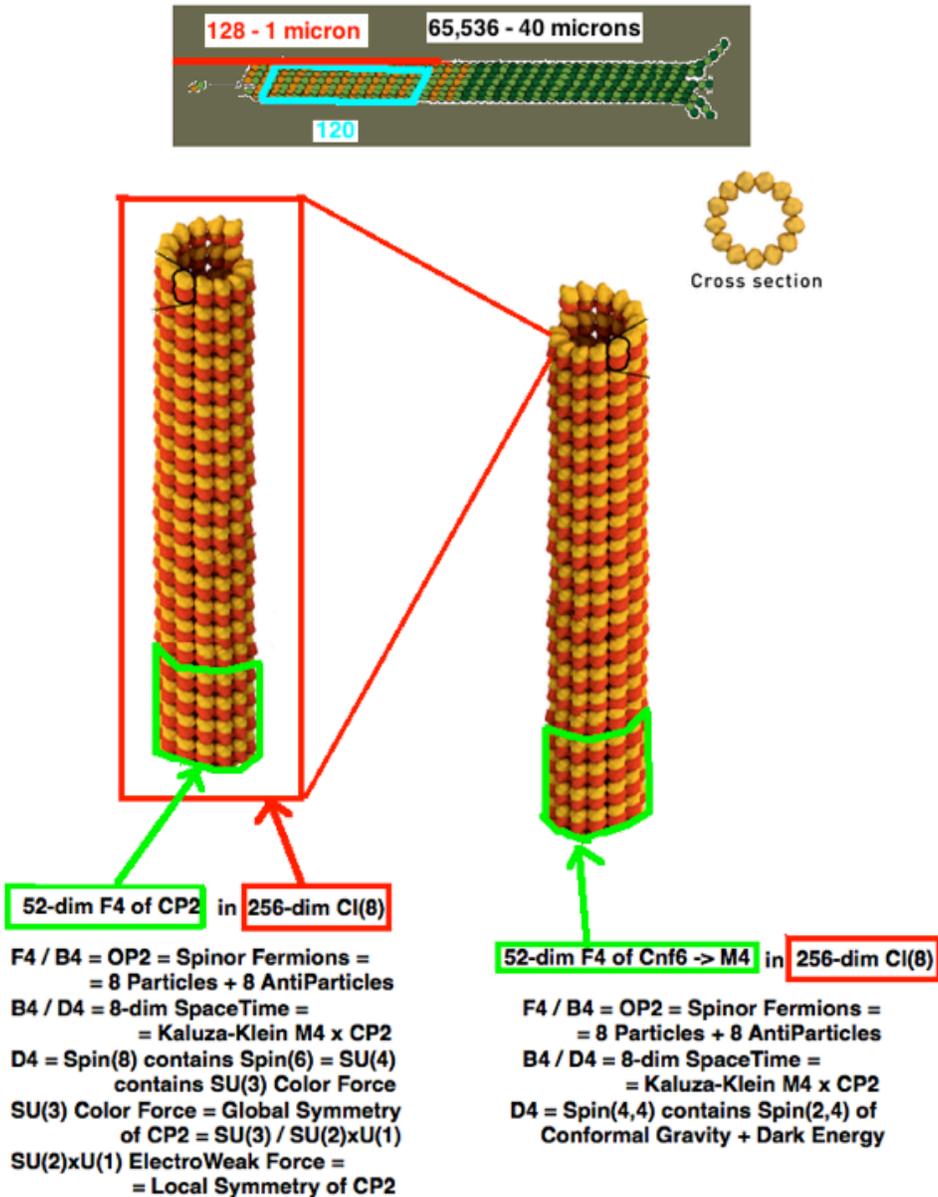
Each Pyramid represented a copy of $Cl(8)$ with graded structure
 $256 = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1 = (8L+8R) \times (8L+8R)$
 contained a copy of **52-dim F4** = $8 + 28 + (8L+8R)$

By 8-Periodicity of Real Clifford Algebras
 the tensor product $Cl(8) \times Cl(8) = Cl(16)$
 induces the product

$E8 = F4(\text{Second Pyramid}) \times F4(\text{Great Pyramid})$
 where

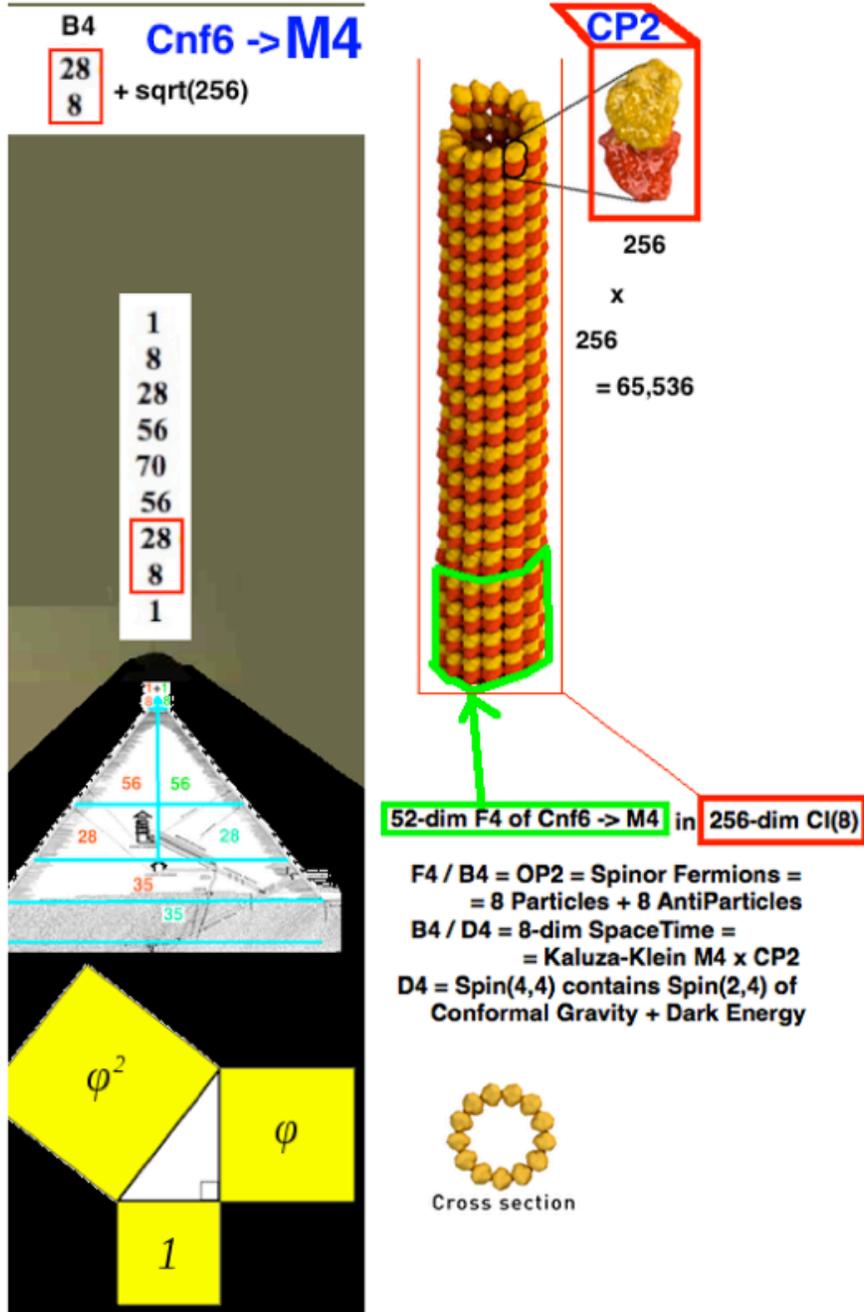
Second F4(Second Pyramid) represents Standard Model
 First F4(Great Pyramid) represents Gravity + Dark Energy

256-dim $Cl(8) \times 256$ -dim $Cl(8) = 65,536$ -dim $Cl(16)$ Clifford Algebra structure is also present in Microtubules which are 40 micron size aggregates of 65,536 tubulin dimers that are the basis of Sarfatti-Bohm-Penrose-Hameroff Quantum Consciousness.



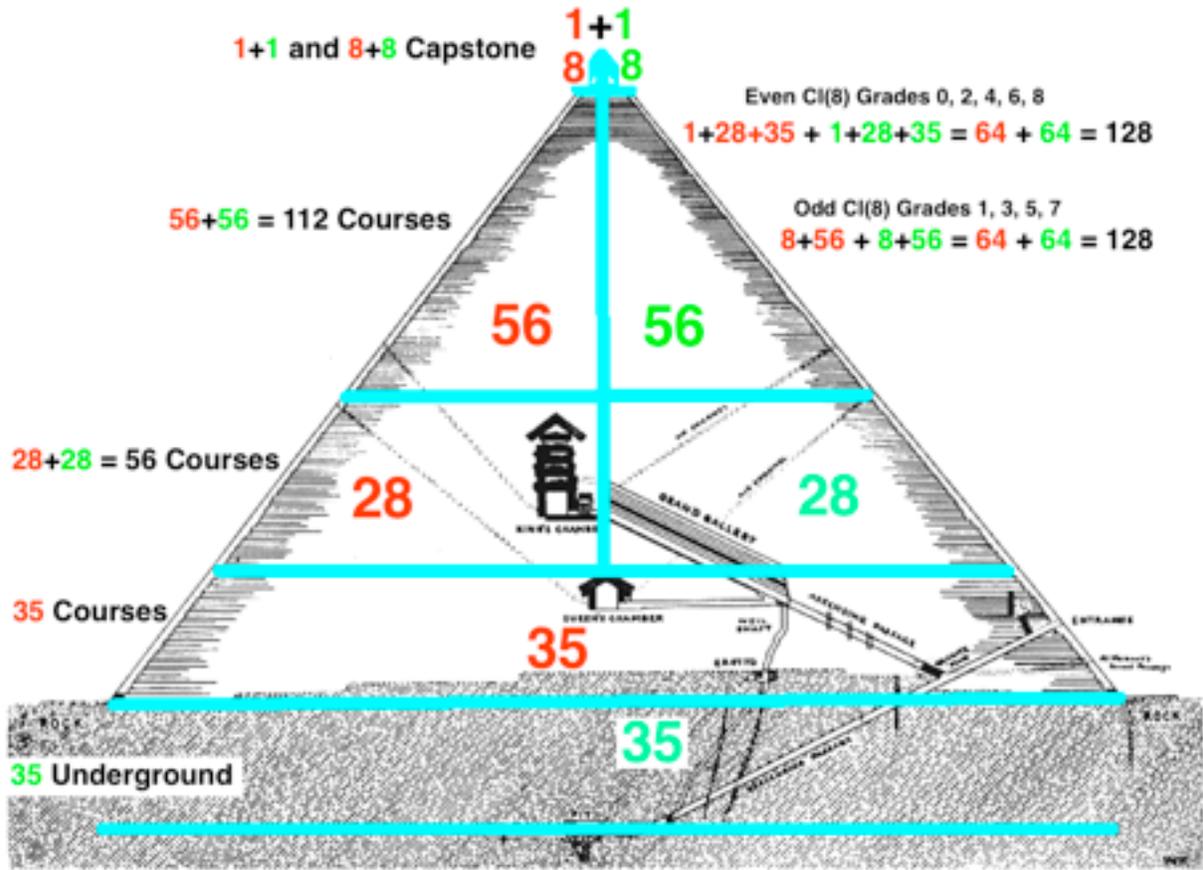
Assembly of 65,536 tubulins into a 40-micron microtubule is analogous to the 256 x 256 tensor product $Cl(8) \times Cl(8) = Cl(16)$ **E8 of $Cl(16)$ only uses 248 of the 65,536 elements so that 65,188 of them are available for Quantum Consciousness thought processes**

The Great Pyramid slope is of a Golden Ratio Right Triangle representing Conformal Gravity+Dark Energy with Gauge Group Spin(2,4) = SU(2,2) It represents M4 of Kaluza-Klein M4 x CP2 and is represented by the First F4



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 their structure was known to Africans in ancient times.

The courses of the Great Pyramid of Giza correspond to the graded structure of 256-dim $Cl(8)$:

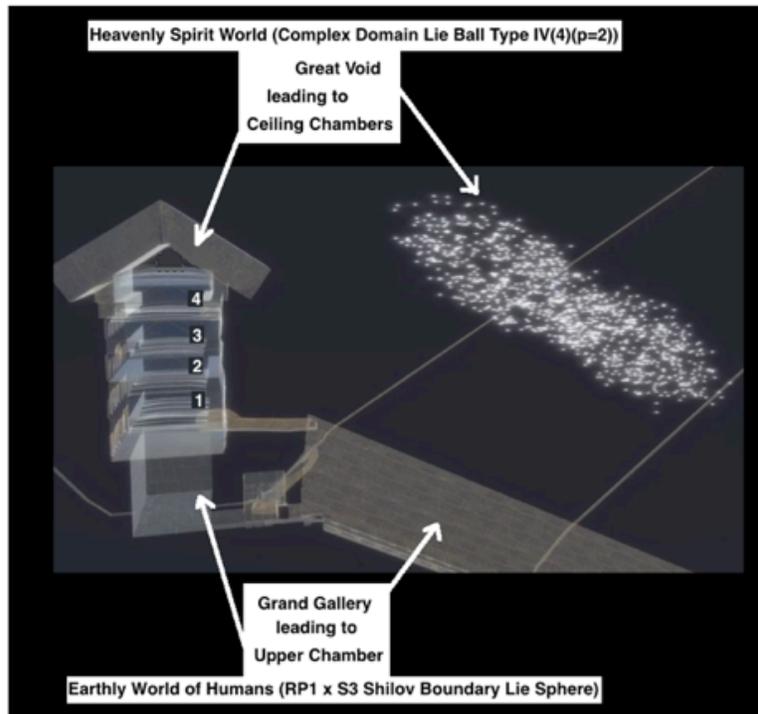


$$1 + 8 + 28 + 56 + (35 + 35) + 56 + 28 + 8 + 1$$

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

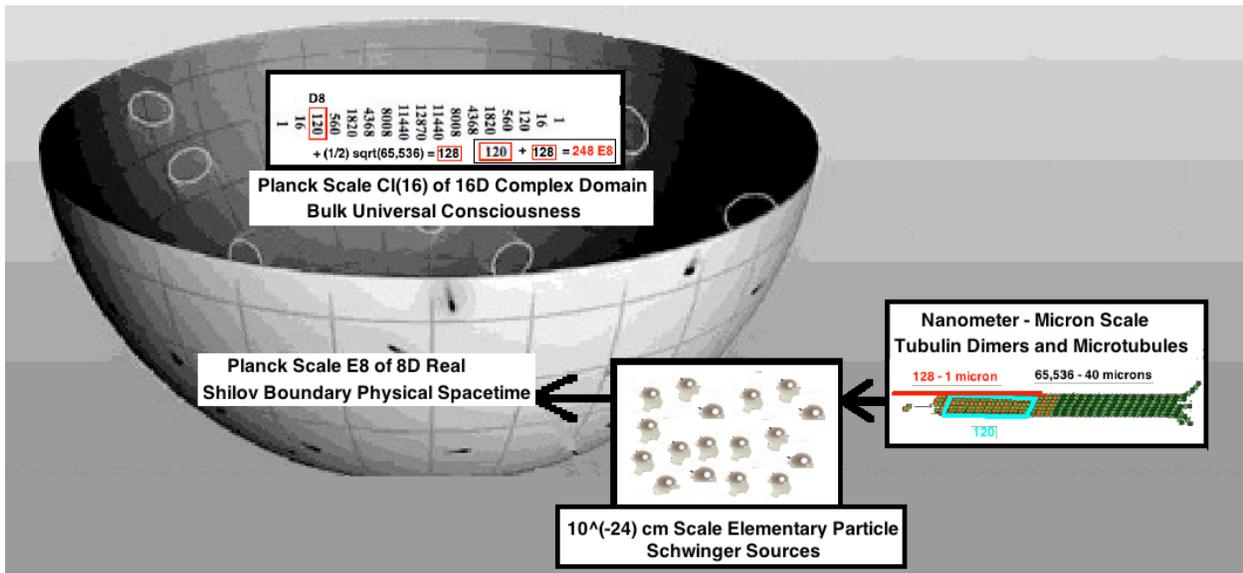
Above the Grand Gallery is a Great Void leading to Ceiling Chambers above the Upper Chamber

(image from ScanPyramids web site)

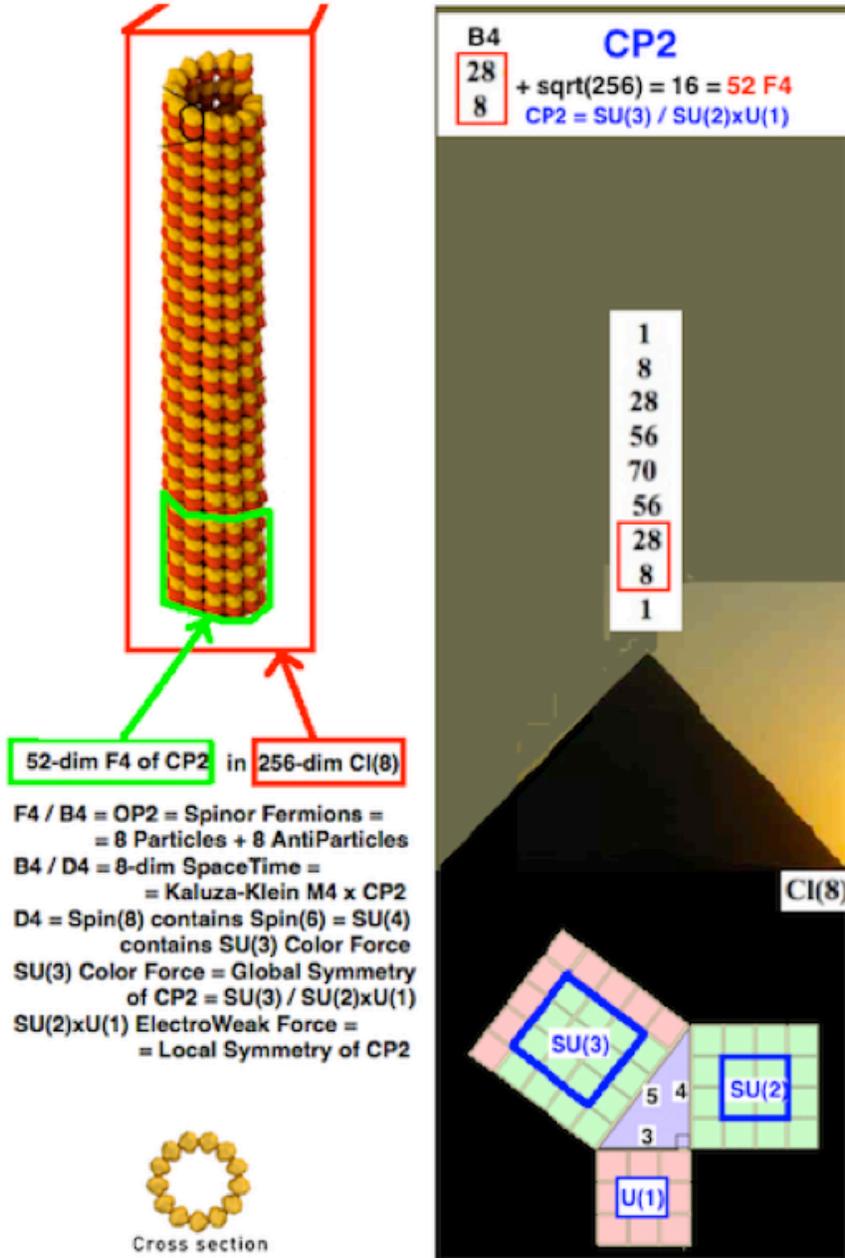


The Builders of the Great Pyramid represented the Real Shilov Boundary Physical world by the Grand Gallery and Upper Chamber that are easily accessible by Humans

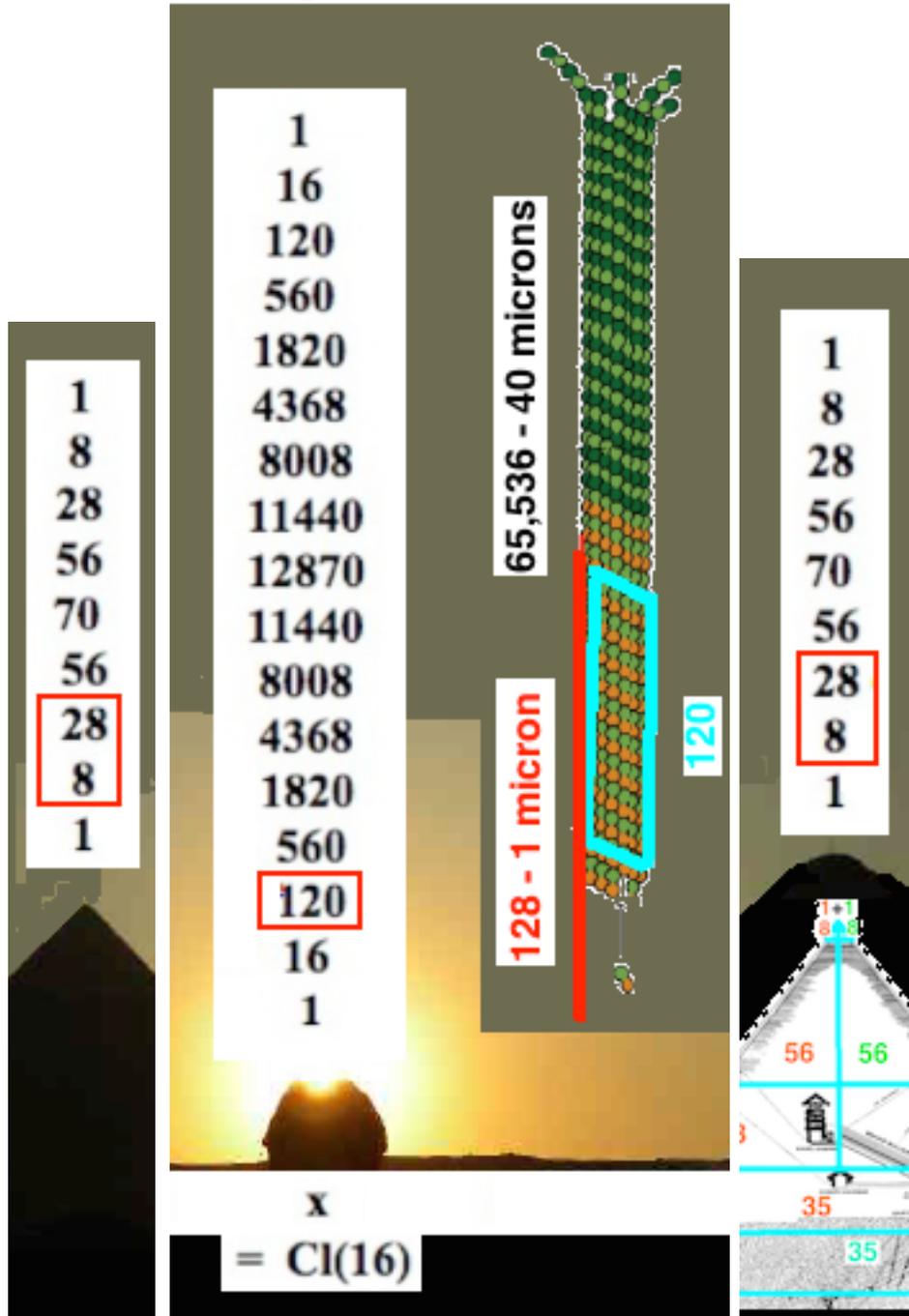
They represented the Imaginary Complex World of CI(16) Spacetime Cells mirroring the Human Microtubule World as Ceiling Chamber spaces and the Great Void that are more accessible to Souls of the Spirit World than to Physical Humans.



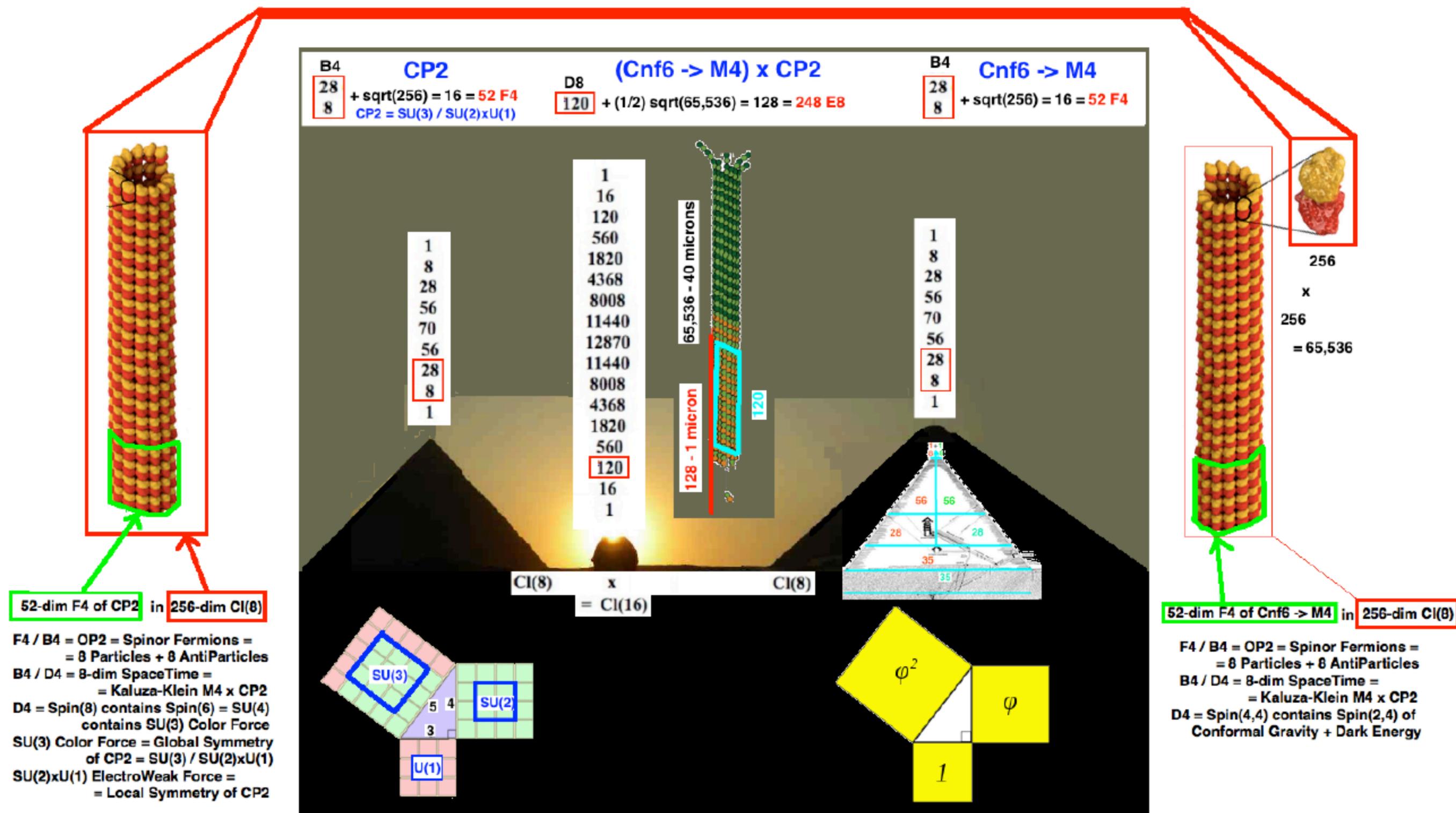
The Second Pyramid slope is of a 3-4-5 Right Triangle representing the Standard Model with Gauge Groups U(1) SU(2) SU(3)
 It represents CP2 of Kaluza-Klein M4 x CP2
 and is represented by the Second F4



The Sphinx represents 65,536-dim Cl(16) containing 248-dim E8 as the tensor product combination of 256-dim Cl(8) containing 52-dim Second F4 related to CP2 of M4 x CP2 and 256-dim Cl(8) containing 52-dim First F4 related to M4 of M4 x CP2



This is how the Sphinx represents
the CI(16) combination of the two large CI(8) Pyramids
and also
the 65,536-element 40 micron Microtubules
of Bohm Quantum Consciousness



E8 Kaluza-Klein (Cnf6 -> M4) x CP2

In (CI(8) of CP2) x (CI(8) of Cnf6 -> M4) = CI(16)
containing EB
at each of the 256 points of CI(8) of Cnf6 -> M4
there are all 256 points of CI(8) of CP2



E8 / D8 = 128-dim Fermion Spinor Space = 8 components of 8+8 Fermions
D8 / D4 x D4 = A7+1 = 64 = 8-dim position x 8-dim momentum
D4 containing D3 = Spin(2,4) = A3 = SU(2,2) for Conformal Gravity + Dark Energy
D4 containing D3 = SU(4) containing Color Force SU(3)

There are two ways that 28 D4 BiVectors of $Cl(8)$ can form Gauge Bosons and Ghosts so there are two ways that F4 can sit inside $Cl(8)$

16 U(2,2) Gauge Bosons of First D4 in First F4 represent Conformal Gravity + Dark Energy and Propagator Phase

8 = Vectors SpaceTime

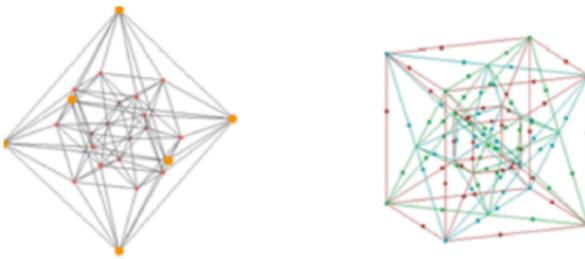
16 U(2,2) + 12 Ghosts $8+(16+12)+16 = 52$ F4

16 = Spinors

(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

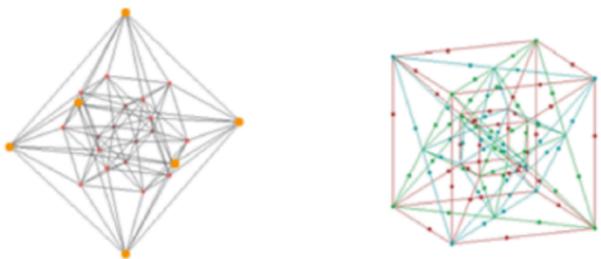
(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

The First F4 has 48 Root Vectors: Vertices of a 4-dim 24-cell and its Dual 24-cell



24 + 96 Dual Edge Golden Ratio Points = 120 Vertices of First H4 600-cell

The Second F4 also has 48 Root Vectors: Vertices of a 4-dim 24-cell and its Dual 24-cell



24 + 96 Dual Edge Golden Ratio Points = 120 Vertices of Second H4 600-cell

8 + 4 = 12 Gauge Bosons of Second D4 in Second F4 represent Standard Model SU(3)xSU(2)xU(1)

SU(3) as subgroup of SU(4) subgroup of D4 and SU(2)xU(1) as little group of CP2 = SU(3) / SU(2)xU(1) where CP2 = Internal Symmetry Space of Kaluza-Klein M4 x CP2 so Second F4 describing the Standard Model has 16 Spinors = 8L (left-handed) + 8R (right-handed)

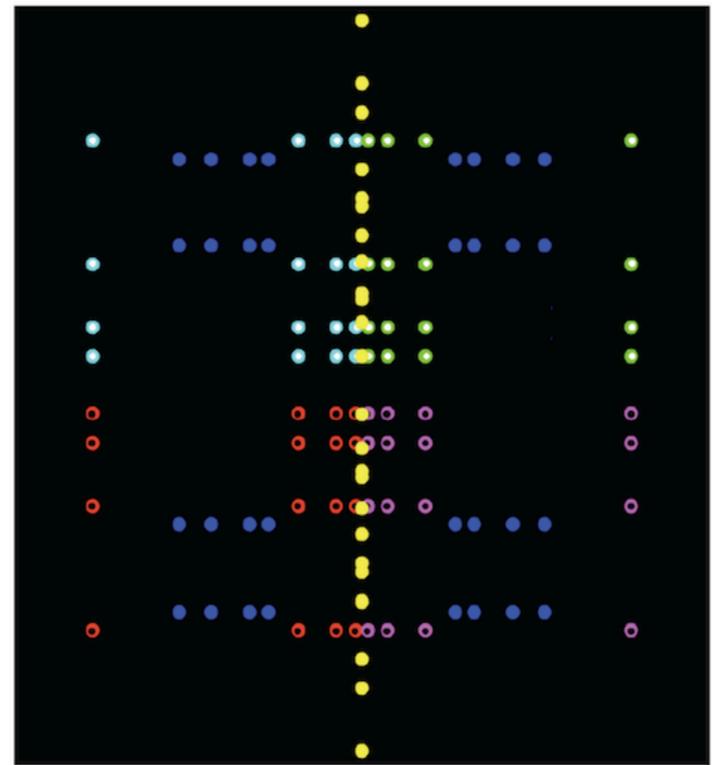
8 SU(3) + U(2) + 16 Ghosts $8+(8+4+16)+16 = 52$ F4

16 = Spinors

(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

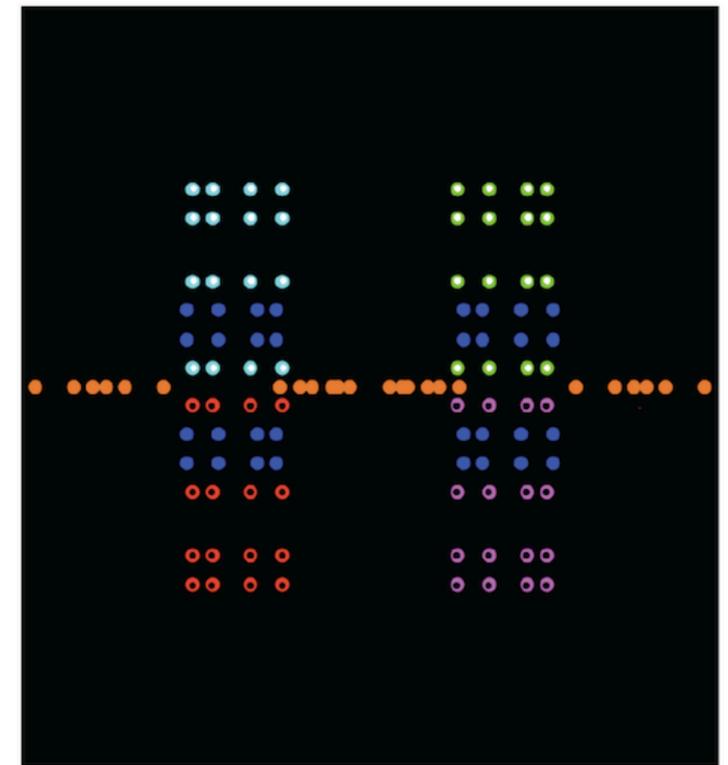
(Nu, rDQ, gDQ, bDQ, bUQ, gUQ, rUQ, E)

28-16 = 12 Ghosts of First D4 in First F4 correspond to the 12 Standard Model Gauge Bosons that live in Second D4

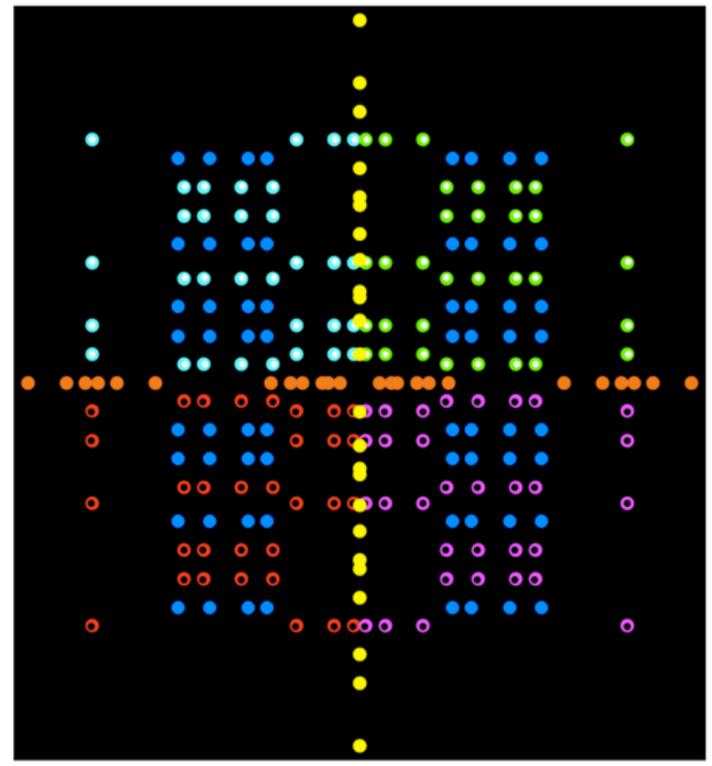


120 Root Vectors of First H4 from First F4 in First Cl(8)

28-12 = 16 Ghosts of First D4 in First F4 correspond to the 16 Gravity+Dark Energy plus Propagator Phase Gauge Bosons which Gauge Bosons live in the First D4

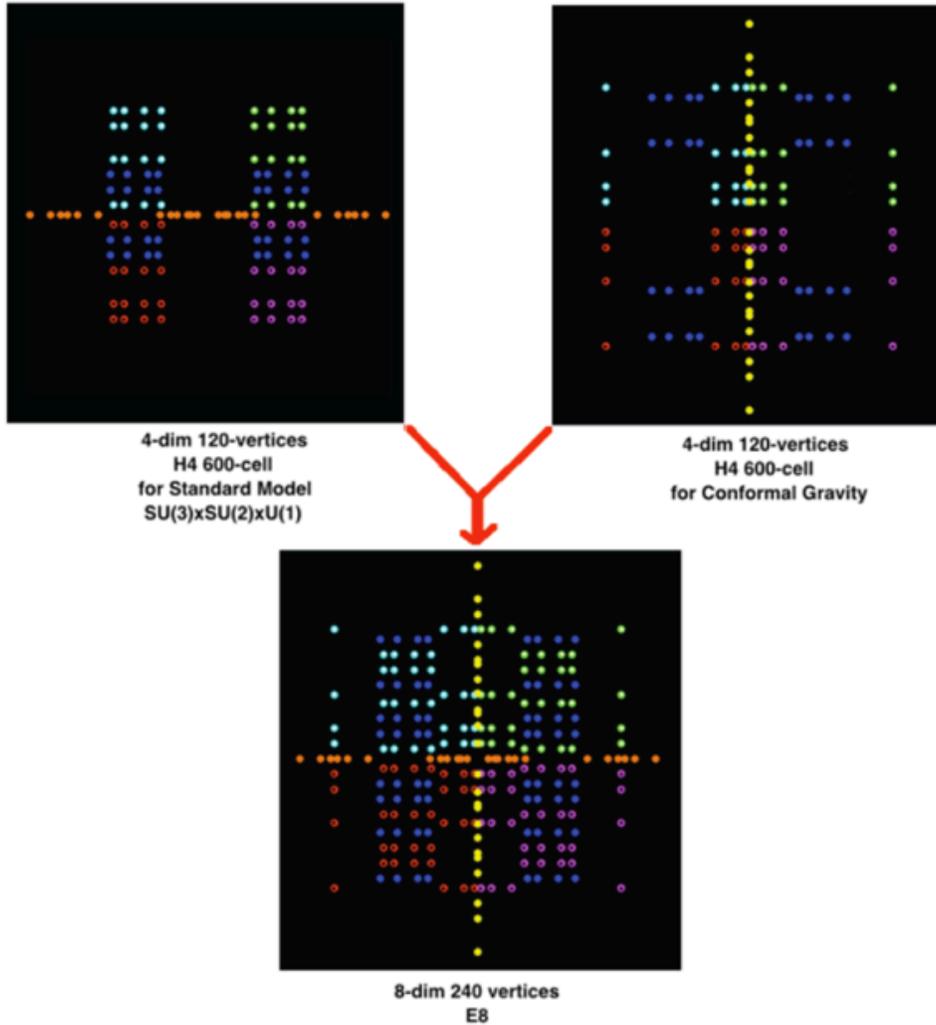


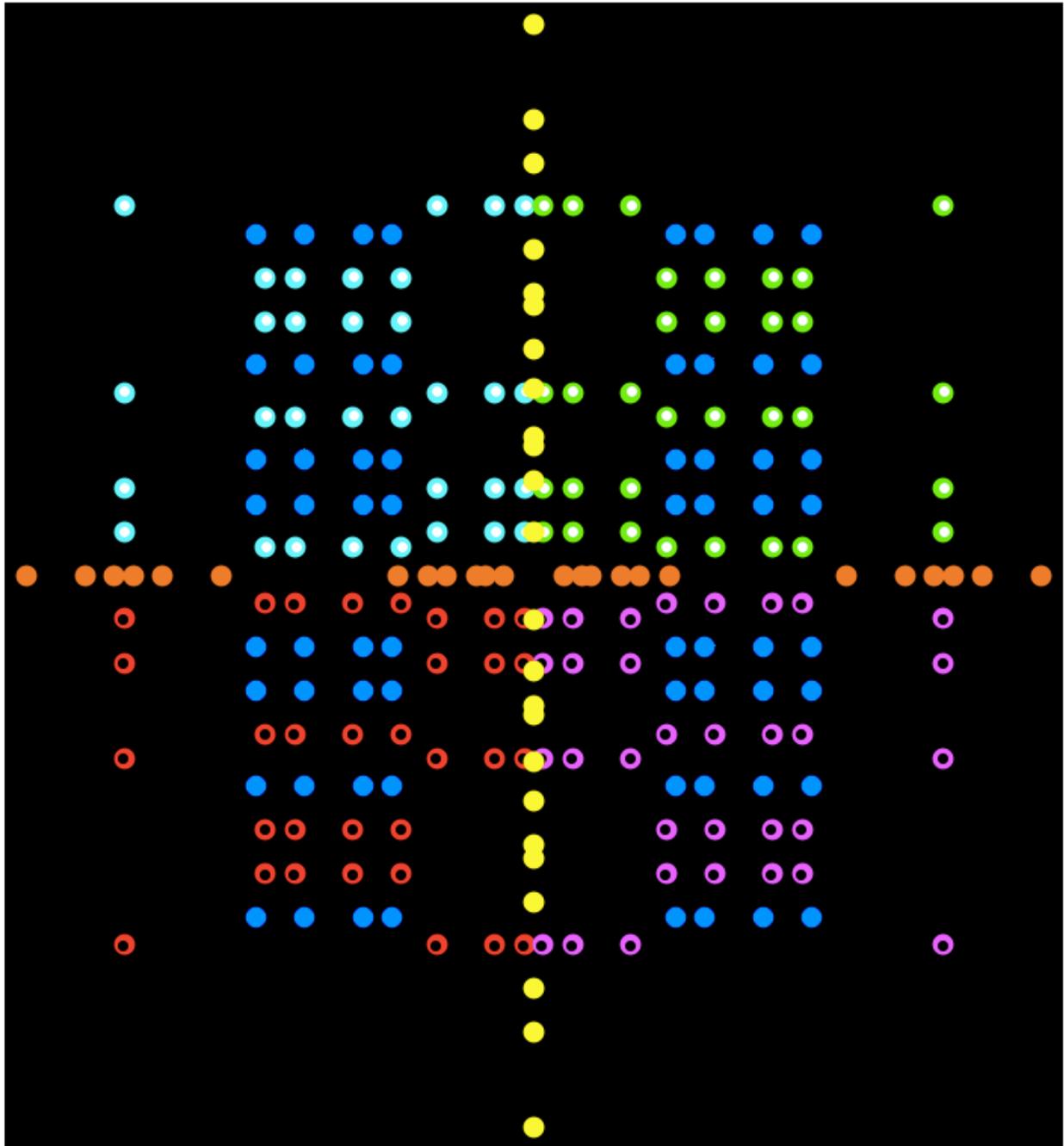
120 Root Vectors of Second H4 from Second F4 in Second Cl(8)



tensor product First Cl(8) x Second Cl(8) = Cl(16)
Cl(16) contains E8 with 240 Root Vectors
Induced tensor-type product First F4 x Second F4 = E8

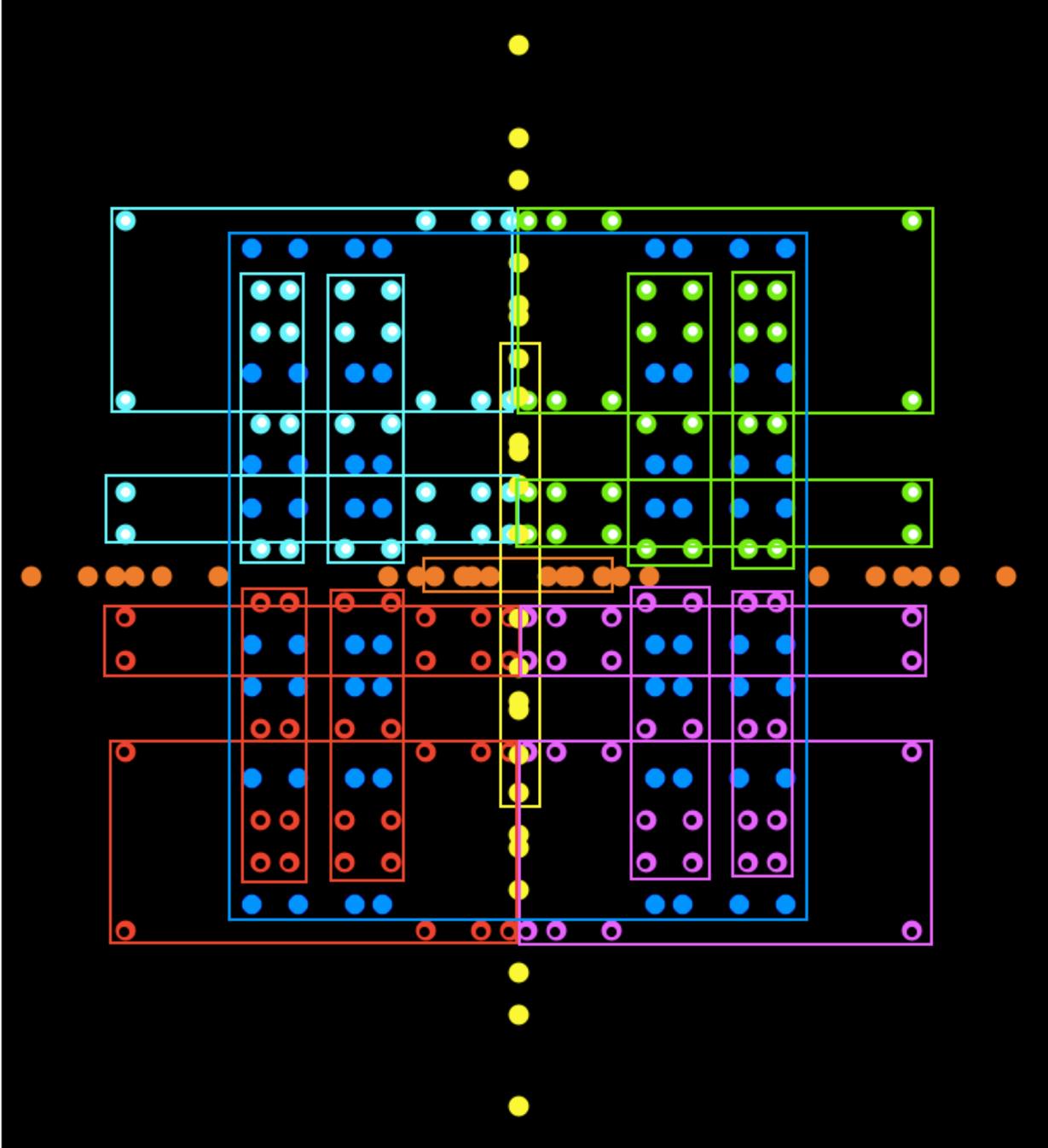
248-dim E8 in $Cl(16)$ has 240 Root Vectors -
 - first shell of 8-dim E8 Lattice.
 Since it is hard to visualize points on S^7 in 8-dim space,
 I prefer to represent the 240 E8 Root Vectors
 in this 2D representation by Ray Aschheim





To understand the Geometry related to the 240 E8 Root Vectors, consider that
 248-dim E8 = 120-dim Spin(16) D8 + 128-dim half-spinor of Spin(16) D8
 240 E8 Root Vectors = 112 D8 Root Vectors + 128 D8 half-spinors
 112 D8 Root Vectors = 24 D4 (orange) + 24 D4 (yellow) + 64 (blue)
 128 D8 half-spinors = 128 elements of E8 / D8

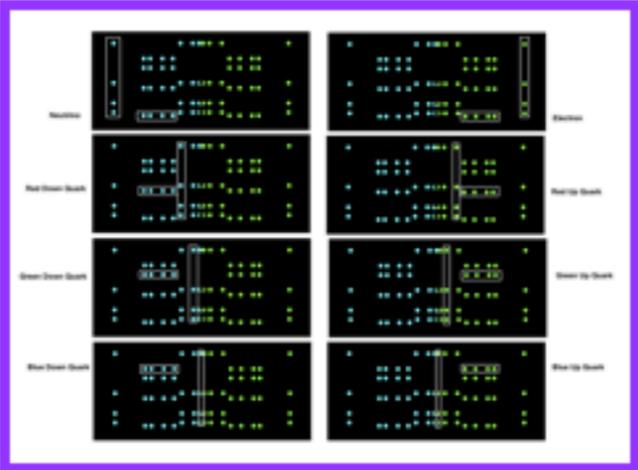
Green and Cyan dots with white centers (32+32 = 64 dots) and
 Red and Magenta dots with black centers (32+32 = 64 dots)
 correspond to the 128 elements of E8 / D8.



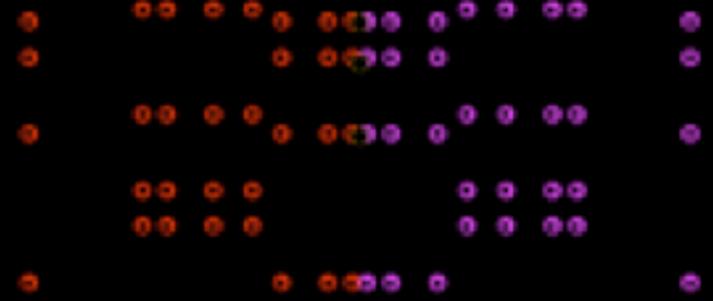
$$240 = 64 + 64 + 64 + 24 + 24$$

The 64 Green and Cyan Root Vectors represent half of the First Generation Fermion Particles of E8 / D8 as the $8 = 4+4$ M4 x CP2 Kaluza-Klein components of each of 8 Particles. The White Centers of their dots indicate that they are Particles.





8 Components of 8 Fermion Particles



E8 / D8

\int

+

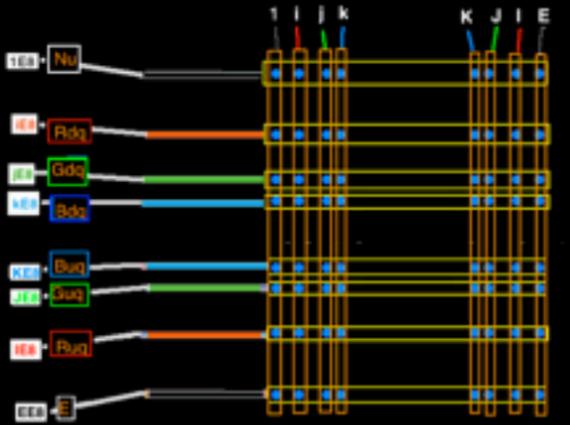
Second D4

+

First D4

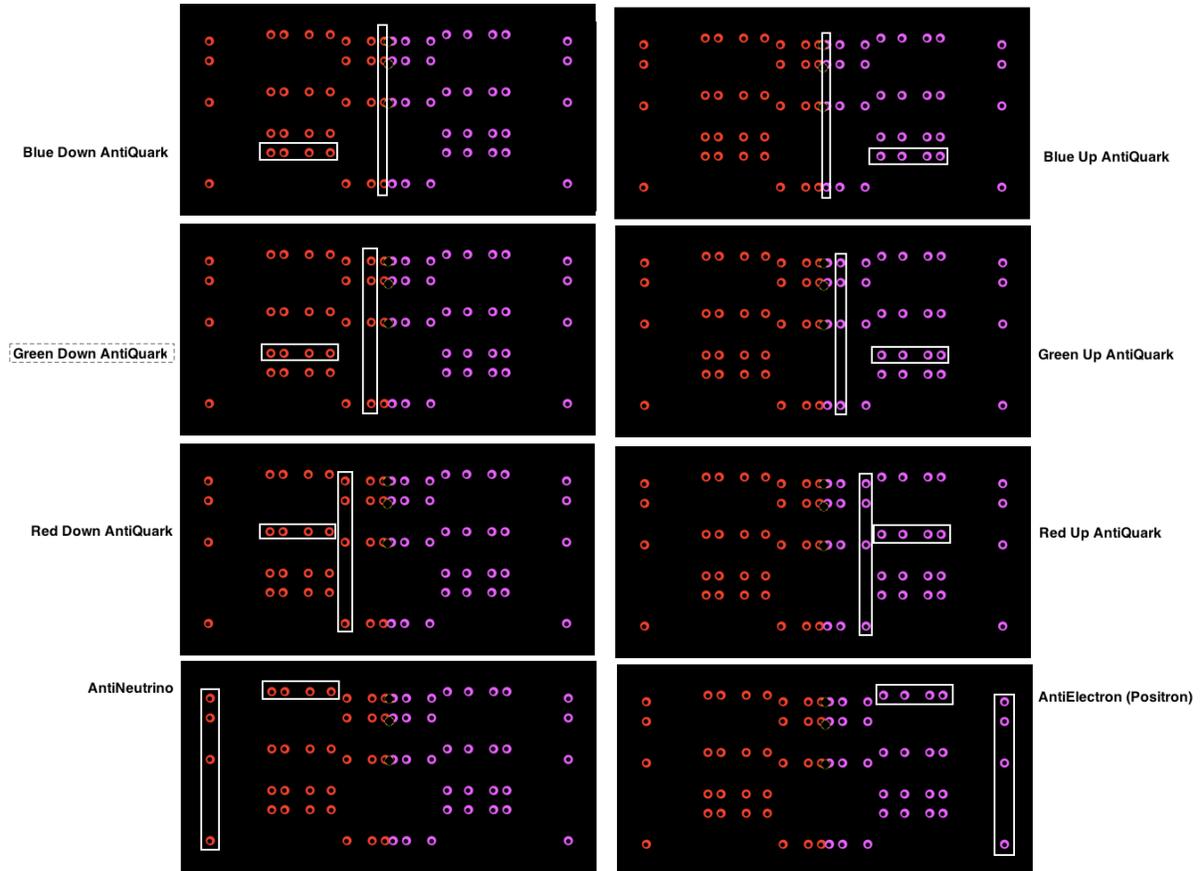
8D Lagrangian

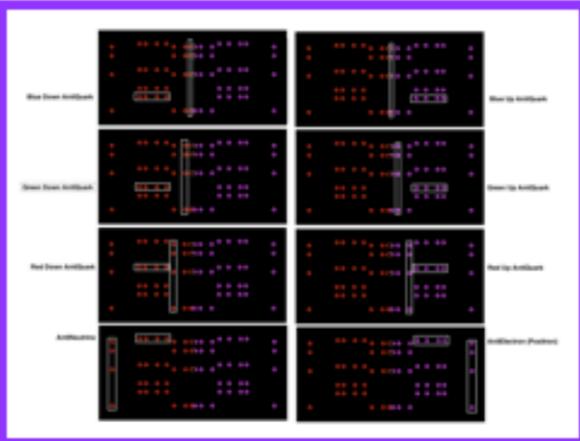
M4 CP2



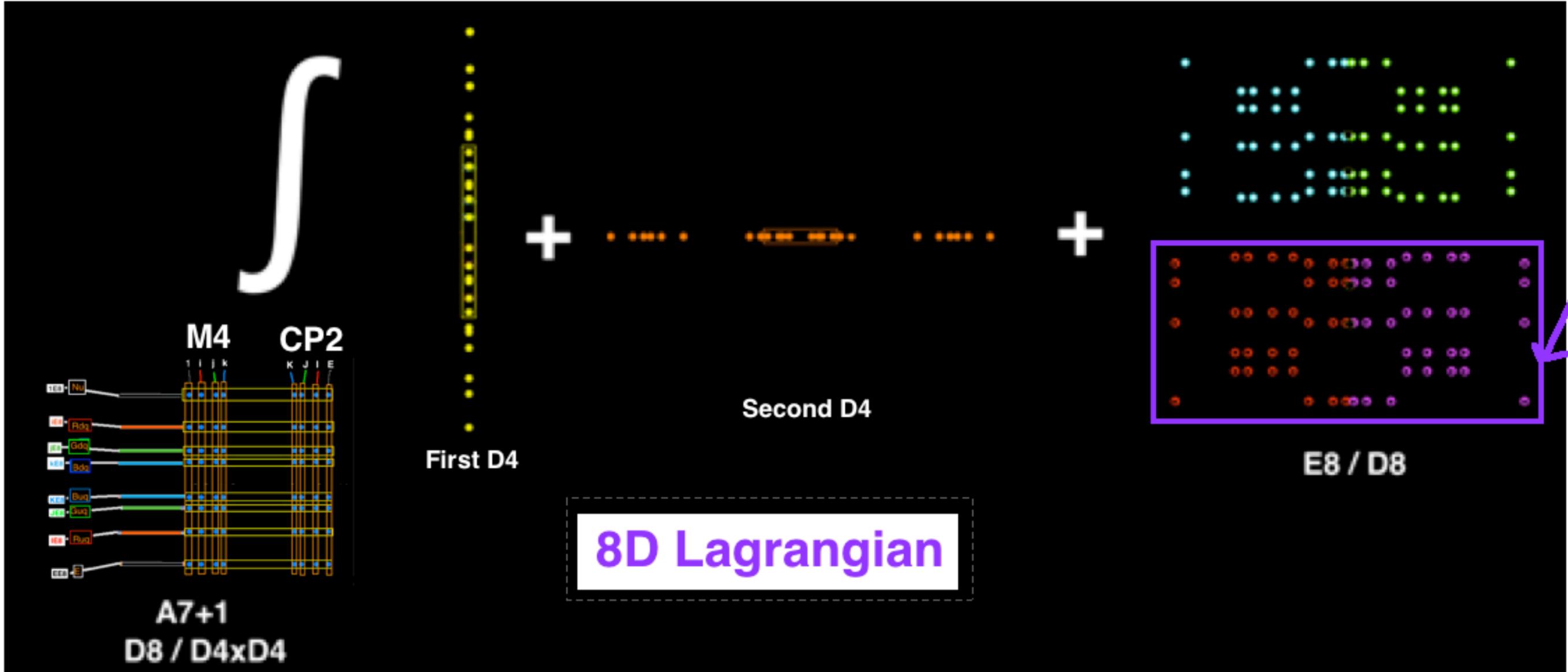
A7+1
D8 / D4xD4

The 64 Red and Magenta Root Vectors represent the other half of the First Generation Fermion AntiParticles of E8 / D8
 $8 = 4+4$ M4 x CP2 Kaluza-Klein components of each of 8 AntiParticles.
 The Black Centers of their dots indicate that they are AntiParticles.





8 Components of 8 Fermion AntiParticles

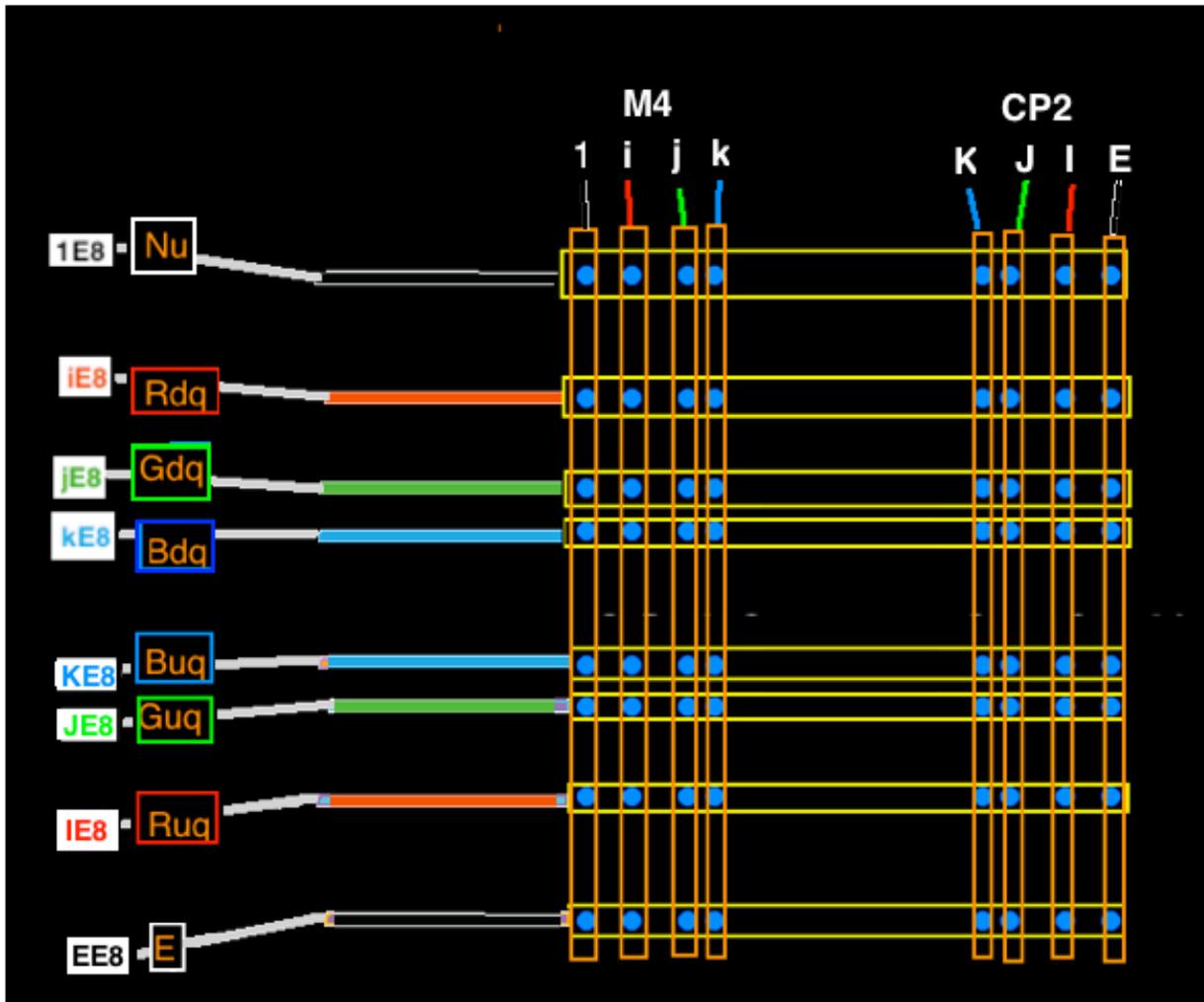


Spacetime, Unimodular Gravity, and Strong CP

The 64 Blue Root Vectors of D8 / D4xD4 are a Superposition of 8 E8 Lattices (7 being Integral Domains) corresponding to the 8 fundamental Fermion Types, each of which has 8-dim M4 x CP2 Kaluza-Klein structure.

Effectively, each Fermion Type propagates within its own E8 Lattice within the Superposition

thus forming an 8-dim Generalized Feynman Checkerboard as to which the continuous structures E8, E8/D8, D8/D4xD4, D4xD4 are useful E8 Physics approximations.



The 64 of D8 / D4xD4 also represent the A7+1 central grade of the Maximal Contraction Heisenberg Algebra of E8 with structure $28 + 64 + (A7+1) = 64 + 28$.

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

A7+1 SpaceTime is related by Triality to 64 + 64 Fermion Components of E8 / D8

A7 = SL(8,R) of Unimodular Gravity

Bradonjic and Stachel in arXiv 1110.2159 said: "... in ... **Unimodular relativity ... the metric tensor ... break[s up] ... into the conformal structure represented by a conformal metric ... with det = -1 and a four-volume element ... at each point of space-time** ...[that]... may be the remnant, in the ... continuum limit, of a more fundamental discrete quantum structure of space-time itself ...".

Frampton, Ng, and Van Dam in J. Math. Phys. 33 (1992) 3881-3882 said: "... Because of the existence of topologically nontrivial solutions, instantons, of the classical field equations associated with quantum chromodynamics (QCD), the quantized theory contains a dimensionless parameter θ ($0 < \theta < 2\pi$) not explicit in the classical lagrangian. Since θ multiplies an expression odd in CP, QCD predicts violation of ... CP ... symmetry unless the phase θ takes one of the special values ... $0 \pmod{\pi}$... this fine tuning is **the strong CP problem ... the quantum dynamics of ... unimodular gravity ... may lead to the relaxation of θ to $\theta = 0 \pmod{\pi}$ without the need ... for a new particle ... such as the axion ...**"

Unimodular SL(4,R) = Spin(3,3) Gravity and Conformal Spin(2,4) = SU(2,2) Gravity seem to be effectively equivalent.

Conformal Spin(2,4) = SU(2,2) Gravity gives Einstein-Hilbert General Relativity (GR).

Padilla and Saltas in arXiv 1409.3573 said:

"... classical unimodular gravity and classical GR are the same thing, and they can be extended into the UV such that the equivalence is maintained. ...

Classical unimodular gravity = classical GR. ...

Quantum unimodular gravity = quantum GR provided we make certain assumptions about how we extend into the UV. ...".

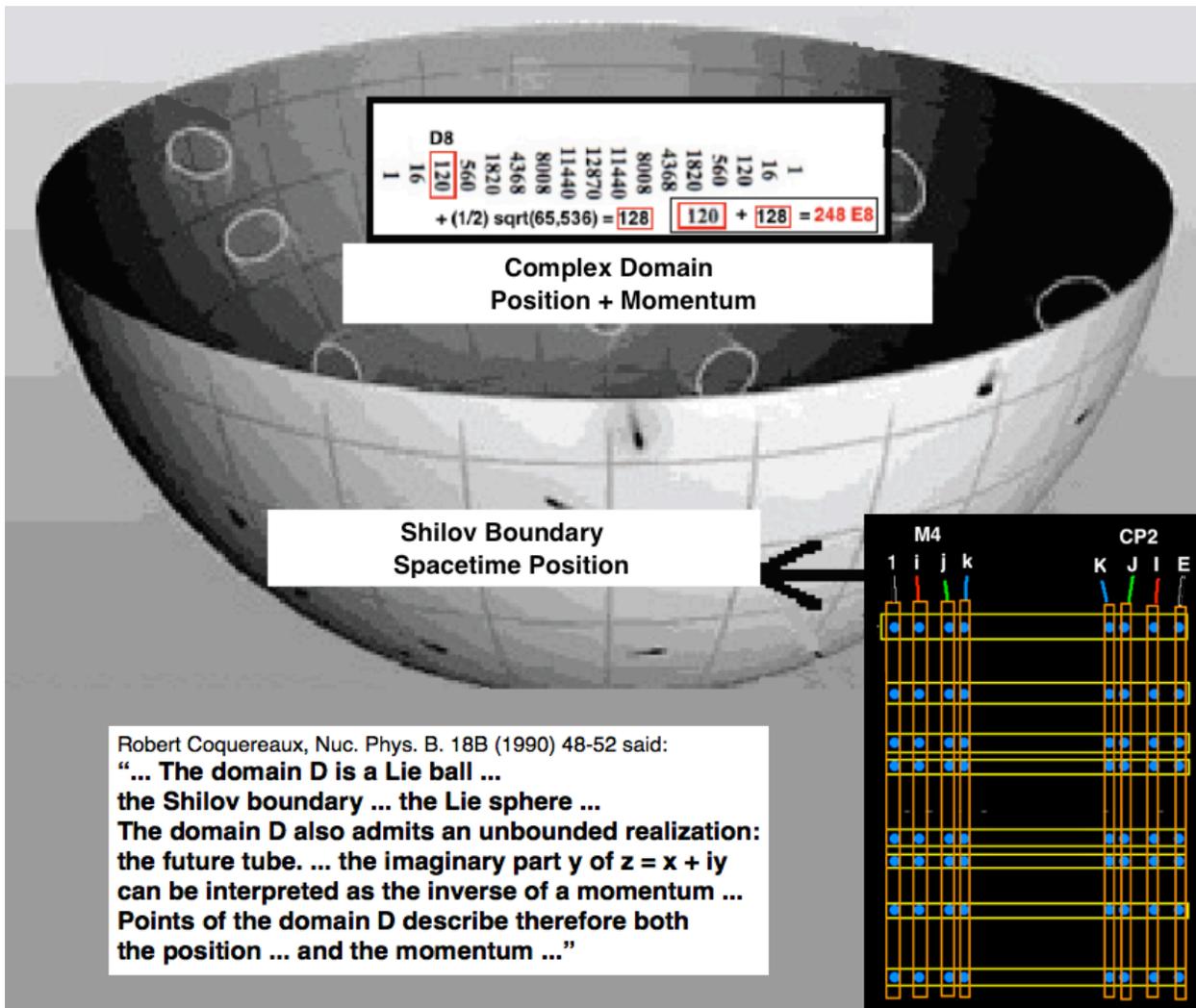
The Conformal Bounded Complex Domain
 corresponding to the Hermitian Symmetric Space $\text{Spin}(2,4) / \text{Spin}(2) \times \text{Spin}(4)$
 is a Lie Ball with Shilov Boundary the Lie Sphere $\text{RP}^1 \times \text{S}^3$

With respect to Real / Octonionic Structure:

10-dim Spacetime of 26D String Theory has symmetry $\text{Spin}(1,9) = \text{SL}(2, \mathbb{O})$

Since $\text{Cl}(1,9) = \text{Cl}(2,8) = 32 \times 32$ Real Matrices we have $\text{Spin}(1,9) = \text{Spin}(2,8)$

The Bounded Complex Domain
 corresponding to the Hermitian Symmetric Space $\text{Spin}(2,8) / \text{Spin}(2) \times \text{Spin}(8)$
 is a Lie Ball with Shilov Boundary the Lie Sphere $\text{RP}^1 \times \text{S}^7$



In the Initial and Inflation Octonionic Phases of Our Universe

the 64 generators of $D_8 / D_4 \times D_4$ act as an Octonionic Conformal Structure where $Spin(0,8)$ of $Cl(0,8)$ does rotations of 8-dim Octonion Space and **$Spin(2,8) = Spin(1,9) = SL(2,0)$ of $Cl(2,8) = Cl(1,9) = M(32,R) = M(2,Cl(0,8))$ indicates a 10-dim Conformal Spacetime within 26-dim String Theory** and

an 8-volume element at each point of Octonion Space indicates a fundamental discrete structure of an underlying 26-dim String Theory **in which Strings = World-Lines and a spin-2 particle carries Bohm Quantum Potential.**

26-dim String Theory has Real Clifford Algebra structure $Cl(1,25)$ Completion of Union of All Tensor Products of $Cl(1,25)$ produces an Algebraic Quantum Field Theory (AQFT) that generalizes the hyperfinite II₁ von Neumann factor algebra.

It has Real / Octonionic structure inherited from $Cl(0,8)$ and also Quaternionic structure due to $Cl(1,25) = Cl(1,9) \times Cl(0,8) \times Cl(0,8)$ and $Cl(1,9) = Cl(1,5) \times Cl(0,4) = Cl(2,4) \times Cl(0,4)$ where the vector space of $Cl(2,4)$ is 6-dim Conformal Spacetime.

10D Spacetime of 26D String Theory = 6D Conformal Spacetime + 4D CP²

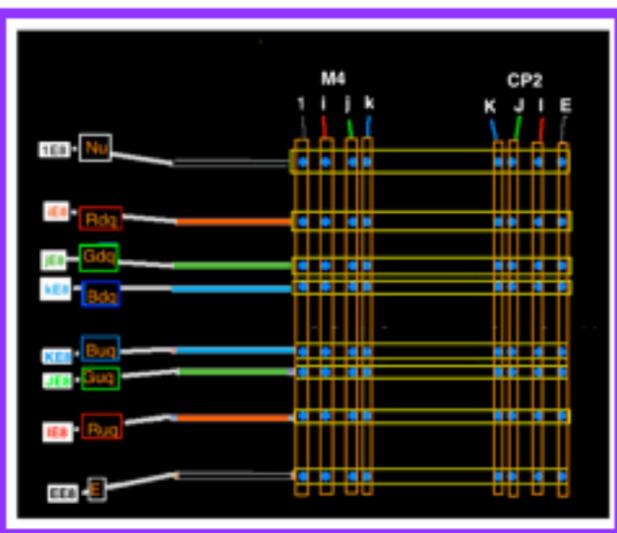
$CP^2 = SU(3) / SU(2) \times U(1)$ is Compact Internal Symmetry Space and

6-dim Conformal Spacetime $R(2,4)$ has Symmetry $SU(2,2) = Spin(2,4) Spin(2,4) / Spin(2) \times Spin(4) = SU(2,2) / U(1) \times SU(2) \times SU(2)$ is biholomorphic to the Klein quadric Q₄ in CP⁵. As described by S. G. Gindikin

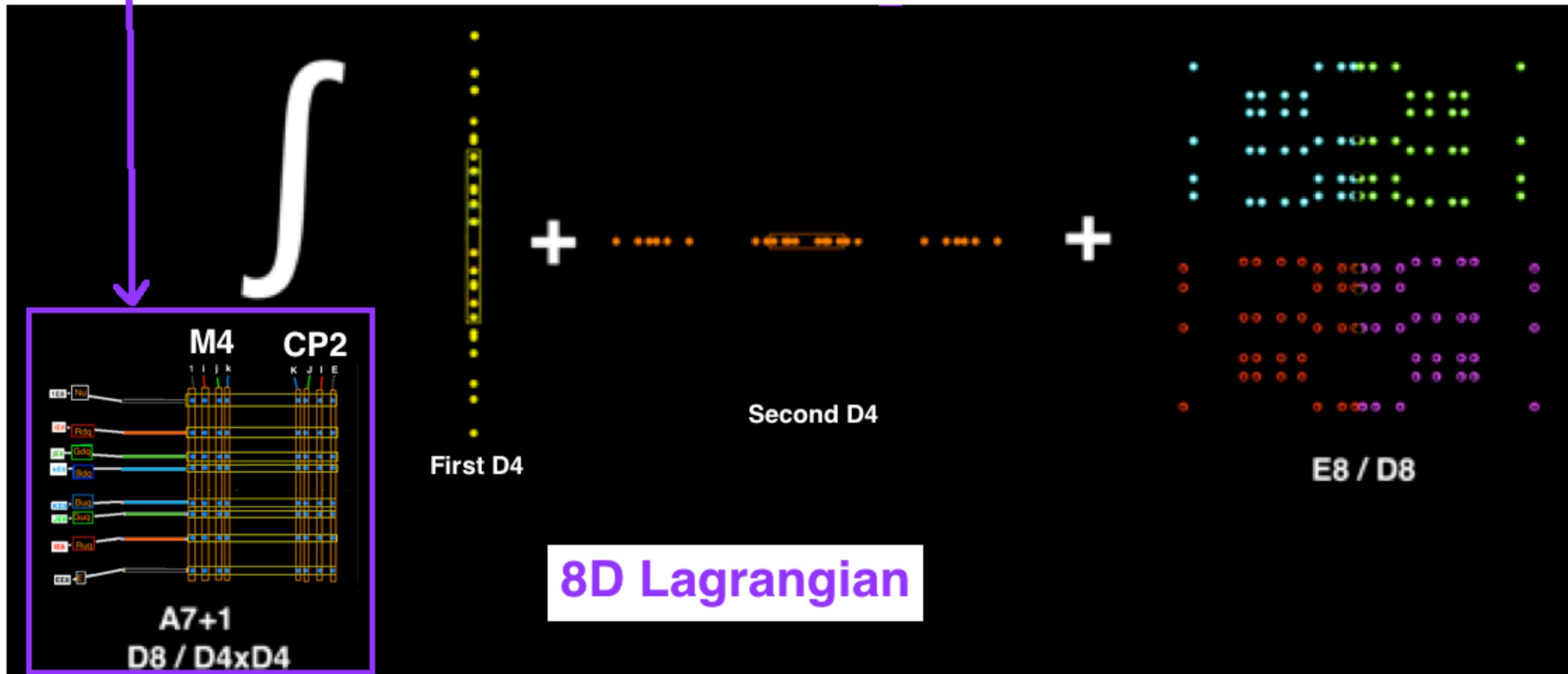
(The Complex Universe of Roger Penrose, Mathematical Intelligencer 5 (no. 1, 1983) 27-35), each point of the 4-complex-dimensional Klein quadric corresponds to a line in CP³. The line in CP³ is such that, if it passes through z , it also passes through z^* (here $*$ denotes complex conjugate).

Through each point z of CP³, there is one and only one line also passing through z^* . Therefore, all of CP³ is the union of such non-intersecting lines, and CP³ is fibred into a base manifold M and fibres which are the 1-complex-dimensional lines.

The dimension of M is the 3 complex dimensions of CP³ less the 1 complex dimension of each line, so that M is 2-complex-dimensional, or 4-real-dimensional.



Base Manifold



M4 CP2

A7+1
D8 / D4xD4

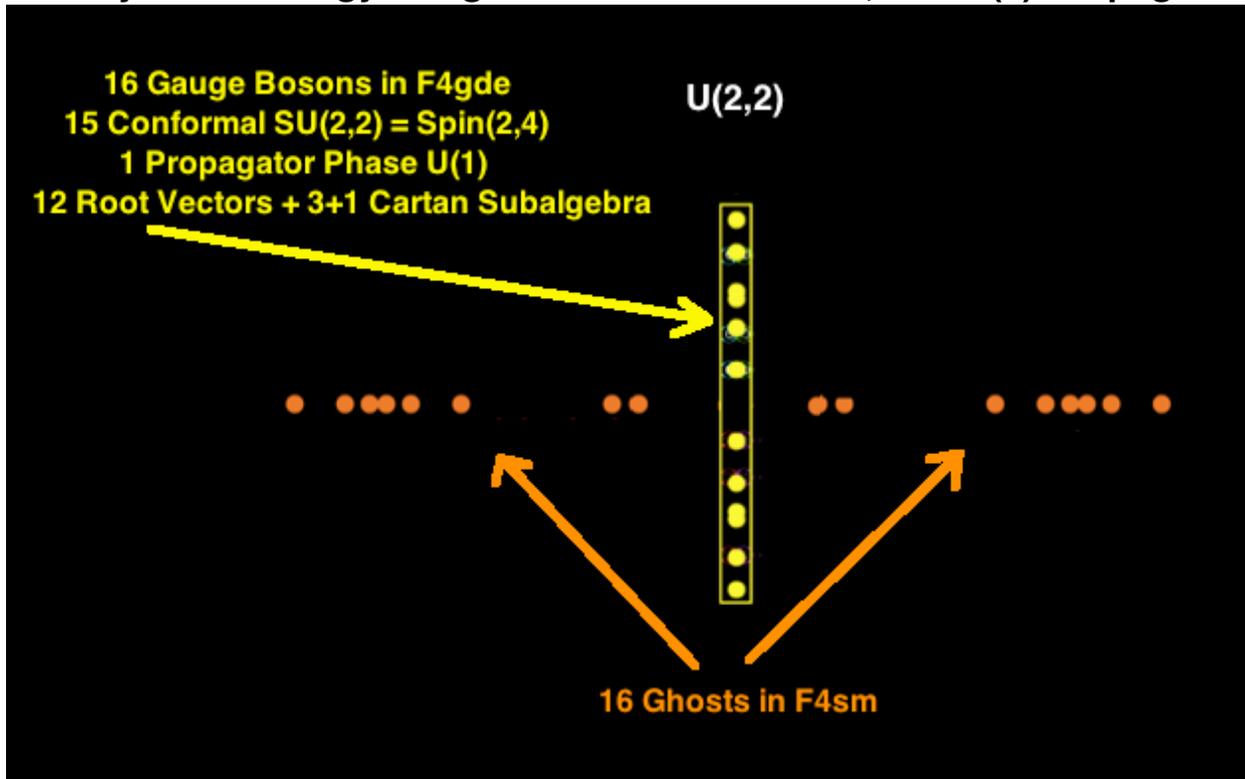
First D4

Second D4

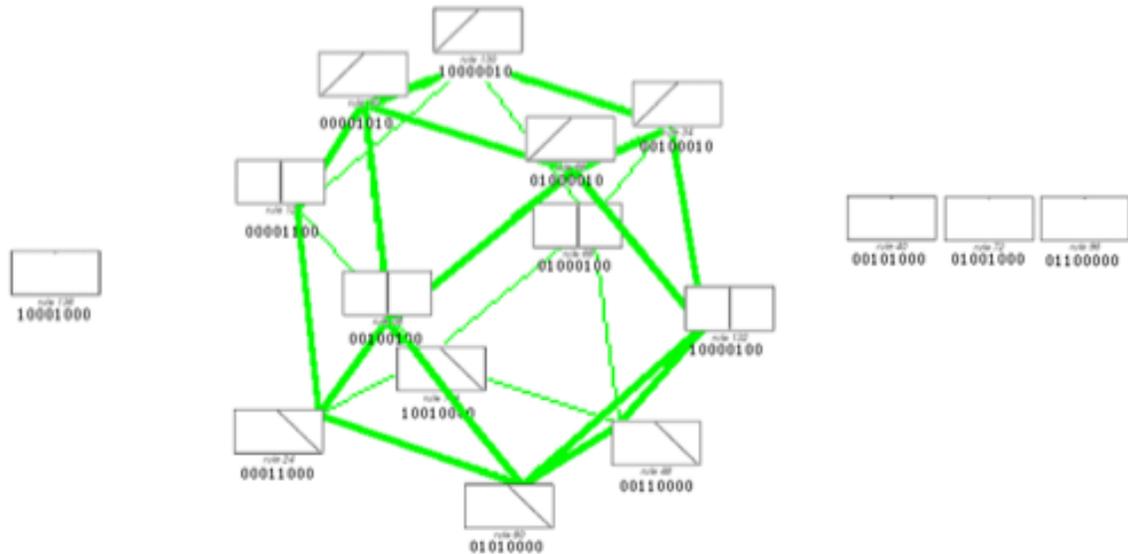
E8 / D8

8D Lagrangian

Gravity+Dark Energy Gauge Bosons and Ghosts, and U(1) Propagator



These 1 + 12 + 3 = 16 grade-2 Cellular Automata correspond to propagator phase, Conformal Lie Algebra Root Vectors, and Conformal Lie Algebra Cartan Subalgebra



**The Conformal Group $\text{Spin}(2,4) = \text{SU}(2,2)$ gives Gravity+Dark Energy by the MacDowell-Mansouri mechanism.
 $\text{U}(2,2) = \text{U}(1) \times \text{SU}(2,2)$ also contains the $\text{U}(1)$ propagator phase**

The basis for calculating the ratio

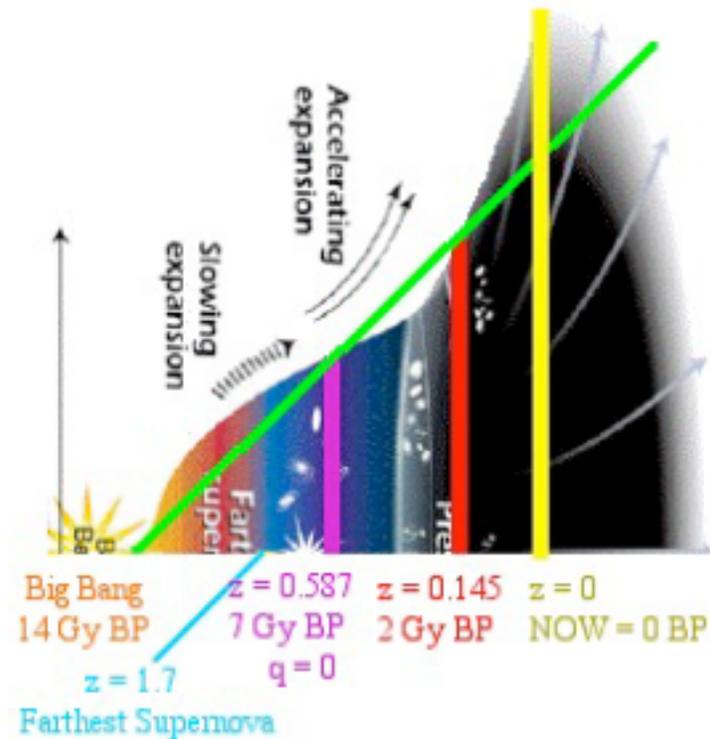
Dark Energy : Dark Matter : Ordinary Matter
is the structure of the Conformal Group $SU(2,2) = Spin(2,4)$
whose 15 generators are:

10 = 6 Lorentz + 4 Special Conformal for Dark Energy
4 = Translations for Primordial Black Hole Dark Matter
1 = Dilation for Higgs Ordinary Matter

giving a tree-level ratio of

$$10 : 4 : 1 = 0.667 : 0.267 : 0.067$$

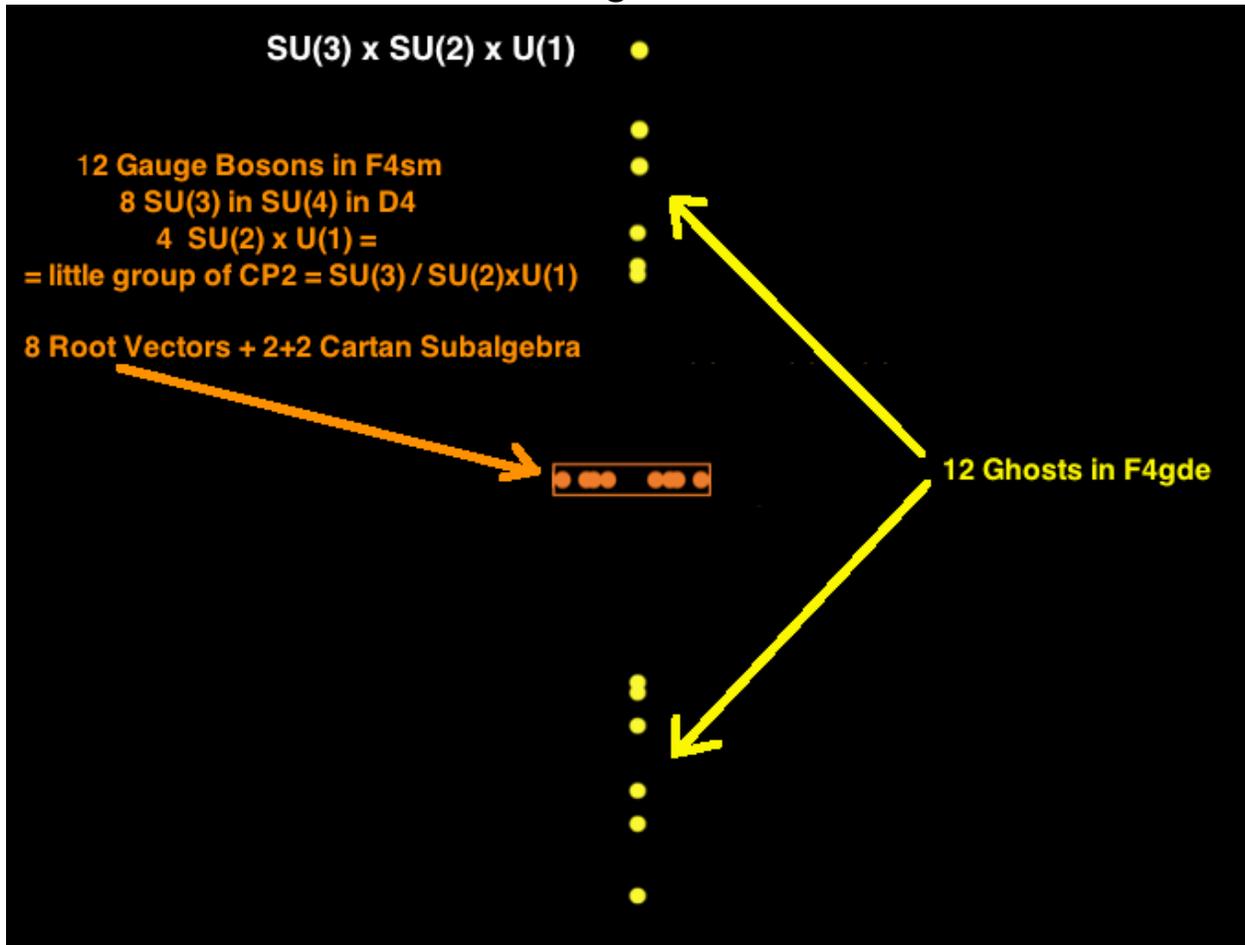
Taking Account of differences between Radiation and Matter Eras
in the Evolution of Our Universe



gives the E8 Physics calculated ratio

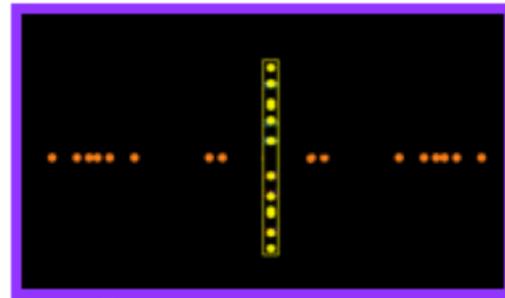
Dark Energy : Dark Matter : Ordinary Matter = 0.75 : 0.21 : 0.04

Standard Model Gauge Bosons and Ghosts



These 1 + 3 + 8 = 12 grade-2 Cellular Automata correspond to U(1) , SU(2) , SU(3) of the Standard Model



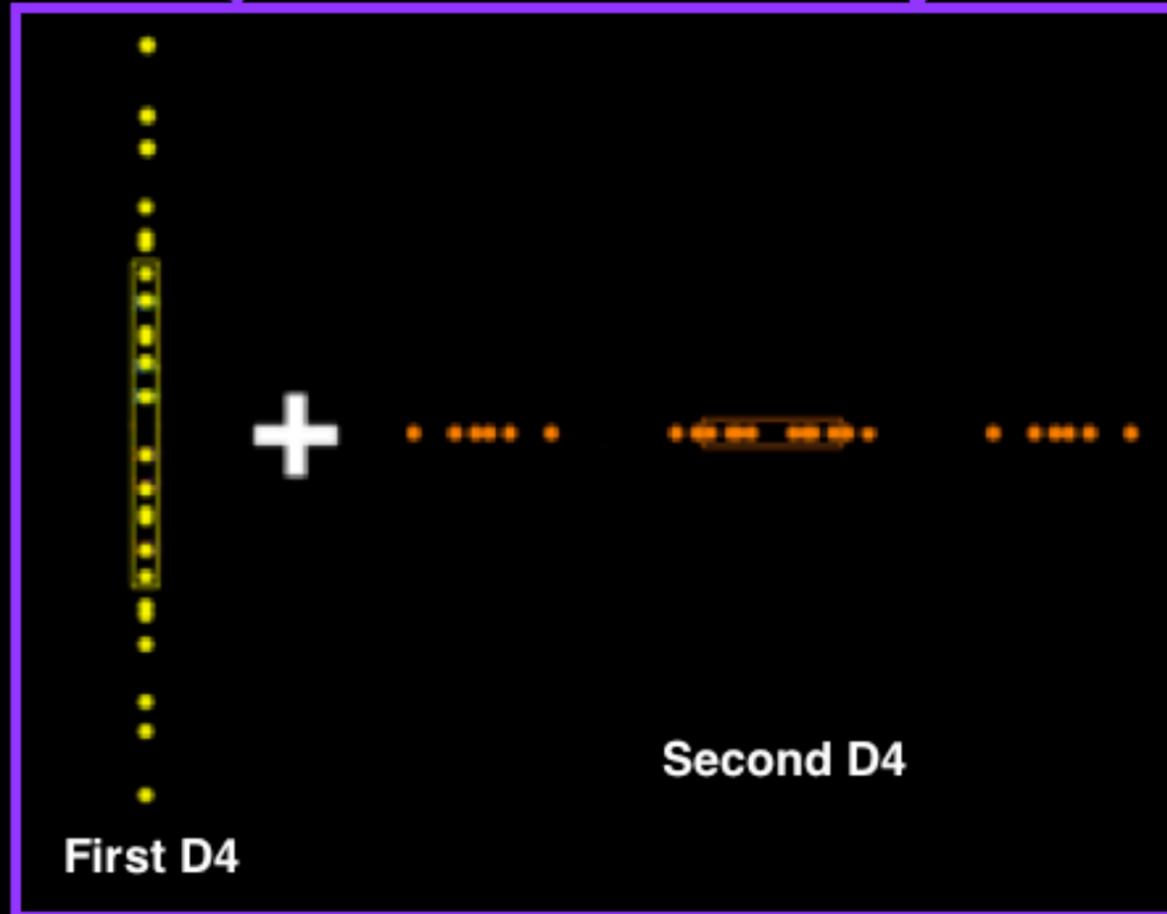


Gravity + Dark Energy
Gauge Bosons and Ghosts
plus propagator phase



Standard Model
Gauge Bosons and Ghosts

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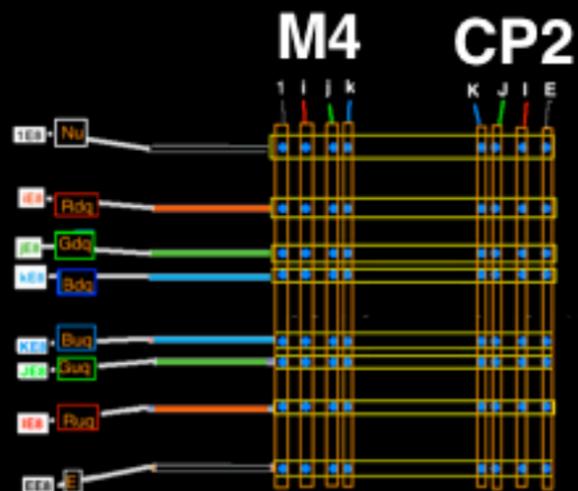


First D4

Second D4

E8 / D8

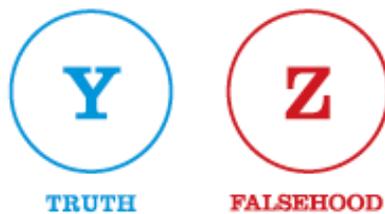
8D Lagrangian



A7+1
D8 / D4xD4

Ron Eglash (in his book "African Fractals" and on his web site) also says:
 "... Following the introduction of geomancy to Europe by Hugo of Santalla in twelfth-century Spain ... European geomancers ... Ramon Lull ... and others ... persistently replaced the deterministic aspects of the system with chance. **By mounting the 16 figures on a wheel and spinning it, they maintained their society's exclusion of any connections between determinism and unpredictability ...**".

Anthony Bonner in his book The Art and Logic of Ramon Llull (Brill 2007) (Llullian illustrations herein are adapted from that book) said:
 "... **Lull wanted to make the Art "general to everyone"** ...
 "a religiously neutral universal science" ... for Llull the Art is not enclosed in its own shell, but ... can even be adapted to "many other principles of science" ...".
 Ramon Llull's Y and Z Figures are analogous to the binary structure of IFA



Ramon Lull's Wheel X has 16 Vertices and 120 Lines and his Elemental Figure has 8x8 = 64 elements

CI(16) BiVectors

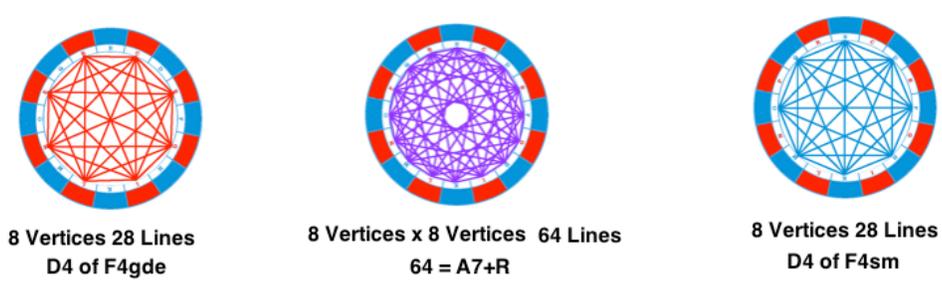
8 Components of 8 Fermion Particles
 Nu rDQ gDQ bDQ bUQ gUQ rUQ E

1	fire	air	water	earth	air	fire	water	earth
j	air	fire	earth	water	fire	air	earth	water
i	water	earth	fire	air	water	earth	air	fire
E	earth	water	air	fire	earth	water	fire	air
k	water	earth	air	fire	earth	water	air	fire
J	earth	water	fire	air	water	earth	air	fire
I	air	fire	water	earth	air	fire	earth	water
K	fire	air	earth	water	fire	air	water	earth

16 Vertices 120 Lines

8 Components of 8 Fermion AntiParticles
 Nu rDQ gDQ bDQ bUQ gUQ rUQ E

1	fire	air	water	earth	air	fire	water	earth
j	air	fire	earth	water	fire	air	earth	water
i	water	earth	fire	air	water	earth	air	fire
E	earth	water	air	fire	earth	water	fire	air
k	water	earth	air	fire	earth	water	air	fire
J	earth	water	fire	air	water	earth	air	fire
I	air	fire	water	earth	air	fire	earth	water
K	fire	air	earth	water	fire	air	water	earth



E8 Maximal Contraction 28 + 64 + (A7+R) + 64 + 28

where 28 = D4 of F4gde and A7+R and 28 = D4 of F4sm are even grade and 64 = 8 Components of 8 Fermions and 64 = 8 Components of 8 AntiFermions are odd.

Ramon Llull, known as Doctor Illuminatus, lived around 1300 so he did not know about the E8 Physics to which his rediscovered Math/Logic structures corresponded.

Therefore,

instead of spinning his Wheels to produce a Quantum Path Integral E8 Physics, he applied his structures to Religious Systems (Judaism, Christianity, Islam) and tried to show their Universality and Equivalence to the leading intellects of the time, at the University of Paris.

Doctor Subtilis = John Duns Scotus (1266-1308) developed Llull's system of Math/Logic into sophisticated Scholasticism which he brought from Paris to the new Universities at Oxford and Cambridge.

Scholasticism was furthered in 1540 by Ignatius Loyola under Pope Paul III who founded the Jesuits, but, without the ability to experimentally measure the relative strengths of the forces of the Standard Model and Gravity and the relative masses of the elementary fermion particles and to compare those observations with the physics model of Llull's mathematical Art, by 1700 Scholasticism had been displaced by the Enlightenment of Descartes et al and Ramon Llull's rediscovery of Math/Logic structures of Cl(16) and E8 was again lost.

Cartan's Lie Group E8 has Three Real Forms:
Compact E8(-248)
NonCompact Split EVIII E8(8)
Quaternionic EIX E8(-24)

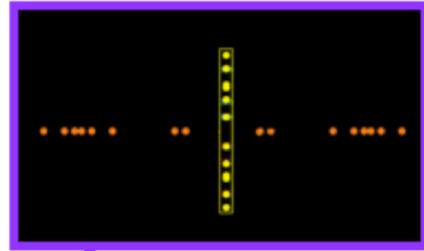
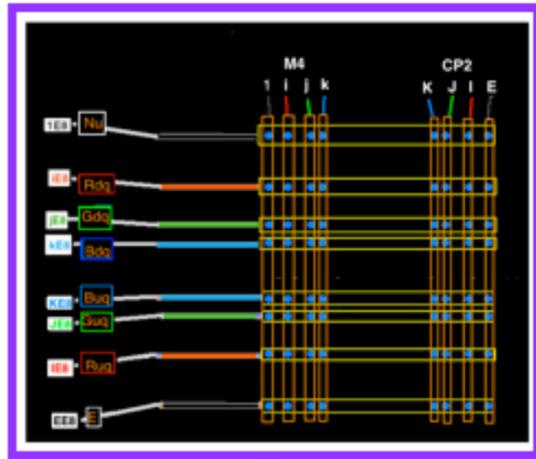
Our Planck Scale Universe emerged from its Parent Universe by Quantum Fluctuation - then it was described by SO(16) symmetry of **Compact E8(-248)**.

Our Universe was expanding during Octonionic Non-Unitary Inflation - then it unfolded from Finite Elliptic Compact to Infinite Hyperbolic NonCompact SO(8,8) symmetry of **NonCompact Split EVIII E8(8)**. That transition was a shifting of SO(16) symmetry from E8(-248) to E8(8) followed by a Weyl Unitary Trick within E8(8) from SO(16) to SO(8,8).

Inflation ended and 8-dim Octonionic Spacetime was broken into (4+4)-dim Unitary Quaternionic M4 x CP2 Kaluza-Klein Spacetime with SO*(16) symmetry of **EIX E8(-24)**.

That transition was a Weyl Unitary Trick within E8(8) from SO(8,8) to SO*(16) followed by a shifting of SO*(16) symmetry from E8(8) to E8(-24).

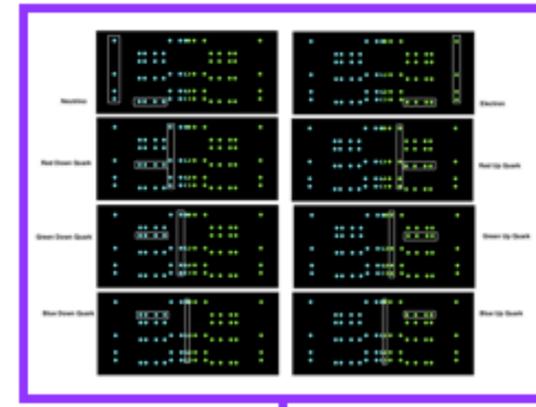
8D Lagrangian



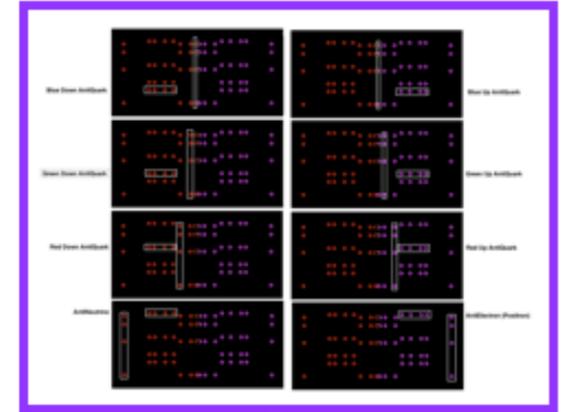
Gravity + Dark Energy
Gauge Bosons and Ghosts
plus propagator phase



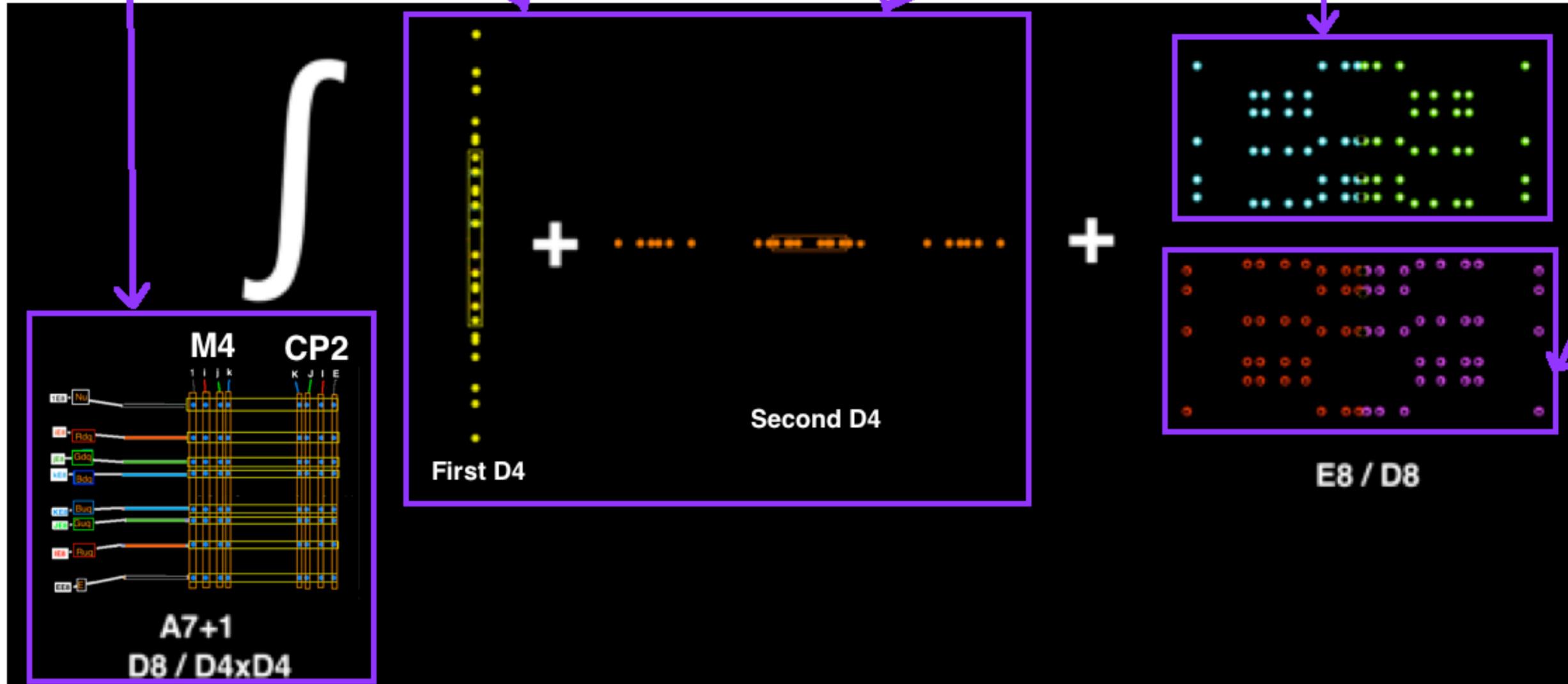
Standard Model
Gauge Bosons and Ghosts

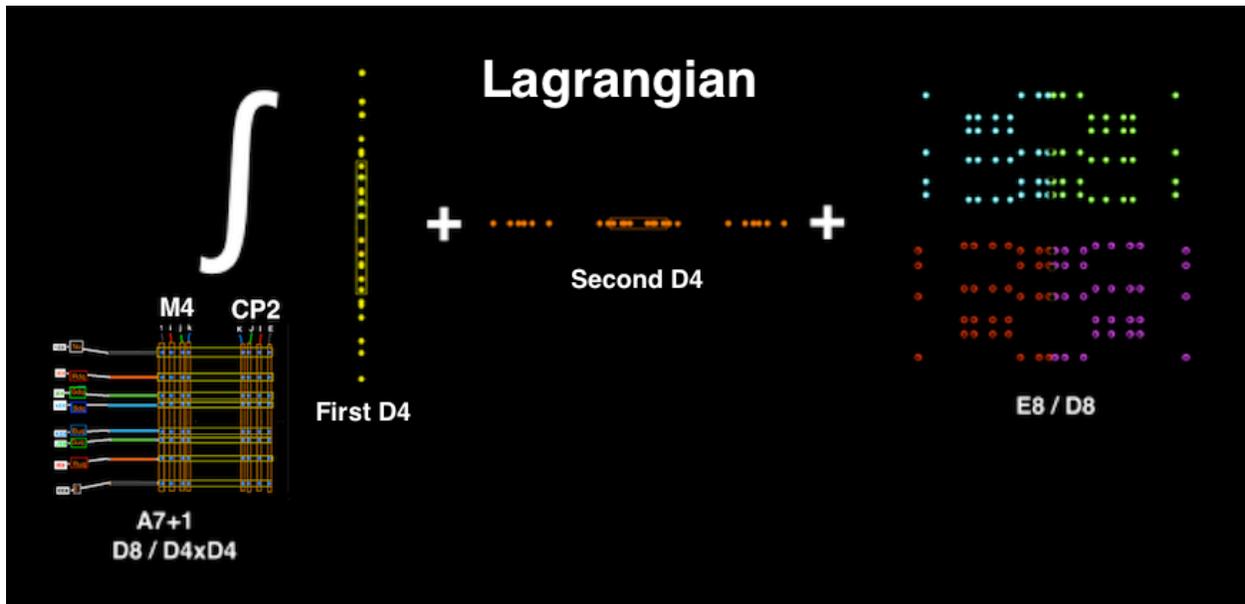


8 Components of 8 Fermion Particles



8 Components of 8 Fermion AntiParticles





The 8D Lagrangian Density of E8 Physics has 3 fundamental terms

Generation-1 Fermion Particles and AntiParticles in E8 / D8
 $(8+8) \times 8$ Components = $64+64 = 128$ Root Vectors

Standard Model Gauge Bosons and Gravity+Dark Energy Ghosts)
 24 Root Vectors and
 4 Cartan Subalgebra elements of CP2 part of E8 Physics

Gravity+Dark Energy Gauge Bosons and Standard Model Ghosts)
 plus U(1) Propagator Phase
 24 Root Vectors and 4 Cartan Subalgebra elements of M4 part of E8
 Physics

The 8D Lagrangian Base Manifold is
 M4 x CP2 Kaluza-Klein of Superposition of 8 E8 Lattices
 $(4+4) \times 8 = 64$ Root Vectors

8D Lagrangian 8-dim Lorentz structure satisfies Coleman-Mandula because its Fermionic fundamental spinor representations are built with respect to spinor representations for 8-dim Spin(1,7) spacetime.

Each Fermionic Term Fermion has in 8-dim Spacetime units of $\text{mass}^{7/2}$.

Each Bosonic Term Gauge Boson + Ghost has units of mass^1

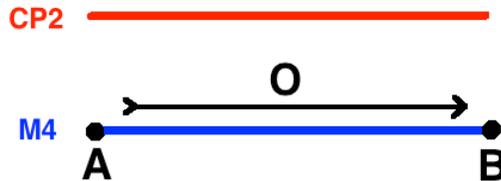
Since $(8+8) \times (7/2) = 56 = 28 + 28$

the Fermionic Terms cancel the Bosonic Terms so the E8 Physics Lagrangian is UltraViolet finite.

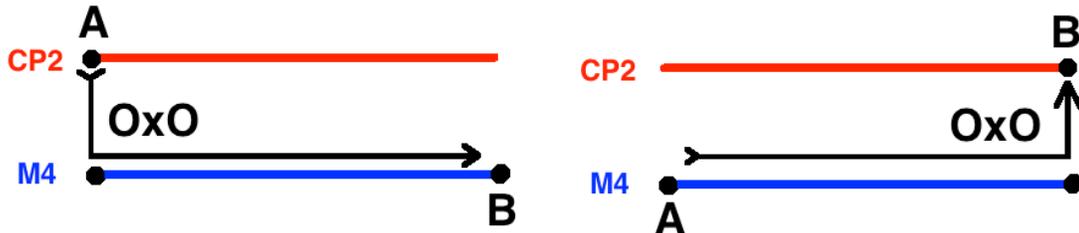
3 Generations of Fermions

In Kaluza-Klein $M4 \times CP2$ there are 3 possibilities for a fermion to go from point A to point B:

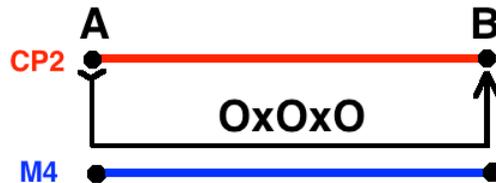
1 - A and B are both in $M4$: First Generation Fermion represented by single O basis element



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



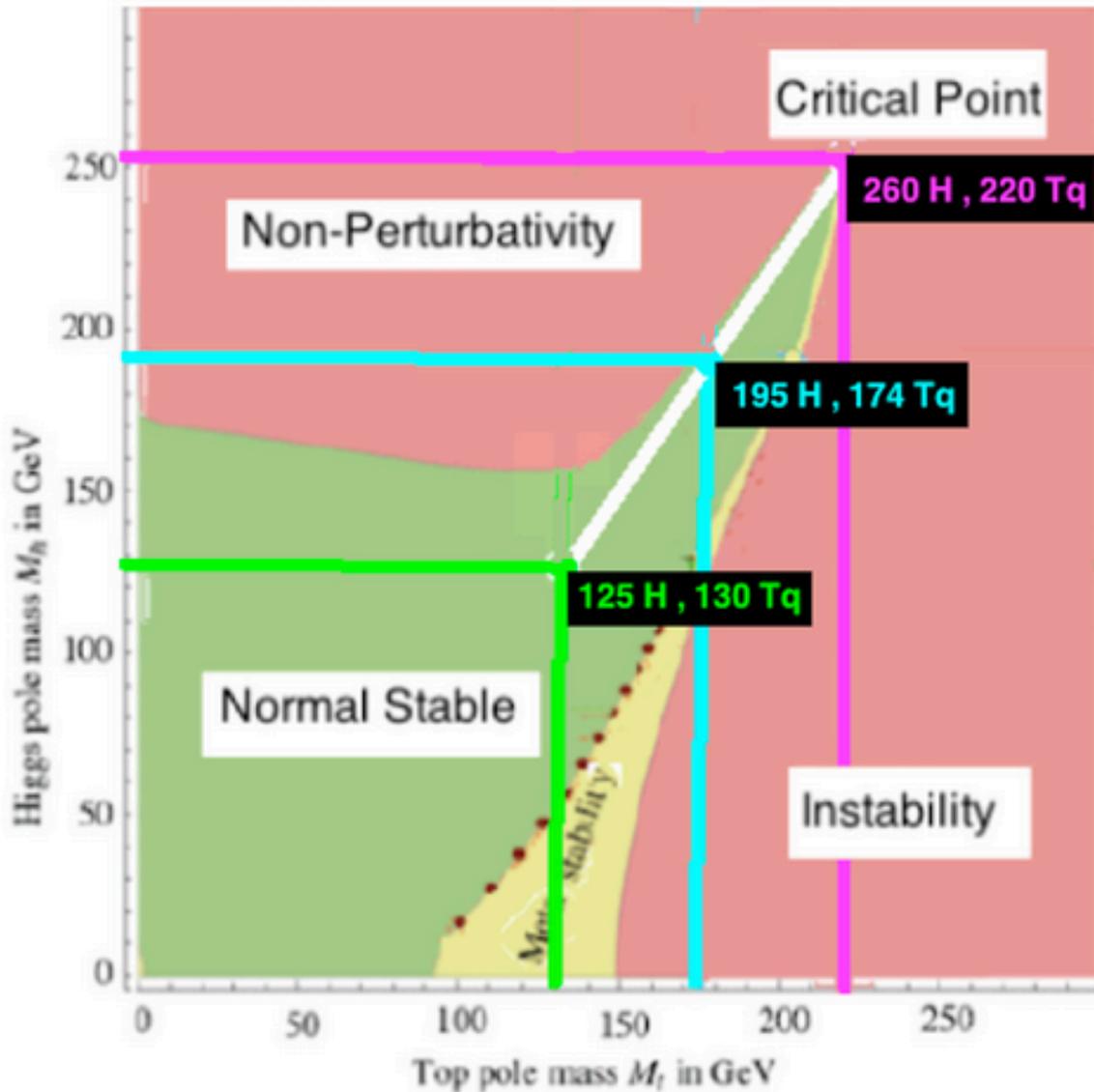
3 - Both A and B are in $CP2$: Third Generation Fermion whose path must be augmented by two projections from $CP2$ to $M4$, which projections can be represented by a second O and a third O, so that Third Generation Fermions are Octonion Triples $OxOxO$.



When Octonionic Spacetime of 8D Lagrangian symmetry
 breaks to Quaternionic (4+4) Kaluza-Klein 4D Lagrangian
 Higgs emerges by Mayer Mechanism

and

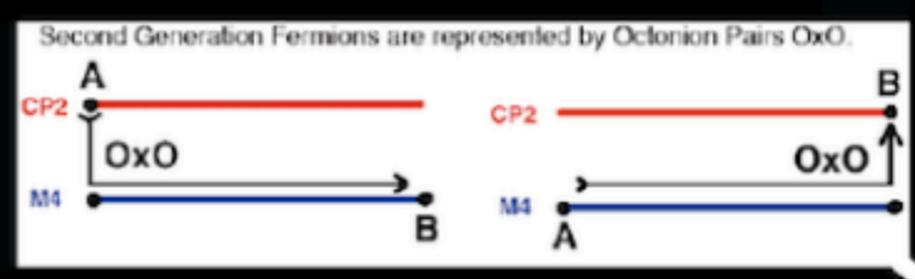
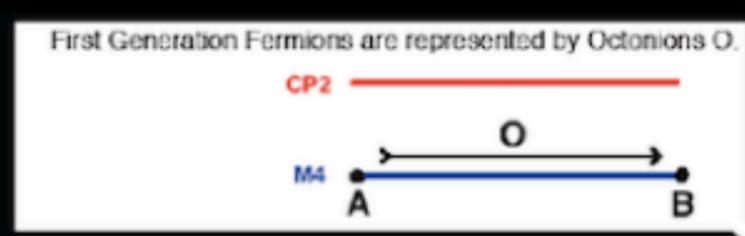
Higgs as Truth Quark-AntiQuark Condensate
 form Nambu - Jona-Lasinio system
 with 3 Mass States for Higgs and Truth Quark



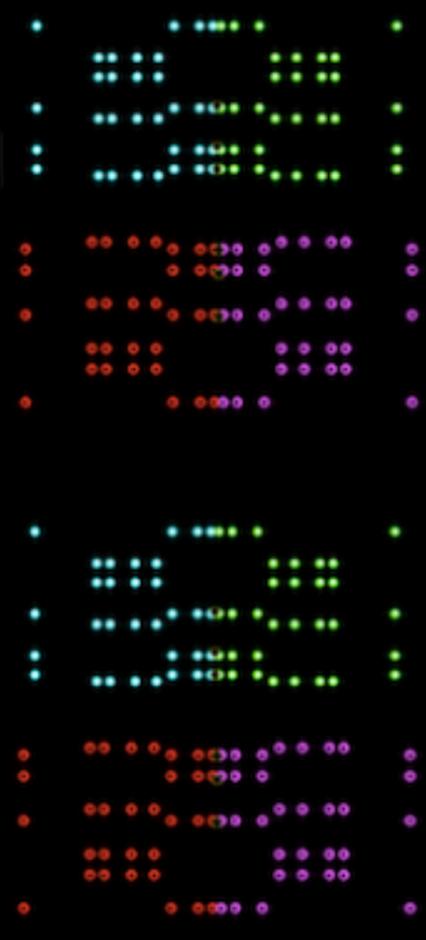
Lagrangian



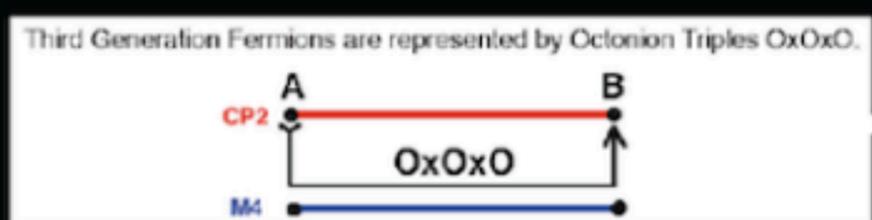
Mayer Mechanism



3 Kaluza-Klein Fermion Generations

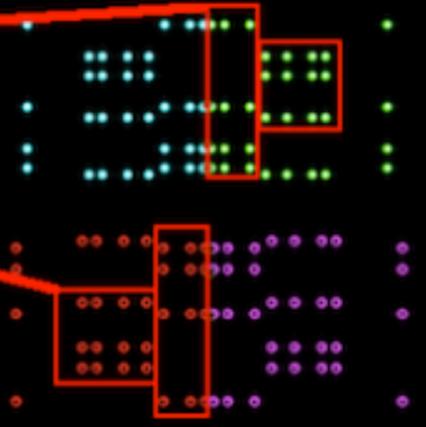


NJL Higgs as Condensate of $T\bar{T}$



RGB Truth Quarks

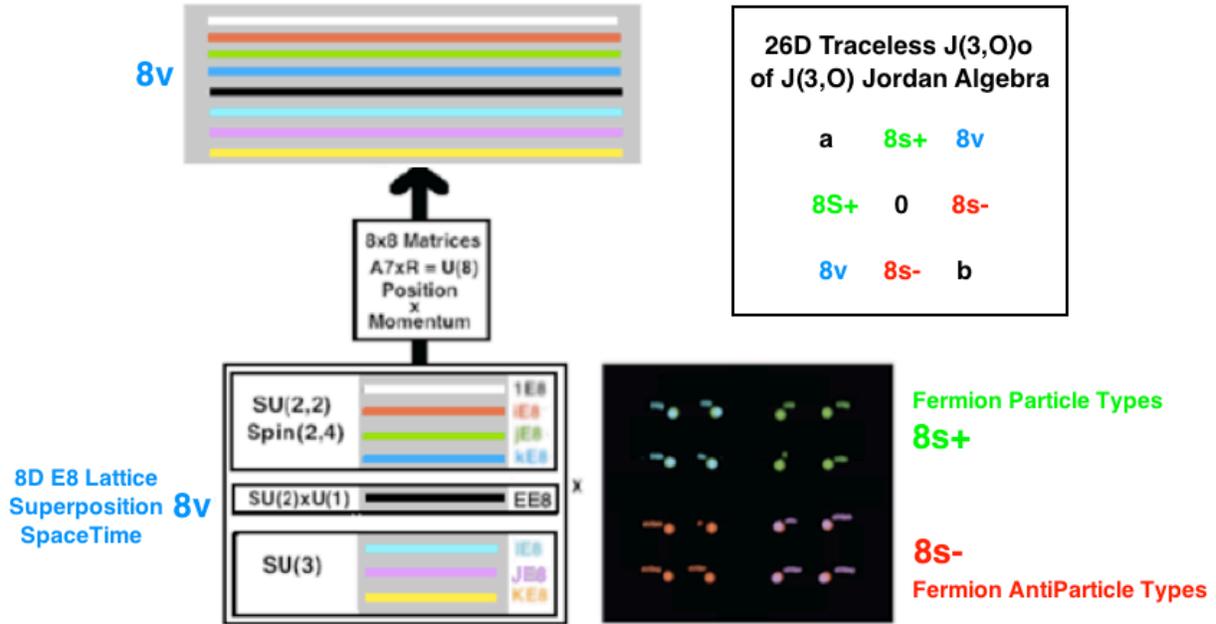
RGB Truth AntiQuarks



E8 Physics as 26D String Theory

**Fundamental Interactions are not among Point Particles
but are among Strings = World-Line Histories of Particles.**

26D E8 String Theory



David Finkelstein said

("Space-Time Code. III" Phys. Rev. D (1972) 2922-2931)

**"... According to relativity,
the world is a collection of processes (events)
with an unexpectedly unified causal or chronological structure.
Then an object is secondary ...[to]...
a long causal sequence of processes, world line. ..
[if] we assemble these ... into chromosomelike code sequences ...
and braid and cross-link these strands
to make more complex objects and their interactions
...[then]... The idea of the quantum jump comes into its own ..."**

With that in mind, here is the construction:

Step 1:

Consider the 26 Dimensions of Bosonic String Theory as the 26-dimensional traceless part $J_3(O)_o$

$$\begin{array}{ccc} a & O_+ & O_v \\ O_+^* & b & O_- \\ O_v^* & O_-^* & -a-b \end{array}$$

(where O_v , O_+ , and O_- are in Octonion space with basis $\{1, i, j, k, E, I, J, K\}$ and a and b are real numbers with basis $\{1\}$) of the 27-dimensional Jordan algebra $J_3(O)$ of 3×3 Hermitian Octonion matrices.

Step 2:

Take a D3 brane to correspond to the Imaginary Quaternionic associative subspace spanned by $\{i, j, k\}$ in the 8-dimensional Octonionic O_v space.

Step 3:

Compactify the 4-dimensional co-associative subspace spanned by $\{E, I, J, K\}$ in the Octonionic O_v space as a $CP^2 = SU(3)/U(2)$, with its 4 world-brane scalars corresponding to the 4 covariant components of a Higgs scalar. Add this subspace to D3, to get D7.

Step 4:

Orbifold the 1-dimensional Real subspace spanned by $\{1\}$ in the Octonionic O_v space by the discrete multiplicative group $Z_2 = \{-1, +1\}$, with its fixed points $\{-1, +1\}$ corresponding to past and future time. This discretizes time steps and gets rid of the world-brane scalar corresponding to the subspace spanned by $\{1\}$ in O_v . It also gives our brane a 2-level timelike structure, so that its past can connect to the future of a preceding brane and its future can connect to the past of a succeeding brane.

Add this subspace to D7, to get D8.

D8, our basic Brane, looks like two layers (past and future) of D7s.

Beyond D8 our String Theory has $26 - 8 = 18$ dimensions, of which $25 - 8$ have corresponding world-brane scalars:

8 world-brane scalars for Octonionic O_+ space;

8 world-brane scalars for Octonionic O_- space;

1 world-brane scalars for real a space; and

1 dimension, for real b space, in which the D8 branes containing spacelike D3s are stacked in timelike order.

Step 5:

To get rid of the world-brane scalars corresponding to the Octonionic O_+ space, orbifold it by the 16-element discrete multiplicative group

$$\text{Oct}16 = \{+/-1, +/-i, +/-j, +/-k, +/-E, +/-I, +/-J, +/-K\}$$

to reduce O_+ to 16 singular points $\{-1, -i, -j, -k, -E, -I, -J, -K, +1, +i, +j, +k, +E, +I, +J, +K\}$.

Let the 8 O_+ singular points $\{-1, -i, -j, -k, -E, -I, -J, -K\}$ correspond to the fundamental fermion particles
{neutrino, red up quark, green up quark, blue up quark,
electron, red down quark, green down quark, blue down quark}
located on the past D7 layer of D8.

Let the 8 O_+ singular points $\{+1, +i, +j, +k, +E, +I, +J, +K\}$ correspond to the fundamental fermion particles
{neutrino, red up quark, green up quark, blue up quark,
electron, red down quark, green down quark, blue down quark}
located on the future D7 layer of D8.

The 8 components of the 8 fundamental first-generation fermion particles = $8 \times 8 = 64$ correspond to the 64 of the 128-dim half-spinor D8 part of E8.

This gets rid of the 8 world-brane scalars corresponding to O_+ , and leaves:

8 world-brane scalars for Octonionic O_- space;

1 world-brane scalars for real a space; and

1 dimension, for real b space, in which the D8 branes containing spacelike D3s are stacked in timelike order.

Step 6:

To get rid of the world-brane scalars corresponding to the Octonionic O_- space, orbifold it by the 16-element discrete multiplicative group

$$\text{Oct}16 = \{+/-1, +/-i, +/-j, +/-k, +/-E, +/-I, +/-J, +/-K\}$$

to reduce O_- to 16 singular points $\{-1, -i, -j, -k, -E, -I, -J, -K, +1, +i, +j, +k, +E, +I, +J, +K\}$.

Let the 8 O_- singular points $\{-1, -i, -j, -k, -E, -I, -J, -K\}$ correspond to the fundamental fermion anti-particles {anti-neutrino, red up anti-quark, green up anti-quark, blue up anti-quark, positron, red down anti-quark, green down anti-quark, blue down anti-quark}
located on the past D7 layer of D8.

Let the 8 O_- singular points $\{+1, +i, +j, +k, +E, +I, +J, +K\}$ correspond to the fundamental fermion anti-particles {anti-neutrino, red up anti-quark, green up anti-quark, blue up antiquark, positron, red down anti-quark, green down anti-quark, blue down anti-quark}
located on the future D7 layer of D8.

The 8 components of 8 fundamental first-generation fermion anti-particles = $8 \times 8 = 64$ correspond to the 64 of the 128-dim half-spinor D8 part of E8.

This gets rid of the 8 world-brane scalars corresponding to O_- , and leaves:

1 world-brane scalars for real a space; and

1 dimension, for real b space, in which the D8 branes containing spacelike D3s are stacked in timelike order.

Step 7:

Let the 1 world-brane scalar for real a space correspond to a Bohm-type Quantum Potential acting on strings in the stack of D8 branes.

Interpret strings as world-lines in the Many-Worlds, short strings representing virtual particles and loops.

Step 8:

Fundamentally, physics is described on HyperDiamond Lattice structures.

There are 7 independent E8 lattices, each corresponding to one of the 7 imaginary octonions. denoted by $iE8$, $jE8$, $kE8$, $EE8$, $IE8$, $JE8$, and $KE8$ and related to both D8 adjoint and half-spinor parts of E8 and with 240 first-shell vertices.

An 8th 8-dim lattice $1E8$ with 240 first-shell vertices related to

the E8 adjoint part of E8 is related to the 7 octonion imaginary lattices.

Give each D8 brane structure based on Planck-scale E8 lattices so that

each D8 brane is a superposition/intersection/coincidence of the eight E8 lattices.

(see viXra 1301.0150)

Step 9:

Since Polchinski says "... If r D-branes coincide ... there are r^2 vectors, forming the adjoint of a $U(r)$ gauge group ...", make the following assignments:

a gauge boson emanating from D8 from its $1E8$ and $EE8$ lattices is

a $U(2)$ ElectroWeak boson thus accounting for the photon and $W+$, $W-$ and $Z0$ bosons.

a gauge boson emanating from D8 from its $IE8$, $JE8$, and $KE8$ lattices is

a $U(3)$ Color Gluon boson thus accounting for the 8 Color Force Gluon bosons.

The $4+8 = 12$ bosons of the Standard Model Electroweak and Color forces correspond to 12 of the 28 dimensions of 28-dim $Spin(8)$

that corresponds to one of the 28 of the 120-dim adjoint D8 parts of E8.

a gauge boson emanating from D8 from its $1E8$, $iE8$, $jE8$, and $kE8$ lattices is

a $U(2,2)$ boson for conformal $U(2,2) = Spin(2,4) \times U(1)$ MacDowell-Mansouri gravity plus conformal structures consistent with the Higgs mechanism and with observed Dark Energy, Dark Matter, and Ordinary matter.

The 16-dim $U(2,2)$ is a subgroup of 28-dim $Spin(2,6)$

that corresponds to the other 28 of the 120-dim adjoint D8 part of E8.

Step 10:
Since Polchinski says

"... there will also be r^2 massless scalars from the components normal to the D-brane. ... the collective coordinates ... X^u ... for the embedding of n D-branes in spacetime are now enlarged to $n \times n$ matrices.

This 'noncommutative geometry' ...[may be]... an important hint about the nature of spacetime. ...",

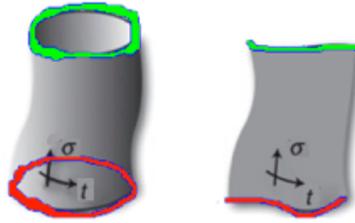
make the following assignment:

The 8×8 matrices for the collective coordinates linking a D8 brane to the next D8 brane in the stack are needed to connect the eight E_8 lattices of the D8 brane to the eight E_8 lattices of the next D8 brane in the stack.

The $8 \times 8 = 64$ correspond to the 64 of the 120 adjoint D8 part of E_8 .

We have now accounted for all the scalars
and
have shown that the model has the physics content of the realistic E_8 Physics model with Lagrangian structure based on $E_8 = (28 + 28 + 64) + (64 + 64)$
and
AQFT structure based on $Cl(1,25)$ with real Clifford Algebra periodicity and generalized Hyperfinite II₁ von Neumann factor algebra.

In my unconventional view



**the red line and the green line
are different strings/worldlines/histories and
the world-sheet is the minimal surface connecting them,
carrying the Bohm Potential,
The t world-sheet coordinate is for Time
The sigma world-sheet coordinate is
for Bohm Potential Gauge Boson at a given Time.**

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 ...”.

Ibanez and Uranga said:

**“... This tachyon ... is ... unstable ...
the antisymmetric part is the 26d 2-form field BMN ...
The symmetric traceless part is the 26d graviton GMN ...
Its trace corresponds to a scalar field, the dilaton ϕ ...”.**

**Tachyons localized at orbifolds of fermions
produce virtual clouds
of particles / antiparticles that dress fermions.**

**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.**

**In E8 Physics,
the String Theory graviton is NOT a graviton
but is the Quantum Bohmion.**

**The 24x24 Real Symmetric Matrices form the Jordan Algebra $J(24, \mathbb{R})$.
24-Real-dim space has a natural Octonionic structure.**

**The corresponding Jordan Algebra is
 $J(3, \mathbb{O}) = 3 \times 3$ Hermitian Octonion matrices.**

**Their 26-dim traceless part $J(3, \mathbb{O})_0$
describes the 26-dim of Bosonic String Theory
and the algebra of its Quantum States, so that
the 24x24 traceless symmetric spin-2 particle
is the Quantum Bohmion.**

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

Tachyons create Schwinger Sources

**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
a neutral cloud of particle/antiparticle pairs
forming a Kerr-Newman black hole.
That cloud constitutes the Schwinger Source.**

**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} .**

**Schwinger Source 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} .**

**As continuous manifold approximating E8 Lattice structure
Schwinger Sources are
Bounded Complex Domains and their Shilov Boundaries.
The Bounded Complex Domains have Bergman Kernels whose
physical interpretation is that of Green's Function Propagators.**

Fock "Fundamental of Quantum Mechanics" (1931): Quantum 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): used Kernel Functions for Complex Classical Domains and calculated volumes of Bounded Domains and Shilov Boundaries.

Schwinger (1951 - see Schweber, PNAS 102, 7783-7788) "... introduced a description in terms of Green's functions, what Feynman had called propagators ...".

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

$$\begin{aligned} S1 \times S1 \times S1 \times S1 &= 4 \text{ copies of } U(1) \\ S2 \times S2 &= 2 \text{ copies of } SU(2) \\ CP2 &= SU(3) / SU(2) \times U(1) \\ S4 &= Spin(5) / Spin(4) = \text{Euclidean version of } Spin(2,3) / Spin(1,3) \end{aligned}$$

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

Schwinger (1969 - see physics/0610054): "... replace[s] the particle with ... properties ... distributed throughout ... small volumes of three-dimensional space ... a source function describing the intermediate propagation of the particle ...".

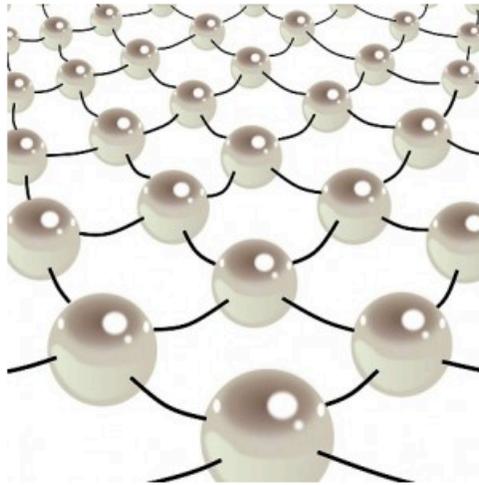
The idea of Schwinger Sources as more than mere points is in **David Finkelstein's Space-Time Code 1968** in which David said "... "... What is too simple about general relativity is the space-time point ... **each point of space-time is some kind of assembly of some kind of thing ... Each point, as 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 ...**".

**Each Source should contain about 10^{27} particle/antiparticle pairs
and its size should be about $10^{(27/3)} \times 1.6 \times 10^{(-33)}$ cm = about $10^{(-24)}$ cm.**

Indra's Net Blockchain of Schwinger Sources

“... "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. Indra's net has a multifaceted jewel at each vertex, and each jewel is reflected in all of the other jewels ...”

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



In E8 Physics **each Indra Jewel is a Schwinger Source.**

Bohm Quantum Potential interactions are not just between two Jewels,
but are **between the two entire World-Line History Strings**



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

From <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.

2. Peer-to-Peer Transmission

Communication occurs directly between peers ...

3. Transparency with Pseudonymity

Every transaction and its associated value are visible to anyone ...

4. Irreversibility of Records

... transaction[s] ... cannot be altered ... they're linked to every ...transaction ... that came before them ...

5. Computational Logic

... blockchain transactions can be tied to computational logic and in essence programmed ...”.

**The Blockchain computational logic for E8 Physics is
the Mind-Stuff Information structure of Real Clifford Algebra**

Each Node is a Schwinger Source that is connected by Bohm Quantum Potential
to all other Schwinger Source Nodes in our Universe
They are all governed by the E8 Physics Lagrangian
and the Algebraic Quantum Field Theory arising from

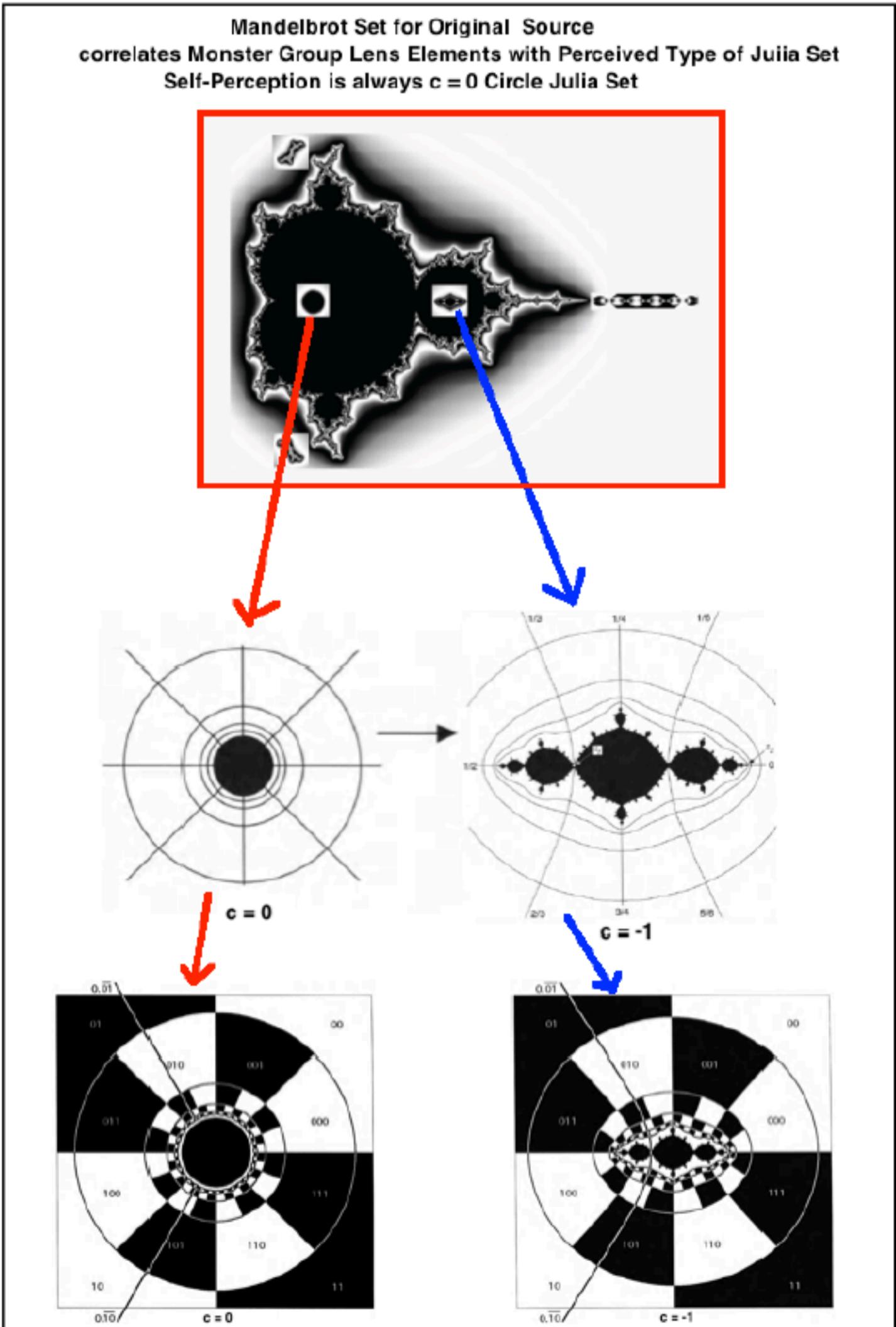
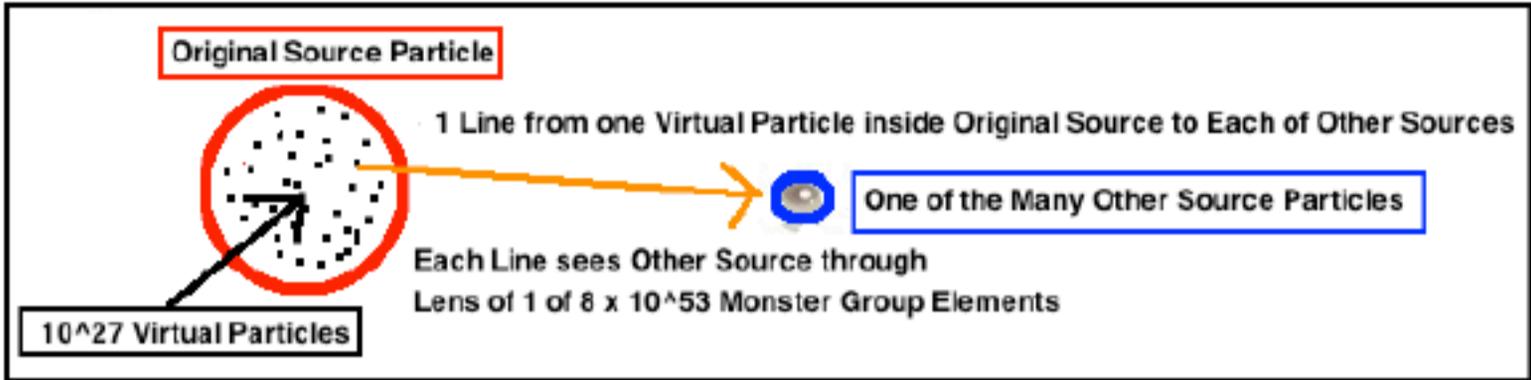
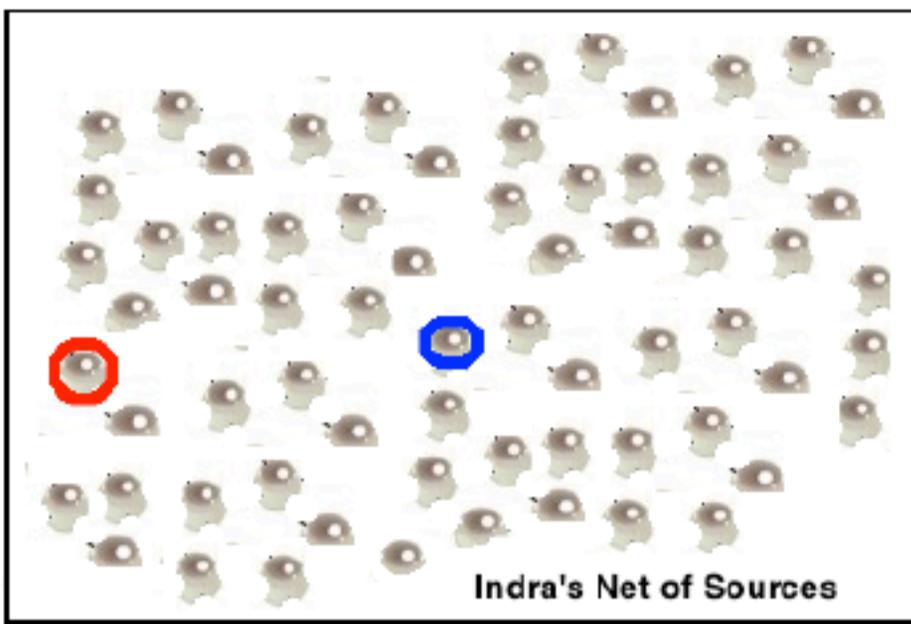
Completion of Union of All Tensor Products of $Cl(1,25)$ = hyperfinite AQFT
each copy of $Cl(1,25)$ contains $Cl(16)$ which contains E8 and the E8 Lagrangian.

**Each of 10^{27} Schwinger Source particle-antiparticle pairs sees the
rest of our Universe by way of 8×10^{53} Monster Symmetry**

so

**a Schwinger Source acting as a Jewel of Indra's Net
can see / reflect**

$10^{27} \times 8 \times 10^{53} = 8 \times 10^{80}$ Other Schwinger Source Jewels.



**To fit inside the initial Schwinger Source
the Information Elements of the Other Schwinger Sources of Our
Universe (10^{77} or so) should be distributed as a Fractal Julia Set.**

**There are 2^n stage-n cells in a Binary Decomposition of Julia Sets,
so a stage-256 Julia level set has $2^{256} =$ about 10^{77} cells
so Full Indra Net information can be seen / reflected
by each Schwinger Source Indra Jewel.**

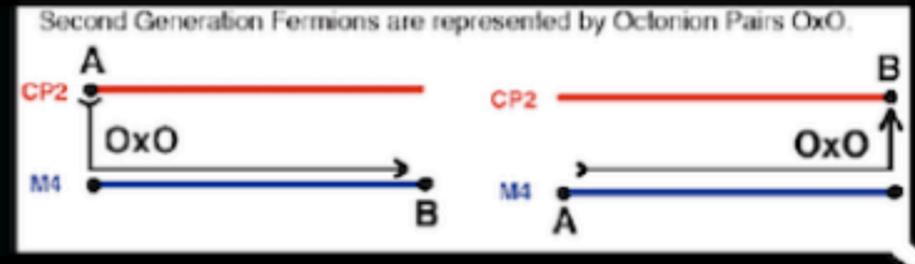
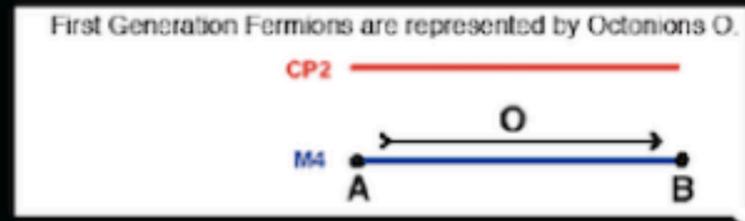
**Each Schwinger Source has a Mandelbrot Set that tells its Source
what each of the many Indra's Net Source Julia set looks like
by correlating Monster Group Lens Elements with Types of Julia Set.
Self-Perception is always the $c = 0$ Circle Julia Set.**

Lagrangian

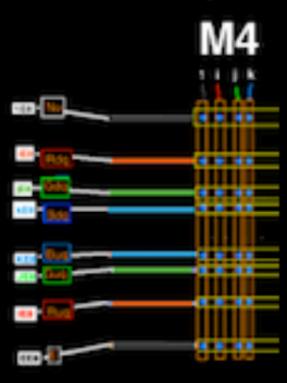


A7+1
D8 / D4xD4

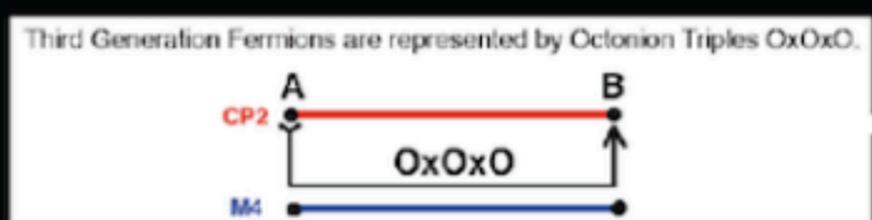
Mayer Mechanism



3 Kaluza-Klein
Fermion Generations

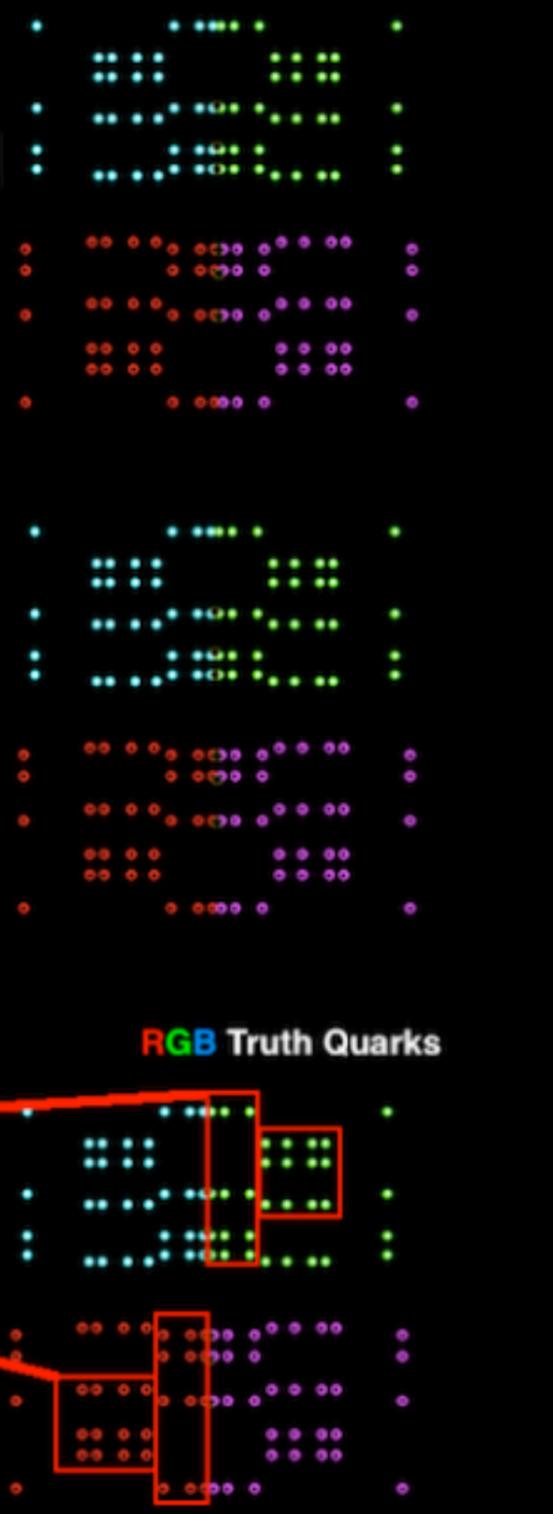


**NJL Higgs as
Condensate of T T̄**



RGB Truth Quarks

RGB Truth AntiQuarks



**The 4D Gauge Boson - Ghost terms emerge from the 8D Terms
by Integration over the CP2 Internal Symmetry Space.**

**The process of breaking Octonionic 8-dim SpaceTime down to
Quaternionic (4+4)-dim M4 x CP2 Kaluza-Klein creates differences in
the way gauge bosons "see" 4-dim Physical SpaceTime.
There 4 equivalence classes of 4-dim Riemannian Symmetric Spaces
with Quaternionic structure for 4-dim Physical SpaceTime:**

**S4 = 4-sphere = Spin(5) / Spin(4) where Spin(5) = Euclidean version
of the Anti-DeSitter subgroup of the Conformal Group
that gives MacDowell-Mansouri Gravity**

**CP2 = complex projective 2-space = SU(3) / U(2)
with the SU(3) of the Color Force**

**S2 x S2 = SU(2)/U(1) x SU(2)/U(1) with two copies
of the SU(2) of the Weak Force**

**S1 x S1 x S1 x S1 = U(1) x U(1) x U(1) x U(1) = 4 components
of the U(1) of the EM Photon**

The Gravity Gauge Bosons (Schwinger-Euclidean versions) live in a Spin(5) subalgebra of the Spin(6) Conformal subalgebra of $D_4 = \text{Spin}(8)$.

They "see" M4 Physical spacetime as the 4-sphere S^4 so that their part of the Physical Lagrangian is

\int_{S^4} Gravity Gauge Boson Term

an integral over SpaceTime S^4 .

The Schwinger Sources for Gravity Gauge 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

$\int_{S^2 \times S^2}$ SU(2) Weak Force Gauge Boson Term

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 $CP^2 = SU(3) / U(2)$

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} (U(1) Electromagnetism Gauge Boson Term

T^4 .

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.**

Ignoring technicalities for exposition geometric factors for force strengths are:
(detailed calculations are in viXra 1804.0121)

Each gauge group is the global symmetry of a symmetric space

$$\begin{aligned} S1 &= \text{for } U(1) \\ S2 &= SU(2)/U(1) = \text{Spin}(3)/\text{Spin}(2) \text{ for } SU(2) \\ CP2 &= SU(3)/SU(2) \times U(1) \text{ for } SU(3) \\ S4 &= \text{Spin}(5)/\text{Spin}(4) \text{ for } \text{Spin}(5) \end{aligned}$$

Each gauge group is the local symmetry of a symmetric space

$$\begin{aligned} &U(1) \text{ for itself} \\ &SU(2) \text{ for } \text{Spin}(5) / SU(2) \times U(1) \\ &SU(3) \text{ for } SU(4) / SU(3) \times U(1) \\ &\text{Spin}(5) \text{ for } \text{Spin}(7) / \text{Spin}(5) \times U(1) \end{aligned}$$

The nontrivial local symmetry symmetric spaces correspond to bounded complex domains

$$\begin{aligned} SU(2) \text{ for } \text{Spin}(5) / SU(2) \times U(1) &\text{ corresponds to } IV3 \\ SU(3) \text{ for } SU(4) / SU(3) \times U(1) &\text{ corresponds to } B^6 \text{ (ball)} \\ \text{Spin}(5) \text{ for } \text{Spin}(7) / \text{Spin}(5) \times U(1) &\text{ corresponds to } IV5 \end{aligned}$$

The nontrivial bounded complex domains have Shilov boundaries

$$\begin{aligned} SU(2) \text{ for } \text{Spin}(5) / SU(2) \times U(1) &\text{ corresponds to } IV3 \text{ Shilov} = RP^1 \times S^2 \\ SU(3) \text{ for } SU(4) / SU(3) \times U(1) &\text{ corresponds to } B^6 \text{ (ball) Shilov} = S^5 \\ \text{Spin}(5) \text{ for } \text{Spin}(7) / \text{Spin}(5) \times U(1) &\text{ corresponds to } IV5 \text{ Shilov} = RP^1 \times S^4 \end{aligned}$$

Very roughly, think of the force strength as

integral over global symmetry space of physical (ie Shilov Boundary) volume =
= strength of the force.

That is:

the geometric strength of the force is given by the product of
the volume of a 4-dim thing with global symmetry of the force and
the volume of the Shilov Boundary for the local symmetry of the force.

When you calculate the product volumes (using some tricky normalization stuff),
you see that roughly:

Volume product for gravity is the largest volume

so since (as Feynman says) force strength = probability to emit a gauge boson means
that the highest force strength or probability should be 1

the gravity Volume product is normalized to be 1, and so (approximately):

$$\begin{aligned} \text{Volume product for gravity} &= 1 \\ \text{Volume product for color} &= 2/3 \\ \text{Volume product for weak} &= 1/4 \\ \text{Volume product for electromagnetism} &= 1/137.03608 \end{aligned}$$

There are two further main components of a force strength:

- 1 - for massive gauge bosons, a suppression by a factor of $1 / M^2$
- 2 - renormalization running (important for color force)

Consider Massive Gauge Bosons:

Gravity as curvature deformation of SpaceTime, with SpaceTime as a condensate of Planck-Mass Black Holes, must be carried by virtual Planck-mass black holes, so that the geometric strength of gravity should be reduced by $1/M_p^{2n}$ to about $5 \times 10^{(-39)}$

The weak force is carried by weak bosons,

so that the geometric strength of the weak force should be reduced by $1/M_W^2$

That gives the result (approximate):

$$\begin{aligned} \text{gravity strength} &= G \text{ (Newton's } G\text{)} \\ \text{color strength} &= 2/3 \\ \text{weak strength} &= G_F \text{ (Fermi's weak force } G\text{)} \\ \text{electromagnetism} &= 1/137.03608 \end{aligned}$$

Consider Renormalization Running for the Color Force:: That gives the result:

$$\begin{aligned} \text{gravity strength} &= G \text{ (Newton's } G\text{)} \\ \text{color strength} &= 1/10 \text{ at weak boson mass scale} \\ \text{weak strength} &= G_F \text{ (Fermi's weak force } G\text{)} \\ \text{electromagnetism} &= 1/137.03608 \end{aligned}$$

The use of compact volumes of Domains and Shilov Boundaries is a calculation device, because it would be more nearly correct, instead of the integral over the compact global symmetry space of the compact physical (ie Shilov Boundary) volume = strength of the force to use the integral over the hyperbolic spacetime global symmetry space of the noncompact invariant measure of the gauge force term.

However, since the strongest (gravitation) geometric force strength is to be normalized to 1, the only thing that matters is ratios, and the compact volumes (finite and easy to look up in the book by Hua) have the same ratios as the noncompact invariant measures.

In fact, I should go on to say that continuous spacetime and gauge force geometric objects are themselves also calculational devices, and that it would be even more nearly correct to do the calculations with respect to a discrete generalized hyperdiamond Feynman checkerboard.

Calculation of Higgs and Weak Boson masses are given in viXra 1804.0121. For example, the triplet $\{ W^+, W^-, W_0 \}$ total mass at the electroweak unification is equal to the total mass of a T - Tbar pair, 259.031 GeV and the triplet $\{ W^+, W^-, Z_0 \}$ total mass is equal to the vacuum expectation value v of the Higgs scalar field, $v = 252.514$ GeV.

Fermion Mass Calculations

(detailed calculations are in viXra 1804.0121)

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
 $Spin(10) / Spin(8) \times U(1)$

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 $Q8 = RP^1 \times S^7$

In E8 Physics, the first generation spinor fermions are seen as +half-spinor and -half-spinor spaces of $Cl(1,7) = Cl(8)$.

Due to Triality, $Spin(8)$ can act on those 8-dimensional half-spinor spaces similarly to the way it acts on 8-dimensional vector spacetime.

Take the the spinor fermion volume to be the Shilov boundary corresponding to the same symmetric space on which $Spin(8)$ acts as a local gauge group that is used to construct 8-dimensional vector spacetime:

the symmetric space $Spin(10) / Spin(8) \times U(1)$
corresponding to a bounded domain of type IV8
whose Shilov boundary is $RP^1 \times S^7$

Since all first generation fermions see the spacetime over which the integral is taken in the same way (unlike what happens for the force strength calculation), the only geometric volume factor relevant for calculating first generation fermion mass ratios is in the spinor fermion volume term.

**E8 Physics model fermions correspond to
Schwinger Source Kerr-Newman Black Holes,
so the quark mass in E8 Physics is a constituent mass.**

Fermion masses are calculated as a product of four factors:

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

$V(Q_{\text{fermion}})$ is the volume of the part of the half-spinor fermion particle manifold $S^7 \times RP^1$ related to the fermion particle by photon, weak boson, or gluon interactions.

$N(\text{Graviton})$ is the number of types of $\text{Spin}(0,5)$ graviton related to the fermion. The 10 gravitons correspond to the 10 infinitesimal generators of $\text{Spin}(0,5) = \text{Sp}(2)$. 2 of them are in the Cartan subalgebra.

6 of them carry color charge, and therefore correspond to quarks.

The remaining 2 carry no color charge, but may carry electric charge and so may be considered as corresponding to electrons. One graviton takes the electron into itself, and the other can only take the first generation electron into the massless electron neutrino. Therefore only one graviton should correspond to the mass of the first-generation electron.

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

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

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

The first generation down quark constituent mass : electron mass ratio can be calculated as follows:

The electron, E, can only be taken into the tree-level-massless neutrino, ν , by photon, weak boson, and gluon interactions.

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

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

Since the electron cannot be related to any other massive Dirac fermion, its volume $V(Q_{\text{electron}})$ is taken to be 1.

Next consider a red down quark i.

By gluon interactions, i can be taken into j and k, the blue and green down quarks.

By also using weak boson interactions,

it can 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 red down quark (similarly, any down quark)

is related to all parts of $S^7 \times RP^1$,

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 $V(Q_{\text{down quark}})$ of the volume of $S^7 \times RP^1$.

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

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

Since the first generation graviton factor is 6,

$m_d / m_e = 6 V(S^7 \times RP^1) = 2 \pi^5 = 612.03937$

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

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 $m_e = 0.5110 \text{ MeV}$.

Then, the constituent mass of the down quark is $m_d = 312.75 \text{ MeV}$,

and the constituent mass for the up quark is $m_u = 312.75 \text{ MeV}$.

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

$$\Sigma m_f = 1.877 \text{ GeV}$$

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

$$m_{\text{proton}} = m_u + m_u + m_d = 938.25 \text{ MeV}$$

which is close to the experimental value of 938.27 MeV.

First Generation Fermions correspond to Octonion Basis Elements while

Second and Third Generation Fermions correspond to Pairs and Triples of them

The Symmetry factor is Combinatorial related to Pairs and Triples

and is calculated in full in viXra 1804.0121. For example,

there are $8^3 = 512$ Triples for Third Generation Fermion,

1 of which represents tau-Neutrino, 7 of which represent the tauon,

21 of which represent the red, green, and blue Beauty Quarks,

and 483 of which represent the red, green, and blue Truth Quarks.

$483 / 21 = 23 = 130 \text{ GeV} / 5.63 \text{ GeV} = \text{Mass Ratio of Truth Quark} / \text{Beauty Quark}$

Neutrino Masses

The heaviest mass state ν_3 corresponds to a neutrino whose propagation begins and ends in CP2 internal symmetry space, lying entirely therein. The mass of ν_3 is zero at tree-level but it picks up a first-order correction propagating entirely through internal symmetry space by merging with an electron through the weak and electromagnetic forces, effectively acting not merely as a point but as a point plus an electron loop at beginning and ending points that is anchored by weak force action through any of the 6 first-generation quarks
so

$$\begin{aligned} M_{\nu_3} &= \sqrt{2} \times M_e \times GW(m_{\text{proton}}^2) \times \alpha_E = \\ &= 1.4 \times 5 \times 10^5 \times 1.05 \times 10^{(-5)} \times (1/137) \text{ eV} = \\ &= 7.35 / 137 = 5.4 \times 10^{(-2)} \text{ eV}. \end{aligned}$$

The intermediate mass state ν_2 corresponds to a neutrino whose propagation begins or ends in CP2 internal symmetry space and ends or begins in M4 physical Minkowski spacetime, thus having only one point (either beginning or ending) lying in CP2 internal symmetry space where it can act not merely as a point but as a point plus an electron loop. The mass of ν_2 is zero at tree-level but it picks up a first-order correction at only one (but not both) of the beginning or ending points so that there are only 6 different anchorings
so

the first-order corrected mass of ν_2 is

$$\begin{aligned} M_{\nu_2} &= M_{\nu_3} / (36 / 6) = 5.4 \times 10^{(-2)} / 6 \\ &= 9 \times 10^{(-3)} \text{ eV}. \end{aligned}$$

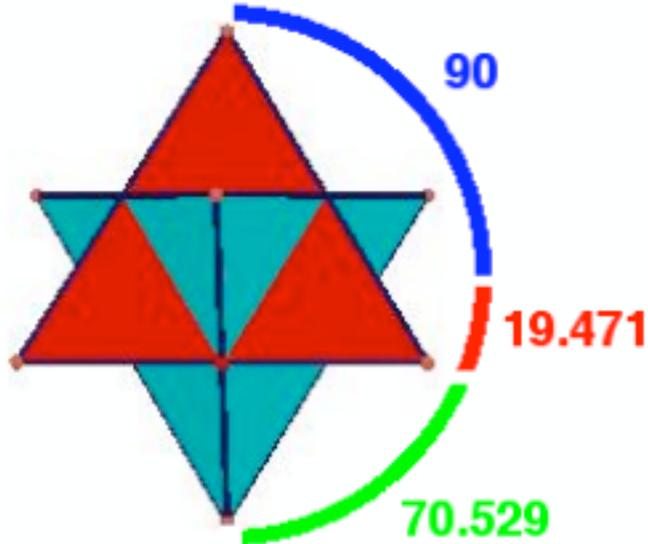
The low mass state ν_1 corresponds to a neutrino whose propagation begins and ends in physical Minkowski spacetime thus having only one anchoring to CP2 internal symmetry space. According to the Cl(1,25) E8 model the mass of ν_1 is zero at tree-level but it has only 1 possible anchoring to CP2
so

the first-order corrected mass of ν_1 is

$$\begin{aligned} M_{\nu_1} &= M_{\nu_2} / 6 = 9 \times 10^{(-3)} / 6 \\ &= 1.5 \times 10^{(-3)} \text{ eV}. \end{aligned}$$

Kobayashi-Maskawa Parameters

In E8 Physics the KM Unitarity Triangle angles can be seen on the Stella Octangula



The Kobayashi-Maskawa parameters are determined in terms of the sum of the masses of the first-generation fermion particles and antiparticles, denoted by

$$\mathbf{Smf1 = 7.508 \text{ GeV,}}$$

and

the similar sums for second-generation and third-generation fermions, denoted by

$$\mathbf{Smf2 = 32.94504 \text{ GeV and Smf3 = 1,629.2675 \text{ GeV.}}$$

The resulting KM matrix is:

	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

Proton-Neutron Mass Difference

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

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

$$(m_s - m_d) (m_d/m_s)^2 a(w) |V_{ds}| = 312 \times 0.25 \times 0.253 \times 0.22 \text{ Mev} = 4.3 \text{ Mev},$$

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

so that the Quantum color force constituent mass Q_{md} of the down quark is

$$Q_{md} = 312.75 + 4.3 = 317.05 \text{ MeV}.$$

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

$$(m_c - m_u) (m_u/m_c)^2 a(w) |V_{uc}| = 1777 \times 0.022 \times 0.253 \times 0.22 \text{ Mev} = 2.2 \text{ Mev},$$

(where $|V_{uc}| = 0.22$ is the magnitude
of the K-M parameter mixing first generation up and second generation charm)

so that the Quantum color force constituent mass Q_{mu} of the up quark is

$$Q_{mu} = 312.75 + 2.2 = 314.95 \text{ MeV}.$$

Therefore, the Quantum color force Neutron-Proton mass difference is

$$m_N - m_P = Q_{md} - Q_{mu} = 317.05 \text{ Mev} - 314.95 \text{ Mev} = 2.1 \text{ Mev}.$$

Since the electromagnetic Neutron-Proton mass difference is roughly

$$m_N - m_P = -1 \text{ MeV}$$

the total theoretical Neutron-Proton mass difference is

$$m_N - m_P = 2.1 \text{ Mev} - 1 \text{ Mev} = 1.1 \text{ Mev},$$

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

Pion as Sine-Gordon Breather

The quark content of a charged pion is a quark - antiquark pair: either Up plus antiDown or Down plus antiUp. Experimentally, its mass is about 139.57 MeV.

The quark is a Schwinger Source Kerr-Newman Black Hole with constituent mass $M = 312$ MeV.

The antiquark is also a Schwinger Source Kerr-Newman Black Hole, with constituent mass $M = 312$ MeV.

In the physical case of quark and antiquark merging to form a toroidal black hole pion the toroidal black hole remains a torus.

The torus is an event horizon and therefore is not a 2-spacelike dimensional torus, but is a (1+1)-dimensional torus with a timelike dimension. **A (1+1)-dimensional torus with a timelike dimension can carry a Sine-Gordon Breather.**

The soliton and antisoliton of a Sine-Gordon Breather correspond to the quark and antiquark that make up the pion, analagous to the Massive Thirring Model.

Sidney Coleman in his Erica lecture Classical Lumps and their Quantum Descendants "... the sine-Gordon equation ... [has] ... an exact periodic solution ...

$$f(x, t) = (4/B) \arctan((n \sin(wt) / \cosh(nwx)))$$

... [that] ... can be thought of as a soliton and an antisoliton oscillation about their common center-of-mass ... it is called ... doublet [or Breather] ... [with] ...

$E = 2M \sqrt{1 - (w^2/A)}$... where ... $M = 8 \sqrt{A} / B^2$ is the soliton mass ... the sine-Gordon equation is equivalent ... to the massive Thirring model ...

$B^2 = \pi$ is where the First-order weak coupling expansion substantially coincides with the (probably exact) DHN formula. ... setting $B^2 = \pi$ and using the DHN formula, the mass of the charged pion is calculated to be ($312.75 / 2.25$) MeV = 139 MeV

which is close to the experimental value of about 139.57 MeV.

So, the physical quark - antiquark pion lives where the first-order weak coupling expansion is exact.

Planck Mass as Superposition Fermion Condensate

At a single spacetime vertex, a Planck-mass black hole is the Many-Worlds quantum sum of all possible virtual first-generation particle-antiparticle fermion pairs allowed by the Pauli exclusion principle to live on that vertex.

Once a Planck-mass black hole is formed, it is stable in the E8 model. Less mass would not be gravitationally bound at the vertex. More mass at the vertex would decay by Hawking radiation.

There are 8 fermion particles and 8 fermion antiparticles for a total of 64 particle-antiparticle pairs. Of the 64 particle-antiparticle pairs, 12 are bosonic pions.

A typical combination should have about 6 pions so it should have a mass of about $.14 \times 6 \text{ GeV} = 0.84 \text{ GeV}$.

Just as the pion mass of $.14 \text{ GeV}$ is less than the sum of the masses of a quark and an antiquark, pairs of oppositely charged pions may form a bound state of less mass than the sum of two pion masses.

If such a bound state of oppositely charged pions has a mass as small as $.1 \text{ GeV}$, and if the typical combination has one such pair and 4 other pions, then the typical combination could have a mass in the range of 0.66 GeV .

Summing over all 2^{64} combinations, the total mass of a one-vertex universe should give a Planck mass roughly around $0.66 \times 2^{64} = 1.217 \times 10^{19} \text{ GeV}$.

The value for the Planck mass given in by the 1998 Particle Data Group is $1.221 \times 10^{19} \text{ GeV}$.

E8 Algebraic Quantum Field Theory as Third Grothendieck Universe

The First Grothendieck Universe is the Empty Set.

The Second Grothendieck Universe is Hereditarily Finite Sets such as a Generalized Feynman Checkerboard Quantum Theory based on E8 Lattices and Discrete $Cl(1,25)$ Clifford Algebra.

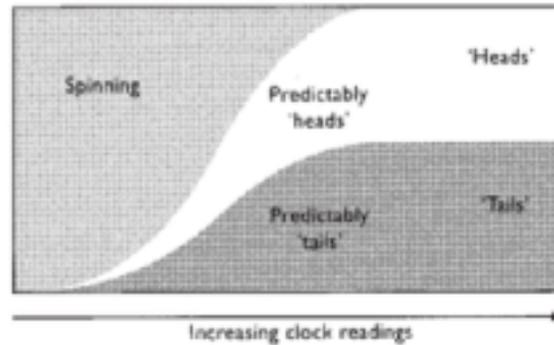
The Third Grothendieck Universe is the Completion of the Union of all tensor products of $Cl(1,25)$ Real Clifford algebra

$Cl(1,25)$ emerges from the Creation Sequence of Real Clifford Algebras:
 $0 \rightarrow Cl(0,0) \rightarrow Cl(0,1) \rightarrow Cl(0,2) \rightarrow Cl(0,4) \rightarrow Cl(0,8) = Cl(0,4) \times Cl(0,4) \rightarrow Cl(0,16) = Cl(0,8) \times Cl(0,8) \rightarrow Cl(0,16) \times Cl(0,8) = Cl(0,24) \rightarrow M(2, Cl(0,24)) = Cl(1,25)$

**Completion of Union of All Tensor Products of $Cl(1,25) =$
 $= 2 \times 2$ matrices of $Cl(0,24)$
is String Theory formulation of the hyperfinite AQFT for E8 Physics**

Its consistency is due to Periodicity-8 of Real Clifford Algebras.
It is a generalization of the usual Hyperfinite II₁ von Neumann factor for creation and annihilation operators on Fermionic Fock Space over C^{2n} that is the completion of the union of all tensor products of 2×2 Complex Clifford algebra matrices, which have Periodicity 2.

The structure of CI(16)-E8 AQFT is similar to the Many-Worlds picture described by David Deutsch in his 1997 book "The Fabric of Reality" (pages 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 ... the snapshots ... fall ... into chains ...".

**For the $Cl(1,25)$ E8 model AQFT to be realistic,
it must be consistent with EPR entanglement relations.**

Joy Christian in arXiv 0904.4259 said:

**“... a [geometrically] correct local-realistic framework
... provides exact, deterministic, and local underpinnings ...
The alleged non-localities ... result from misidentified [geometries]
of the EPR elements of reality. ...
The correlations are ... the classical correlations [such as those]
among the points of a 3 or 7-sphere ...
S3 and S7 ... are ... parallelizable ...
The correlations ... can be seen most transparently
in the elegant language of Clifford algebra ...”.**

**Since E8 is a Lie Group and therefore parallelizable
and lives in Clifford Algebra $Cl(1,25)$,
the $Cl(1,25)$ E8 model is consistent with EPR.**

The Creation-Annihilation Operator structure of $Cl(1,25)$ E8 AQFT is given by the

Maximal Contraction of E8 = semidirect product $A7 \times h92$
 where $h92 = 92+1+92 = 185$ -dim Heisenberg algebra
 and $A7 = 63$ -dim $SL(8)$

The Maximal E8 Contraction $A7 \times h92$ 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

$SL(8,R) = Spin(8) + Traceless Symmetric 8 \times 8$ Matrices,
 so $SL(8,R)$ represents a local 8-dim SpaceTime in Polar Coordinates.

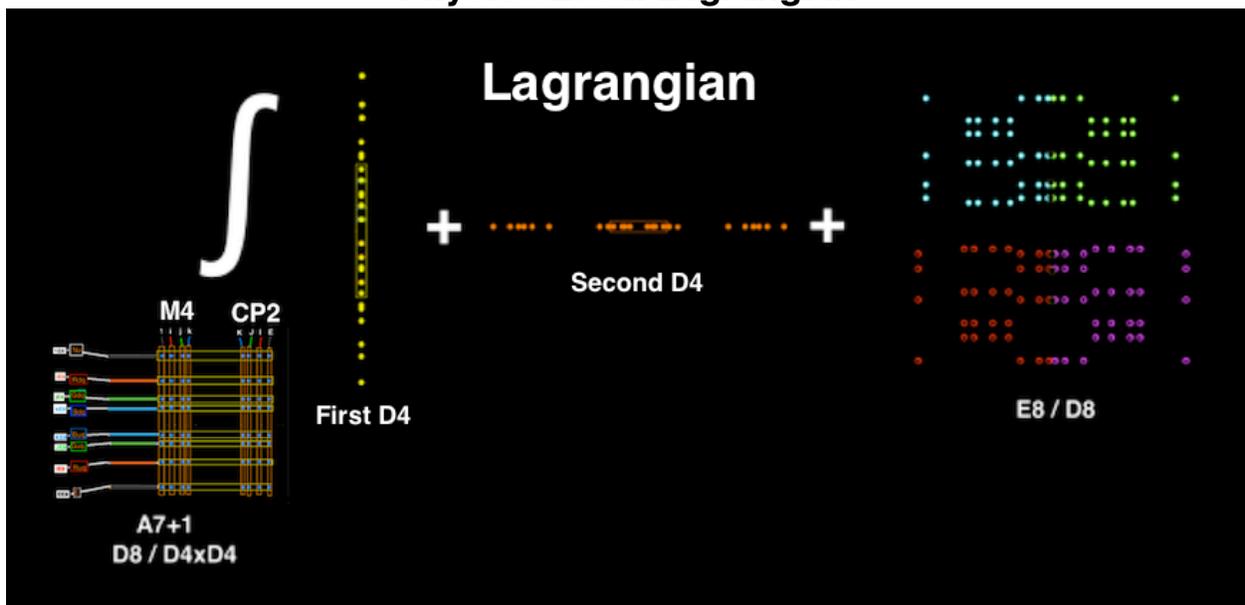
Odd Grades -1 and +1 = $64 + 64$

Each $64 = 8 \times 8 =$ Creation/Annihilation Operators for 8 components of
 8 Fundamental Fermions.

Even Grades -2 and +2 = $28 + 28$

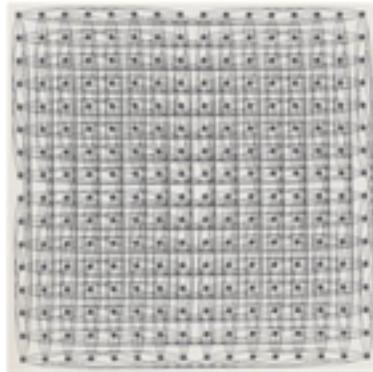
Each $28 =$ Creation/Annihilation for Gauge Bosons and Ghosts
 of Standard Model and Gravity+Dark Energy plus Propagator Phase

The Algebraic Quantum Field Theory (AQFT) structure of the Bohm
 Quantum Potential of 26D String Theory is given by the $Cl(1,25)$ E8
 Physics Local Lagrangian



and by 8-Periodicity of Real Clifford Algebras,
 as the Completion of the Union of all Tensor Products of the form
 $Cl(1,25) \times \dots (N \text{ times tensor product}) \dots \times Cl(1,25)$

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



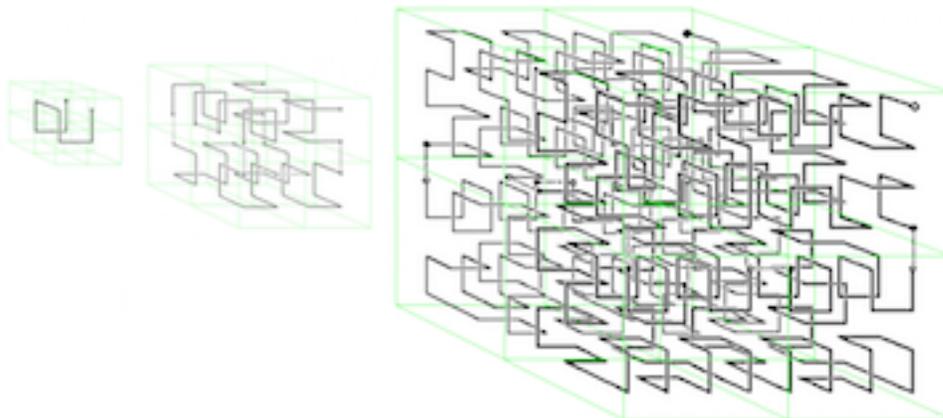
For $N = 2^{16} = 65,536 = 4^8$ copies of $Cl(1,25)$ fill in 8-dim HyperCube described by William Gilbert's web page: "... The n-bit reflected binary Gray code will describe a path on the edges of an n-dimensional cube that can be used as the initial stage of a Hilbert curve that will fill an n-dimensional cube. ...".

As N grows, copies of $Cl(1,25)$ continue to fill the 8-dim HyperCube using higher Hilbert curve stages subdividing the initial 8-dim HyperCube into more and more sub-HyperCubes.

If edges of sub-HyperCubes, equal to the distance between adjacent copies of $Cl(1,25)$, remain constantly at the Planck Length, then the full 8-dim HyperCube of our Universe expands as N grows to 2^{16} and beyond

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

from William Gilbert's web page:



AQFT Quantum Code

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

$[[256, 0, 24]] \times [[256, 0, 24]] \times [[256, 0, 24]]$ corresponds to

AQFT (Algebraic Quantum Field Theory) hyperfinite von Neumann factor algebra

that is Completion of the Union of All Tensor Products of $Cl(1,25)$

Quantum Reed-Muller code $[[256, 0, 24]]$ is described in quantum-ph/9608026 by Steane as mapping a quantum state space of 256 qubits into 256 qubits, correcting $[(24-1)/2] = 11$ errors, and detecting $24/2 = 12$ errors.

Let $C(n,t) = n! / t!(n-t)!$

Then

$[[256, 0, 24]]$ is of the form

$[[2^n,$	$2^n - C(n,t) - 2 \sum_{k=0}^{t-1} C(n,k),$	$2^t + 2^{(t-1)}]]$
$[[2^8,$	$2^8 - C(8,4) - 2 \sum_{k=0}^3 C(8,k),$	$2^4 + 2^{(4-1)}]]$
$[[2^8,$	$2^8 - 70 - (1+8+28+56) - (1+8+28+56),$	$16 + 8]]$
$[[256,$	$256 - (1+8+28+56+70+56+28+8+1),$	$16 + 8]]$
$[[256,$	$16 \times 16 - \sum_{k=0}^8 \binom{8}{k} \binom{8}{k} \dots \binom{8}{k} \dots \binom{8}{k},$	$16 + 8]]$

The quantum code $[[256, 0, 24]]$ can be constructed from the classical Reed-Muller code $(256, 93, 32)$ of the form

$$\begin{aligned} & (2^8, \quad 2^8 - \sum_{0 \leq k \leq t} C(n,k), \quad 2^{(t+1)}) \\ & (2^8, \quad 2^8 - \sum_{0 \leq k \leq 4} C(n,k), \quad 2^5) \\ & (2^8, \quad 2^8 - (70+56+28+8+1), \quad 32) \\ & (2^8, \quad 1+8+28+56, \quad 32) \end{aligned}$$

To construct the quantum code $[[256, 0, 24]]$:

First, form a quantum code generator matrix from the 128×256 generator matrix G of the classical code $(256, 93, 32)$:

$$\left| \begin{array}{c|c} G & 0 \\ \hline 0 & G \end{array} \right|$$

Second, form the generator matrix of a quantum code of distance 16 by adding to the quantum generator matrix a matrix D_x such that G and D_x together generate the classical Reed-Muller code $(256, 163, 16)$:

$$(2^8, \quad 1+8+28+56+70, \quad 16) :$$

$$\left| \begin{array}{c|c} G & 0 \\ \hline 0 & G \\ \hline D_x & 0 \end{array} \right|$$

This quantum code has been made by combining the classical codes $(256, 93, 32)$ and $(256, 163, 16)$, so that it is of the form

$$\begin{aligned} & [[256, 93 + 163 - 256, \min(32, 16)]] = \\ & = [[256, 0, 16]]. \end{aligned}$$

It is close to what we want, but has distance 16.
 For the third and final step, increase the distance to $16+8 = 24$
 by adding Dz to the quantum generator matrix:

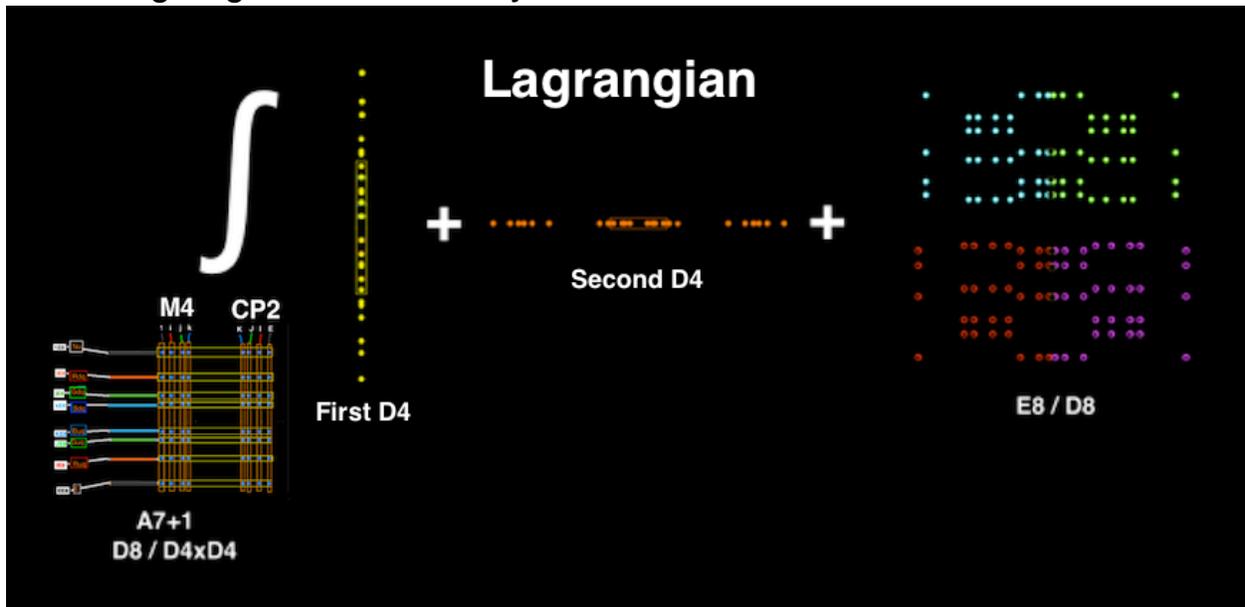
$$\left(\begin{array}{c|c} G & 0 \\ \hline 0 & G \\ \hline Dx & Dz \end{array} \right)$$

This is the generator matrix of the quantum code $[[256, 0, 24]]$
 as constructed by Steane.

The two classical Reed-Muller codes used to build $[[256, 0, 24]]$
 are $(256, 163, 32)$ and $(256, 93, 16)$,
 classical Reed-Muller codes of orders 4 and 3, which are dual.
 Due to the nested structure of Reed-Muller codes,
 they contain the Reed-Muller codes of orders 2, 1, and 0 :

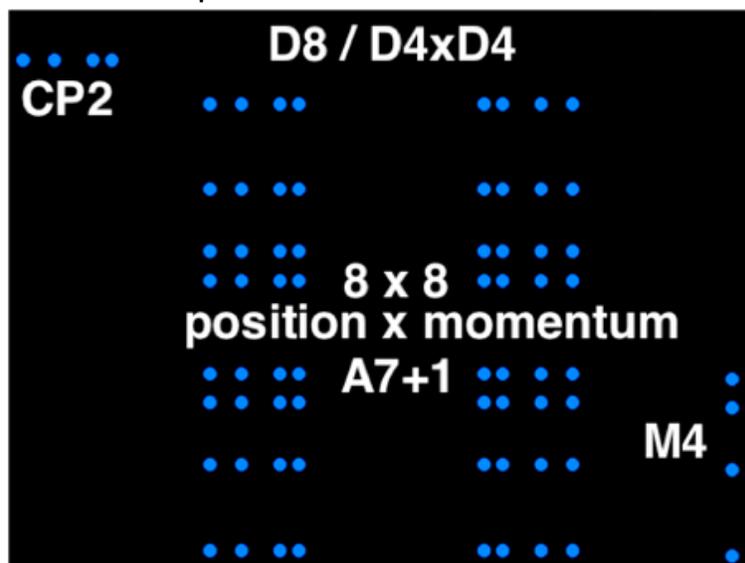
Classical Reed-Muller Codes of Length $2^8 = 256$			Order
(256,	1+8+28+56+70+56+28+8+1,	1)	8
(256,	1+8+28+56+70+56+28+8,	2)	7
(256,	1+8+28+56+70+56+28,	4)	6
(256,	1+8+28+56+70+56,	8)	5
(256,	1+8+28+56+70,	16)	4
(256,	1+8+28+56,	32)	3
(256,	1+8+28,	64)	2
(256,	1+8,	128)	1
(256,	1,	256)	0

In the Lagrangian of the E8 Physics Model



the Higgs scalar prior to dimensional reduction corresponds to the 0th order classical Reed-Muller code (256, 1, 256), the classical repetition code;

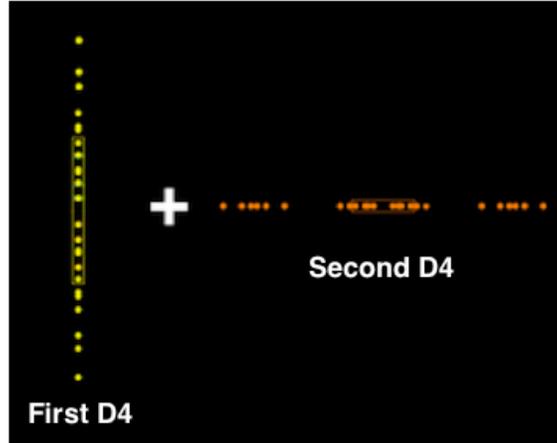
the 8-dimensional vector spacetime



prior to dimensional reduction corresponds to non-0th-order part of 1st order classical Reed-Muller code (256, 9, 128), which is dual to the 6th order classical Reed-Muller code (256, 247, 4), which is the extended Hamming code,

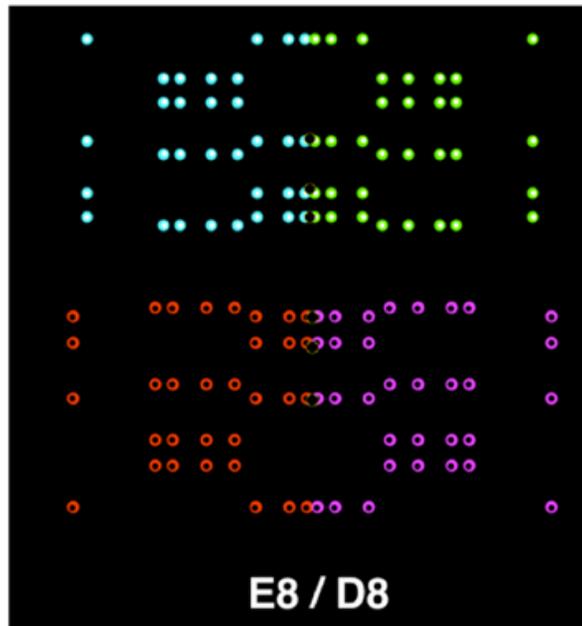
extended from the binary Hamming code (255, 247, 3), which is dual to the simplex code (255, 8, 128) ;

the 28-dimensional bivector adjoint gauge boson spaces



prior to dimensional reduction correspond to the non-1st-order part of the 2nd order classical Reed-Muller code (256, 37, 64) .

The 8 first generation fermion particles and 8 first generation antiparticles of the 16-dim spinor representation of 256-dimensional Cl(0,8)



correspond to the distance of the classical Reed-Muller code (256, 93, 16), and to the 16-dimensional Barnes-Wall lattice Λ_{16} , which lattice comes from the (16,5,8) Reed-Muller code.

Each Λ_{16} vertex has 4320 nearest neighbors.

The other 8 of the $16+8 = 24$ distance of the quantum Reed-Muller code $[[256, 0, 24]]$ corresponds to the 8-dimensional vector spacetime, and to the 8-dimensional E_8 lattice which comes from the (8,4,4) Hamming code, with weight distribution $0(1) 4(14) 8(1)$.

It can also be constructed from the repetition code (8,1,1). The dual of (8,1,1) is (8,7,2), a zero-sum even weight code, containing all binary vectors with an even number of 1s. Each E_8 lattice vertex has 240 nearest neighbors.

In Euclidean R_8 , there is only one way to arrange 240 spheres so that they all touch one sphere, and only one way to arrange 56 spheres so that they all touch a set of two spheres in contact with each other, and so forth, giving the following classical spherical codes: (8,240,1/2), (7,56,1/3), (6,27,1/4), (5,16,1/5), (4,10,1/6), and (3,6,1/7).

(If you use an Octonion Integral Domain instead of Euclidean R_8 without multiplication then there are 7 algebraically independent ways to arrange the 240 spheres.)

The total 24 distance of the quantum Reed-Muller code $[[256, 0, 24]]$ corresponds to the 24-dimensional Leech lattice, and to the classical extended Golay code (24, 12, 8) in which lattice each vertex has 196,560 nearest neighbors.

In Euclidean R_{24} , there is only one way to arrange 196,560 spheres so that they all touch one sphere, and only one way to arrange 4600 spheres so that they all touch a set of two spheres in contact with each other, and so forth, giving the following classical spherical codes: (24,196560,1/2), (23,4600,1/3), (22,891,1/4), (21,336,1/5), (20,170,1/6),

Lagrangian for Bohm Quantum Potential

**Sarfatti-Bohm Quantum Potential emerges from 26D E8 World-Line String Theory
so is treated separately from
the Local Classical E8 Lagrangian in 8D (or in 4D)
describing the Standard Model and Gravity+Dark Energy plus
Propagator Phase.**

Roderick Sutherland (arXiv 1509.02442)

gave a Lagrangian for the Bohm Potential

saying: "... This paper focuses on interpretations of QM in which the underlying reality is taken to consist of particles have definite trajectories at all times ... An example ... is the Bohm model ...

This paper ... provid[es]... a Lagrangian ...[for]... the unfolding events ... describing more than one particle while maintaining a relativistic description ... requires the introduction of final boundary conditions as well as initial, thereby entailing retrocausality ...

In addition ... the Lagrangian approach pursued here to describe particle trajectories also entails the natural inclusion of an accompanying field to influence the particle's motion away from classical mechanics and reproduce the correct quantum predictions.

In so doing, it is ... providing a physical explanation for why quantum phenomena exist at all ... **the particle is seen to be the source of a field which alters the particle's trajectory via self-interaction** ...

The Dirac case ... each particle in an entangled many-particle state will be described by an individual Lagrangian density ... of the form:

$$\mathcal{L} = \text{Re} \left[\frac{1}{\langle f|i} \left(-i\bar{\Psi}_f \gamma^\alpha \partial_\alpha \Psi_i + m\bar{\Psi}_f \Psi_i \right) \right] \mp \sigma_0 \rho_0 \left| \mathbf{u}_\alpha \mathbf{u}^\alpha \right|^{1/2} + \sigma_0 \mathbf{u}_\alpha \mathbf{j}^\alpha$$

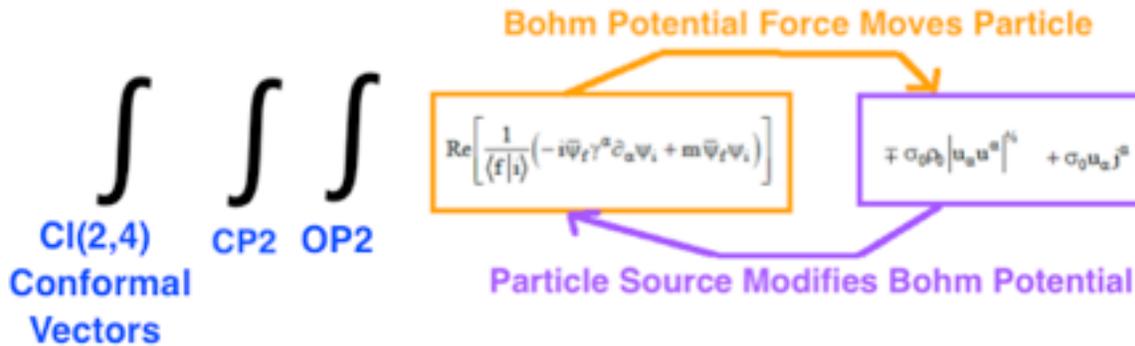
... the ...[first]... term ...[is]... Lagrangian densities for the PSI field alone ...

... sigma_o is the rest density distribution of the particle through space ...

j is the current density ...

... rho_o and u are the rest density and 4-velocity of the probability flow ...".

Jack Sarfatti extended the Sutherland Lagrangian to include Back-Reaction



where a, b and VM4 form CI(2,4) vectors and VCP2 forms CP2 and S+ and S- form OP2 so that
 26D = 16D orbifolded fermions + 10D
 and 10D = 6D Conformal Space + 4D CP2 ISS

(ISS = Internal Symmetry Space and
 6D Conformal contains 4D M4 of Kaluza-Klein M4xCP2)

saying (linkedin.com Pulse 13 January 2016):

“... the reason entanglement cannot be used as a direct messaging channel between subsystems of an entangled complex quantum system, is the lack of direct back-reaction of the classical particles and classical local gauge fields on their shared entangled Bohmian quantum information pilot wave ... Roderick. I. Sutherland ... using Lagrangian field theory, shows how to make the original 1952 Bohm pilot-wave theory completely relativistic, and how to avoid the need for configuration space for many-particle entanglement.

The trick is that final boundary conditions on the action as well as initial boundary conditions influence what happens in the present.

The general theory is "post-quantum" ... and it is non-statistical ... There is complete two-way action-reaction between quantum pilot waves and the classical particles and classical local gauge fields ...

orthodox statistical quantum theory,
with no-signaling ...[is derived]... in two steps,

first arbitrarily set the back-reaction (of particles and classical gauge field on their pilot waves) to zero. This is analogous to setting the curvature equal to zero in general relativity, or more precisely in setting G to zero.

Second, integrate out the final boundary information, thereby adding the statistical Born rule to the mix. ...

the mathematical condition for zero post-quantum back-reaction of particles and classical fields (aka "beables" J.S. Bell's term) is exactly de Broglie's guidance constraint. That is, in the simplest case, the classical particle velocity is proportional to the gradient of the phase of the quantum pilot wave. It is for this reason, that the independent existence of the classical beables can be ignored in most quantum calculations.

However, orthodox quantum theory assumes that the quantum system is thermodynamically closed between strong von Neumann projection measurements that obey the Born probability rule.

The new post-quantum theory in the equations of Sutherland, prior to taking the limit of orthodox quantum theory, should apply to pumped open dissipative structures.

Living matter is the prime example. ...".

Jack Sarfatti (email 31 January 2016) said:

"... post-quantum theory with action-reaction between quantum information pilot wave and its be-able is compatible with free will. ..."

Sarfatti-Bohm-Penrose-Hameroff Quantum Consciousness

In "Space-Time Code. III" Phys. Rev. D (1972) 2922-2931 David Finkelstein said
 "... **The primitive quantum processes or chronons of which world lines are made can be thought of as acts of emission or creation, Their duals, antichronons, represent acts of absorption or annihilation. ...**".

The Creation-Annihilation Operator structure of the Bohm Quantum Potential of 26D String Theory 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

$$28 + 64 + (SL(8, \mathbb{R}) + 1) + 64 + 28$$

Central Even Grade 0 = $SL(8, \mathbb{R}) + 1$

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

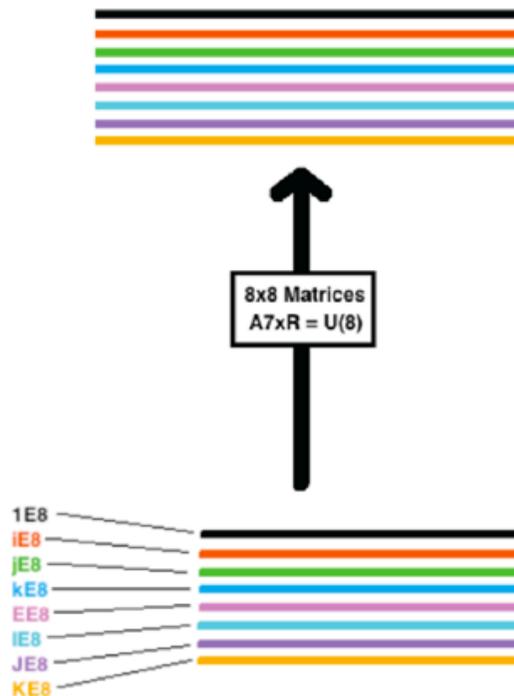
Odd Grades -1 and +1 = 64 + 64

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

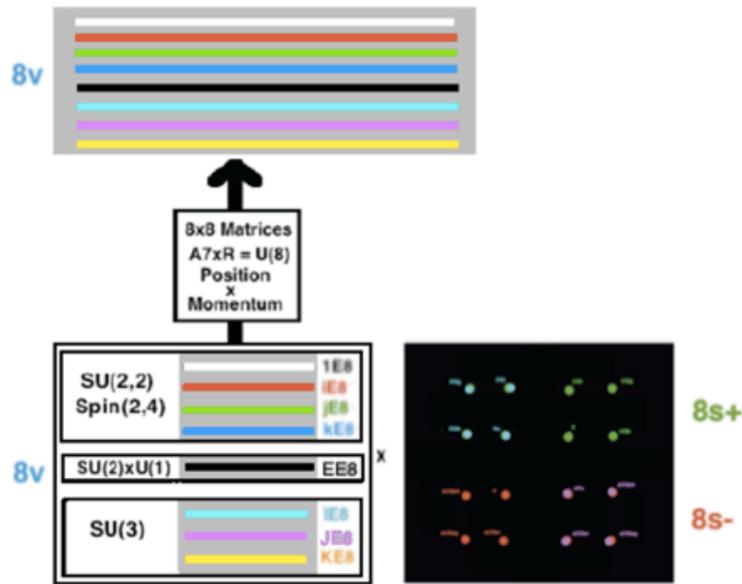
Even Grades -2 and +2 = 28 + 28

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 $A7 \times \mathbb{R} = U(8)$



26D String Theory Structure is



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

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

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

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

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

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

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

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

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

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

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

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

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

and

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

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

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

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

The Quantum State Form of a Conscious Brain is determined by the configuration of a subset of its 10^{18} to 10^{19} Tubulin Dimers described by a large Real Clifford Algebra. Paola Zizzi in gr-qc/0007006 describes the Octonionic Inflation Era of Our Universe as a Quantum Consciousness Superposition of States ending with Self-Decoherence after 64 doublings of Octonionic Inflation, at which time Our Universe is "... a superposed state of quantum ... [qubits].

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

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

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

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

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

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

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

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

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

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

the size of our Universe was then about $10^{(-24)}$ cm
which is about the size of a Fermion Schwinger Source Kerr-Newman Cloud.

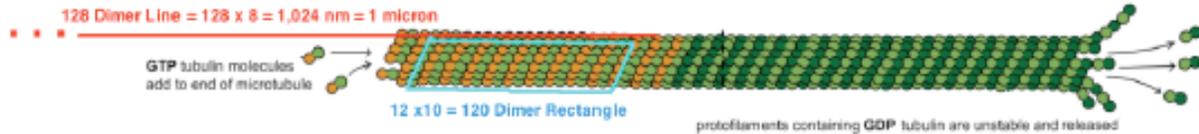
The 2^{64} qubits created by Inflation is roughly 10^{19} which is roughly the number of Quantum Consciousness Tubulins in the Human Brain.

Therefore

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

Further,

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



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

and so

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

so that **at any and all Times**

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

Therefore

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

in which the Human States of Consciousness = Souls exist.

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

**A Single Cell of E8 26-dimensional Bosonic String Theory,
in which Strings are physically interpreted as World-Lines,
can be described by taking the quotient of its 24-dimensional O+, O-, Ov
subspace modulo the 24-dimensional Leech lattice.**

**Its automorphism group is the largest finite sporadic group, the Monster Group,
whose order is**

8080, 17424, 79451, 28758, 86459, 90496, 17107, 57005, 75436, 80000, 00000

=

2^46 .3^20 .5^9 .7^6 .11^2 .13^3 .17.19.23.29.31.41.47.59.71

or about 8 x 10^53.

**"... Bohm's Quantum Potential can be viewed as an internal energy of a quantum
system ..."** according to Dennis, de Gosson, and Hiley (arXiv 1412.5133) and
Peter R. Holland says in "The Quantum Theory of Motion" (Cambridge 1993): **"... the total force ...
from the quantum potential ... does not ... fall off with distance ...
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Penrose-Hameroff-type Quantum Consciousness is due to Resonant Quantum Potential Connections among Quantum State Forms.

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

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



[such as Tubulin Dimers]

Because there are charges at the two ends of the dipole, we can have a contribution to the electric coupling from the scalar potential ... as well [as] from the magnetic coupling ... from the vector potential ... electric dipole coupling is stronger than magnetic dipole coupling ... the coupling of ... two ... configurations ... is the same, whether retarded or advanced potentials are used. Any ... configuration ... couples to any other on its light cone, whether past or future. ... The total phase accumulation in a ... configuration ... is the sum of that due to its own current, and that due to currents in other ... configurations ... far away ...

The energy in a single resonator alternates between the kinetic energy of the electrons (inductance), and the potential energy of the electrons (capacitance). With the two resonators coupled, the energy shifts back and forth between the two resonators in such a way that the total energy is constant ... The conservation of energy holds despite an arbitrary separation between the resonators ... Instead of scaling linearly with the number of charges that take part in the motion, the momentum of a collective system scales as the square of the number of charges! ... The inertia of a collective system, however, is a manifestation of the interaction, and cannot be assigned to the elements separately. ... Thus, it is clear that collective quantum systems do not have a classical correspondence limit. ...”.

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

Philip W. Anderson in cond-mat/0007287 and cond-mat/007185 said:
"... Laughlin and Pines have introduced the term "Quantum protectorate" as a general descriptor of the fact that certain states of quantum many-body systems exhibit properties which are unaffected by imperfections, impurities and thermal fluctuations. They instance ... flux quantization in superconductors, equivalent to the Josephson frequency relation which again has mensuration accuracy and is independent of imperfections and scattering. ...

... the source of quantum protection is a collective state of the quantum field involved such that the individual particles are sufficiently tightly coupled that elementary excitations no longer involve a few particles but are collective excitations of the whole system, and therefore, macroscopic behavior is mostly determined by overall conservation laws ... **a "quantum protectorate" ...[is]... a state in which the many-body correlations are so strong that the dynamics can no longer be described in terms of individual particles, and therefore perturbations which scatter individual particles are not effective ...**".

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

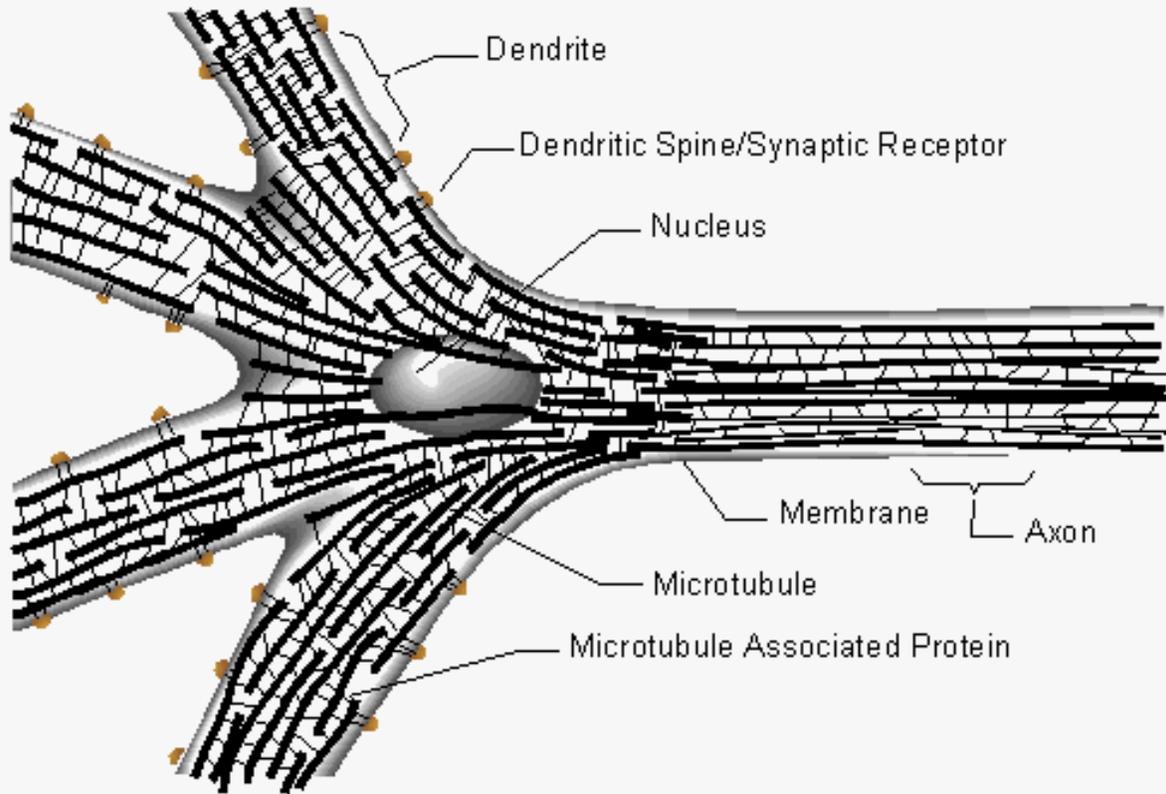


Classically, the various dimers can only be in the ...[those]... conformations. Each dimer is influenced by the neighboring dimers resulting in the possibility of a transition. This is the basis for classical information processing, which constitutes the picture of a (classical) cellular automaton.

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

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

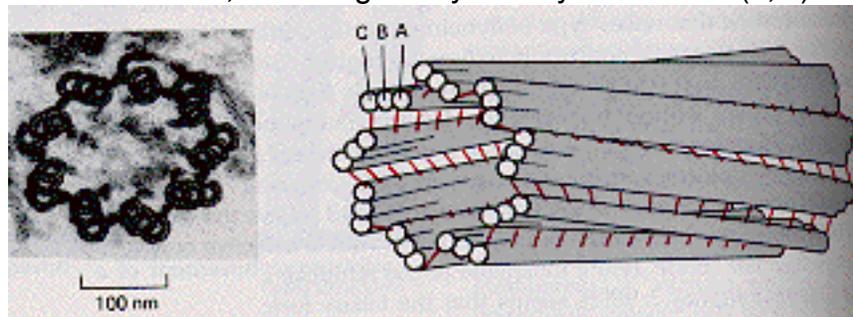
The Human Brain has about 10^{11} Neuron cells, each about 1,000 nm in size.
 The cytoskeleton of cells, including neurons of the brain, is made up of Microtubules



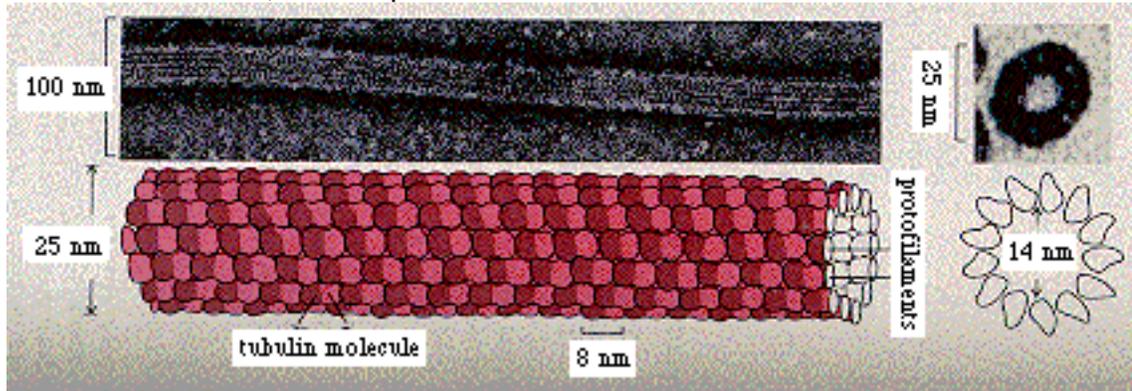
(image from "Orchestrated Objective Reduction of Quantum Coherence in Brain Microtubules: The "Orch OR" Model for Consciousness" by Penrose and Hameroff)

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

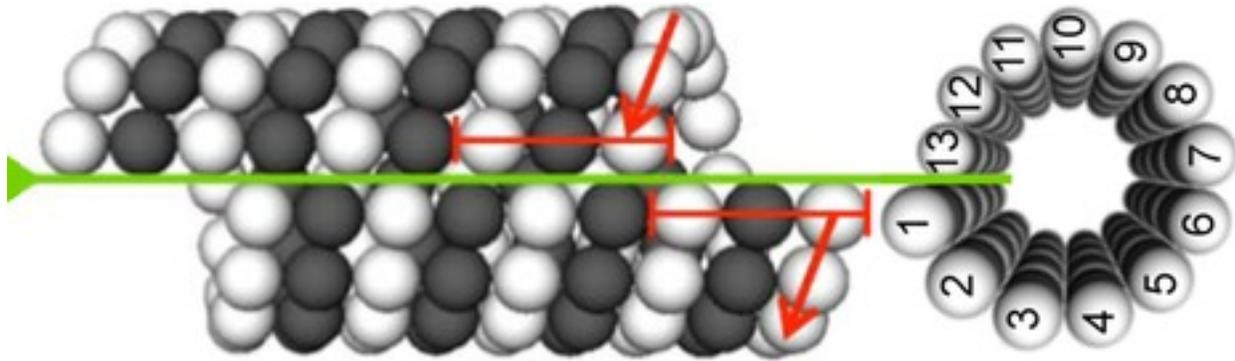
A Centriole is about 200 nm wide and 400 nm long. Its wall is made up of 9 groups of 3 Microtubules, reflecting the symmetry of 27-dim $J(3,0)$



Each Microtubule is a hollow cylindrical tube with about 25 nm outside diameter and 14 nm inside diameter, made up of 13 columns of Tubulin Dimers



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



(image from Wikipedia on Microtubule)

Each Tubulin Dimer is about 8 nm x 4 nm x 4 nm, consists of two parts, alpha-tubulin and beta-tubulin (each made up of about 450 Amino Acids, each containing roughly 20 Atoms)
 A Microtubule 40 microns = 40,000 nm long contains $13 \times 40,000 / 8 = 65,000$ Dimers



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

The black dots indicate the position of the Conformation Electrons.

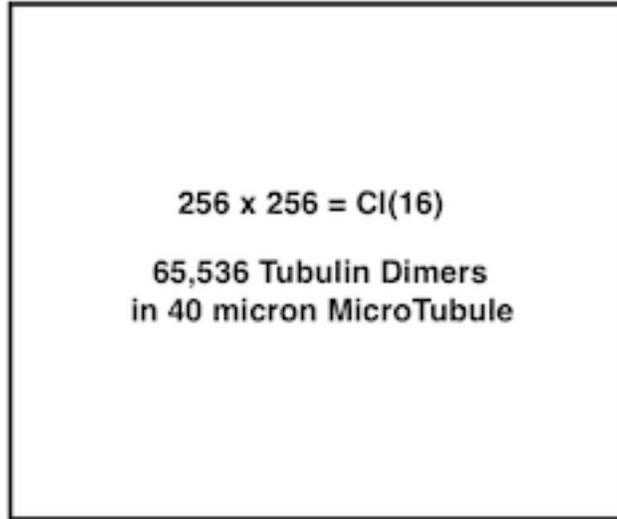
There are two energetically distinct configurations for the Tubulin Dimers:

Conformation Electrons Similarly Aligned (left image) - State 0

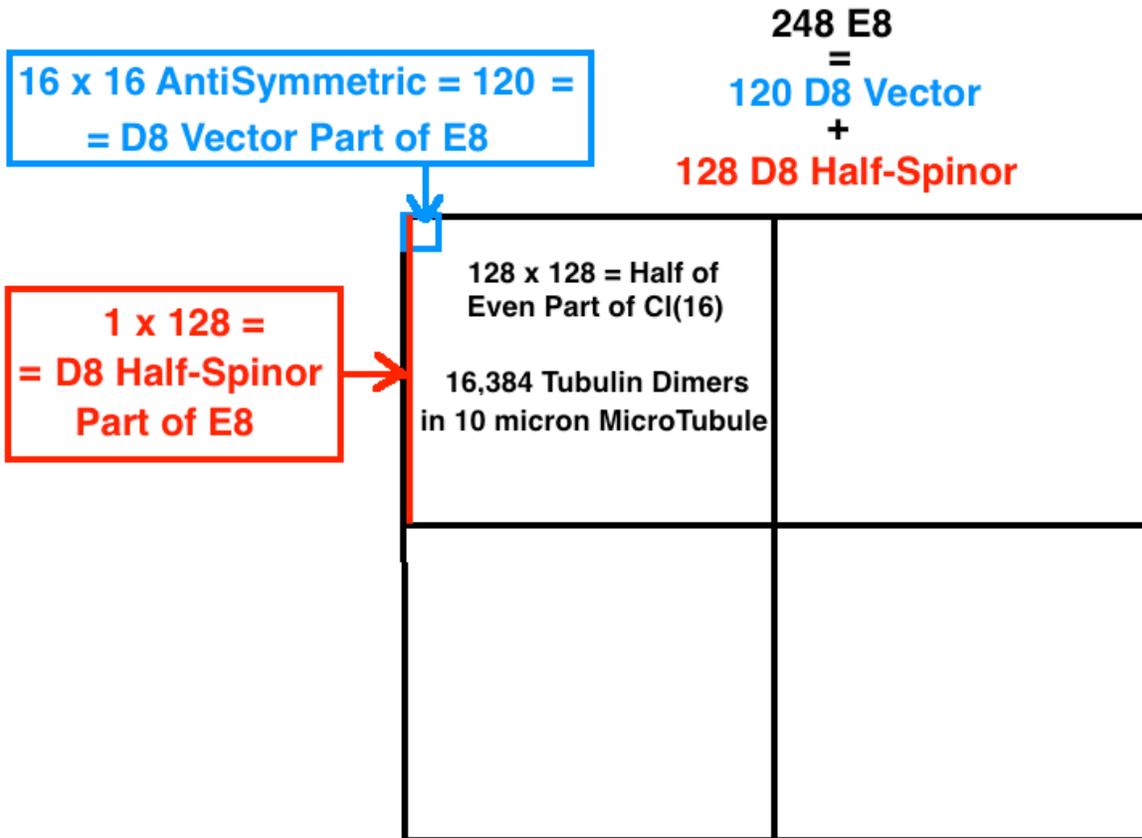
Conformation Electrons Maximally Separated (right image) - State 1

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

Microtubule binary math / code system corresponds to Clifford Algebras $Cl(8)$ and $Cl(8) \times Cl(8) = Cl(16)$ containing E_8

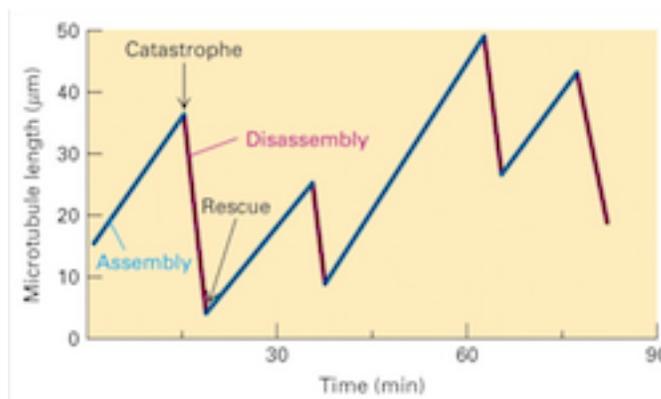
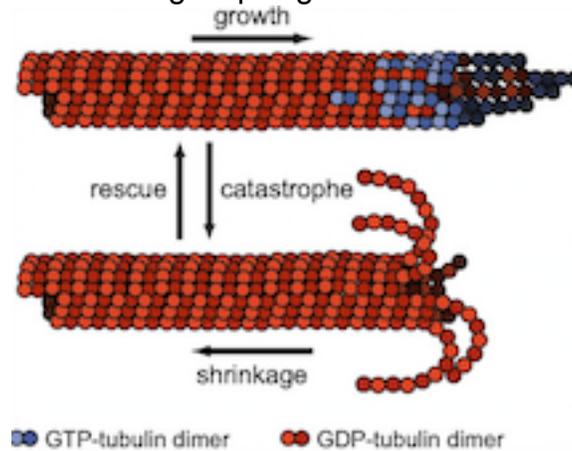


A 40 micron Microtubule contains Dimers representing the 65,536 elements of $Cl(16)$ which contains the 248 elements of Lie Algebra E_8 that defines E_8 Physics Lagrangian.



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.

According to 12biophys.blogspot.com Lecture 11 Microtubule structure is dynamic: “... One end of the microtubule is composed of stable (GTP) monomers while the rest of the tubule is made up of unstable (GDP) monomers. The GTP end comprises a cap of stable monomers. Random fluctuations either increase or decrease the size of the cap. This results in 2 different dynamic states for the microtubule. Growing: cap is present Shrinkage: cap is gone ...



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

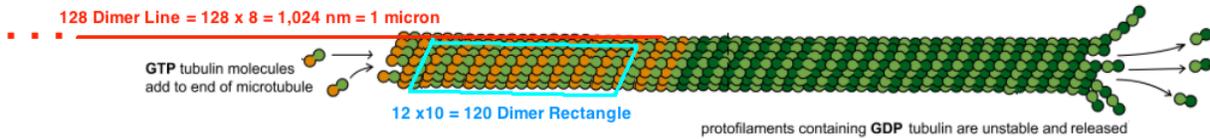
$$248 \text{ E8} = 120 \text{ D8 Vector } \square + 128 \text{ D8 Half-Spinor } \text{---}$$

<p>128 x 128 = Half of Even Part of Cl(16) 16,384 Tubulin Dimers in 10 micron MicroTubule</p>		<p>2 x (128 x 128) Even Part of Cl(16) 32,768 Tubulin Dimers in 20 micron MicroTubule</p>	<p>256 x 256 = Cl(16) 65,536 Tubulin Dimers in 40 micron MicroTubule</p>

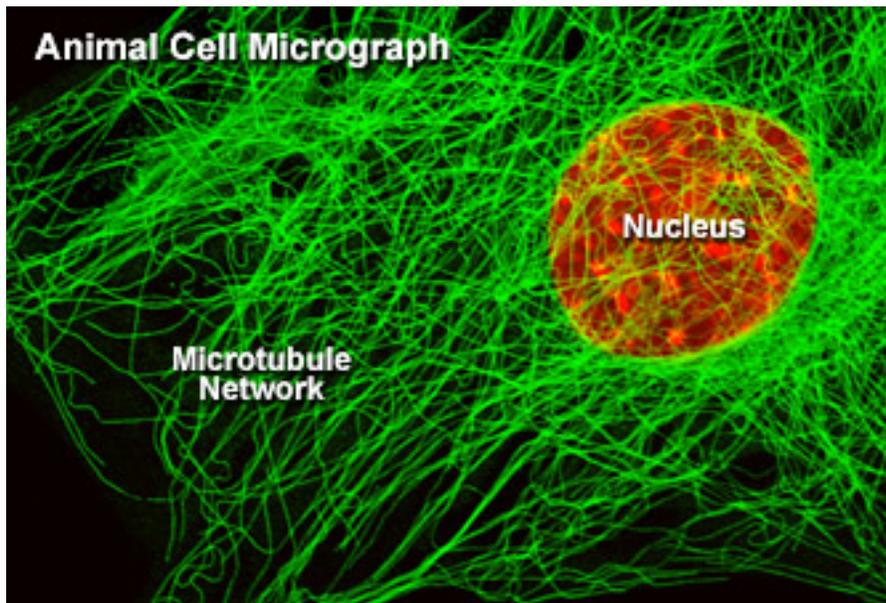
or as the Even Part (half) of Cl(16) (20 microns) or as full Cl(16) (40 microns).

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)



The image immediately above does not show how thin is the Microtubule.
The following image (from micro.magnet.fsu.edu) shows overall Microtubule shape



How do the Microtubules communicate with each other ?

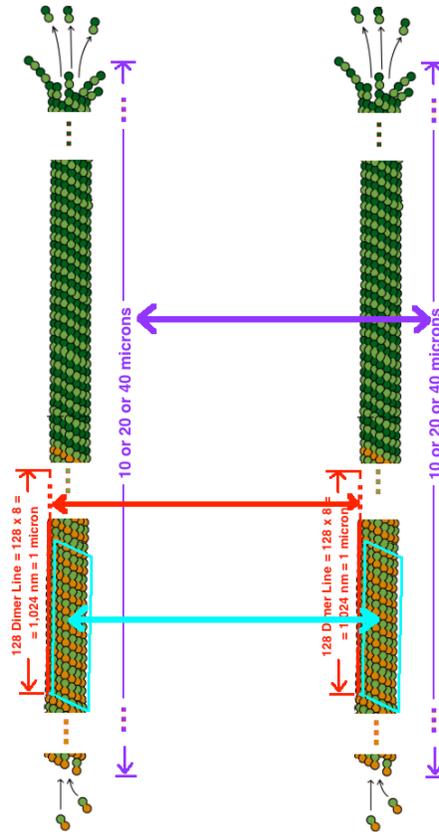
Consider the Superposition of States State 0 and State 1 involving one Tubulin Dimer
with Conformation Electron mass m and State1 / State 0 position separation a .

The Superposition Separation Energy Difference is the internal energy

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

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

Communication between two Microtubules is by the Bohm Quantum Potential between their respective corresponding Dimers (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)



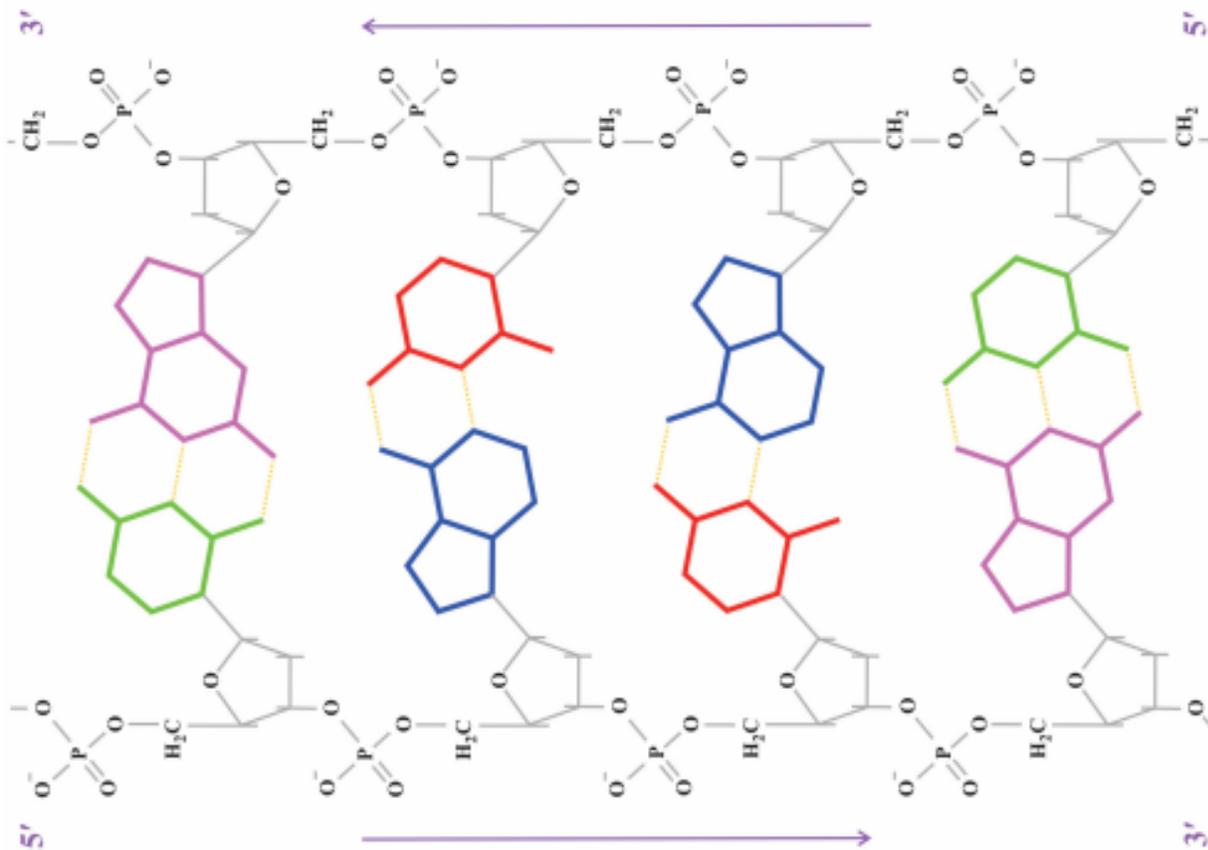
How is information encoded in the Microtubules ?

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, analogous to the Book of Genesis of $(22+5)^{78,064}$ Hebrew Letter/Final possibilities.

65,536-dimensional CI(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. ...



... The Sugar-phosphate group consists of 2-deoxyribose and phosphoric acid residues. DNA chain orientation is identified by carbon atoms of 2-deoxyribose: (5')CH₂ and (3')COH. The biological function of DNA and storage and transfer of genetic information to daughter cells is based on specific, complimentary pairing of nucleotides:

A is paired with T, and G with C.

...

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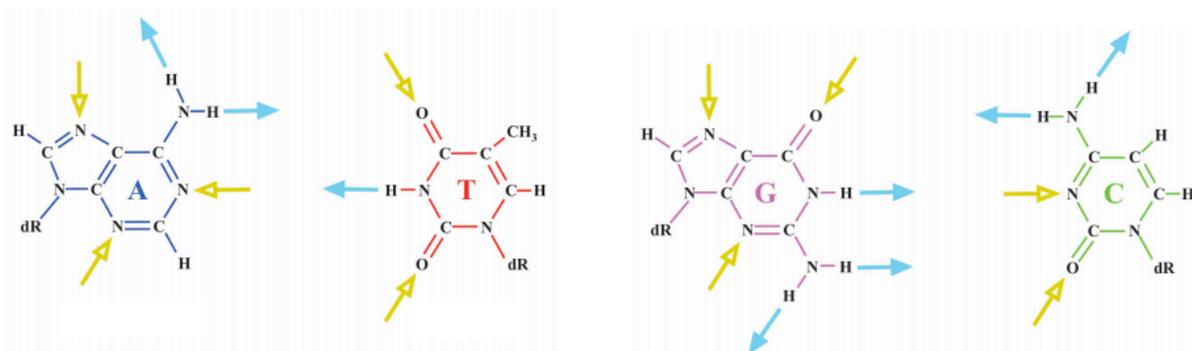


Figure 1.4 Potential vectors of hydrogen bond of DNA nucleotides.
Yellow arrows—acceptors, blue arrows—donors of hydrogen.

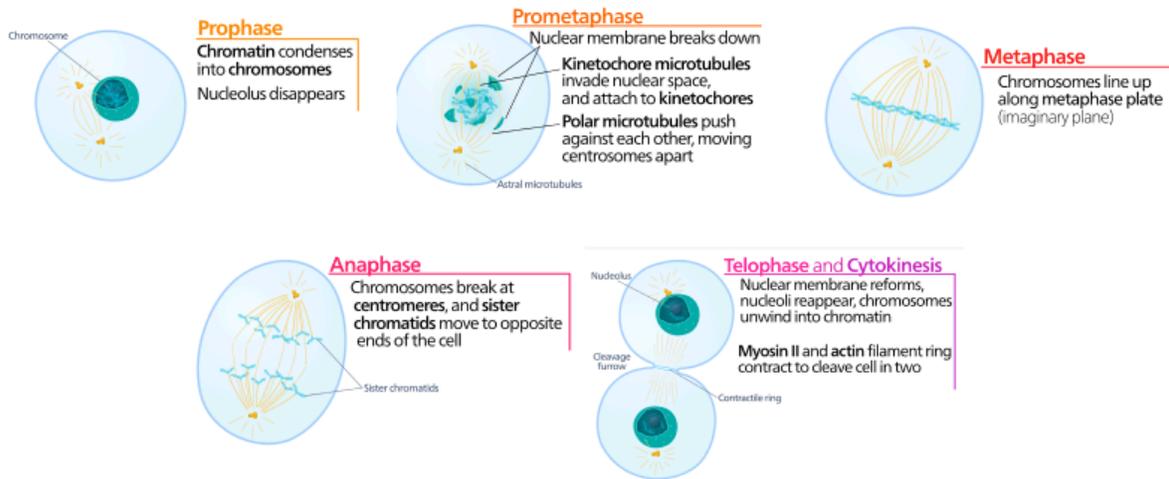
The space of DNA nucleotide states contains $2^3 \otimes 2^4 \otimes 2^5 \otimes 2^6 = 2^{18}$ elements of Clifford algebras. This space reduction to four nucleotides means compression of DNA information by a factor of $2^{18} / 4 = 65536$. Reduction of the nucleotide state space leads to DNA compactization and chromosome condensation. ...”.

In “Chromosome Condensation and Cohesion” (eLS December 2010) Laura Angelica Diaz-Martinez and Hongtau Yu say: “... The diploid human genome consists of 46 chromosomes, which collectively contain about 2 m of deoxyribonucleic acid (DNA). During mitosis, the genome is packaged into 46 pairs of sister chromatids, each less than 10 μm long. ...”.

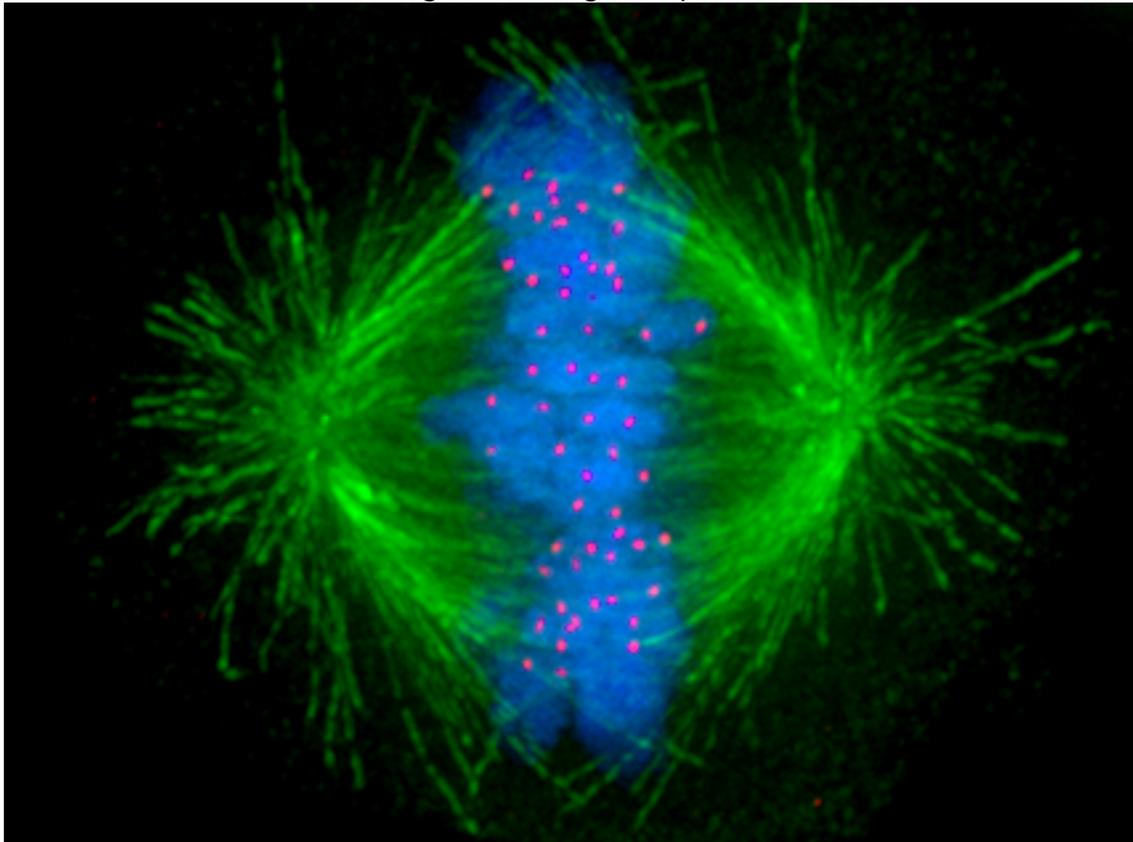
**The DNA information condensation factor of 65,536 is the dimension of $Cl(16)$
which is
the Real Clifford Algebra containing 248-dim E_8 of E_8 Physics
as 120-dim bivector D_8 plus 128-dim D_8 half-spinor
and is also
the Clifford Algebra of Microtubule information in Quantum Consciousness.**

Microtubule information = 65,536 = CI(16) = DNA condensation information

Wikipedia describes interaction of Microtubules with DNA in mitosis condensation: “...



... Micrograph showing condensed chromosomes in blue, kinetochores in pink, and microtubules in green during metaphase of mitosis ...



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

Stcherbic and Buchatsky also say: "... Ribonucleic acid (RNA) can also store genetic information. A single RNA helix is seldom used as a carrier of genetic information (only in some viruses); its main role is storing DNA sites as copies of individual proteincoding genes (mRNA) or in formation of large structural complexes, e.g., ribosomes and spliceosomes. At self-splicing, RNA may perform the function of an enzyme. RNA also performs an important role during DNA replication. So called RNA-primers are necessary to synthesize DNA complementary chains, although this fact is not obvious. RNA contains sugar, ribose, which hydroxyl groups make more reactive than DNA. Besides, RNA contains uracil U, which is somewhat lighter than thymine.

...

At translation of mRNA triplets into genetic code amino acids, the dynamics of triplets to amino acids transformation should be taken into account.

...

At transition ... functional volume is equal to $3^5 = 243$.

To this volume there should be added the volume of auxiliary spaces, equal to $13 = 5 + 4 + 3 + 1$.

Accordingly, we get

256 functions of mRNA triplet transformation into amino acids of the genetic code.

Reverse transition ... from amino acids ... to triplet ... needs $5^3 + 3^1 = 128$ functions.

In addition, 128 triplets of mRNA-tRNA pairing should be added to this number. ...".

**The 256 of mRNA triplet to amino acids is represented by $Cl(8)$ Clifford algebra
and
the $128+128 = 256$ of amino acids to mRNA triplets is represented by another $Cl(8)$
so
that the mRNA triple - amino acid connection is represented by the tensor
product $Cl(8) \times Cl(8)$ which by 8-Periodicity of Real Clifford Algebras is the
Real Clifford Algebra $Cl(16)$
which also contains 248-dim E_8 of viXra 1508.0157 E_8 Physics
and is also the Clifford Algebra
of Microtubule information in viXra 1512.0300 Quantum Consciousness.**

What about information in the Many Microtubules of Human Consciousness ?

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

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**.

(see Appendix - Details of World-Line String Bohm Quantum Theory)

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

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

Now consider the case of N Tubulin Dimers in Coherent Superposition connected by the Bohm Quantum Potential Force that does not fall off with distance.

Jack Sarfatti defines coherence length L by $L^3 = N a^3$ so that

the Superposition Energy E_N of N superposed Conformation Electrons is

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

The decoherence time for the system of N Tubulin Electrons is

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

so we have the following rough approximate Decoherence Times T_N

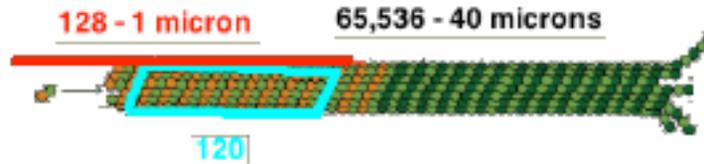
Number of Involved Tubulin Dimers	Time T_N	
$10^{(11+9)} = 10^{20}$	$10^{(-33 + 26)} = 10^{-7}$ sec	10^{11} neurons x 10^9 TD / neuron 10^{20} Tubulin Dimers in Human Brain

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 $10^{16} \times 10 \text{ nm} / c = (10^{16} \times 10^{-6}) \text{ cm} / c = 10^{10} \text{ cm} / c = 0.3 \text{ sec}$

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 $13 \times 40,000 / 8 = 65,000$ 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 componets of 8+8 First-Generation Fermions
- D8 / D4 x D4 for 8-dim spacetime position x 8-dim spacetime momentum
- D4 for Standard Model Gauge Bosons and Gravity - Dark Energy Ghosts
- D4 for Gravity - Dark Energy Gauge Bosons and Standard Model Ghosts

Microtubule Information in the Boundary
has Resonant Connection to Cl(16) Information in Bulk Space
by 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.

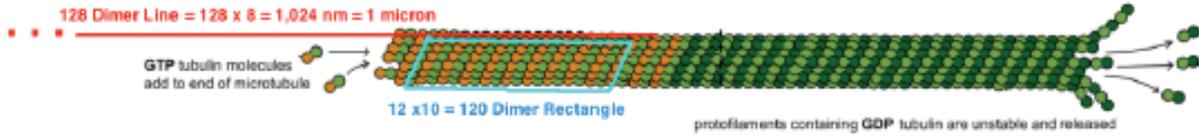
The Bulk Space Domain Type IV8
corresponds to the Symmetric Space Spin(10) / Spin(8)xU(1)
and is a Lie Ball whose Shilov Boundary RP1 x S7 is a Lie Sphere 8-dim Spacetime.

It is related to
the Stiefel Manifold $V(10,2) = \text{Spin}(10) / \text{Spin}(8)$ of dimension $20-3 = 17$ by the fibration
 $\text{Spin}(10) / \text{Spin}(8) \times U(1) \rightarrow V(10,2) \rightarrow U(1)$

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

(R. Coquereaux Nuc. Phys. B. 18B (1990) 48-52) "Lie Balls and Relativistic Quantum Fields".

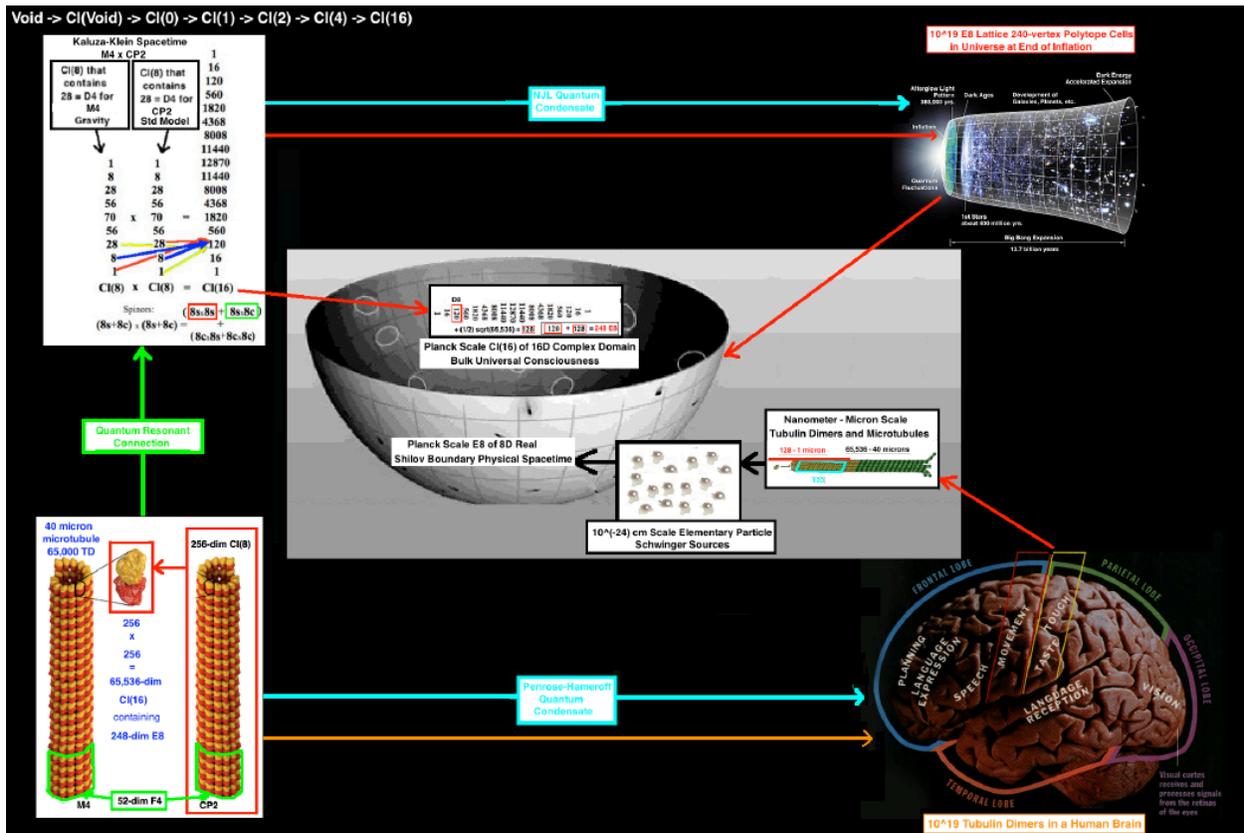
Human Brain Microtubules 40 microns long have 65,536 Tubulin Dimers



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

and so

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



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

Therefore

E8 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.

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

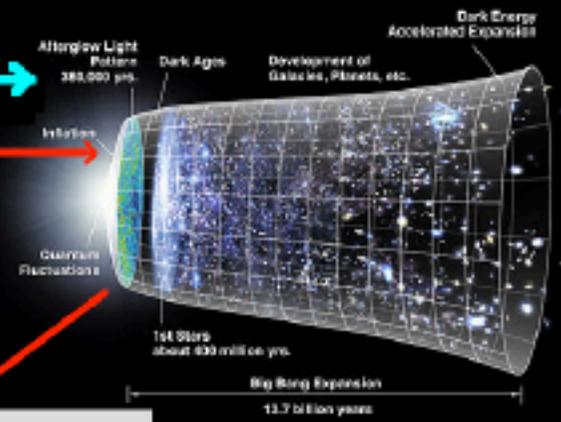
Kaluza-Klein Spacetime
M4 x CP2

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

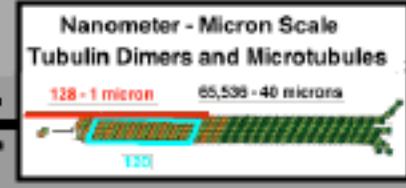
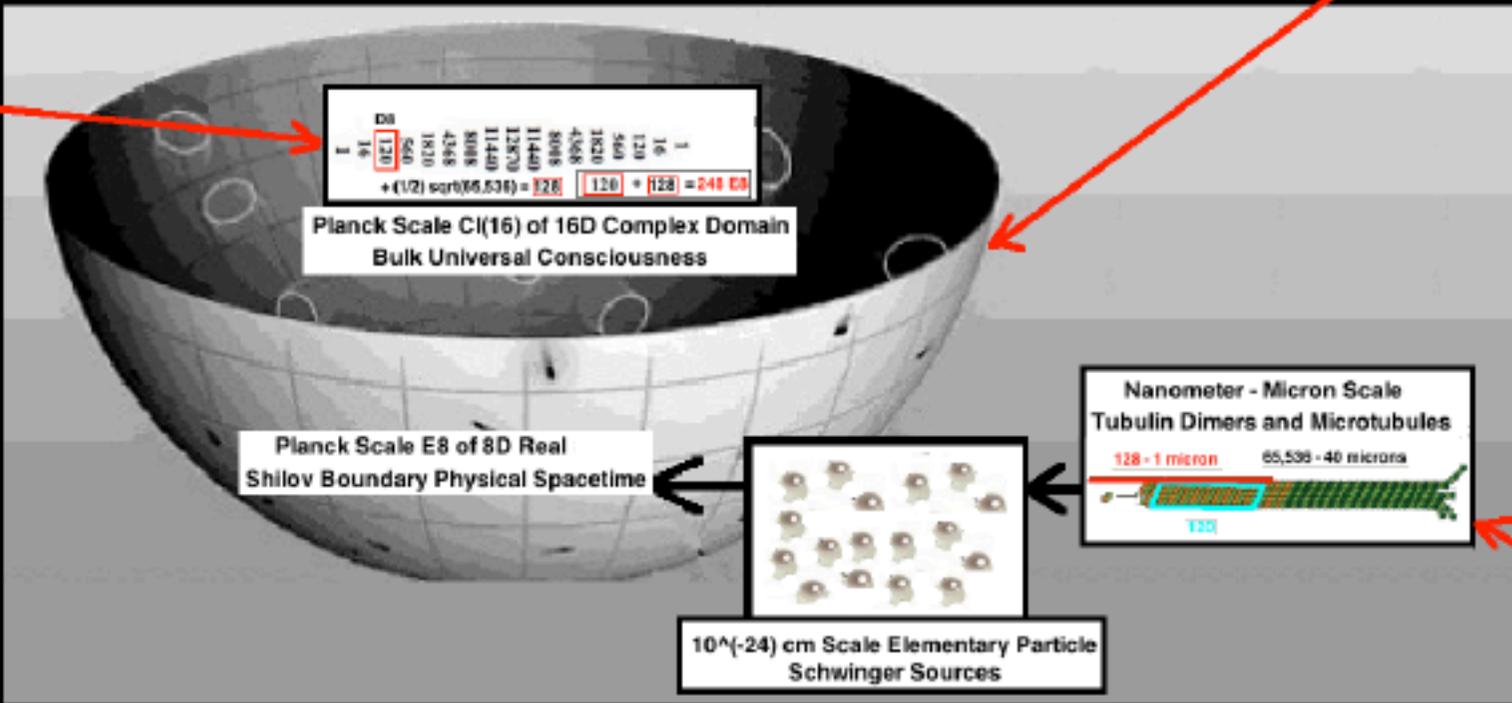
$Cl(8) \times Cl(8) = Cl(16)$

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

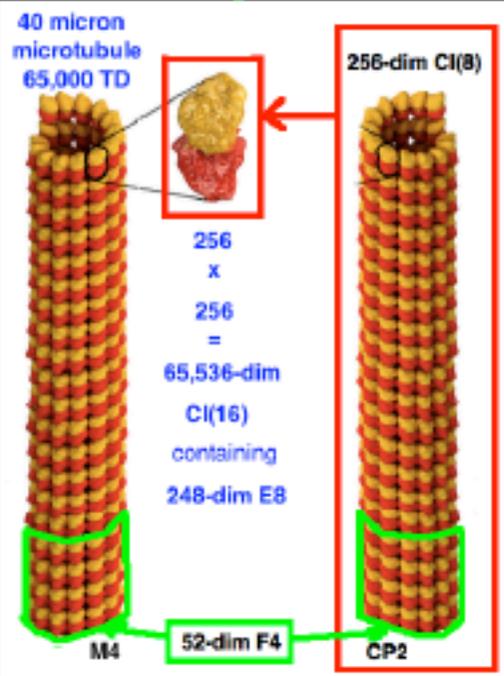
10¹⁹ E8 Lattice 240-vertex Polytope Cells in Universe at End of Inflation



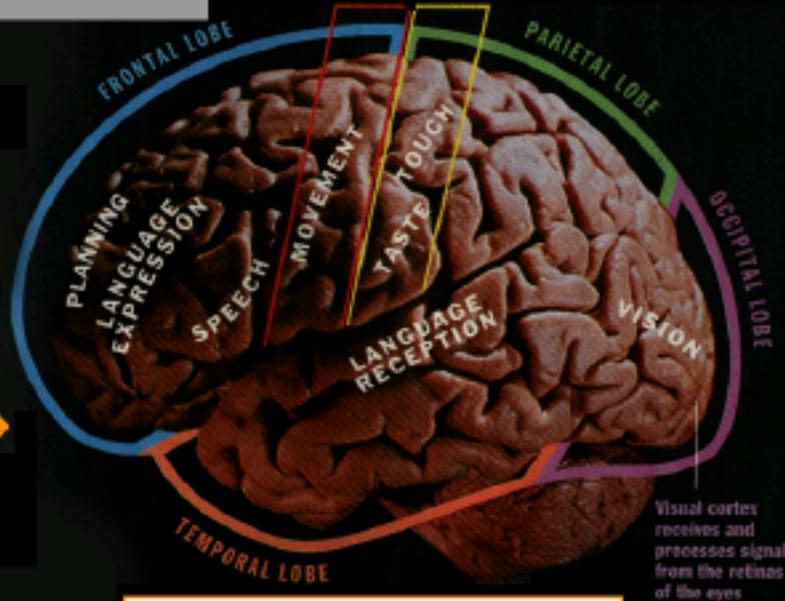
NJL Quantum Condensate



Quantum Resonant Connection



Penrose-Hameroff Quantum Condensate



10¹⁹ Tubulin Dimers in a Human Brain

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