Overview of Cl(16) Physics with Pd-D Fusion

Frank Dodd (Tony) Smith, Jr. - 2018

Abstract

This is a pdf file of 40 slides about the Basic Ideas of Cl(16) Physics with Pd-D Fusion
It is only an Overview of Basic Ideas. Details are in http://vixra.org/pdf/1807.0166v2.pdf and http://vixra.org/pdf/1603.0098v2.pdf and my viXra pages and my web sites including http://valdostamuseum.com/hamsmith/

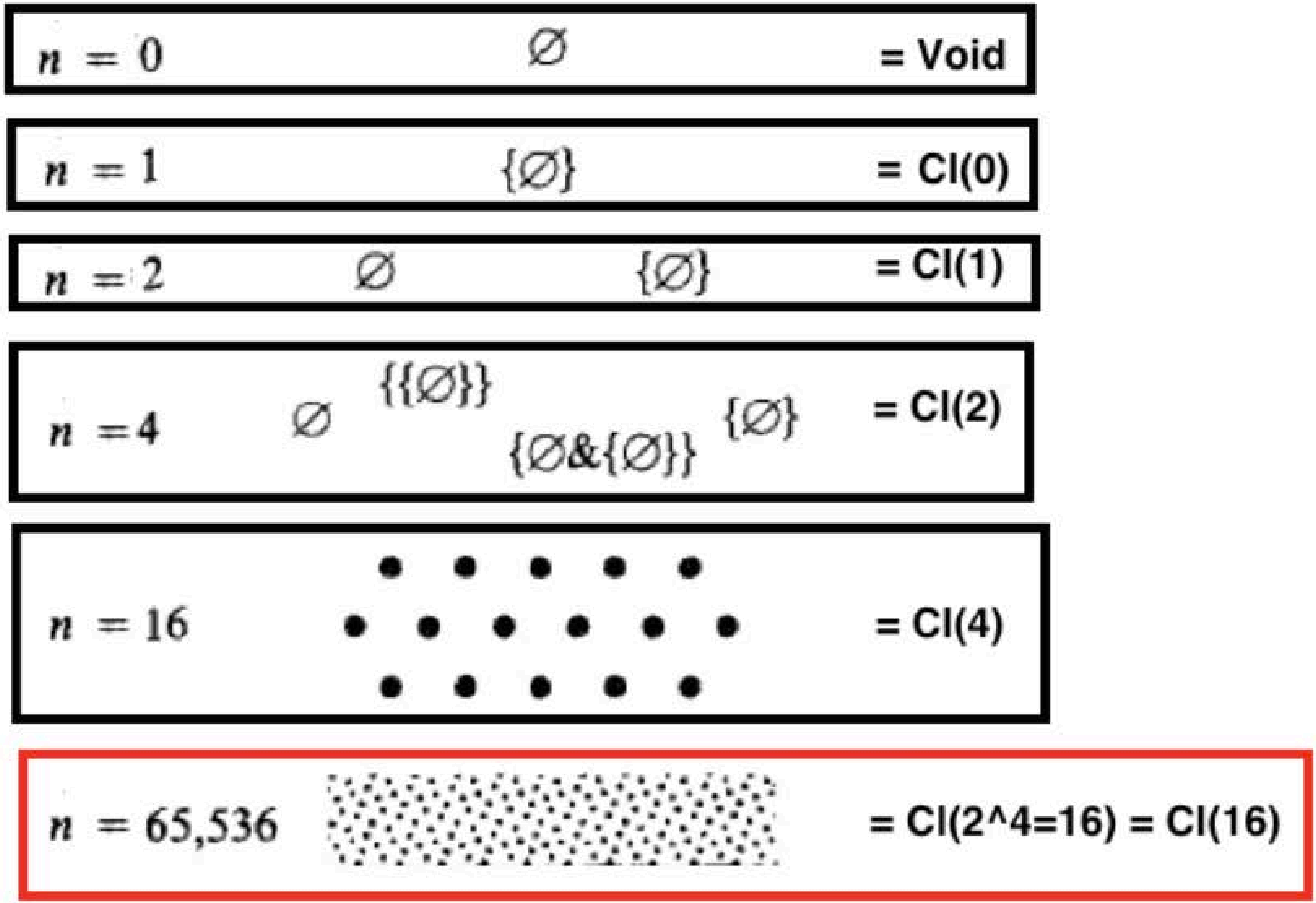
The Slideshow in mov format is on the web at

http://valdostamuseum.com/hamsmith/Cl16PdD.mov

The mov slides have no audio narration
because I think that audio would distract from video presentation of the slides.

Table of Contents

All Universes begin as Quantum Fluctuations of the Empty Set = Void
by Quantum Fluctuation of Compact E8(-248) Real Form of E8
which is the First Grothendieck Universe and they all evolve according to
David Finkelstein's Iteration of Real Clifford Algebras:



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
	1	1	12870
	8	8	11440
	28	28	8008
	56	56	4368
	70	70	1820
TriVectors	56	56	560
BiVectors	28	28	120
	8	8	16
	1	1	1
	Cl(8)	x Cl(8)	= Cl(16)

8-Periodicity tensor product

$$560 = 56 + 8 \times 28 + 28 \times 8 + 56$$
$$120 = 28 + 8 \times 8 + 28$$

Cl(16) is M256(R) = 256 x 256 Matrix Algebra of Real Numbers.
Cl(8) is M16(R) = 16 x 16 Matrix Algebra of Real Numbers.

BiVectors with an antisymmetric Bracket Product form a Lie Algebra.
120-dim Cl(16) BiVectors + 128-dim Cl16) half-Spinors = 248-dim E8

TriVectors with a symmetric Jordan Product form a Jordan Algebra.
560-dim Cl(16) TriVectors = 10 copies of 56-dim Fr3(O)
Fr3(O) = Complexification of 27-dim J3(O)

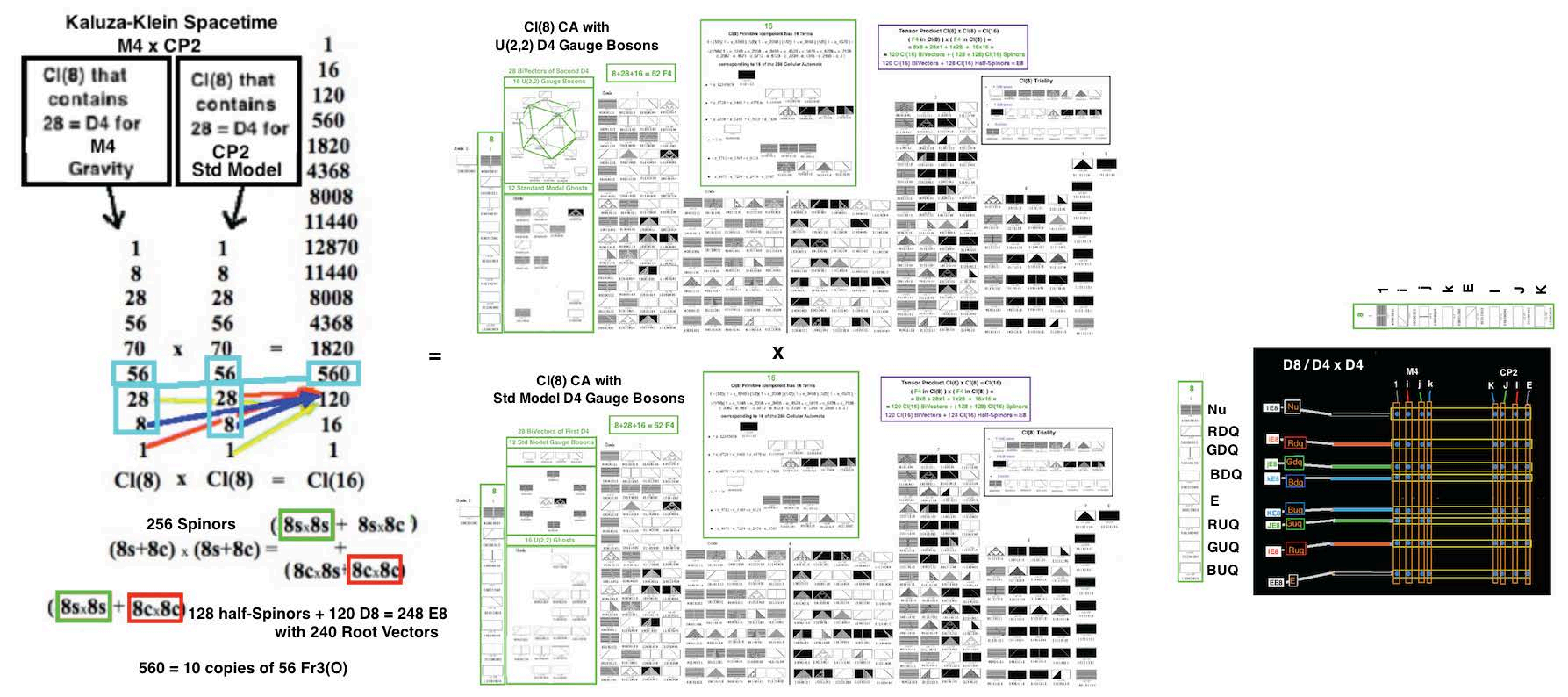
Similarly, the Spinor structure of Cl(16) is

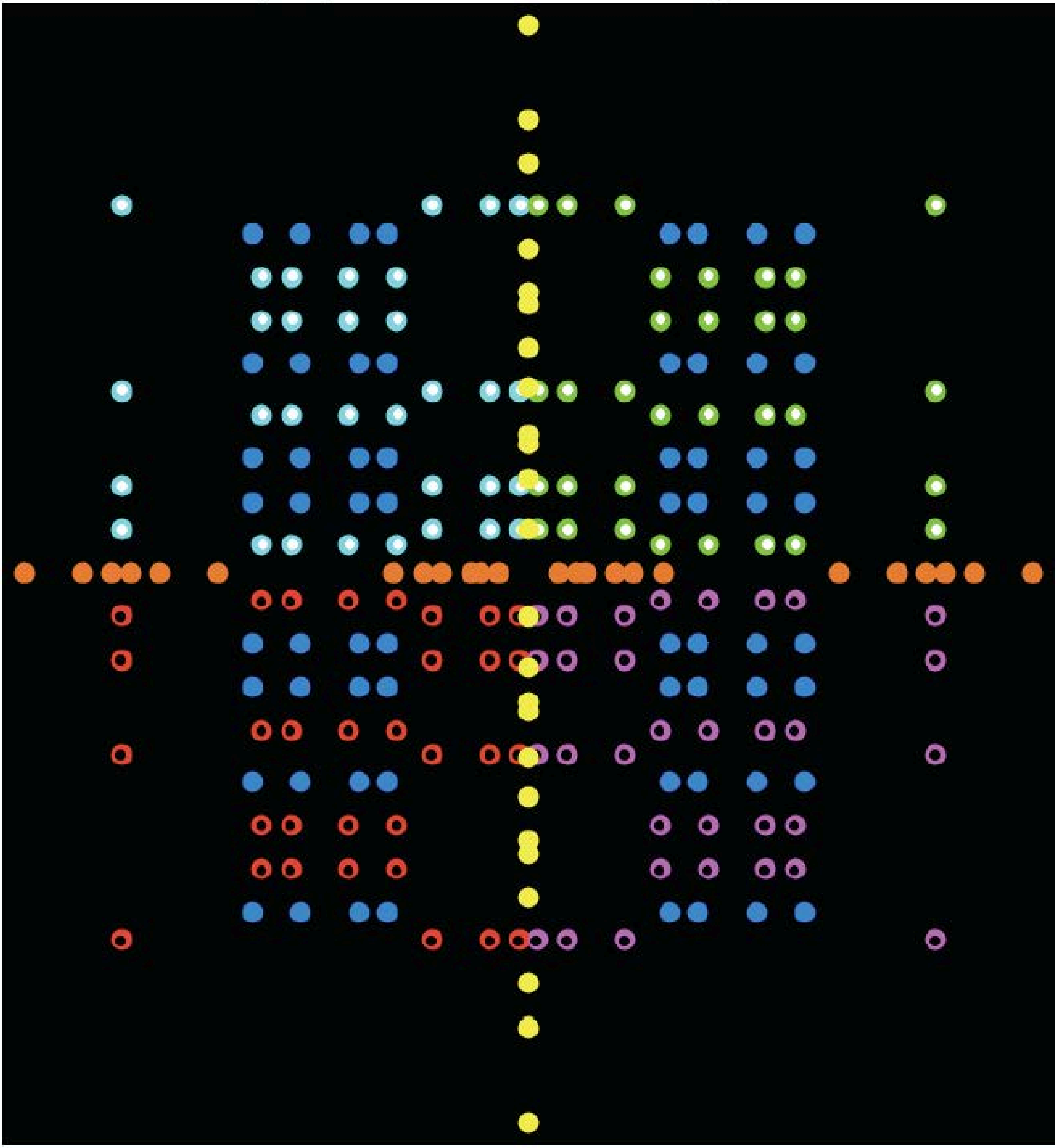
Cl(8) Spinors x Cl(8) Spinors = Cl(16) Spinors
8-Periodicity tensor product

Cl(8) 8 S+ + 8 S- x Cl(8) 8 S+ + 8 S- =
= Cl(16) 8x8 S++ + 8x8 S+- + 8x8 S-+ + 8x8 S--

Cl(16) helicity consistent Spinors = 64 S++ + 64 S-- = 128

Cl(8) structure is in African IFA divination through its 16x16 = 2^8 = 256 Odu
and is also represented by the 256 Elementary Cellular Automata
the binary nature of which has its historical origin in Africa.
Ron Eglash (in his book "African Fractals" (Rutgers 1999) and on his web site) says:
"... **a historical path for base-2 calculation ... begins with African divination** ...".

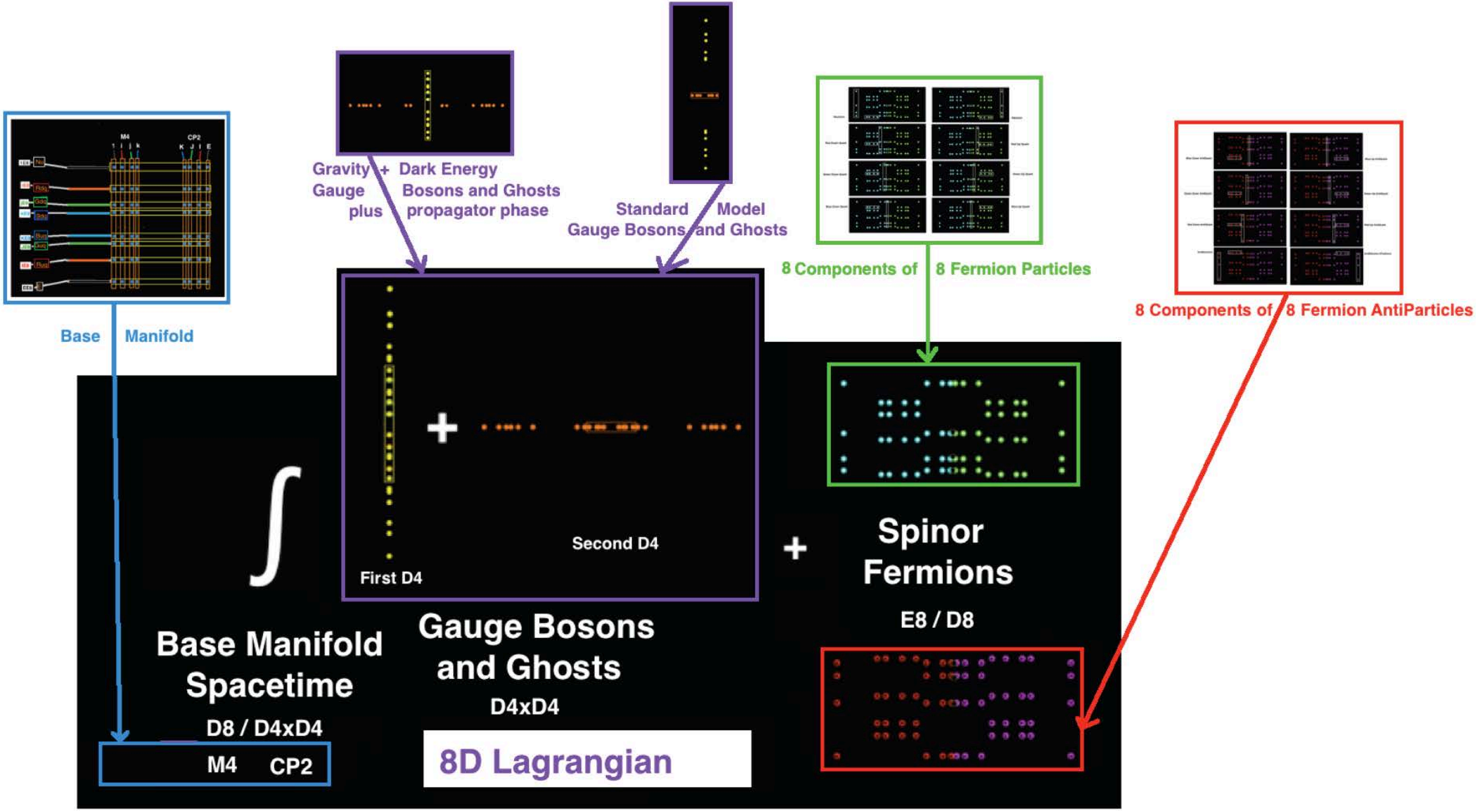

Kaluza-Klein Spacetime
M4 x CP2
Cl(8) that contains 28 = D4 for M4 Gravity
Cl(8) that contains 28 = D4 for CP2 Std Model
1 8 28 56 70 56 28 8 1
1 8 28 56 70 56 28 8 1
1 16 120 560 1820 4368 8008 11440 12870 11440 8008 4368 1820 560 120 16 1
x
=
Cl(8) x Cl(8) = Cl(16)
256 Spinors
(8s+8c) x (8s+8c) = (8sx8s + 8sx8c) + (8cx8s + 8cx8c)
(8sx8s + 8cx8c) 128 half-Spinors + 120 D8 = 248 E8
with 240 Root Vectors
560 = 10 copies of 56 Fr3(O)
=
Cl(8) CA with
U(2,2) D4 Gauge Bosons
8+28+16 = 52 F4
28 BiVectors of Second D4
16 U(2,2) Gauge Bosons
12 Standard Model Ghosts
Cl(8) Triality
X
Cl(8) CA with
Std Model D4 Gauge Bosons
8+28+16 = 52 F4
28 BiVectors of First D4
12 Std Model Gauge Bosons
16 U(2,2) Ghosts
Nu
RDQ
GDQ
BDQ
E
RUQ
GUQ
BUQ
D8 / D4 x D4
M4
1 i j k
CP2
K J I E
Nu
Rdq
Gdq
Bdq
Buq
Guq
Ruq
E



240 E8 Root Vectors = 112 D8 Root Vectors + 128 D8 half-spinors
128 D8 half-spinors = 128 elements of E8 / D8
Green and Cyan dots with white centers (32+32=64 dots) = Fermion Particles
Red and Magenta dots with black centers (32+32=64 dots) = Fermion AntiParticles

112 D8 Root Vectors = 64 D8 / D4xD4 (blue) + 24 D4 (yellow) + 24 D4 (orange)

In terms of 16x16 Matrices of Cl(8) and 256x256 Matrices of Cl(16)
(Matrices of Real Numbers. Cl(8) TriVectors = 2-color dots with dark blue outer part.)
Cl(8)
16x16 Matrix Representation
15 Purple = Spin(2,4) = SU(2,2) Gauge Bosons
1 Grey = U(1) of U(2,2) Propagator Phase
12 Orange = Standard Model Ghosts
x
Cl(8)
16x16 Matrix Representation
12 Orange = SU(3) x SU(2) x U(1) Gauge Bosons
1 Grey = U(1) of U(3) Propagator Phase
15 Purple = Gravity + Dark Energy Ghosts
=
Cl(16) 256x256 Matrix Representation
E8 / D8
Spinor Fermions
8 Components of 8 Fermion Particles
8 Components of 8 Fermion AntiParticles
Cl(16) Vectors
BiVectors TriVectors
1
2
4
3
10
5
9
8
6
7
Fr3(O) is Zorn-type matrices
a,b,d,d',e,e',f,f' are Real Numbers
S+,S'+,V, V',S-,S'- are Octonions
* = Conjugate
Second D4
Standard Model Gauge Bosons
Gravity + Dark Energy Ghosts
propagator phase Ghost
M4
CP2
D8 / D4xD4
Base Manifold
First D4
Gravity + Dark Energy Gauge Bosons
propagator phase
Standard Model Ghosts
16x16 Matrix Representation of Cl(8)
Cl(8) TriVectors (4 grey, 8 blue, 8 green, 8 red)
representing 56-dim Fr3(O)
which contains two copies of 27-dim J3(O)
Each J3(O) contains 26-dim traceless part J3(O)o
which represents a copy of 26DString Theory
a
d
S+* e
V* S-* f
S+
V
S-
d'
S'+* V'*
e'
S'-*
f'
S'+
V'
S'-
b


Gravity + Dark Energy
Gauge plus
Bosons and Ghosts propagator phase
Standard Model
Gauge Bosons and Ghosts
8 Components of 8 Fermion Particles
8 Components of 8 Fermion AntiParticles
Base Manifold
First D4
Second D4
Spinor Fermions
E8 / D8
Base Manifold Spacetime
D8 / D4xD4
M4 CP2
Gauge Bosons and Ghosts
D4xD4
8D Lagrangian

The 8D-4D E8 Lagrangian System has these characterictics:

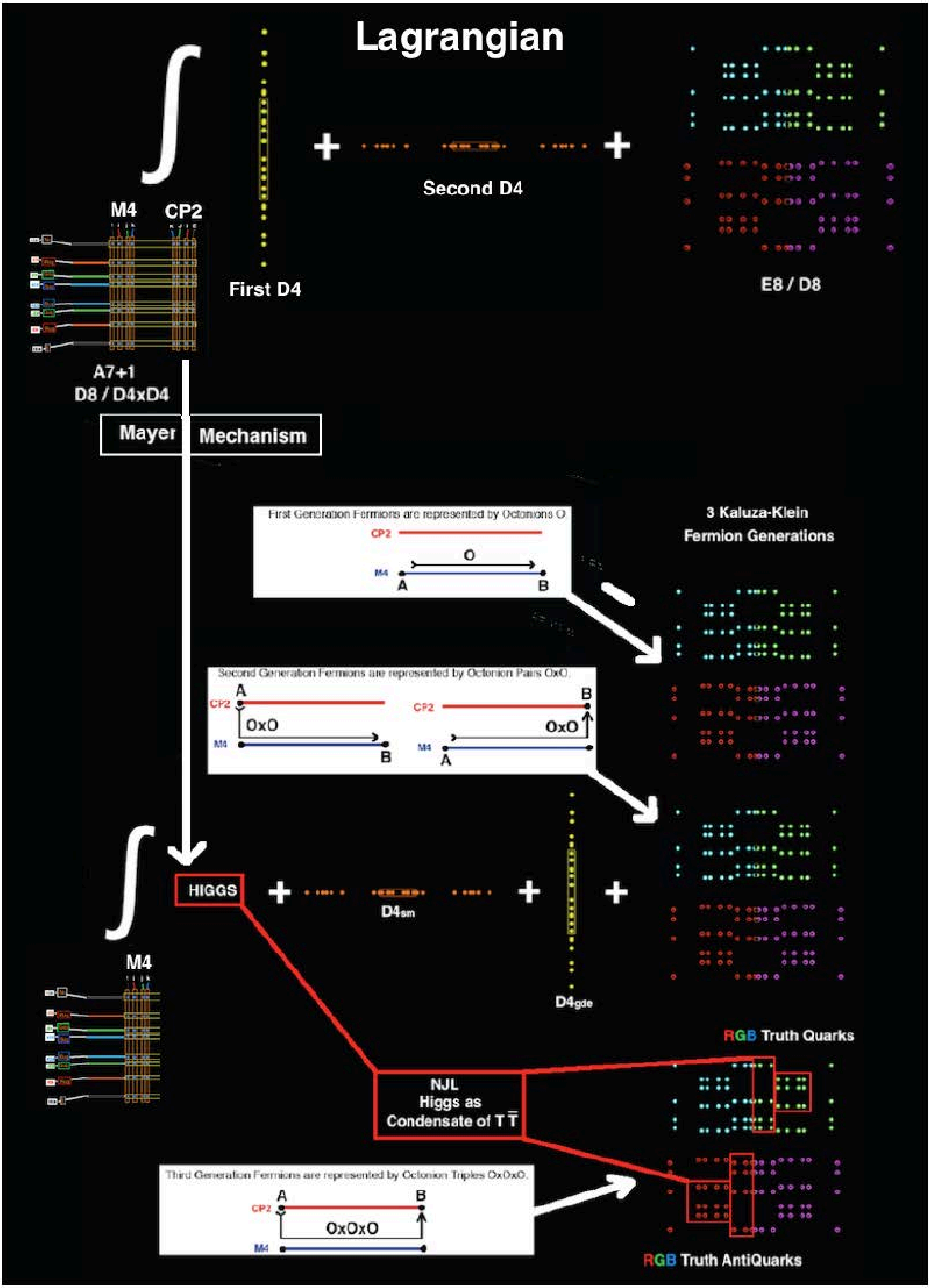
Lagrangian has 8-dim Lorentz structure satisfying Coleman-Mandula because its Fermionic fundamental spinor representations are built with respect to spinor representations for 8-dim Spin(1,7) spacetime - see Steven Weinberg, "The Quantum Theory of Fields" Volume III

Lagrangian is UltraViolet finite because each Fermionic Term Fermion has in 8-dim Spacetime units of mass^(7/2) and each Bosonic Gauge Boson + Ghost Term has units of mass^(1), so, since (8+8)x(7/2) = 56 = 28 + 28 the Fermionic Terms cancel the Bosonic Terms - see Steven Weinberg "1986 Dirac Lectures Elementary Particles and the Laws of Physics"

Lagrangian is Chiral because E8 contains Cl(16) half-spinors (64+64) for a Fermion Generation but does not contain Cl(16) Mirror Fermion AntiGeneration half-spinors.
Fermion +half-spinor Particles with high enough velocity are seen as left-handed.
Fermion -half-spinor AntiParticles with high enough velocity are seen as right-handed.

Lagrangian obeys Spin-Statistics because the CP2 part of M4xCP2 Kaluza-Klein has index structure Euler number 2+1 = 3 and Atiyah-Singer index -1/8 which is not the net number of generations because CP2 has no spin structure but you can use a generalized spin structure (Hawking and Pope (Phys. Lett. 73B (1978) 42-44)) to get (for integral m) the generalized CP2 index n_R - n_L = (1/2) m (m+1)
Prior to Dimensional Reduction: m = 1, n_R - n_L = (1/2)x1x2 = 1 for 1 generation
After Reduction to 4+4 Kaluza-Klein: m = 2, n_R - n_L = (1/2)x2x3 = 1 for 3 generations
Hawking and Pope say: "Generalized Spin Structures in Quantum Gravity ...what happens in CP2 … one could replace the electromagnetic field by a Yang-Mills field whose group G had a double covering G~. The fermion field would have to occur in representations which changed sign under the non-trivial element of the kernel of the projection … G~ -> G while the bosons would have to occur in representations which did not change sign …". For E8 physical gauge bosons are in the 28+28=56-dim D4xD4 subalgebra. D4 = SO(8) is the Hawking-Pope G with double covering G~ = Spin(8).
The 8 fermion particles / antiparticles are D4 half-spinors represented within E8 by anti-commutators and so do change sign while the 28 gauge bosons are D4 adjoint represented within E8 by commutators and so do not change sign.

E8 Lagrangian inherits from F4 the property whereby its Spinor Part need not be written as Commutators but can also be written in terms of Fermionic AntiCommutators - see Pierre Ramond hep-th/0112261 -also, F4 lives in Cl(8) as Vectors + BiVectors + Spinors and by 8-Periodicity Cl(16) = tensor product Cl(8) x Cl(8) and E8 lives in Cl(16) as BiVectors + half-Spinors.


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

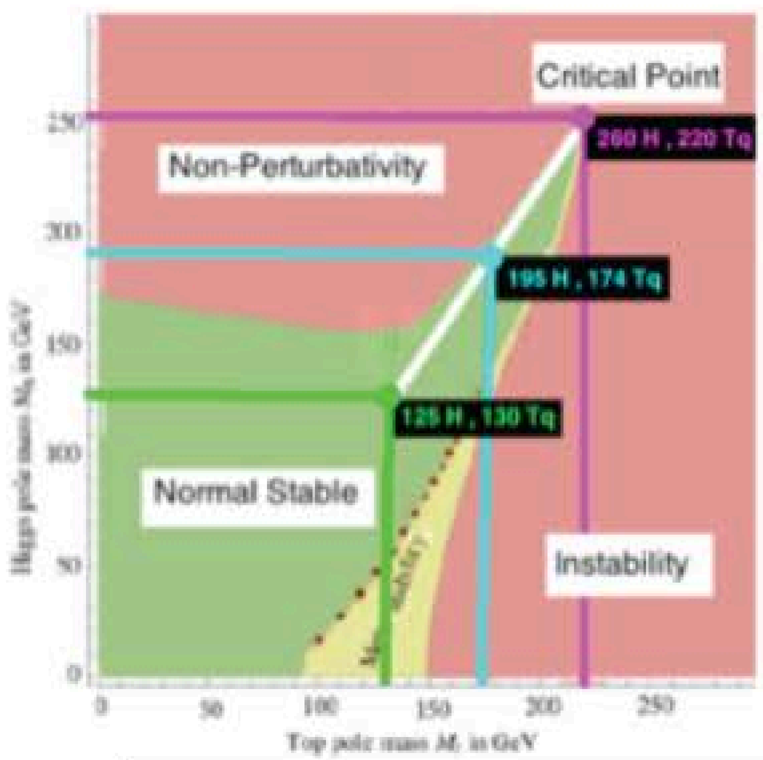
The Real Form of E8 at Initial Big Bang is Compact E8(-248) with SO(16) Symmetry.

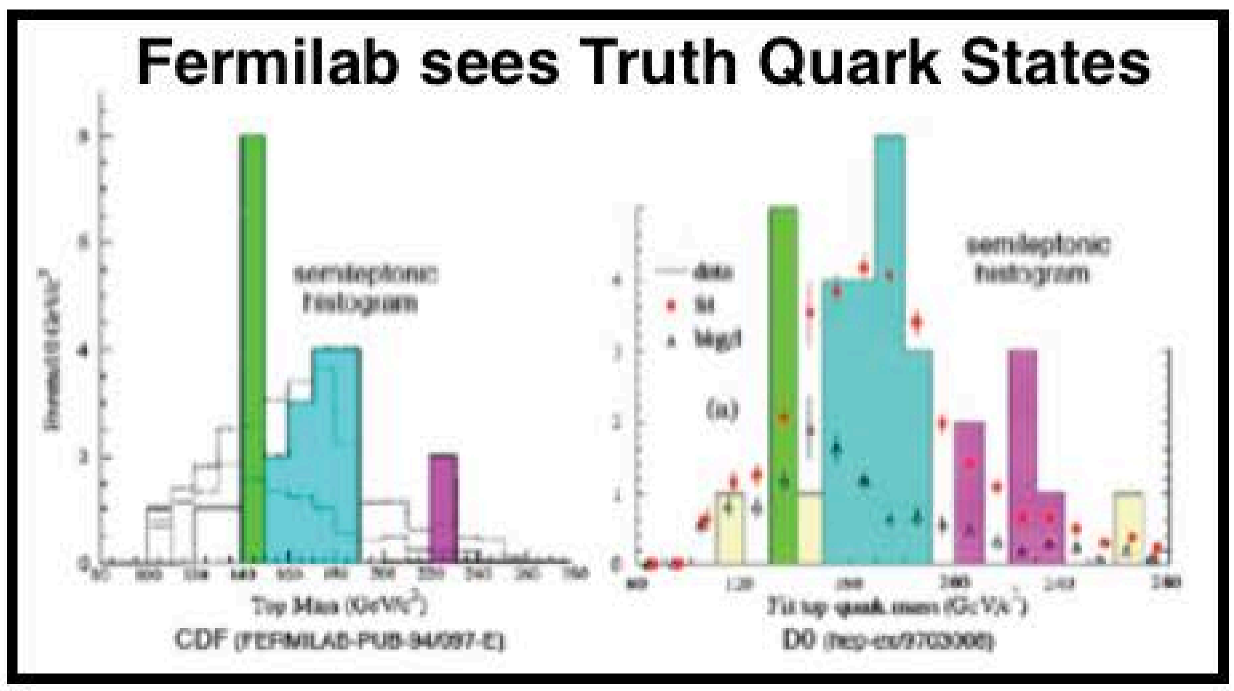
The Real Form of E8 during Inflation is E8(8) with SO(8,8) Symmetry.
In the 8D Lagrangian the Base Manifold Spacetime is 8-dim Octonion
with respect to which Quantum Processes are Non-Unitary
so that during Inflation Particles are created.

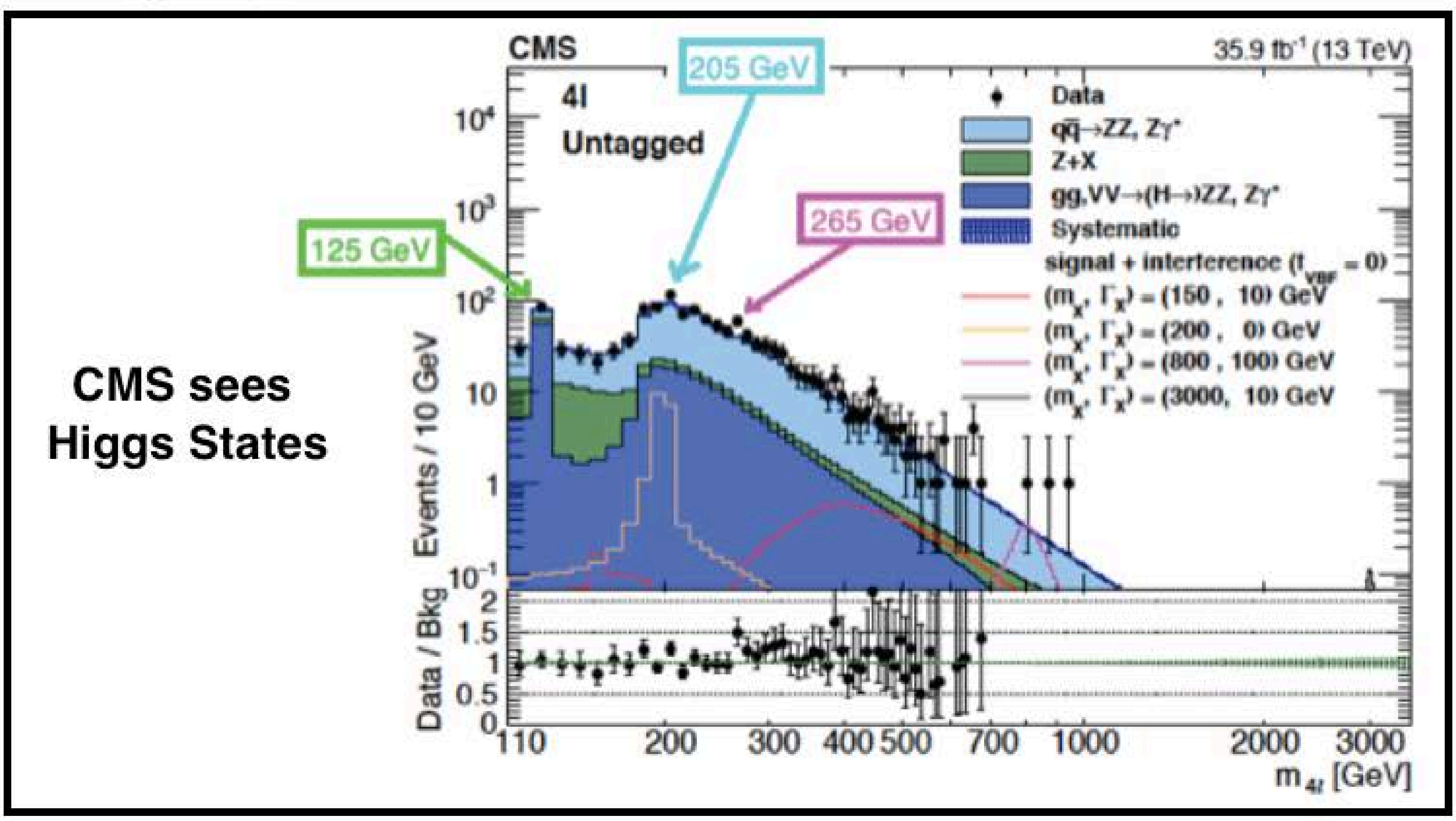
After Inflation the Symmetry of Spacetime is broken from Octonion to Quaternion,
the Real Form of E8 becomes E8(-24) with SO*(16) = Sk(8,H) Symmetry,
and the Base Manifold Spacetime becomes M4 x CP2 Kaluza-Klein
(where M4 = Minkowski and CP2 = SU(3) / SU(2)xU(1) = Internal Symmetry Space)

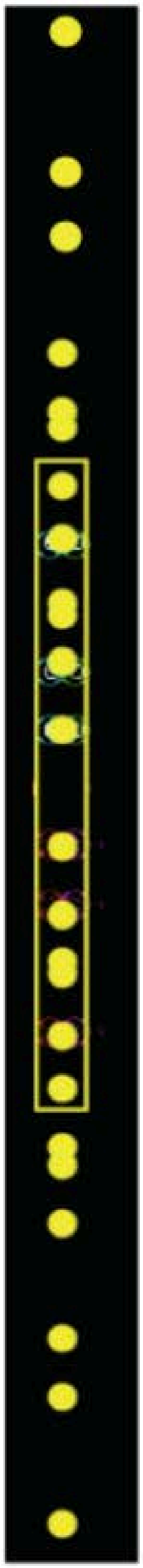
Breaking Spacetime and World-Lines of Particles into M4 x CP2 Kaluza-Klein
produces Higgs (Mayer and Trautman in Acta Physica Austriaca, Suppl. XXIII (1981))
and Fermion Generations 2 and 3 which produces a Nambu - Jona-Lasinio System of
Higgs and Truth Quarks (Yamawaki et al in hep-ph/9603293 and hep-ph/0311165)
that has Higgs as Truth Quark-AntiQuark condensate and 3 mass states:

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









The 24 Yellow Root Vectors of the D4 of E8 Gravity + Standard Model Ghosts are on the Vertical Y-axis.
12 of them in theYellow Box represent the 12 Root Vectors of the Conformal Gauge Group SU(2,2) = Spin(2,4) of Conformal Gravity + Dark Energy.
The 4 Cartan Subalgebra elements of SU(2,2)xU(1) = U(2,2) correspond to the 4 Cartan Subalgebra elements of D4 of E8 Gravity + Standard Model Ghosts and to the other half of the 8 Cartan Subalgebra elements of E8.

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

Gravity and Dark Energy come from its Conformal Subgroup SU(2,2) = Spin(2,4)
- see Mohapatra "Unification and Supersymmetry section 14.6
R. Aldrovandi and J. G. Peireira in gr-qc/9809061

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

1 Dilation representing Higgs Ordinary Matter

4 Translations representing Primordial Black Hole Dark Matter

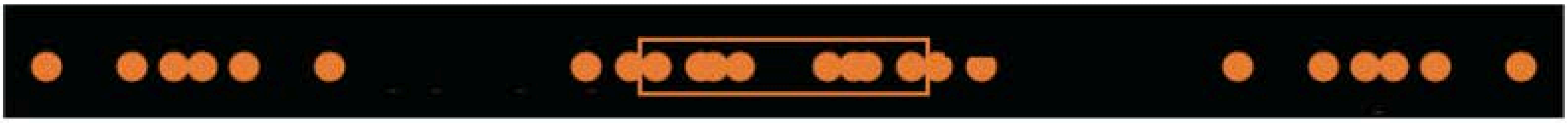
10 = 4 Special Conformal + 6 Lorentz representing Dark Energy
(see Irving Ezra Segal, "Mathematical Cosmology and Extragalactic Astronomy" (Academic 1976))

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

Ghosts correspond to Gauge Bosons:

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^u may be written as one-forms A_a = A_a_u dx_u, 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^u d/dx^u 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 ...".

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



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

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

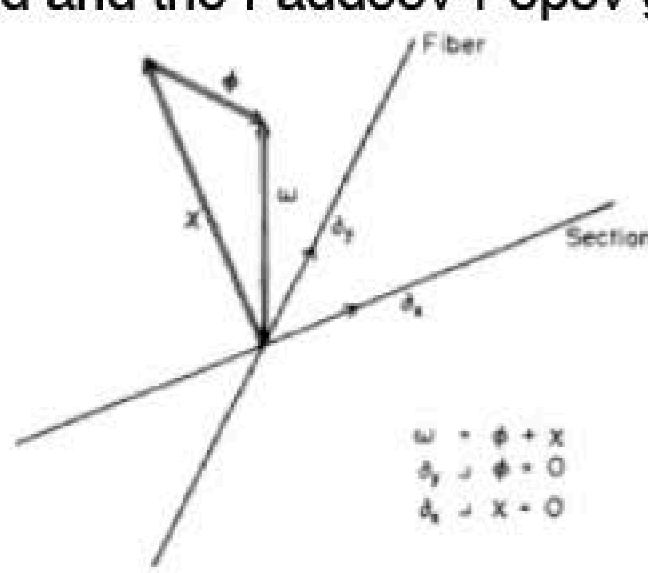
Standard Model Gauge groups come from CP2 = SU(3) / SU(2) x U(1)
(as described by Batakis in Class. Quantum Grav. 3 (1986) L99-L105)

Electroweak SU(2) x U(1) is gauge group as isotropy group of CP2.

SU(3) is global symmetry group of CP2 but due to Kaluza-Klein M4 x CP2 structure of compact CP2 at every M4 spacetime point,
it acts as Color gauge group with respect to M4.

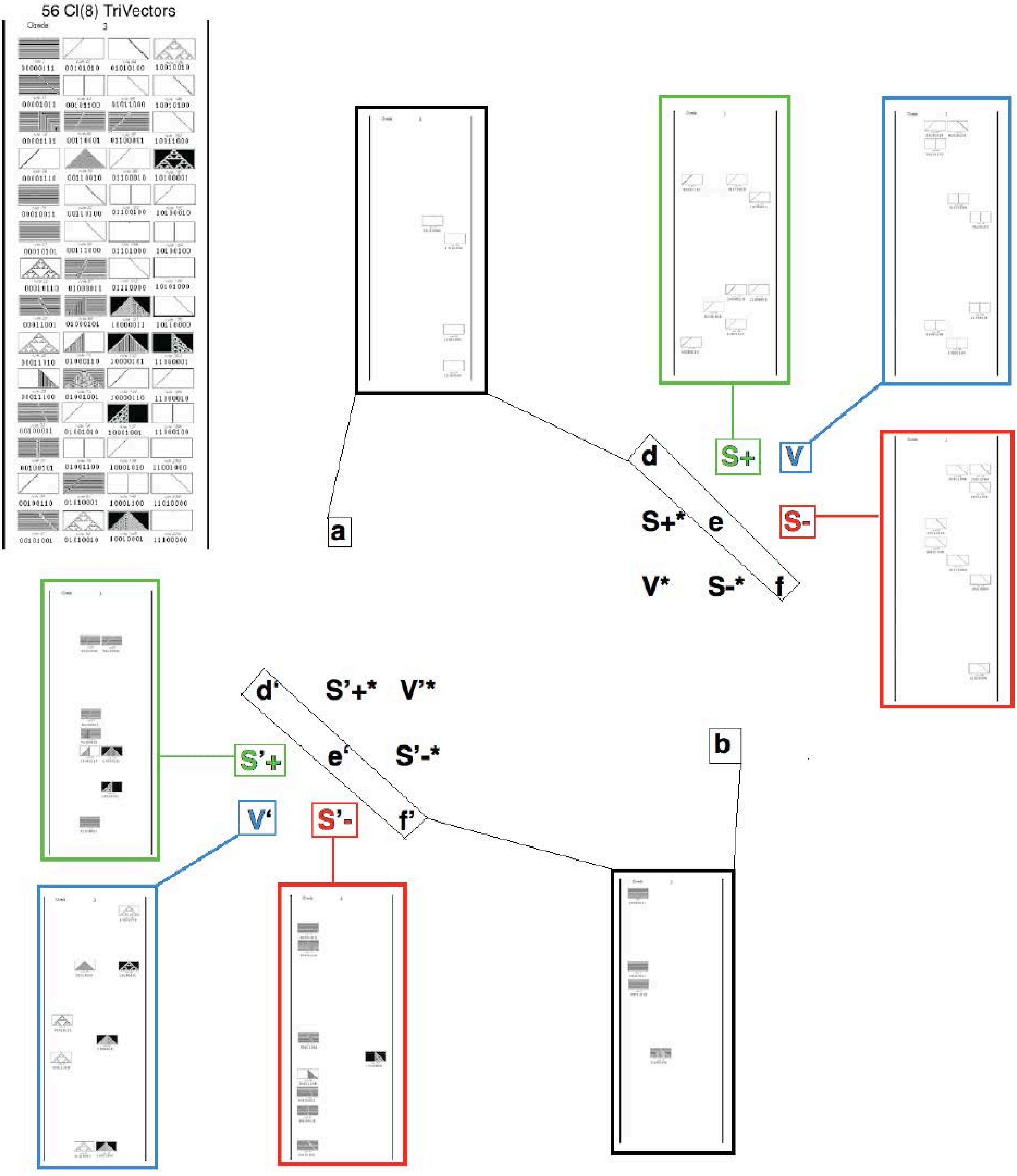
Ghosts correspond to Gauge Bosons:

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 w is assumed to be vertical.
Its contravariant components PHI and X are recognized, respectively,
as the Yang-Mills gauge field and the Faddeev-Popov ghost form ...



...".

56 Cl(8) TriVectors correspond to Fr3(O) of 26D World-Line=String Theory



To see how Fr3(O) gives String Theory look at one of the J3(O)o in Fr3(O)

One of the two 26D traceless J3(O)o parts of Fr3(O)

d	**S+**	**V**
S+*	**-d-f**	**S-**
V*	**S-***	**f**

S+ = 8 First-Generation Fermion Particles
S- = 8 First-Generation Fermion AntiParticles

S+ and S- are Orbifolded in the 26D String Theory Space
leaving 26 - 16 = 10 dimensions of 8-dim V and 1-dim d and 1-dim f.

d and f act to make 10-dim V+d+f a Conformal Space over 8-dim V
with Octonionic symmetries Spin(1,9) = SL2(O) and Spin(0,8) = Spin(1,7)
due to the Clifford Algebra isomorphism Cl(0,8) = Cl(1,7) = M16(R)

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 (analagous 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.

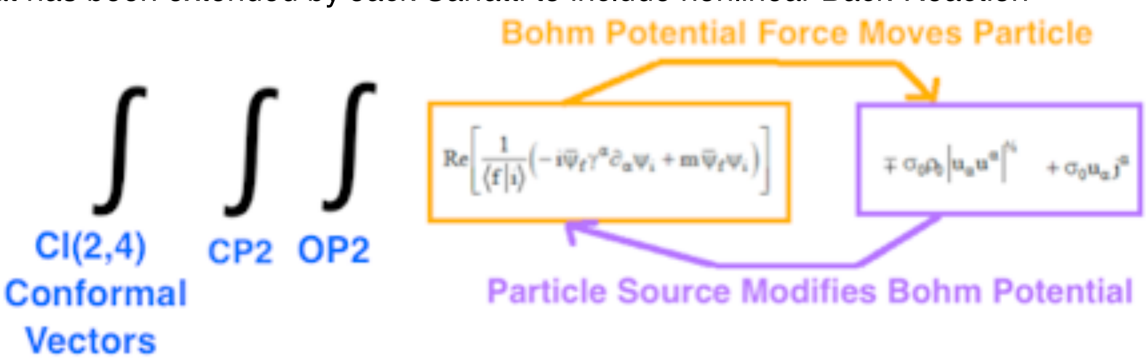
The massless spin 2 state = Bohmion = Carrier of the Bohm Force of the Bohm Quantum Potential.

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

Andrew Gray (quant-ph/9712037v2) said:
"... A new formulation of **quantum mechanics ... assign[s] ... probabilities ... to entire fine-grained histories ... [It] is fully relativistic and applicable to multi-particle systems** ...[and]...
makes the same experimental predictions as quantum field theory ...
consider space and time cut up into small volume elements
... and then take the limit as ... volume ... ---> 0 ...
get the final amplitude ... by considering all possible distributions at a time t earlier ...
for each such distribution the amplitude for it to occur [is] multiplied by the amplitude to get ... the final distribution ... **the interference factor ... is a measure of how much interference between the different possible histories that contain the distribution of interest there is at each time** ... This result is the ...
Feynman amplitude squared times the product of all the interference factors ...".

Consider the Gray Fine-Grained History to be a World-Line String.

The Gray Fine-Grained History Quantum Theory
is equivalent to
the Nambu-Goto action of 26D String Theory.
Nambu-Goto 24x24 traceless spin-2 particle
is
Quantum Bohmion carrier of Bohm Quantum Potential
Roderick I. Sutherland (arXiv 1509.02442v3) has given a Lagrangian
for the Gray Fine-Grained Nambu-Goto Quantum Bohm Potential
that has been extended by Jack Sarfatti to include nonlinear Back-Reaction



that enables Penrose-Hameroff Quantum Consciousness and Free Will,
justifying Clifford's characterization of Real Clifford Algebras as
"... mind-stuff tak[ing] the form of ... human consciousness ...".

Tachyons localized at orbifolds of fermions produce virtual clouds of particles / antiparticles that dress fermions and so produce Schwinger Sources.

W**hen a fermion particle/antiparticle appears in E8 spacetime** it does not remain a single Planck-scale entity because **Tachyons create a cloud of particles/ antiparticles**. The cloud is one Planck-scale Fundamental Fermion Valence Particle plus an effectively neutral cloud of particle/antiparticle pairs forming a Kerr-Newman black hole. That cloud constitutes the **Schwinger Source.**
Its **structure comes from the 24-dim Leech lattice part of the Monster Group which is**
2^(1+24) times the double cover of Co1, for a total order of about 10^26.

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

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

Quantum Kernel Functions and Schwinger Source Green's Functions

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

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

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

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

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

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

Cl(16) Physics constructs the **Lagrangian** integral such that the **mass m emerges as the integral over the Schwinger Source spacetime region** of its Kerr-Newman cloud of virtual particle/antiparticle pairs plus the Valence Fermion so that the volume of the Schwinger Source fermion defines its mass, which, being dressed with the particle/ antiparticle pair cloud, gives **quark mass as constituent mass**.

Armand Wyler used Harmonic Geometry to calculate:

Fermion masses as a product of four factors:

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

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

Force Strengths are made up of two parts:

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

for SU(2) Shilov = RP^1xS^2
for SU(3) Shilov = S^5
for Spin(5) Shilov = RP^1xS^4

Schwinger Sources as described above are continuous manifold structures of Bounded Complex Domains and their Shilov Boundaries but the E8-Cl(16) model at the Planck Scale has spacetime condensing out of Clifford structures forming a Lorentz Leech lattice underlying 26-dim String Theory of World-Lines
with 8 + 8 + 8 = 24-dim of fermion particles and antiparticles and of spacetime.
The automorphism group of a single 26-dim String Theory cell modulo the Leech lattice is the Monster Group of order about 8 x 10^53.

Cl(1,25) Algebraic Quantum Field Theory (AQFT)

26D String Theory has a Real Clifford Algebra Cl(1,25) constructed from

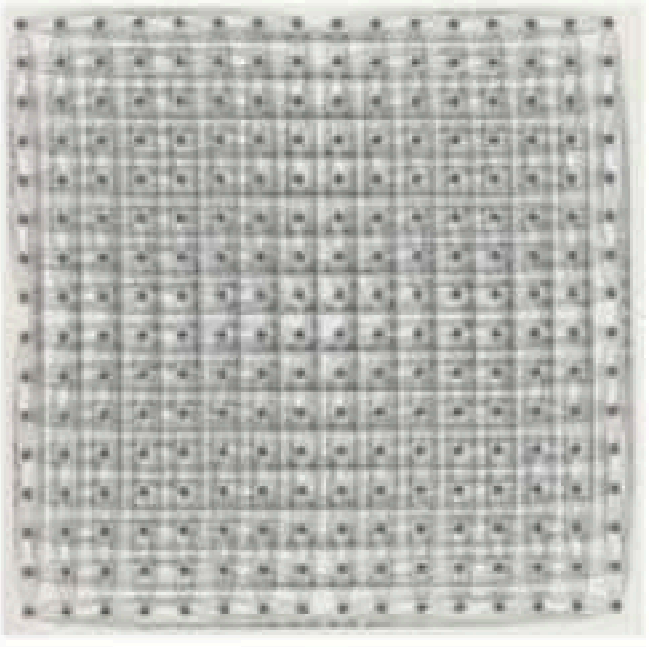
Cl(16) = Cl(8)xCl(8) -> Cl(8)xCl(8)xCl(8) = Cl(24)
to get to the Leech Lattice 24-dim Vector Space

Conformal Structure of 2x2 matrices with entries in Cl(24)
(Porteous, Clifford Algebras and the Classical Groups and
Lounesto and Porteous, Lectures on Clifford (Geometric) Algebras and Applications)
gives M(2,Cl(24)) = Cl(1,25) with Lorentz Leech Lattice Vector Space.

Since all the matrix entries are tensor product of 3 copies of Cl(0,8)
8-Periodicity allows formation of the tensor products of copies of Cl(1,25)

Cl(1,25) x ...(N times tensor product)... x Cl(1,25)

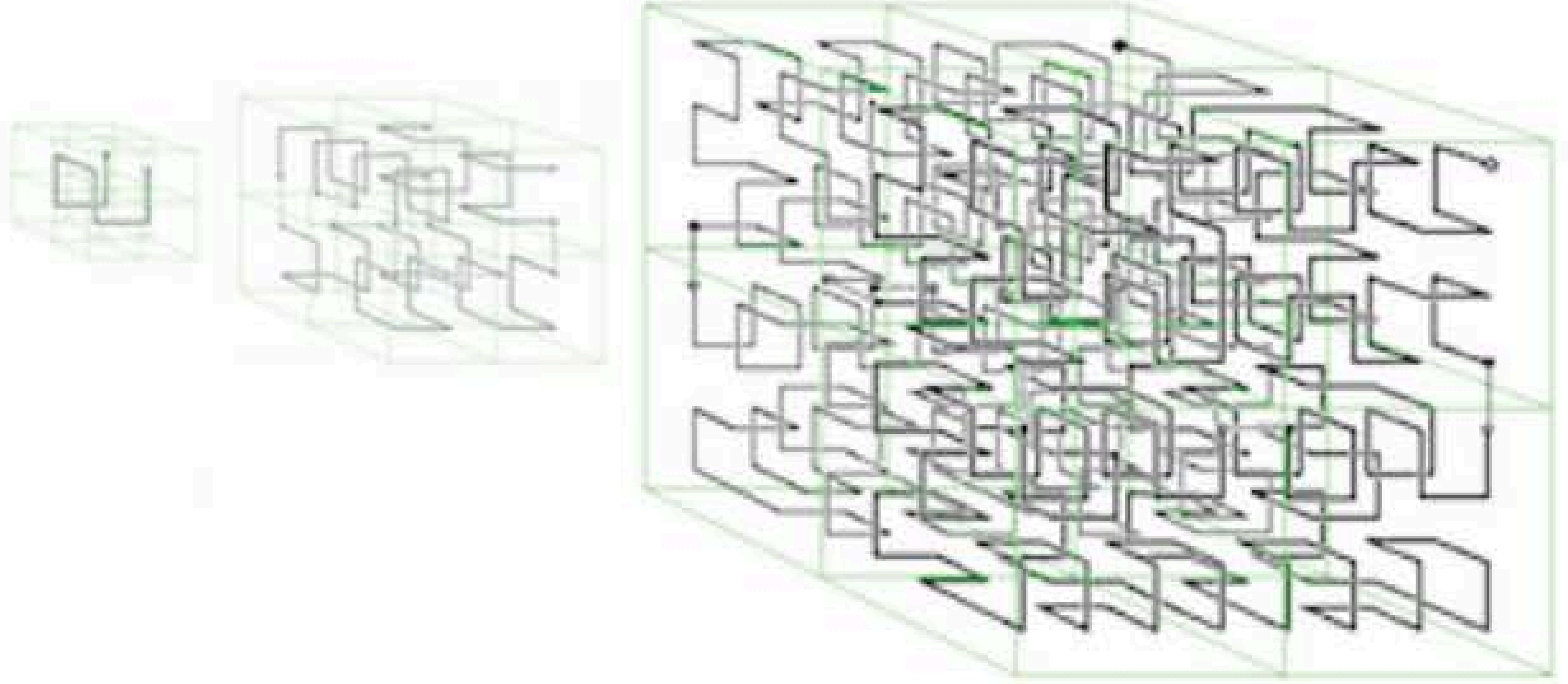
For N = 2^8 = 256 the copies of Cl(1,25) are on the 256 vertices
of the 8-dim HyperCube



For N = 2^16 = 65,536 the copies of Cl(1,25) fill in the 8-dim HyperCube
William Gilbert's web page says: "... 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-dim... cube. ...".

As N grows, the copies of Cl(1,25) continue to fill the 8-dim HyperCube of E8 SpaceTime using higher Hilbert curve stages from the 8-bit reflected binary Gray code subdividing the initial 8-dim HyperCube into more and more sub-HyperCubes.

If edges of sub-HyperCubes, equal to the distance between adjacent copies of Cl(1,25), remain constantly at the Planck Length, then the full 8-dim HyperCube of our Universe expands as N grows to 2^16 and beyond similarly to the way shown by this 3-HyperCube example for N = 2^3, 4^3, 8^3 from Wiliam Gilbert's web page:



Completion of Union of All Tensor Products of Cl(1,25) =
= hyperfinite AQFT = Algebraic Quantum Field Theory =
= the Third Grothendieck Universe

The AQFT contains a copy of E8 within Cl(16) within each copy of Cl(1,25)
The E8 is a Recipe for a Realistic Physics Lagrangian
so the AQFT has a natural realistic Lagrangian structure.

The Vector Space of Cl(1,25) is the Spacetime of a 26D String Theory
in which Strings are World-Lines of Particles
and
the Massless Symmetric Spin 2 State is the Carrier
of the Bohm Quantum Potential with Sarfatti Back-Reaction

The **Cl(1,25) AQFT** being the completion of the union of all tensor products of Cl(1,25)
it **is the Real Clifford Algebra (8-Periodicity) analog**
of the completion of the union of all tensor products of the Complex Clifford Algebra
(2-Periodicity) Cl(2;C) of 2x2 Complex Matrices = M2(C) of Spinor Fock Space that
is the **Hyperfinite II1 von Neumann factor algebra**.

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

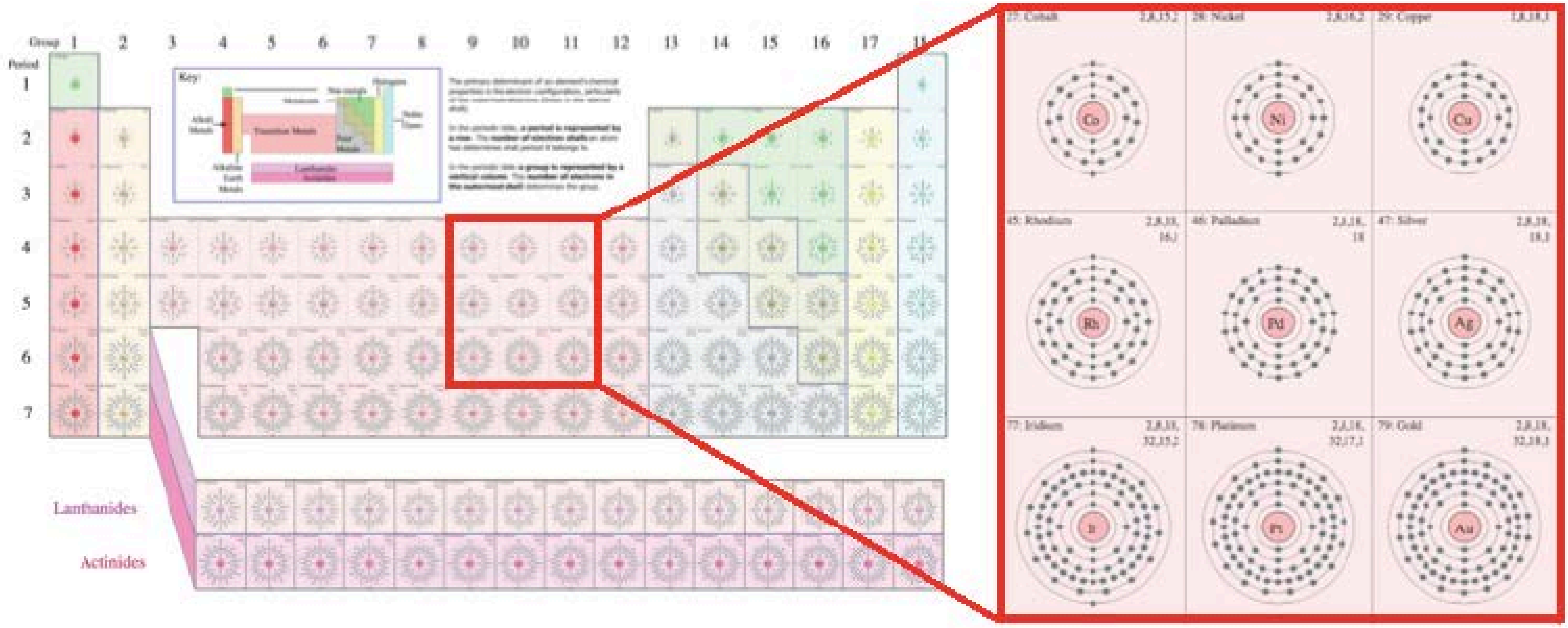
The phase angle d13 is taken to be 1 radian.

The problem of the determination of the quark masses is not trivial. We can define as a "current" quark mass the mass entering in the Lagrangian (or Hamiltonian) representation of a hadron; this comes out to be of the order of some MeV/c^2 for u, d quarks, and $\sim 0.2\,\mathrm{GeV}/c^2$ for s quarks. However, the strong field surrounds the quarks in such a way that they acquire a "constituent" (effective) mass including the equivalent of the color field; this comes out to be of the order of some 300 MeV/c^2 for u, d quarks, and $\sim 0.5\,\mathrm{GeV}/c^2$ for s quarks. Current quark masses are almost the same as constituent quark mass for heavy quarks. Alessandro De Angelis · Mário Pimenta

Introduction to Particle and Astroparticle Physics Second Edition

Constituent Mass Quarks (Schwinger Sources)
combine to form Nuclei for Atoms such as
Deuterium and Palladium.

Wikipedia says (I added red material specifically about Pd): "...



... Each s subshell holds at most 2 electrons Each p subshell holds at most 6 electrons Each d subshell holds at most 10 electrons Each f subshell holds at most 14 electrons Each g subshell holds at most 18 electrons ...

Shell name	Subshell name	Subshell max electrons	Shell max electrons
K	1s	2	2
L	2s	2	2 + 6 = 8
	2p	6	
M	3s	2	2 + 6 + 10 = 18
	3p	6	
	3d	10	
N	4s	2	2 + 6 + 10 + 14 = 32
	4p	6	
	4d	10	
	4f	14	

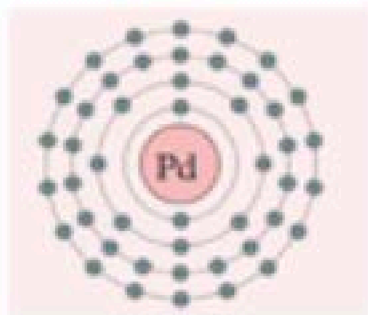
Palladium

2

2+6 = 8

2+6+10 = 18

2+6+10 = 18

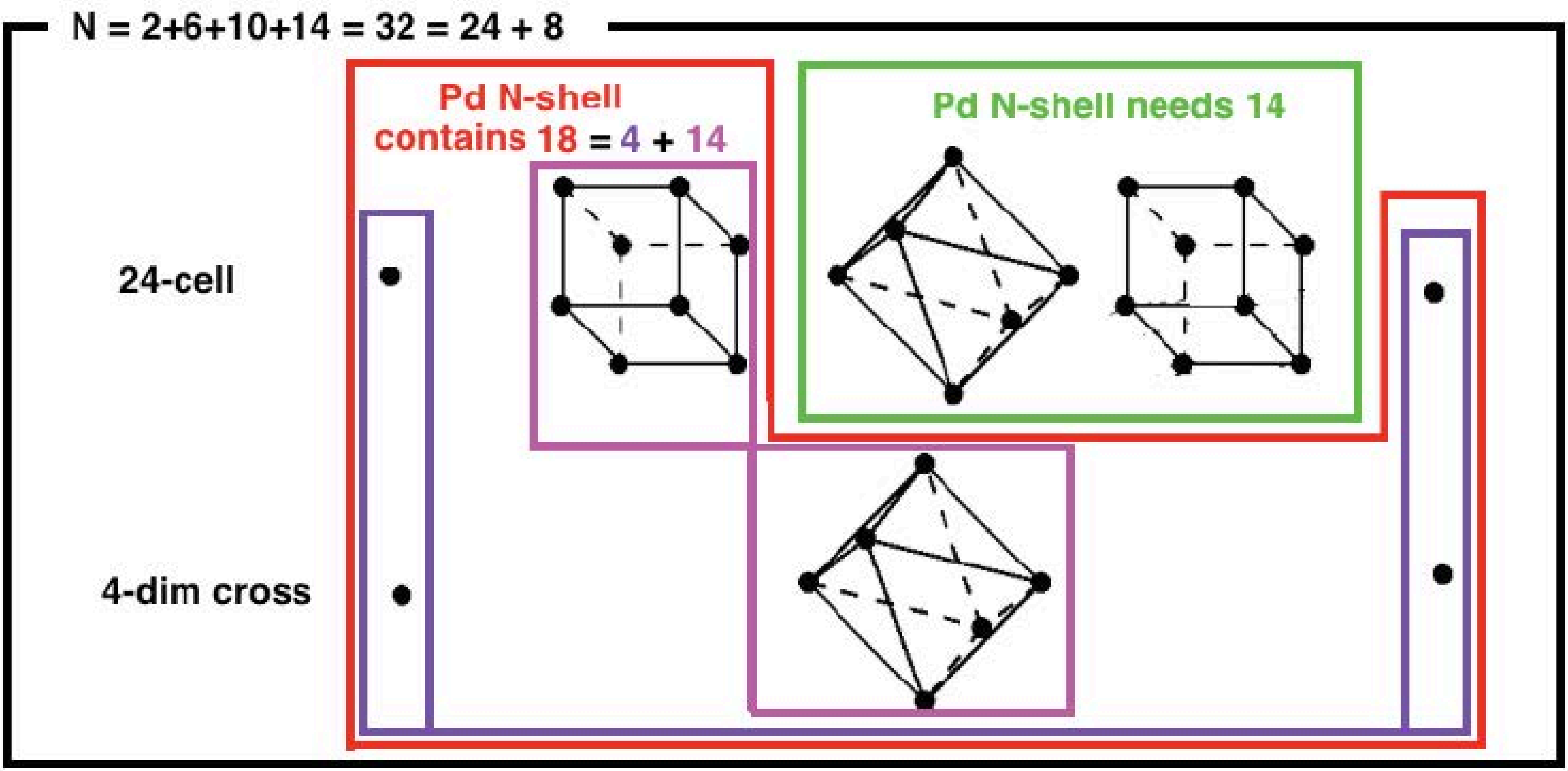


... ...

palladium (atomic number 46) has no electrons in the fifth shell, unlike other atoms ...[in its periodic table neighborhood]...".

A full N-shell has s + p + d + f = 2 + 6 + 10 + 14 = 32 electrons.

Palladium N-shell has 2 + 6 + 10 = 18 electrons and “holes” to receive 14 electrons:

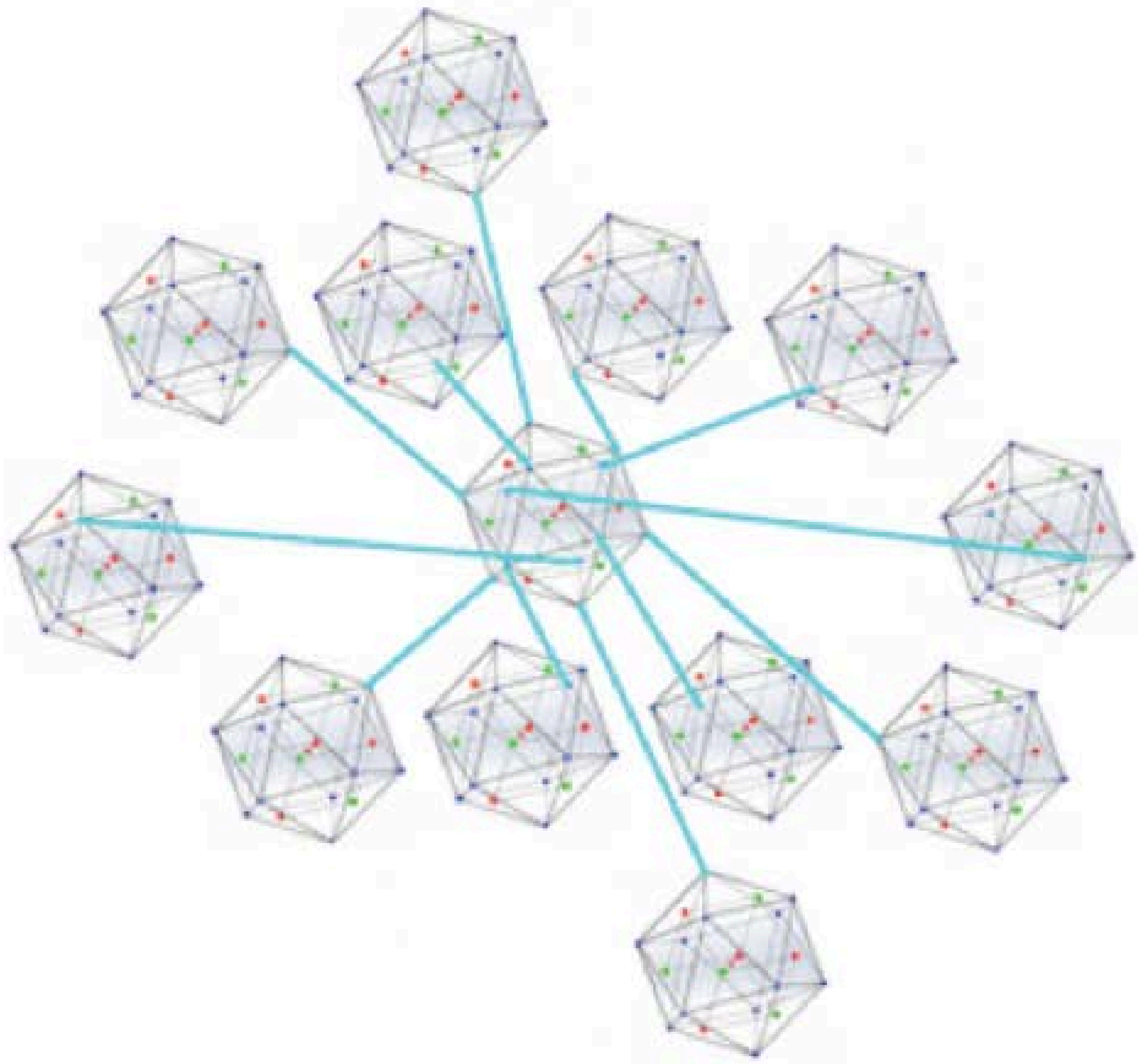


Each Palladium atom has 18-14 = 4 N-shell electrons that can interact
with 4 electrons of 4 Deuterium atoms absorbed into a Pd cluster,
helping them to participate in a Schwinger coherent quantum state for TSC Fusion.

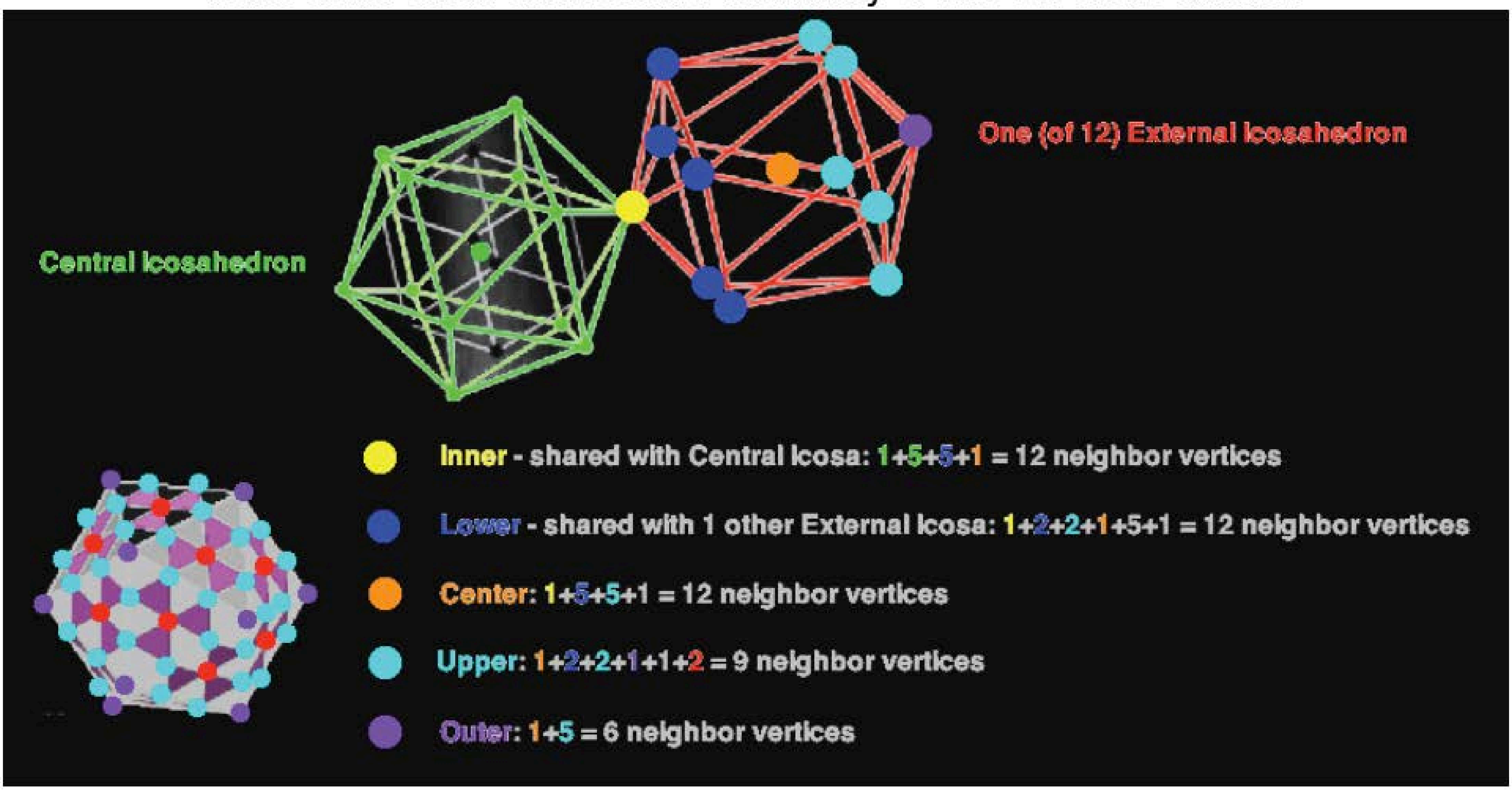
Further, each Palladium atom has 14 N-shell electrons
12 to fill needs of other Pd atoms
and 2 for a Dirac Fermion Band for Klein Paradox Tunnelling.

What is the structure of the icosahedral 147-atom Pd cluster ?

The icosahedral 147-atom ground state has 12 exterior icosahedra
and a central icosahedron with 12 interior vertices
which are the innermost vertices of 12 exterior TSC Fusion site icosahedra:

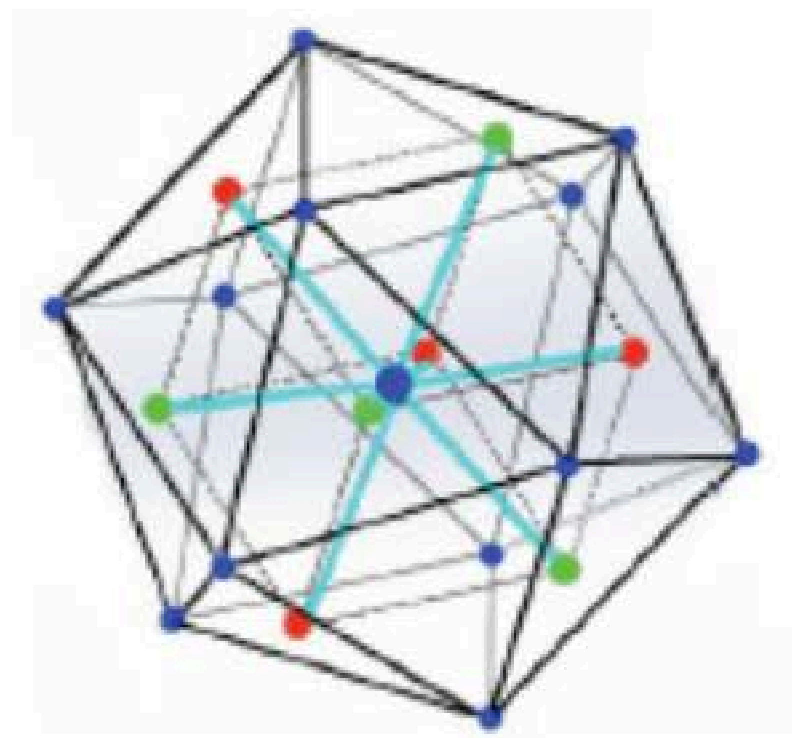


The 12 exterior icosahedra each
have outer faces on the outer boundary of the 147-atom cluster.



In TSC Icosahedra of a Pd cluster
4 D (D+D+D+D) form a Schwinger Coherent Quantum State

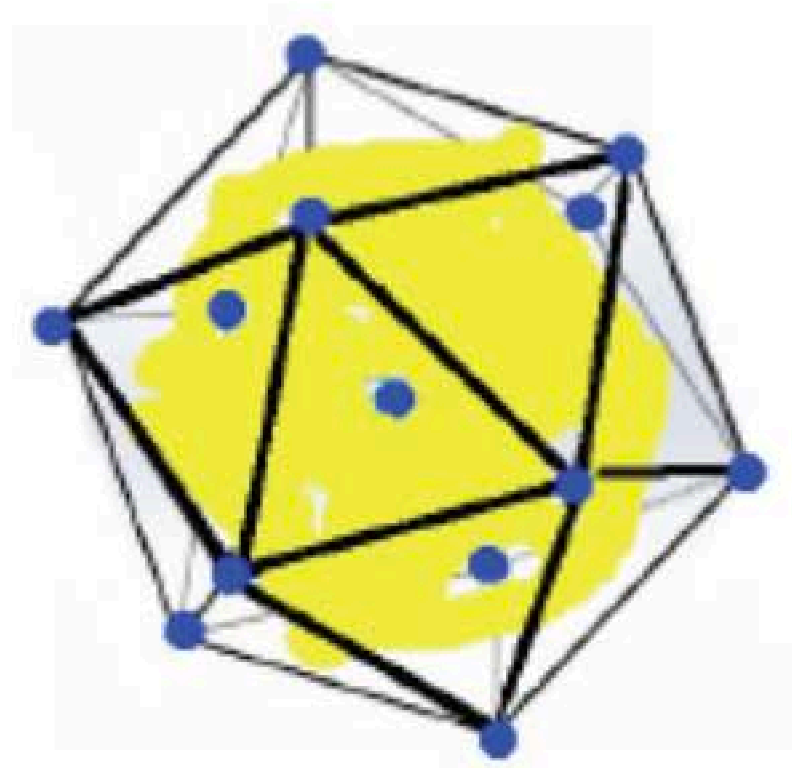
From a classical approximation point of view there are 12+1 = 13 Pd nuclei (blue) within which there is a 2-tetrahedral configuration of 4 D nuclei (red) and 4 D electrons green)



In the Schwinger coherent quantum state (yellow) the 4 D nucei and 4 D electrons are smeared out all over the interior of the icosahedral TSC cell

and

the 4 D electrons screen out the positive charge of the 4 D nuclei making the Schwinger coherent quantum cloud effectively neutral with no Coulomb repulsion or attraction.

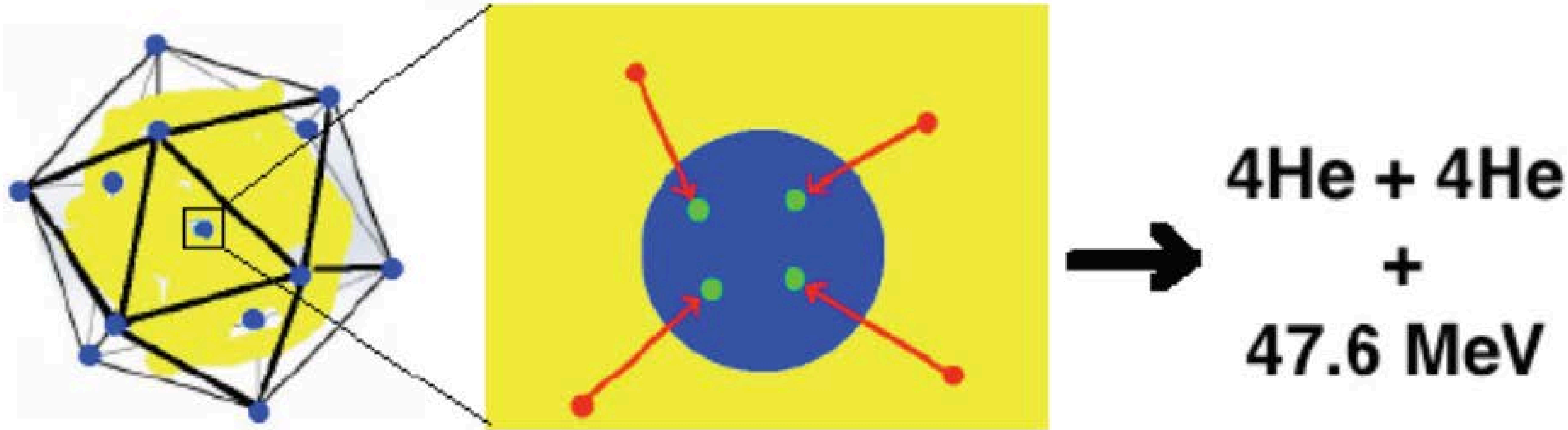


The process of forming the Schwinger State which collapses to the central Pd atom where Deuterium nuclei undergo Cold Fusion is called by Akito Takahashi Tetrahedral Symmetric Condensation (TSC).

The D Schwinger State nuclei go to the central Pd atom and by Klein Paradox Tunnelling 4 D nuclei undergo TSC Cold Fusion producing 4He + 4He + 47.6 MeV

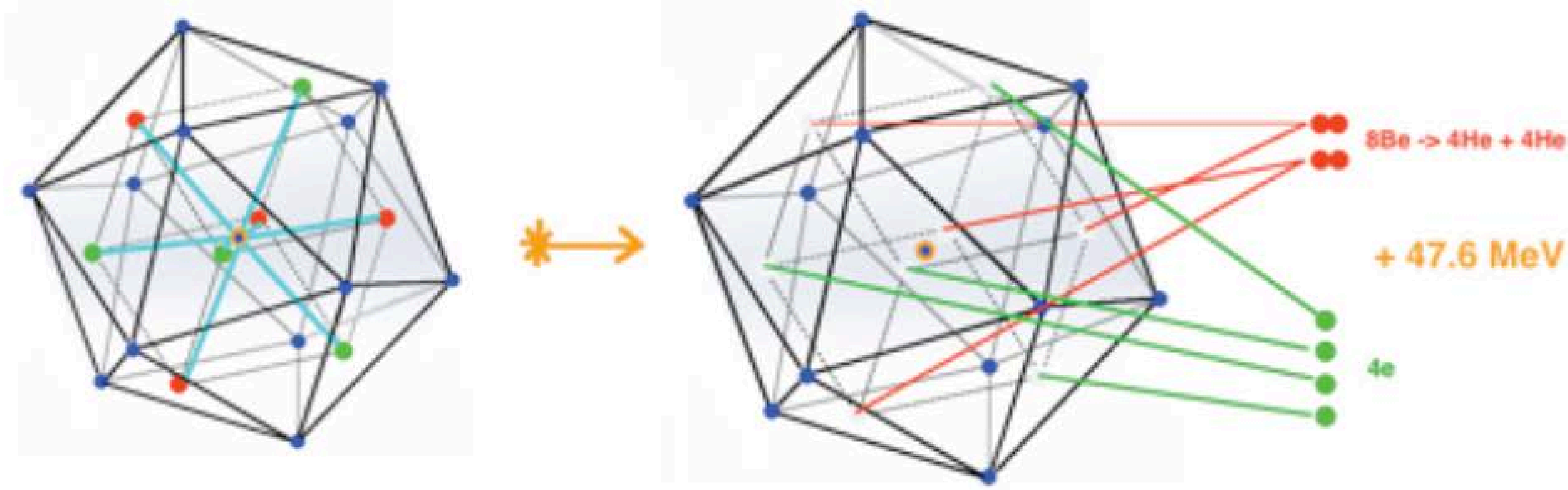
Now look at the central Pd atom in the TSC cell.
Its outer electron shell of 18 electrons has 4 free electrons
(14 of them being bound to the outer 12 Pd atoms plus 2 forming a Dirac Fermion Band)

which 4 free electrons pull the 4 D nuclei out of the Schwinger quantum cloud into the Central Pd Atom

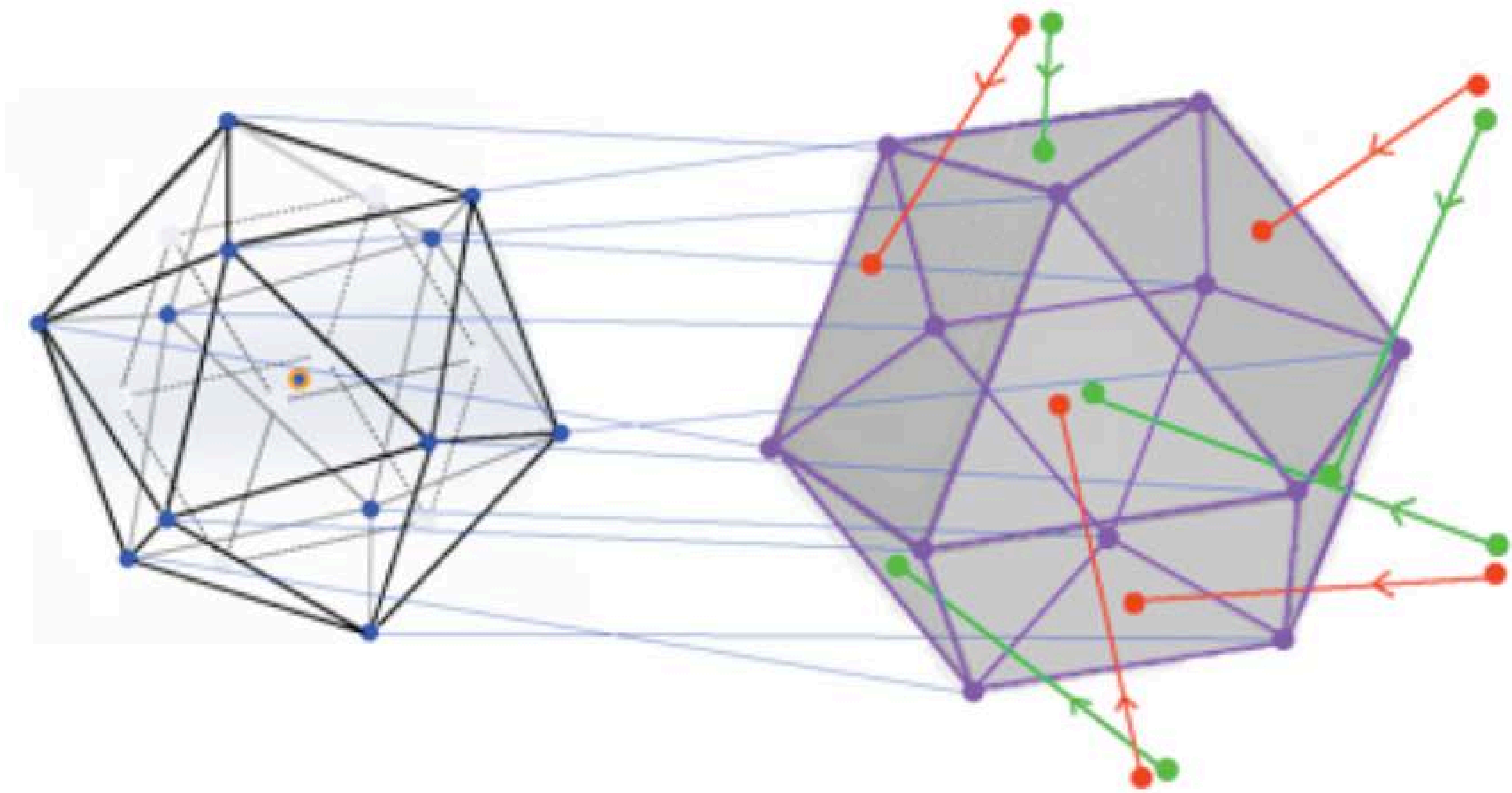


When the 4 D nuclei get into the small volume of the Central Pd Atom
they "see" each other as repulsive like electrical charges
resulting in a very high Coulomb barrier between them
but
that is when the Dirac Fermion Band takes effect
and gets them to rapidly penetrate the barrier by Klein Paradox Tunnelling

Some of the TSC Fusion Energy goes to a Jitterbug transformation

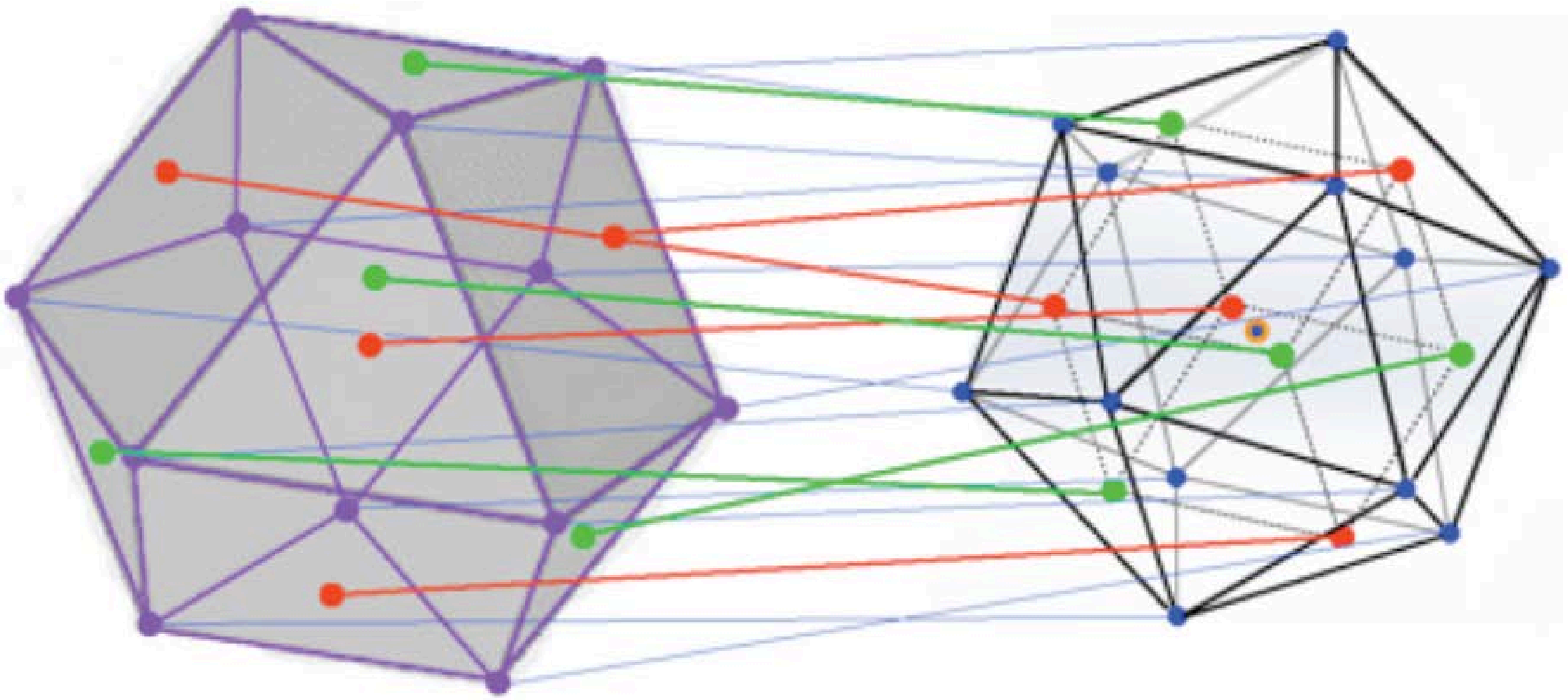


of the icosahedral Palladium, depleted of Deuterium fusion fuel,
to a cuboctahedral configuration

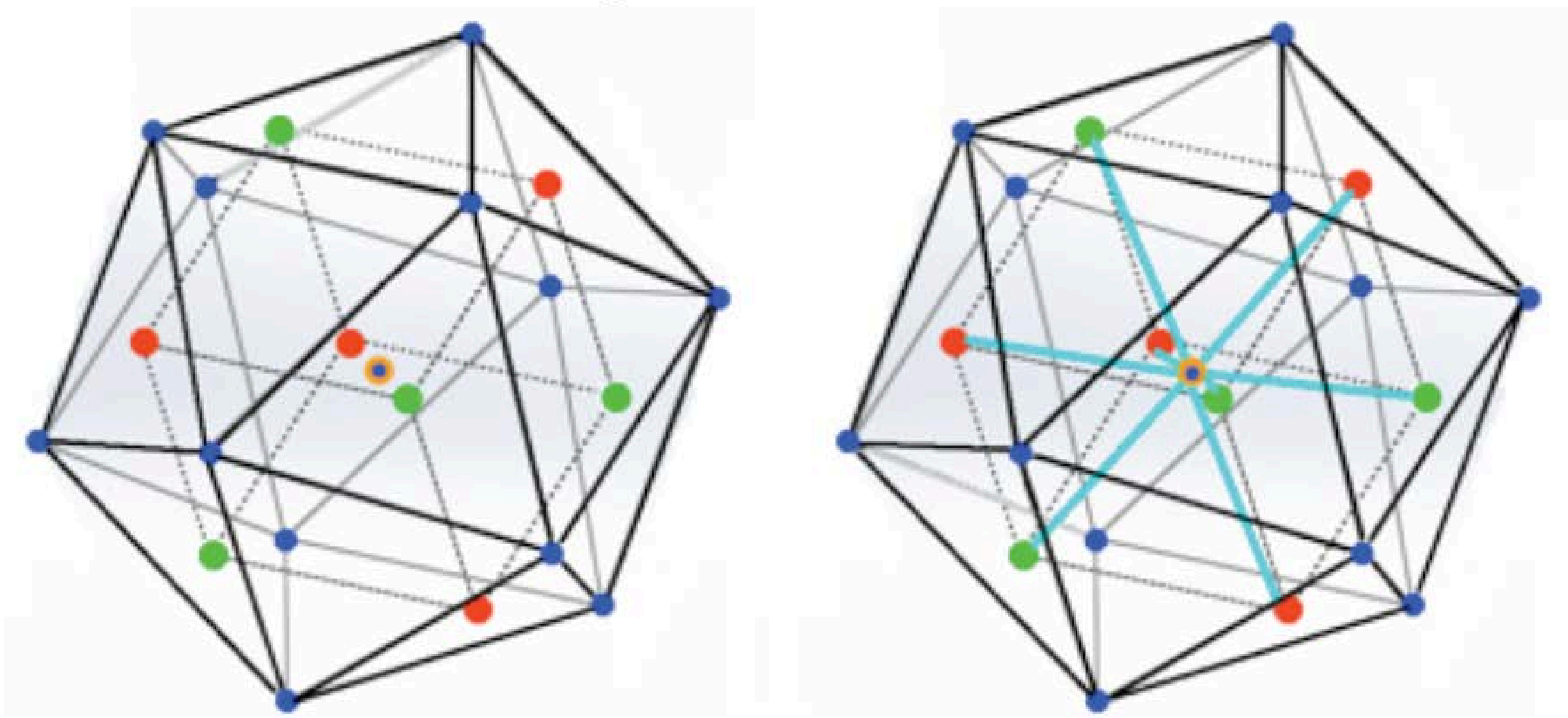


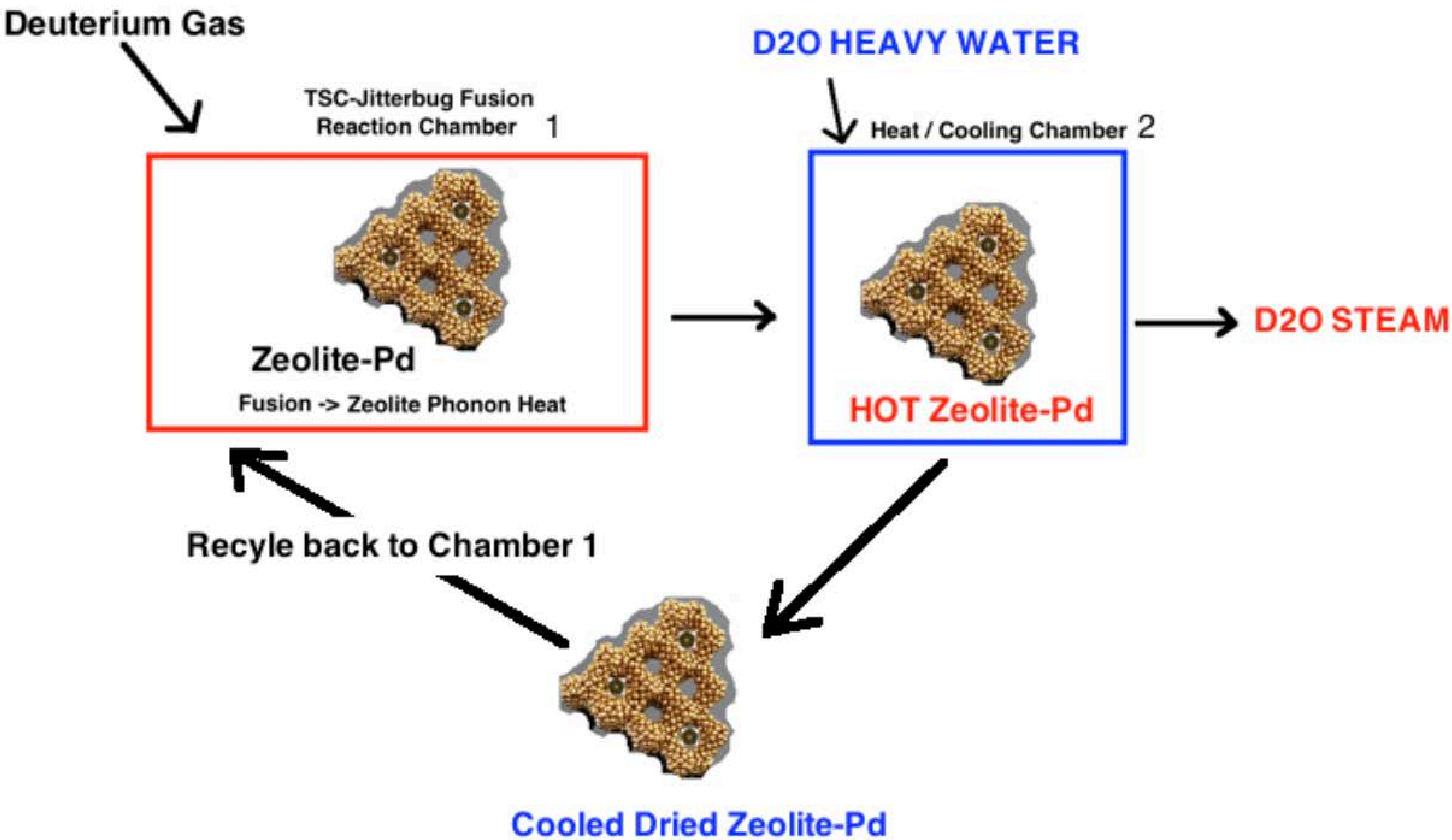
which has 6 large square openings through which
the 4He TSC Fusion Product Ash can leave the Pd cluster
and ambient Deuterium Fuel can enter to reload the Palladium cluster.

Then, since the icosahedral configuration is the Palladium cluster ground state, another Jitterbug transformation



takes the Palladium cluster to an icosahedral configuration with the replenished Deuterium nuclei and electrons ready for another round of TSC fusion





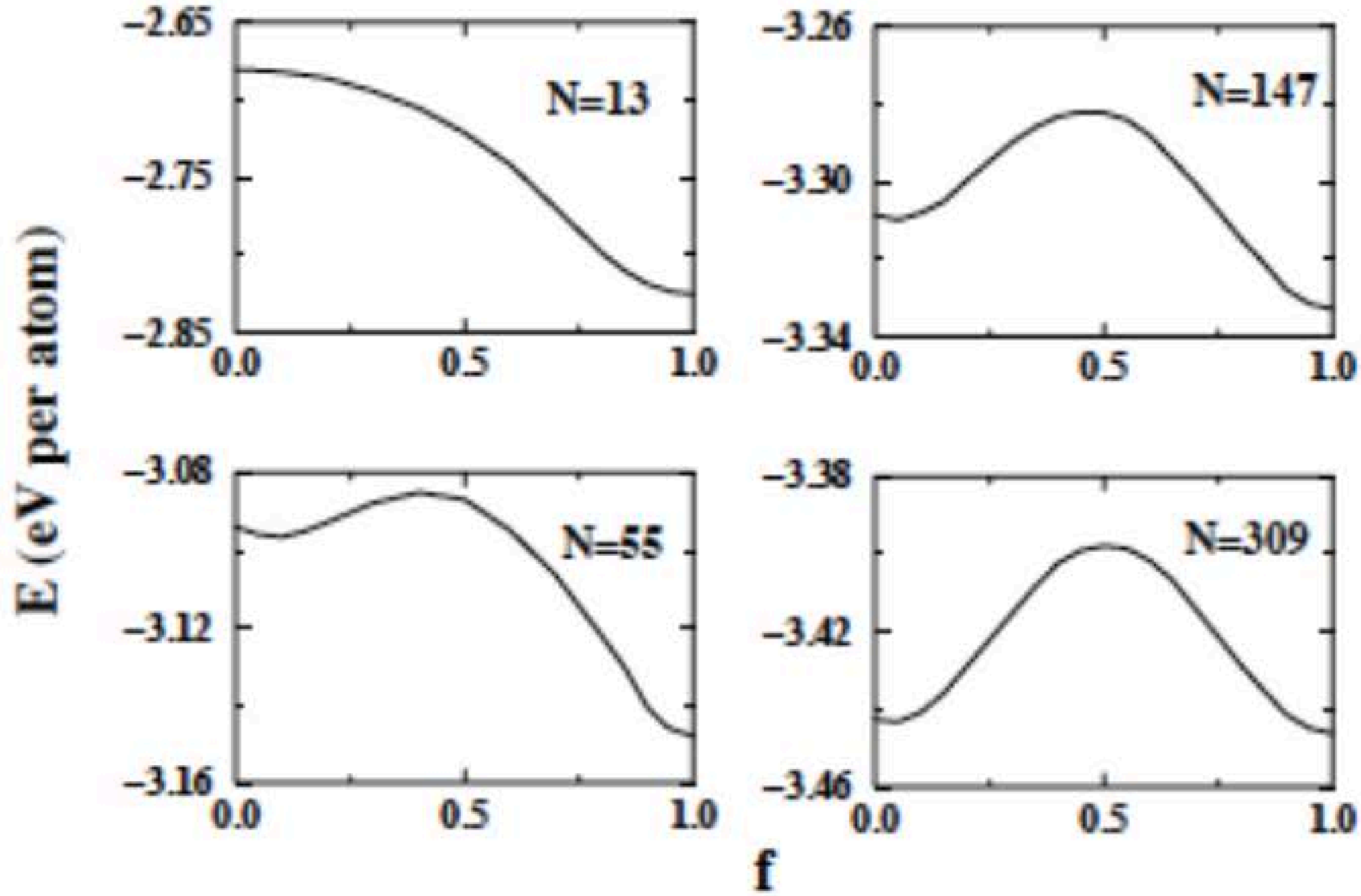
Deuterium Gas
TSC-Jitterbug Fusion
Reaction Chamber 1
Zeolite-Pd
Fusion -> Zeolite Phonon Heat
D2O HEAVY WATER
Heat / Cooling Chamber 2
HOT Zeolite-Pd
D2O STEAM
Recyle back to Chamber 1
Cooled Dried Zeolite-Pd

As more layers are added, the deformations of tetrahedra and octahedra accumulate and eventually destabilize the structures necessary for Jitterbug and TSC Fusion.
The next Mackay cluster beyond 147 atoms has 147+162 = 309 atoms.

Barretau, Desjonqueres, and Spanjaard in Eur. Phys. J. D. 11 (2000) 395-402 say:
"... the icosahedron is the preferred structure at small sizes, and the critical size at which the relative stability becomes favorable to cuboctahedrons is N = 561 for PdN clusters ...[for which]...
For N = 13 the cuboctahedron is ... unstable.

For N = 55, 147, and 309 atoms the cuboctahedron is metastable and slightly distorted.
Its transformation to a perfect icosahedral structure needs an activation energy of 12 meV for N = 55, 28 meV for N = 147 and 45 meV for N = 309.
The activation energies involved in the inverse transformation are 61 meV for N = 55, 51 meV for N = 147 and 48 meV for N = 309.

...[compare 47.6 MeV for each TSC Fusion event]...



... The evolution of the potential energy profile of homogeneously relaxed ... PdN clusters during the Mackay [Jitterbug] transformation for increasing values of N.
f is a fraction of the displacements ... f = 0 and 1 correspond to the ... cuboctahedron and icosahedron, respectively ...".

N = 309 is disfavored for TSC-Jitterbug Fusion with respect to N = 147 for two reasons:

energy levels are too close for rapid Jitterbug cubocta to icosa transition

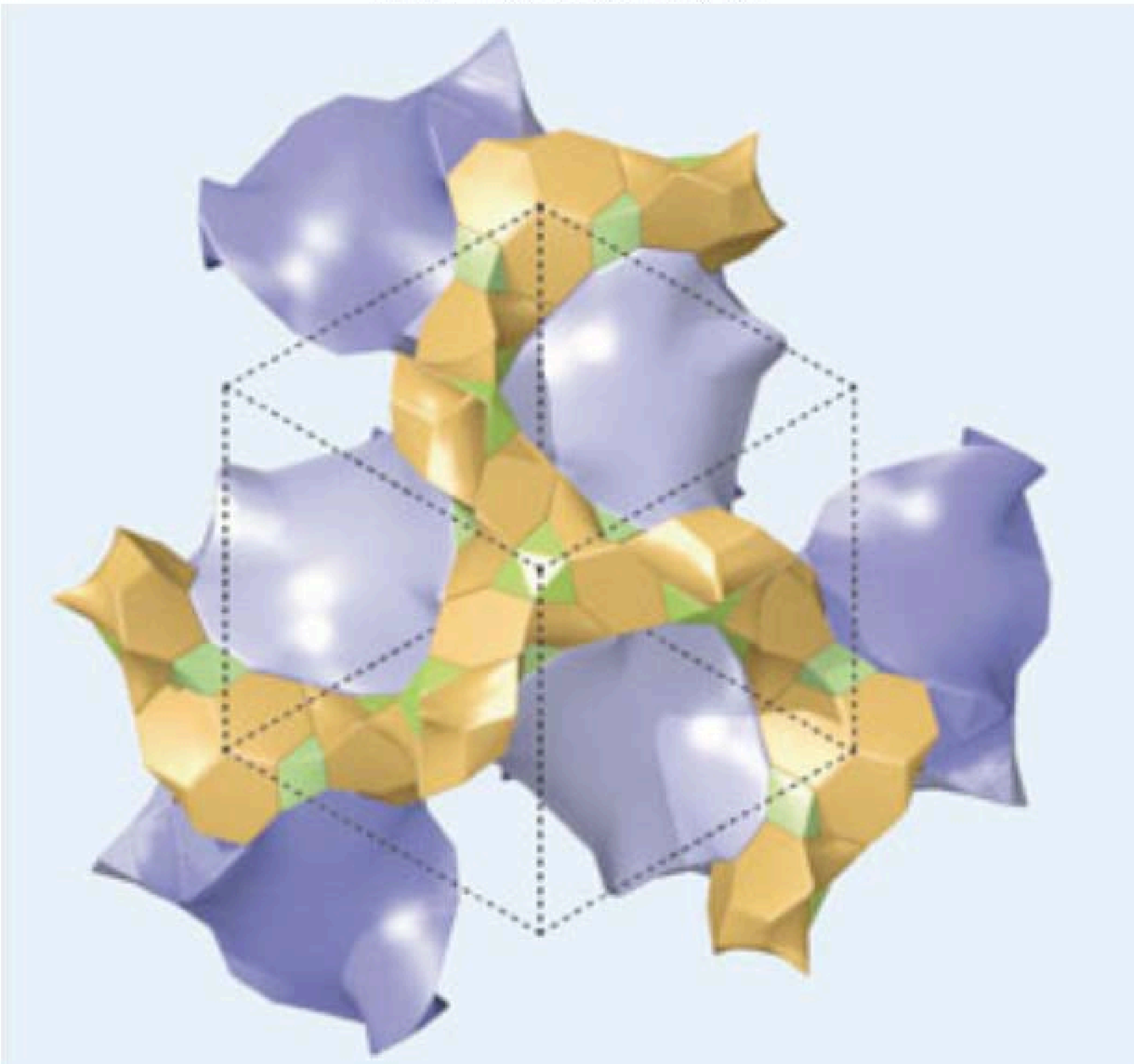
N = 309 Pd Cluster is too large (2 nm) to fit through 1.5 nm expanded Sodium Zeolite Y pore

so

147 atoms is optimal for Pd cluster Cold Fusion

I would like to see experiments
with Zeolite directly using Sandia 1.5 nm Palladium NanoClusters.

If there is difficulty with getting the Sandia Clusters
to fit into the Sodium Zeolite Y
then
I would like to see experiments
with Zeolite ITQ-37



which has pore size about 2 nanometers.
(Royal Society of Chemistry, 29 April 2009 and Sun et al, Nature 2009)

Julian Schwinger in 1990 lecture at Universite de Bourgogne said:

"... **in the very low energy cold fusion, one deals essentially with a single state, described by a single wave function, all parts of which are coherent** ...".

Akito Takahashi proposed a process Tetrahedral Symmetric Condensation (TSC) that for **4 Deuterons (D) in an icosahedral cluster of Palladium (Pd) atoms produces a Schwinger coherent quantum state** that **effectively distributes the electron population among deuterons** so that the Coulomb barrier is eliminated and the four Deuterium (D) nuclei can simultaneously interact and fuse, forming two 4He nuclei plus 47.6 MeV energy.

Peter Hagelstein used phonon models for Relativistic Coupling Between Lattice Vibrations and Nuclear Excitation, enabled by break-down of Foldy-Wouthuysen transformation due to 8-15 THz Lattice Vibration Modes, to show direct transfer of the 47.6 MeV energy of Cold Fusion to the Pd lattice as excited optical phonon modes.

The only Cold Fusion experiments producing heat consistently and reproducibly are the detections of heat using Pd Clusters and Deuterium gas by Arata and Zhang (replicated by McKubre at SRI) and by Iraj Parchamazad.

Arata and Zhang (and SRI) used Palladium black with initial cluster sizes distributed around 5 nm so that a substantial number of Pd clusters had diameter 1.5 nm. However, clumping increased the cluster size to around 40 nm at which size Takahashi et al said, based on their similar work, the "heat-power level drop[ped]... drastically".

(see Current Science 108 (25 Feb 2015) LENR Special Section Preface)

Iraj Parchamazad and Melvin Miles avoided the clumping problem by growing the Pd clusters within Zeolite cavities. Using Sodium Zeolite Y whose cavity size is around 1.2 nm (but capable of expansion by about a factor of 2), they produced Pd clusters of 1.5 nm size size which were dispersed within the Zeolite cavities thus preventing clumping. Upon exposure of his Pd clusters in Zeolite to Deuterium gas, he produced heat in 10 out of 10 experiments with **Cold Fusion Energy on the scale of kiloWatts per milligram of Palladium**.

(see coldfusionnow.org/iraj-parchamazad-lenr-with-zeolites/)

For Everybody on Earth to be Happy, the Abundant Cheap Energy must provide a high Standard of Living (current USA standard) for a lot of people (10 billion), and:

last for a long time (more than decades) - rules out Oil, Gas, Methane, and Coal;

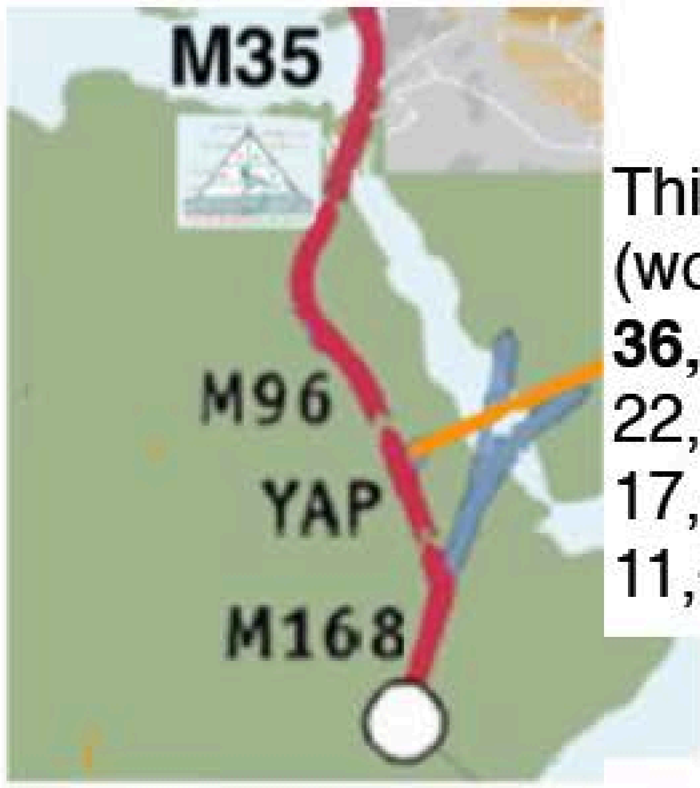
have no serious radioactive waste - rules out Uranium, Thorium, and Tritium (Lithium);

have realistically scalable capital cost - rules out Solar which would require Satellite collectors with area 1% of pi x 6,000^2 = 1,000,000 km^2 = (1,000 km)^2
or cloud-free collectors on Earth surface with the same area. Less than 100% efficiency would require correspondingly larger area of collectors.

That leaves one possible source of Abundant Cheap Energy for 10 billion people:

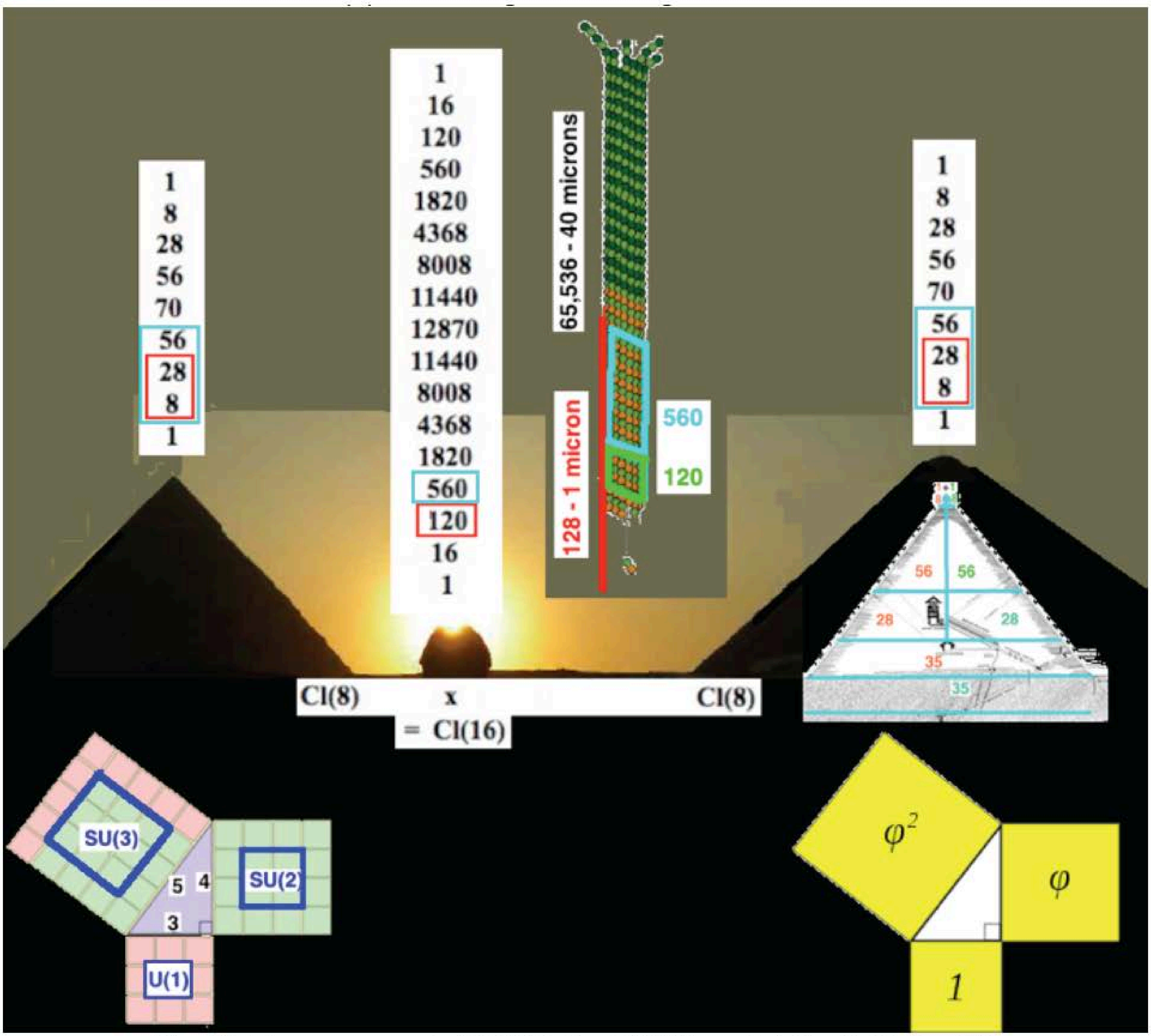
	Reserves (Terawatt-years)	Duration years)
Deuterium	1.9 x 10^9 (1/1000 of ocean supply)	2,000,000

36,000 Years Ago - National Geographic Genographic YDNA - M168 - YAP - M96 - **M35 Humans follow North Star Vega up the Nile to Giza and Mediterranean**



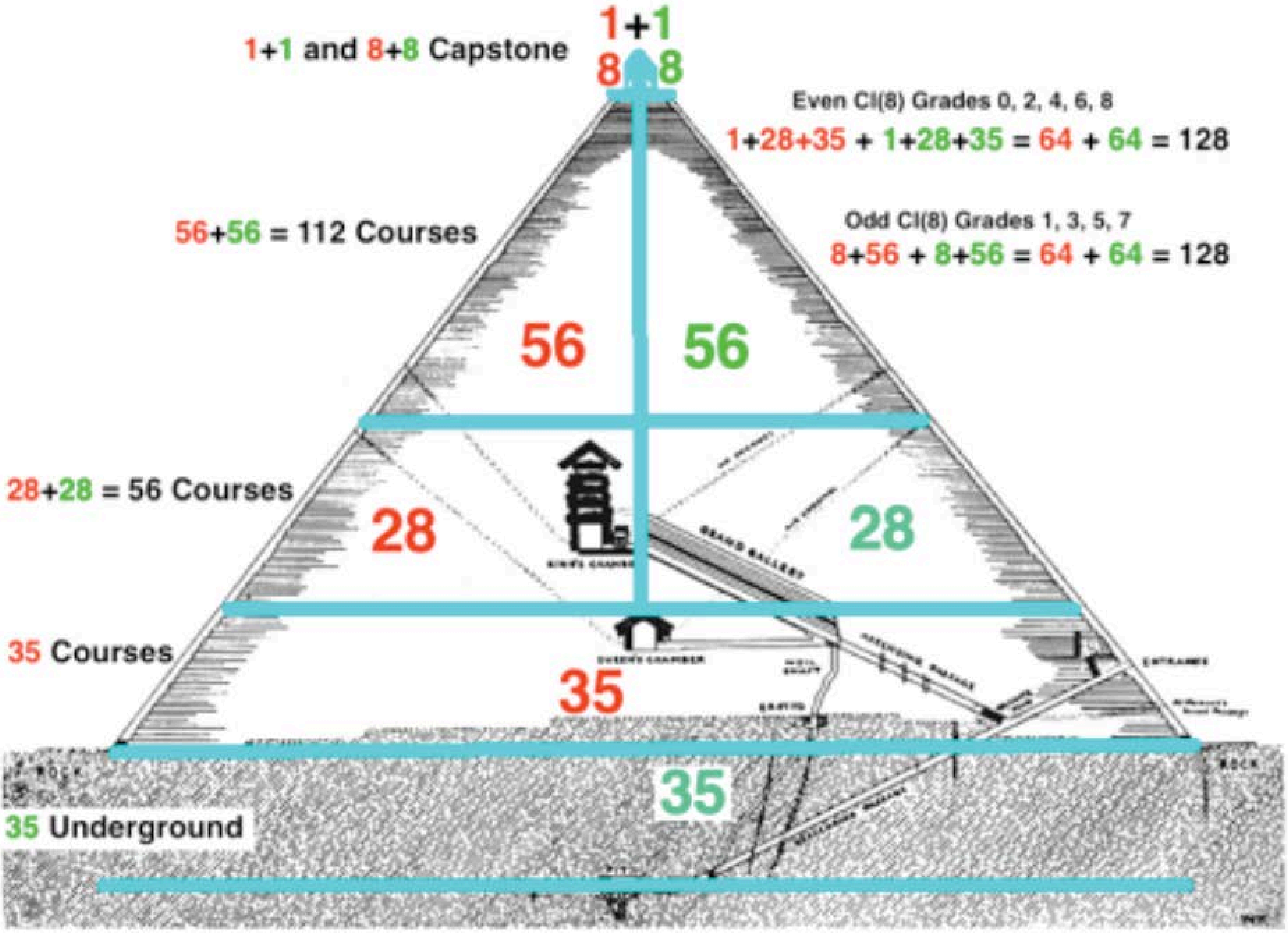
This coincided with the beginning of Egyptian History according to Manetho (working under Alexander's General and sucessor Ptolemy I):

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



The Sphinx represents 65,536-dim Cl(16) containing 248-dim E8 as tensor product of 256-dim Cl(8) containing 52-dim F4sm of CP2 and 256-dim Cl(8) containing 52-dim F4gde of M4 of M4 x CP2

Clifford Algebras were not known to European mathematicians until Clifford in the 19th century and not known to European physicists until Dirac in the 20th century but it seems to me that their structure was known to Africans in ancient times. 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)

William KIngdon Clifford (1845 - 1879), according to Wikipedia
said in (1878, "On the Nature of Things-in-Themselves", Mind, Vol. 3, No. 9, pp. 57–67),

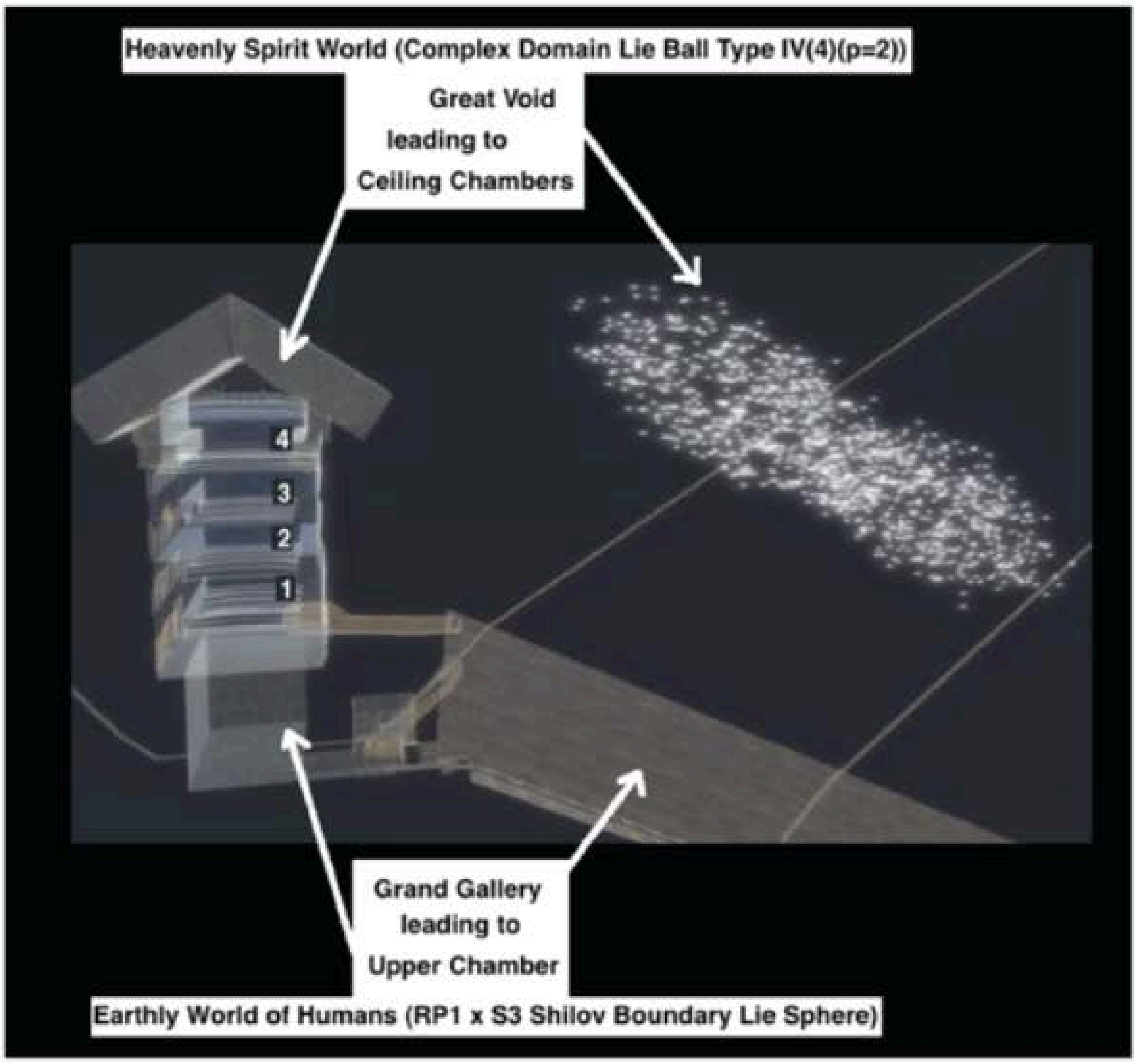
"... That element of which ... even the simplest feeling is a complex,
I shall call **Mind-stuff**.
A moving molecule of inorganic matter does not possess mind or consciousness ; but it possesses a small piece of mind-stuff. ...
When molecules are ... combined together ... **the elements of mind-stuff** which go along with them ... **combine ... to form the ... beginnings of Sentience**.
When the molecules are so combined as to form the brain and nervous system ... the corresponding elements of mind-stuff are so combined as to form some kind of consciousness ... changes in the complex which take place at the same time get so linked together that the repetition of one implies the repetition of the other.
When matter takes the complex form of a living human brain,
the corresponding mind-stuff takes the form of a human consciousness ...".

Tensor Product Cl(0,8) x Cl(p,q) =
= M(R,16) x Cl(p,q) = Cl(p,q+8)

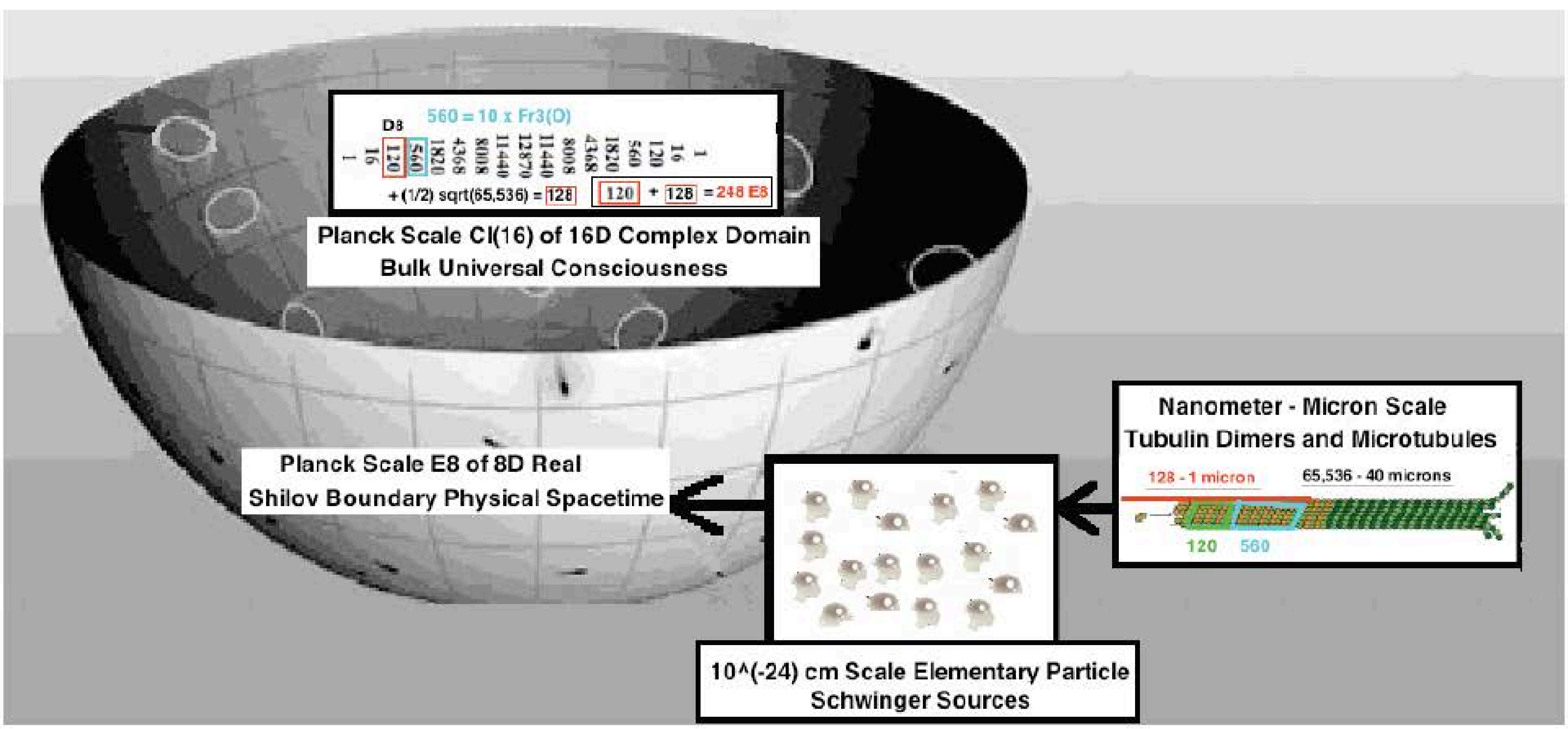
Real Clifford Algebras
Cl(p,q)

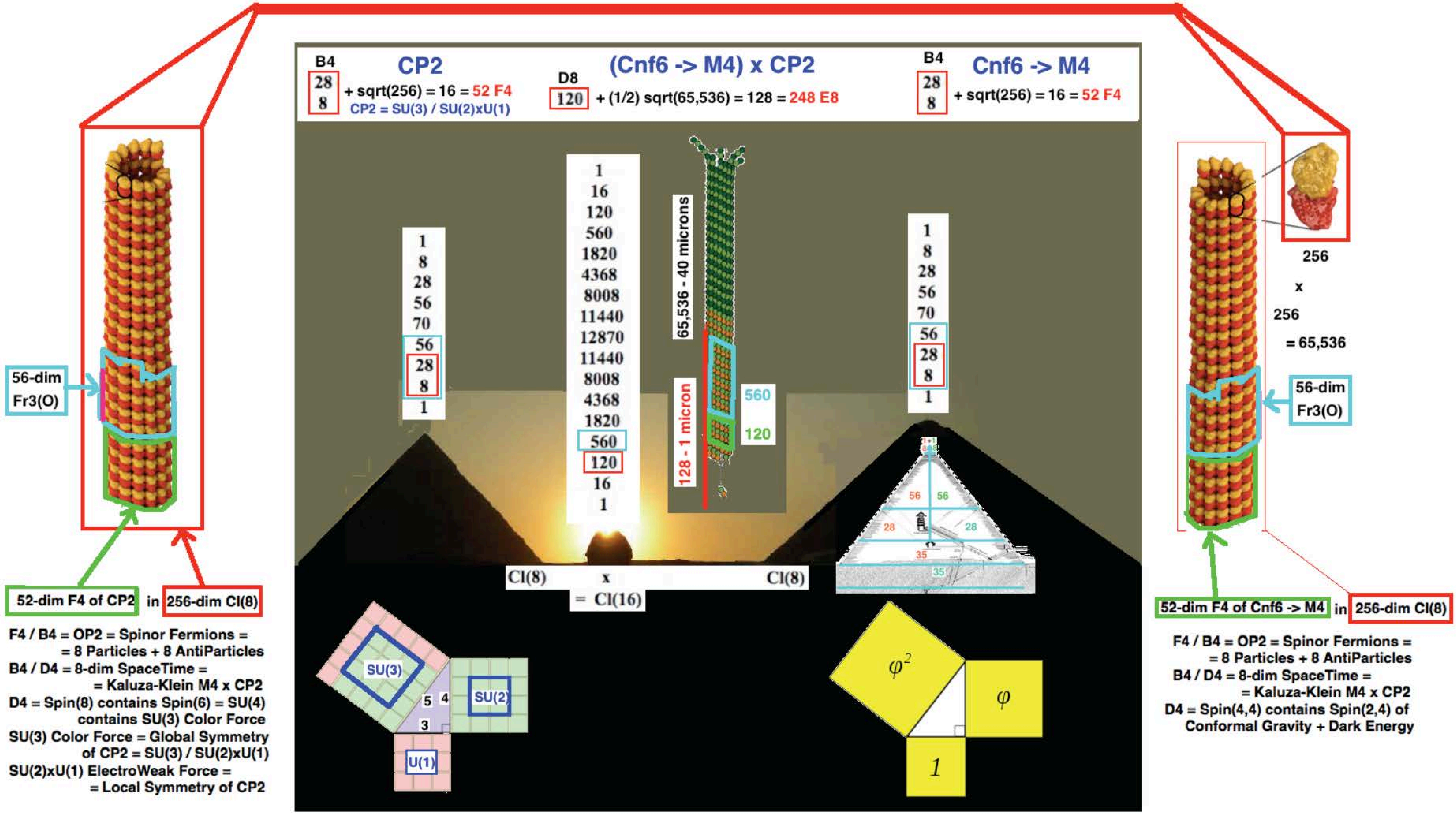
p ↑ \ q →	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
8	$M_{16}(R)$	$M_{16}(C)$	$M_{16}(H)$	$M_{16}(H) \oplus M_{16}(H)$	$M_{32}(H)$	$M_{64}(C)$	$M_{128}(R)$	$M_{128}(R) \oplus M_{128}(R)$	$M_{256}(R)$								
7	$M_8(C)$	$M_8(H)$	$M_8(H) \oplus M_8(H)$	$M_{16}(H)$	$M_{32}(C)$	$M_{64}(R)$	$M_{64}(R) \oplus M_{64}(R)$	$M_{128}(R)$	$M_{128}(C)$	$M_{128}(H)$							
6	$M_4(H)$	$M_4(H) \oplus M_4(H)$	$M_8(H)$	$M_{16}(C)$	$M_{32}(R)$	$M_{32}(R) \oplus M_{32}(R)$	$M_{64}(R)$	$M_{64}(C)$	$M_{64}(H)$	$M_{64}(H) \oplus M_{64}(H)$	$M_{128}(H)$						
5	$M_2(H) \oplus M_2(H)$	$M_4(H)$	$M_8(C)$	$M_{16}(R)$	$M_{16}(R) \oplus M_{16}(R)$	$M_{32}(R)$	$M_{32}(C)$	$M_{32}(H)$	$M_{32}(H) \oplus M_{32}(H)$	$M_{64}(H)$	$M_{128}(C)$	$M_{256}(R)$					
4	$M_2(H)$	$M_4(C)$	$M_8(R)$	$M_8(R) \oplus M_8(R)$	$M_{16}(R)$	$M_{16}(C)$	$M_{16}(H)$	$M_{16}(H) \oplus M_{16}(H)$	$M_{32}(H)$	$M_{64}(C)$	$M_{128}(R)$	$M_{128}(R) \oplus M_{128}(R)$	$M_{256}(R)$				
3	$M_2(C)$	$M_4(R)$	$M_4(R) \oplus M_4(R)$	$M_8(R)$	$M_8(C)$	$M_8(H)$	$M_8(H) \oplus M_8(H)$	$M_{16}(H)$	$M_{32}(C)$	$M_{64}(R)$	$M_{64}(R) \oplus M_{64}(R)$	$M_{128}(R)$	$M_{128}(C)$	$M_{128}(H)$			
2	$M_2(R)$	$M_2(R) \oplus M_2(R)$	$M_4(R)$	$M_4(C)$	$M_4(H)$	$M_4(H) \oplus M_4(H)$	$M_8(H)$	$M_{16}(C)$	$M_{32}(R)$	$M_{32}(R) \oplus M_{32}(R)$	$M_{64}(R)$	$M_{64}(C)$	$M_{64}(H)$	$M_{64}(H) \oplus M_{64}(H)$	$M_{128}(H)$		
1	$R \oplus R$	$M_2(R)$	$M_2(C)$	$M_2(H)$	$M_2(H) \oplus M_2(H)$	$M_4(H)$	$M_8(C)$	$M_{16}(R)$	$M_{16}(R) \oplus M_{16}(R)$	$M_{32}(R)$	$M_{32}(C)$	$M_{32}(H)$	$M_{32}(H) \oplus M_{32}(H)$	$M_{64}(H)$	$M_{128}(C)$	$M_{256}(R)$	
0	R	C	H	$H \oplus H$	$M_2(H)$	$M_4(C)$	$M_8(R)$	$M_8(R) \oplus M_8(R)$	$M_{16}(R)$	$M_{16}(C)$	$M_{16}(H)$	$M_{16}(H) \oplus M_{16}(H)$	$M_{32}(H)$	$M_{64}(C)$	$M_{128}(R)$	$M_{128}(R) \oplus M_{128}(R)$	$M_{256}(R)$

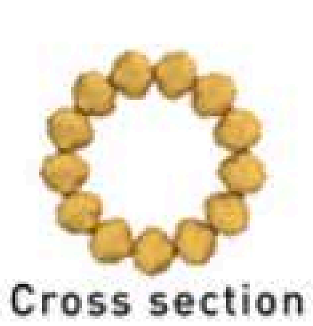
H = Quaternion
C = Complex
R = Real



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 with Microtubule Quantum Consciousness and
they represented the Imaginary Complex World of Cl(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.







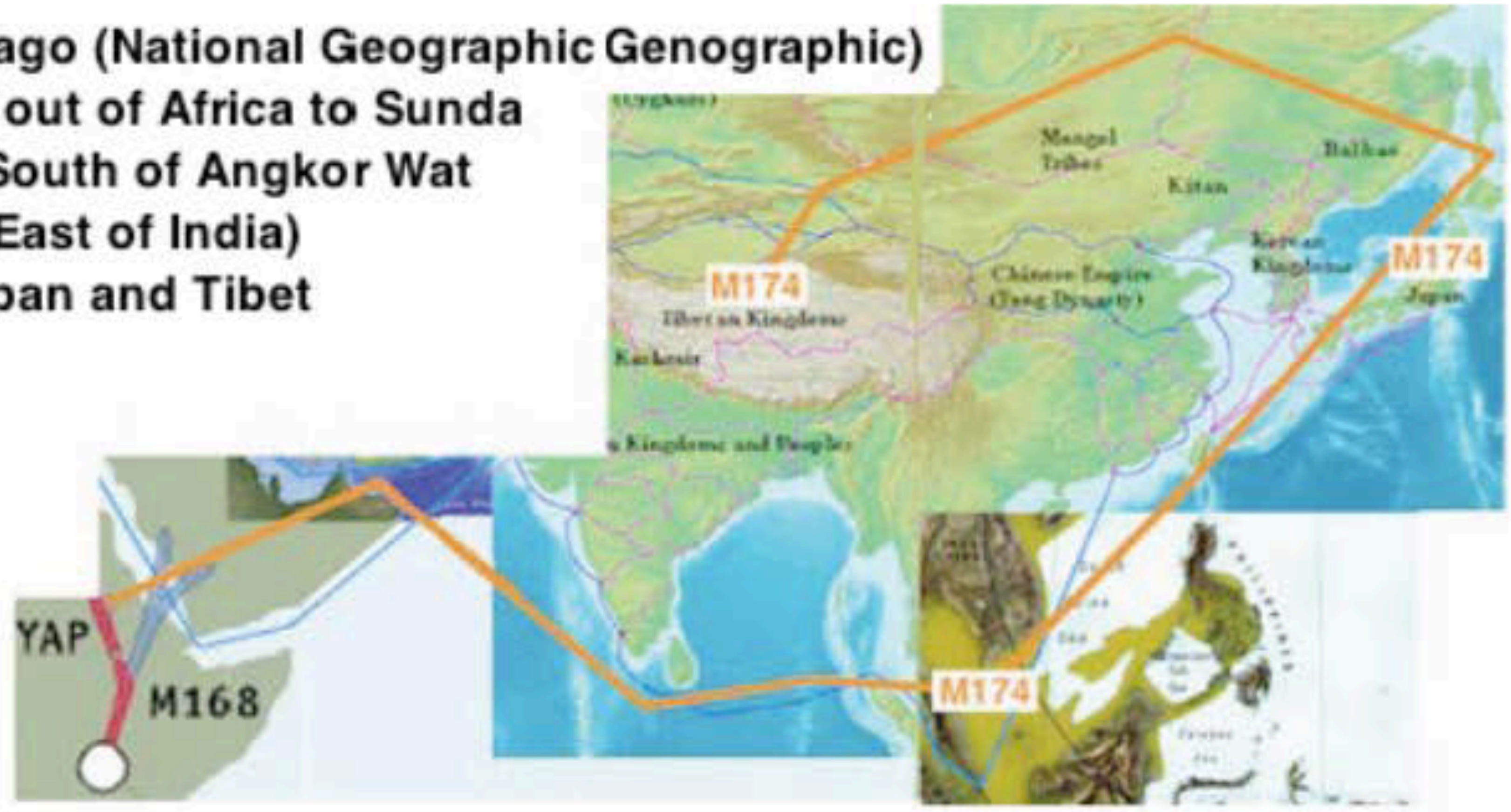
E8 Kaluza-Klein (Cnf6 -> M4) x CP2

In (Cl(8) of CP2) x (Cl(8) of Cnf6 -> M4) = Cl(16) containing E8
at each of the 256 points of Cl(8) of Cnf6 -> M4 there are all 256 points of Cl(8) of CP2

D8 = Cl(16) BiVectors = 120
E8 / D8 = 128-dim Fermion Spinor Space = 8 components of 8+8 Fermions
D8 / D4 x D4 = A7+1 = 64 = 8-dim position x 8-dim momentum
D4 containing D3 = Spin(2,4) = A3 = SU(2,2) for Conformal Gravity + Dark Energy
D4 containing D3 = SU(4) containing Color Force SU(3)
10xFr3(O) = Cl(16) TriVectors = 560

Rig Veda / Angkor Wat

About 50,000 years ago (National Geographic Genographic)
YAP and M174 went out of Africa to Sunda
(then dry land South of Angkor Wat
and SouthEast of India)
and on to Japan and Tibet



Angkor Thom, Angkor Wat, Phnom Bakheng
<-->
Giza Great Pyramid Cl(8) (D4gde), Second Pyramid Cl(8) (D4sm), Sphinx Cl(16) (E8 + Fr3(O))

Angkor Thom: 8 yellow Outer Towers + 16 green Middle Towers = 24-dim OxOxO of Fr3(O) 26-D String=World-Line Theory
1 orange Inner Tower = Bohm Quantum Potential from Cl(16) TriVectors
4 red + 12 gray Inner Towers = Fundamental Lepton + Quark Particles / AntiParticles from Cl(16) half-Spinors

Angkor Wat: 4 yellow Inner Towers = 4-dim Minkowski Physical Spacetime of Kaluza-Klein M4 x CP2 from Cl(16) BiVectors
4 orange Middle Towers = 4-dim CP2 = SU(3) / SU(2) x U(1) of Kaluza-Klein M4 x CP2 from Cl(16) BiVectors

Phnom Bakheng: 64 cyan Towers = D8 / D4 x D4 = by Cl(16) Triality = ++half-Spinor Fermion Particles
= --half-Spinor Fermion AntiParticles
++half-Spinor Fermion Particles + --half-Spinor Fermion AntiParticles = 64+64 = 128 = E8 / D8

Rig Veda encodes the 240 Root Vectors of E8 = 24+24+64+64+64

24 First Richa Syllables + 24 First Richa Gaps = D4sm + D4gde (purple box)

8x8 = 64 Last-8 Syllables of Last 8 Lines = D8 / D4sm x D4gde (blue box)

8x8 = 64 First-8 Syllables of Last 8 Lines (green box)
and
8x8 = 64 Middle-8 Syllables of Last 8 Lines (red box)
give 128 = E8 / D8 = Fermion Particles and AntiParticles