Outline of E8 Physics by Frank Dodd Tony Smith Jr

1 - Empty set grows by Clifford Process to arbitrarily large Cl(16N) which factors by periodicity to N-fold tensor product of Cl(16) = Cl(8)xCl(8) with each local Cl(16) containing an E8 that describes physics of that local region

2 - E8 has Chirality because E8 contains only one set of Cl(16) half-spinors

3 - E8 D8 part = 120 = 112 + 8 = 64 + (24+4) + (24+4)

4 - 64 + 64 E8 spinor part as anticommuting Fermions

5 - Spacetime emerges like condensation by all E8 regions consistently aligning their local 8-dim Octonionic spacetimes with 8-dim position and momentum described by 64-dim D8 / D4xD4 (blue dots) where D8 is a 120-dim subalgebra of 248-dim E8

6 - 8-dim Lorentz structure satisfies Coleman-Mandula because the fermionic fundamental spinor representations of the E8 model are built with respect to Lorentz, spinor, etc representations based on 8-dim Spin(1,7) spacetime

7 - Fundamental High-Energy E8 Lagrangian for Octonionic 8-dim SpaceTime is UltraViolet Finite

8 - High-Energy Octonionic Physics is NOT Unitary due to Octonion Non-Associativity
    so the initial Inflationary Phase of Our Universe produces many particles

9 - World-Lines as Strings of 26-dim String Theory and Quantum Consciousness

10 - 8-dim SpaceTime breaks into (4+4)-dim Quaternionic Kaluza-Klein

11 - Schwinger Sources with symmetry from inherited from Monster Group
                                    have
            Kerr-Newman Black Hole structure size about 10^(-24) cm
                                    and
            Geometry of Bounded Complex Domains and Shilov boundaries

12 - Combinatorics of (4+4)-dim Kaluza-Klein structure contributes to Fermion mass ratios for 2nd and 3rd generations

13 - Kobayashi-Maskawa mass formulas

14 - neutrino masses beyond tree level

15 - Higgs-Tquark system with 3 mass states and Higgs as Tquark condensate

16 - Proton-Neutron mass difference

17 - Pion as sine-Gordon breather structure

18 - Planck mass as superposition condensate of Fermions

19 - Segal-type Conformal gravity with conformal generator structure giving
Dark Energy, Dark Matter, and Ordinary Matter ratio

20 - Dark Energy explanations for Pioneer Anomaly and Uranus spin-axis tilt
Conformal Dark Energy can explain the Pioneer Anomaly

21 - Dark Energy experiment by BSCCO Josephson Junctions and geometry of 600-cell

22 - Real Clifford Algebra periodicity allows construction of Algebraic Quantum Field
Theory as a generalization of II1 hyperfinite von Neumann factor algebra

23 - maximal contraction of E8 = semidirect product A7 x h92
gives a creation/annihilation algebra
where h92 = 92+1+92 = 185-dim Heisenberg algebra and A7 = 63-dim SL(8)

24 - AQFT and Third Grothendieck Universe

This is a 24-point Outline of E8 Physics
and so contains almost no technical details or references to papers, books, or images.
Such details and references can be found on my web sites at
http://www.valdostamuseum.com/hamsmith/
http://www.tony5m17h.net/
and my papers on viXra listed at
http://vixra.org/author/frank_dodd_tony_smith_jr
which papers include
http://vixra.org/abs/1310.0182
and the 11,445 page pdf file (about 313 MB) at
http://vixra.org/abs/1311.0094

Overview of E8 Physics:

Frank Dodd Tony Smith Jr - 2013

1 - Empty set grows by Clifford Process to arbitrarily large Cl(16N) which factors by periodicity to N-fold tensor product of Cl(16) = Cl(8)xCl(8) with each local Cl(16) containing an E8 that describes physics of that local region

1	= Cl(0) = 1
ø	

1	1	= Cl(1) = 2
ø	(ø)	

1	2	1	= Cl(2) = 4
ø	(ø)	(ø (ø))	
	((ø))		

1	4	6	4	1 = Cl(4) = 16
ø	(ø)	(ø (ø))	((ø) ((ø)) (ø (ø)))	(ø (ø) ((ø)) (ø (ø)))
	((ø))	(ø ((ø)))	(ø ((ø)) (ø (ø)))	
	(((ø)))	(ø (ø (ø)))	(ø (ø) (ø (ø)))	
	((ø (ø)))	((ø) ((ø)))	(ø (ø) ((ø)))	
		((ø) (ø (ø)))		
		(((ø)) (ø (ø)))		

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

= Cl(16) = 2^16 = 65,536 = ((64+64) + (64+64)) x ((64+64) + (64+64))

## 120 + 64 + 64 = E8
E8 root vectors = 112 + 64 + 64

2 - E8 has Chirality because E8 contains only one set of Cl(16) half-spinors

3 - E8 D8 part = 120 = 112 + 8 = 64 + (24+4) + (24+4)
(24+4) = D4 producing Conformal Gravity
(24+4) = D4 producing Standard Model SU(3)

4 - 64 + 64 E8 spinor part as anticommuting Fermions
8 components of 8 Particles and 8 components of 8 AntiParticles of the First Generation
In Cl(8): F4 = V8 + BV23 + S+8 + S-8 with anticommutator structure for S+8 + S-8
In Cl(8) x Cl(8) = Cl(16): E8 = BV120 + S+64 + S-64
where S+64 = S+8 x S+8 and S-64 = S-8 x S-8 inherit anticommutator structure from F4
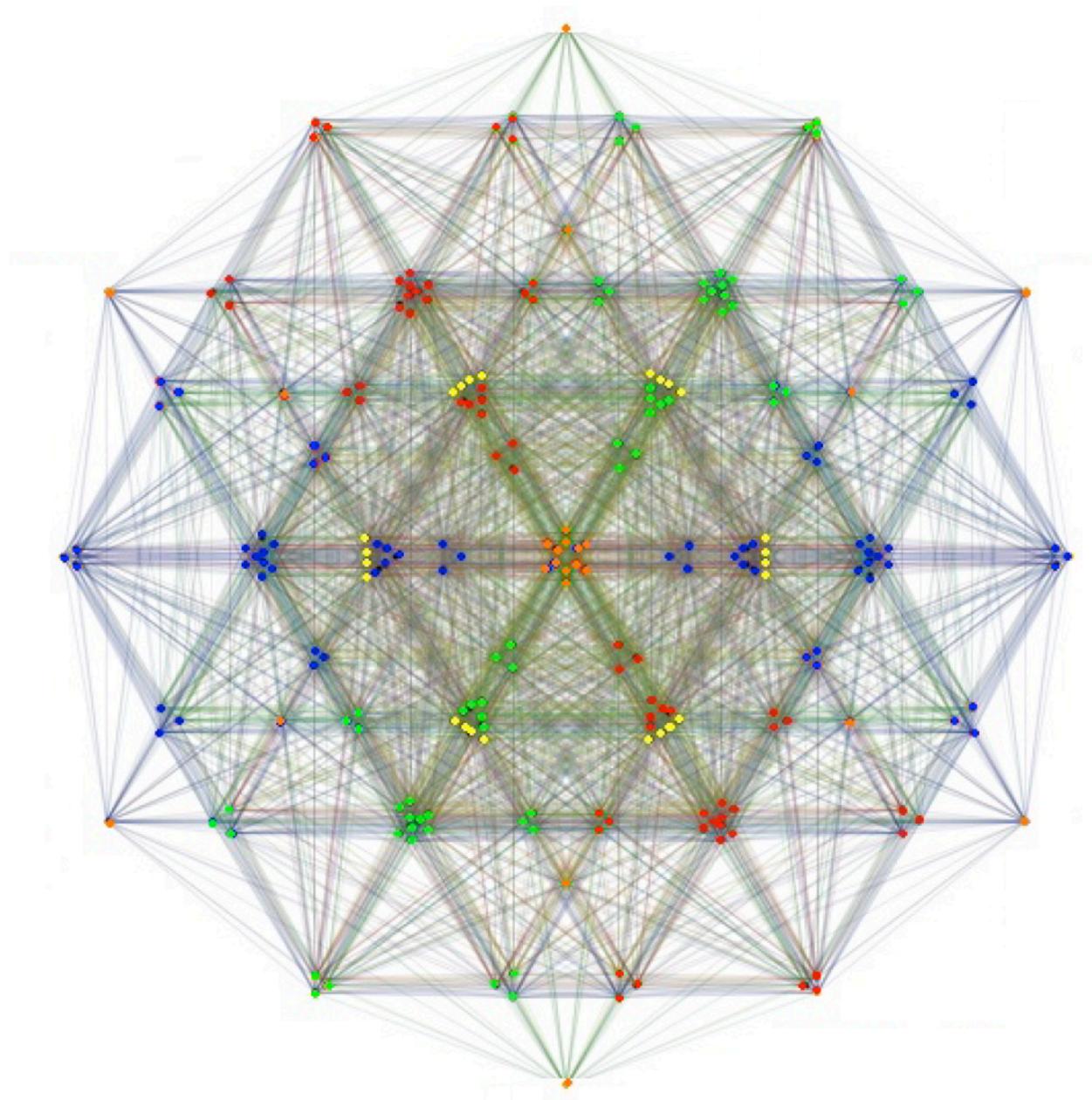
5 - Cl(16) x ... x Cl(16) where each Cl(16) contains E8 produces Emergent Spacetime
with all E8 local 8-dim Octonionic spacetimes consistently aligned
with 8-dim position and momentum described by 64-dim D8 / D4xD4 (blue dots)
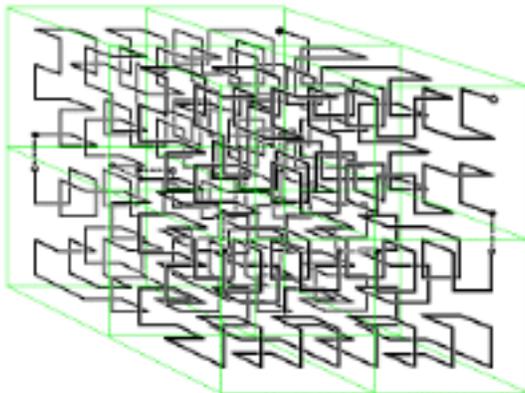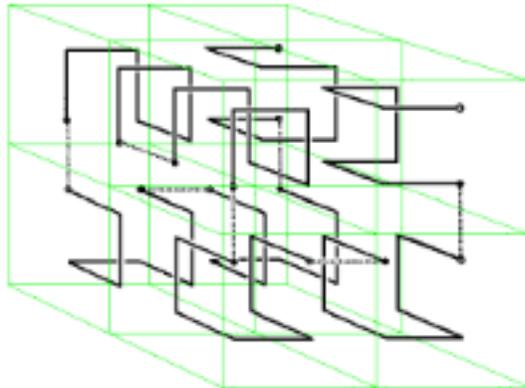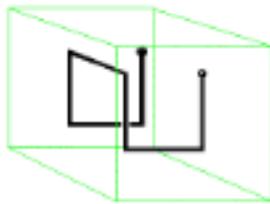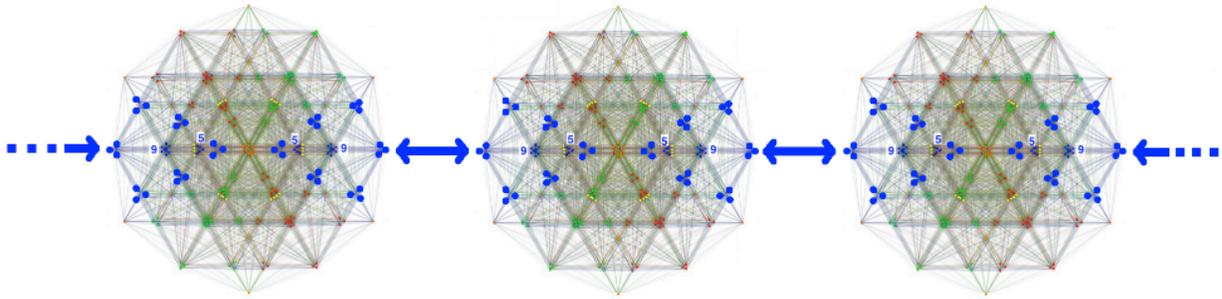
6 - 8-dim Lorentz structure satisfies Coleman-Mandula because the fermionic
fundamental spinor representations of the E8 model are built with respect to Lorentz,
spinor, etc representations based on 8-dim Spin(1,7) spacetime.

7 - Fundamental High-Energy E8 Lagrangian for Octonionic 8-dim SpaceTime
is UltraViolet Finite because:

$$\int_{\text{8-dim SpaceTime}} \text{Gauge Boson Term} \;+\; \text{Fermion Particle-AntiParticle Term}$$

.

Gauge Boson Term has total weight 28 x 1 = 28
16 generators for U(2,2) of Conformal Gravity
+
12 generators for U(3) and U(2) Standard Model
=
28 D4 Gauge Bosons
each with 8-dim Lagrangian weight = 1

Fermion Particle-AntiParticle Term also has total weight 8 x (7/2) = 28
8 Fermion Particle/Antiparticle types
each with 8-dim Lagrangian weight = 7/2

8 - High-Energy Octonionic Physics is NOT Unitary due to Octonion Non-Associativity
so the initial Inflationary Phase of Our Universe produces many particles.

As 8-dimensional Spacetime remains Octonionic throughout Inflation, the paper
gr-qc/0007006 by Paola Zizzi shows that "... during inflation, the universe can be
described as a superposed state of quantum ... [qubits].
The self-reduction of the superposed quantum state is ... reached at the end of
inflation ...[at]... the decoherence time ... [Tdecoh = 10^9 Tplanck = 10^(-34) sec] ...
and corresponds to a superposed state of ... [10^19 = 2^64 qubits]. ...
This is also the number of superposed tubulins-qubits in our brain ...
leading to a conscious event. ...".

If at each of the 64 doubling stages of Zizzi inflation the 2 particles of a pair
produced 8+8 = 16 fermions, then at the end of inflation non-unitary processes would
have produced about 2 x 16^64 = 4 x (2^4)^64 = 4 x 10^77 fermion particles.
Each of the 10^77 fermions had energy of 10^14 GeV so that collisions among them
would for each fermion produce jets containing 10^12 particles of energy 100 GeV
so that the total number of particles at the End of Inflation was about 10^89.

The Zizzi Inflation phase of our universe ends with decoherence "collapse" of the
2^64 Superposition Inflated Universe into Many Worlds of the Many-Worlds
Quantum Theory, only one of which Worlds is our World which therefore carries only a
tiny fraction of the entropy of the 2^64 Superposition Inflated Universe.

9 - World-Lines as Strings of 26-dim String Theory

26-dim Bosonic String Theory = 26-dim traceless part J3(O)o

$$a \qquad O+ \qquad Ov$$

$$O+^* \qquad b \qquad O-$$

$$Ov^* \qquad O-^* \qquad -a-b$$

Octonionic Ov contains Quaternionic Associative Subspace D3 brane
Compactify CoAssociative Subspace of Ov into CP2 Internal Symmetry Space
D3 + CP2 = D7 brane

Orbifold by Z2 the 1-dim Real Subspace of Ov to discretize time into Tz2
D7 brane + Tz2 = D8 brane

Give D8 branes Planck-Scale Lattice Structure as superpositons of 8 types of E8 Lattice
denoted by 1E8, iE8, jE8, kE8, EE8, IE8, JE8, KE8

Orbifold by Oct16 the O+ to get 8 components of 8 Fermion Particles

Orbifold by Oct16 the O- to get 8 components of 8 Fermion AntiParticles

Stack D8 branes to get SpaceTime with Strings = World-Lines
with
a and b representing
ordering of D8 brane stacks and Bohm-type Quantum Potential

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

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

Gauge Bosons from 1E8, iE8, jE8, and kE8 parts of a D8 give U(2,2) Conformal Gravity.

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

 Green, Schwartz, and Witten say in their book "Superstring Theory" vol. 1 (Cambridge 1986)
"... For the ... closed ... bosonic string .... The first excited level ... consists of ...
the ground state ... tachyon ... and ... a scalar ... 'dilaton' ... and ...
SO(24) ... little group of a ...[26-dim]... massless particle ... and ...
a ... massless ... spin two state ...".

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

Dilatons are Goldstone bosons of spontaneously broken scale invariance that (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 two state is what I call the Bohmion:
the carrier of the Bohm Force of the Bohm-Sarfatti Quantum Potential.
Peter R. Holland says in his book "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 ...".

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} Tubulin Dimers with math description in terms of a large Real Clifford Algebra.

First consider Superposition of States involving one tubulin with one electron of mass m and two different position states separated by a .
The Superposition Separation Energy Difference is the gravitational energy
$$E\_electron = G\, m^2 / a$$
For any single given tubulin a = 1 nanometer = 10^{-7} cm so that for a single Electron
$$T = h / E\_electron = (\text{Compton} / \text{Schwarzschild})\,(a/c) = 10^{26}\ \text{sec} = 10^{19}\ \text{years}$$

Now consider the case of N Tubulin Electrons in Coherent Superposition
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
$$E\_N = G\, M^2 / L = N^{(5/3)}\, E\_electron$$
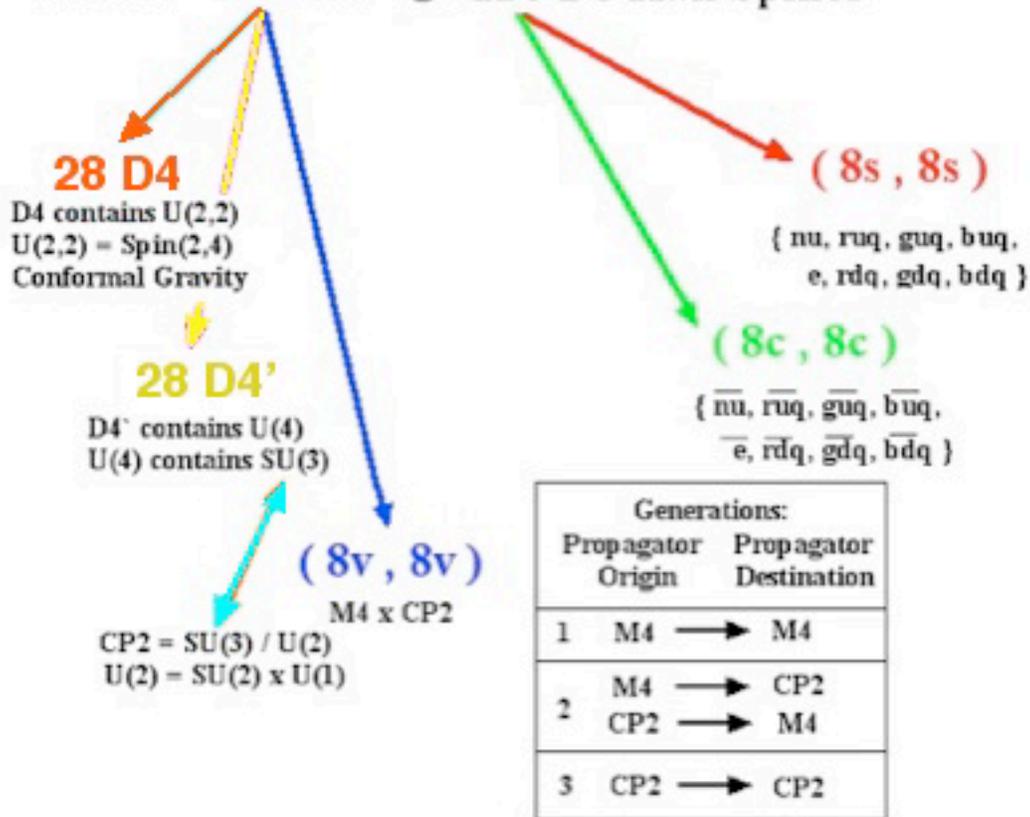The decoherence time for the system of N Tubulin Electrons is
$$T\_N = h / E\_N = h / N^{(5/3)}\, E\_electron = N^{(-5/3)}\, 10^{26}\ \text{sec}$$
So we have the following rough approximate Table of Decoherence Times T_N

Time T_N	Number of Tubulins
10^{-5} sec	10^{18}
5×10^{-4} sec (2 kHz)	10^{17}
25×10^{-3} sec (40 Hz)	10^{16}
100×10^{-3} sec (EEG alpha)	4×10^{15}
500×10^{-3} sec (Libet)	1.5×10^{15}

248 E8 = 120 D8 $\oplus$ 128 D8 Half Spinor

28 D4

D4 contains U(2,2)
U(2,2) = Spin(2,4)
Conformal Gravity

28 D4'

D4' contains U(4)
U(4) contains SU(3)

(8v , 8v)

M4 x CP2

CP2 = SU(3) / U(2)
U(2) = SU(2) x U(1)

(8s , 8s)

{ nu, ruq, guq, buq,
e, rdq, gdq, bdq }

(8c , 8c)

{ n̄u, r̄uq, ḡuq, b̄uq,
ē, r̄dq, ḡdq, b̄dq }

Generations:		
Propagator Origin		Propagator Destination
1	M4 $\longrightarrow$	M4
2	M4 $\longrightarrow$ CP2	
	CP2 $\longrightarrow$ M4	
3	CP2 $\longrightarrow$	CP2

Lagrangian: $\int$ gauge term + fermion term

KKspacetime

Higgs-Mayer:

Kobayashi-Nomizu:

THEOREM 11.7. Assume in Theorem 11.5 that $\mathfrak{k}$ admits a subspace $\mathfrak{m}$ such that $\mathfrak{k} = \mathfrak{j} + \mathfrak{m}$ (direct sum) and ad $(J)(\mathfrak{m}) = \mathfrak{m}$, where ad (J) is the adjoint representation of J in $\mathfrak{k}$. Then

(1) There is a 1:1 correspondence between the set of K-invariant connections in P and the set of linear mappings Λ_m: $\mathfrak{m} \to \mathfrak{g}$ such that

$$\Lambda_m(\text{ad } (j)(X)) = \text{ad } (\lambda(j))(\Lambda_m(X)) \quad \text{for } X \in \mathfrak{m} \text{ and } j \in J;$$

the correspondence is given via Theorem 11.5 by

$$\Lambda(X) = \begin{cases} \lambda(X) & \text{if } X \in \mathfrak{j}, \\ \Lambda_m(X) & \text{if } X \in \mathfrak{m}. \end{cases}$$

(2) The curvature form Ω of the K-invariant connection defined by Λ_m satisfies the following condition:

$$2\Omega_m(X, Y) = [\Lambda_m(X), \Lambda_m(Y)] - \Lambda_m([X, Y]_m) - \lambda([X, Y]_{\mathfrak{j}})$$
$$\text{for } X, Y \in \mathfrak{m},$$
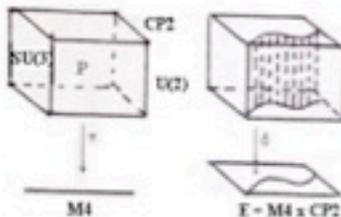
The Higgs and the T-quark form a system in which
the Higgs is effectively a T-quark condensate.

11 - Schwinger Sources with symmetry from inherited from Monster Group
have
Kerr-Newman Black Hole structure size about 10^(-24) cm
and
Geometry of Bounded Complex Domains and Shilov boundaries

The E8 Lagrangian for Octonionic (4+4)-dim Kaluza-KleinSpaceTime is

$$\int_{\text{4D PhyST}}$$ Gauge Boson Term   +   Fermion Particle-AntiParticle Term + Higgs Term

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

Fermion Schwinger Sources correspond to the Lie Sphere Symmetric space
Spin(10) / Spin(8)xU(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 = RP1 x S7

Consider the Gauge Boson Term
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-dimensional Riemannian Symmetric Spaces
with Quaternionic structure consistent with 4-dim Physical SpaceTime:

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

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 copies of the U(1) of the EM Photon
(1 copy for each of the 4 covariant components of the Photon)

The Gravity Gauge Bosons (Schwinger-Euclidean versions) live in
a Spin(5) subalgebra of the Spin(6) Conformal subalgebra of D4 = Spin(8).
They "see" M4 Physical spacetime as the 4-sphere S4
so that their part of the Physical Lagrangian is

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

an integral over SpaceTime S4.
The Schwinger Sources for GRb bosons are the Complex Bounded Domains and
Shilov Boundaries for Spin(5) MacDowell-Mansouri Gravity bosons.
However, due to Stabilization of Condensate SpaceTime
by virtual Planck Mass Gravitational Black Holes,
for Gravity, the effective force strength that we see in our experiments
is not just composed of the S4 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

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

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

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

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 CP2 = SU(3) / U(2)
They "see" M4 Physical spacetime as four 1-sphere circles S1xS1xS1xS1 = T4
(T4 = 4-torus) so that their part of the Physical Lagrangian is

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

an integral over SpaceTime T4.
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 T4 volume and the U(1) Schwinger Source volume.

12 - Combinatorics of (4+4)-dim Kaluza-Klein structure contributes to Fermion mass ratios for 2nd and 3rd generations. For example:
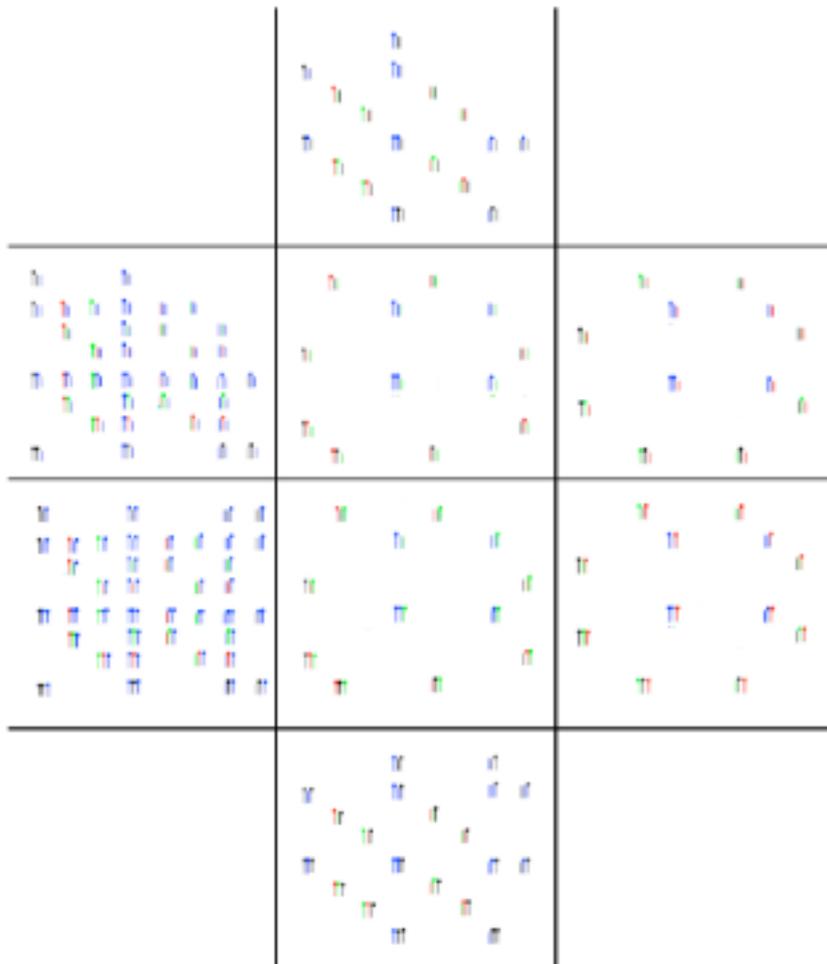
Blue Down Quark is 1 out of 8
Blue Up Quark is 1 out of 8

Blue Strange Quark is 3 out of 8x8 = 64
Blue Charm Quark is 17 out of 8x8 = 64

Blue Beauty Quark is 7 out of 8x8x8 = 512
Blue Truth Quark is 161 out of 8x8x8 = 512

The E8 Physics calculation results are:

Since calculations are for ratios of particle masses and force strengths,
the Higgs mass and the Geometric Part of the Gravity force strength are set so that the
ratios agree with conventional observation data.

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

13 - Kobayashi-Maskawa mass formulas

In E8 Physics the KM Unitarity Triangle angles can be seen on the Stella Octangula
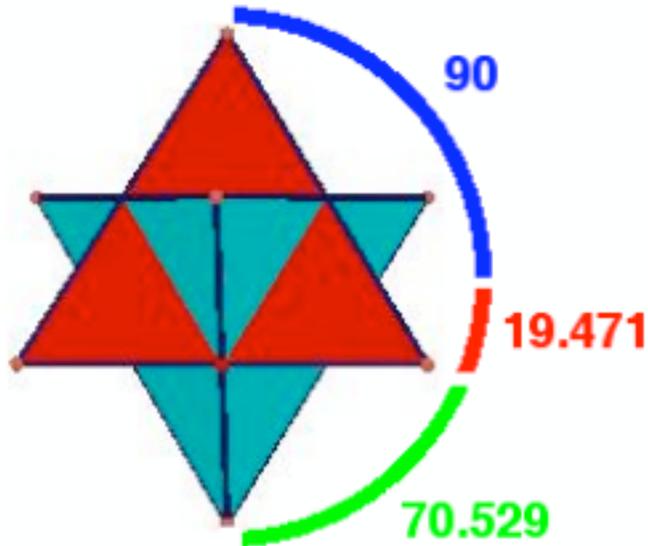
The Kobayashi-Maskawa parameters are determined in terms of
the sum of the masses of the 30 first-generation fermion particles and antiparticles,
denoted by

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

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

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

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

14 - neutrino masses beyond tree level

The heaviest mass state nu_3 is for a neutrino whose propagation
begins and ends in CP2 internal symmetry space, lying entirely therein.
In E8 Physics the mass of nu_3 is zero at tree-level
but it picks up a first-order correction by
propagating entirely through internal symmetry space,
merging with a virtual electron through the weak and electromagnetic forces,
effectively acting not merely as a point
but as a point plus an electron loop at both beginning and ending points.

Calculation along those lines produce these results

for masses

Particle	Tree-Level	Higher-Order
e-neutrino	0	0 for nu_1
mu-neutrino	0	9×10^{-3} eV for nu_2
tau-neutrino	0	5.4×10^{-2} eV for nu_3

and for mixing matrix

nu_1 nu_2 nu_3

|	nu_1	nu_2	nu_3
nu_e	0.853	0.493	0.056 - 0.157 i
nu_m	-0.388 - 0.096 i	0.592 - 0.056 i	0.697
nu_t	0.320 - 0.096 i	0.632 - 0.056 i	0.697

The Magenta Dot   is the high-mass state of a 220 GeV Truth Quark and a 240 GeV Higgs. It is at the critical point of the Higgs-Tquark System with respect to Vacuum Instability and Triviality. It corresponds to the description in hep-ph/9603293 by Koichi Yamawaki of the Bardeen-Hill-Lindner model. That high-mass Higgs is around 250 GeV in the range of the Higgs Vacuum Instability Boundary which range includes the Higgs VEV.

The Gold Line leading down from the Critical Point roughly along the Triviality Boundary line is based on Renormalization Group calculations with the result that MH / MT = 1.1 as described by Koichi Yamawaki in hep-ph/9603293 .

The Cyan Dot   where the Gold Line leaves the Triviality Boundary to go into our Ordinary Phase is the middle-mass state of a 174 GeV Truth Quark and Higgs around 200 GeV. It corresponds to the Higgs mass calculated by Hashimoto, Tanabashi, and Yamawaki in hep-ph/0311165 where they show that for 8-dimensional Kaluza-Klein spacetime with the Higgs as a Truth Quark condensate 172 < MT < 175 GeV and 178 < MH < 188 GeV.
That mid-mass Higgs is around the 200 GeV range of the Higgs Triviality Boundary at which the composite nature of the Higgs as T-Tbar condensate in (4+4)-dim Kaluza-Klein becomes manifest.

The Green Dot   where the Gold Line terminates in our Ordinary Phase
is the low-mass state of a 130 GeV Truth Quark and a 126 GeV Higgs.
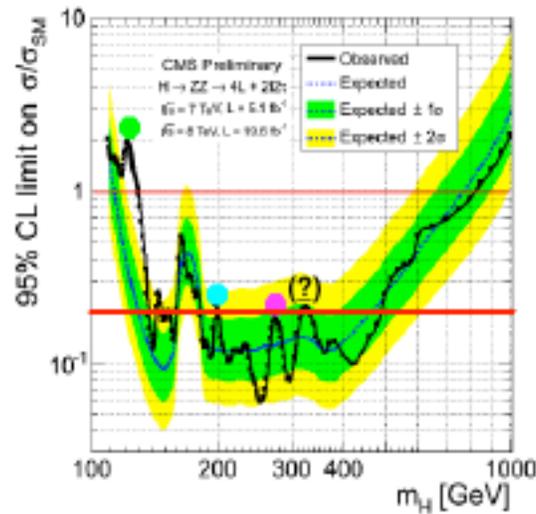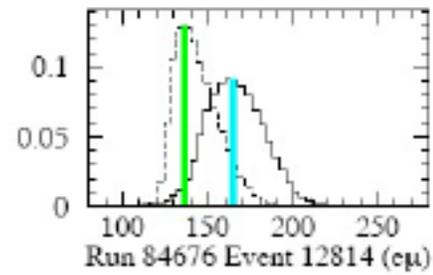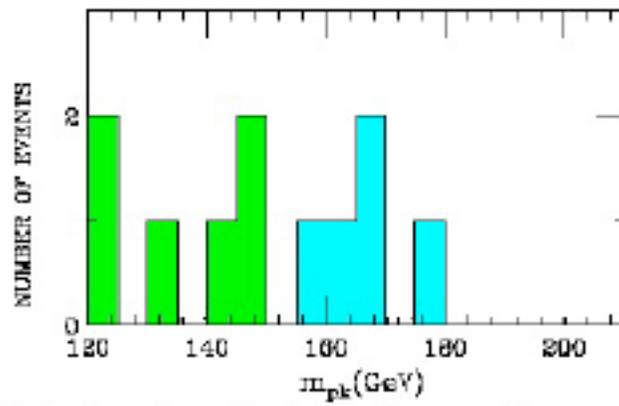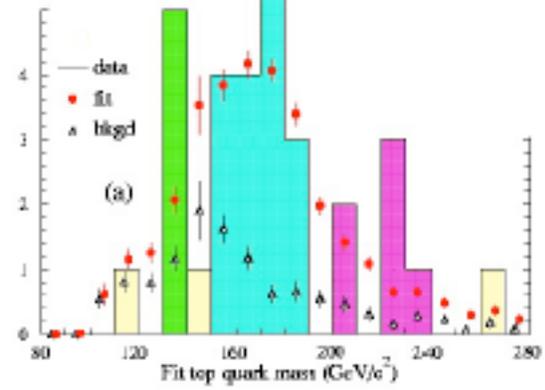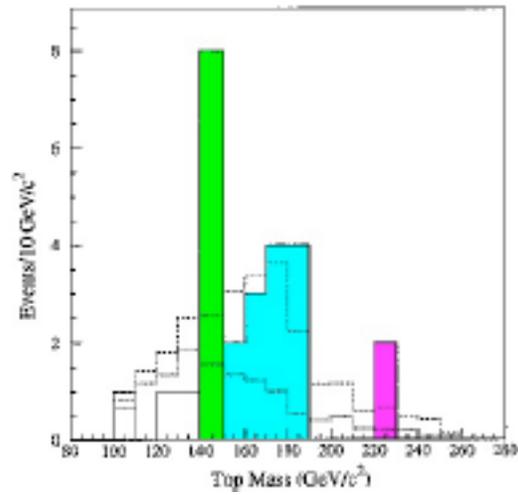
An up valence quark, constituent mass 313 Mev, does not often swap places with a 2.09 Gev charm sea quark,
but a 313 Mev down valence quark can more often swap places with a 625 Mev strange sea quark.
Therefore the Quantum color force constituent mass of the down valence quark is heavier by about
(ms - md) (md/ms)^2 a(w) IVdsI = 312 x 0.25 x 0.253 x 0.22 Mev = 4.3 Mev,
(where a(w) = 0.253 is the geometric part of the weak force strength and I Vdsl = 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 Qmd of the down quark is

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

Similarly, the up quark Quantum color force mass increase is about
(mc - mu) (mu/mc)^2 a(w) IV(uc)I = 1777 x 0.022 x 0.253 x 0.22 Mev =
= 2.2 Mev, (where IVucl = 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 Qmu of the up quark is
$$Qmu = 312.75 + 2.2 = 314.95 \text{ MeV.}$$

Therefore, the Quantum color force Neutron-Proton mass difference is
mN - mP = Qmd - Qmu = 317.05 Mev - 314.95 Mev = 2.1 Mev.

Since the electromagnetic Neutron-Proton mass difference is roughly
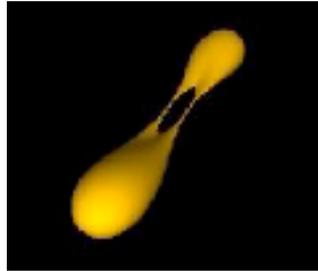$$mN - mP = -1 \text{ MeV}$$
the total theoretical Neutron-Proton mass difference is
$$mN - mP = 2.1 \text{ Mev} - 1 \text{ Mev} = 1.1 \text{ Mev,}$$

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

When a quark Kerr-Newman Black Hole and antiquark KNBH form a pion

the resulting 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
that can can carry a Sine-Gordon Breather that is equivalent to the massive
Thirring model. The soliton and antisoliton of a Sine-Gordon Breather
correspond to the quark and antiquark that make up the pion.

Using the E8 Physics constituent mass of the Up and Down quarks
and antiquarks, about 312.75 MeV, as the soliton and antisoliton masses,
and setting Coleman's parameter B^2 = pi and using the DHN formula,
the mass of the charged pion is calculated to be
$$(312.75 / 2.25) \text{ MeV} = 139 \text{ MeV}$$
which is close to the experimental value of about 139.57 MeV.

The value B^2 = pi (or, using Coleman's eq. (5.14), the Thirring coupling
constant g = 3 pi) is used because B^2 = pi is where
the First-order weak coupling expansion coincides with the DHN formula.

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 .14x6 GeV = 0.84 GeV. Just as the pion mass of .14 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 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
$$1.221 \times 10^{19} \text{ GeV}.$$

19 - Segal-type Conformal gravity with conformal generator structure giving
Dark Energy, Dark Matter, and Ordinary Matter ratio

Gravity and the Cosmological Constant come from the MacDowell-
Mansouri Mechanism and the 15-dimensional Spin(2,4) = SU(2,2)
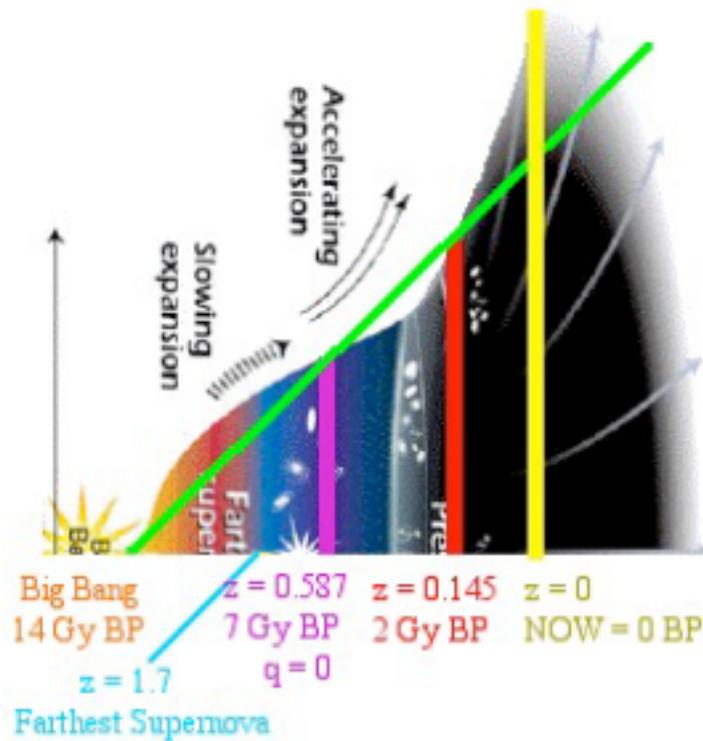Conformal Group, which is made up of:

3 Rotations;

3 Boosts;

4 Translations;

4 Special Conformal transformations; and

1 Dilatation.

The Cosmological Constant comes from
the 10 Rotation, Boost, and Special Conformal generators
of the Conformal Group Spin(2,4) = SU(2,2),
so the fractional part of our Universe of the Cosmological Constant
should be about 10 / 15 = 67% for tree level.

Black Holes, including Dark Matter Primordial Black Holes, are curvature
singularities in our 4-dimensional physical spacetime,
and since Einstein-Hilbert curvature comes from the 4 Translations
of the 15-dimensional Conformal Group Spin(2,4) = SU(2,2)
through the MacDowell-Mansouri Mechanism (in which the generators
corresponding to the 3 Rotations and 3 Boosts do not propagate),
the fractional part of our Universe of Dark Matter Primordial Black Holes
should be about 4 / 15 = 27% at tree level.

Since Ordinary Matter gets mass from the Higgs mechanism
which is related to the 1 Scale Dilatation
of the 15-dimensional Conformal Group Spin(2,4) = SU(2,2),
the fractional part of our universe of Ordinary Matter
should be about 1 / 15 = 6% at tree level.

However, as Our Universe evolves the Dark Energy, Dark Matter, and
Ordinary Matter densities evolve at different rates, so that the differences in
evolution must be taken into account from the initial End of Inflation to the
Present Time.

Big Bang
14 Gy BP   z = 1.7
Farthest Supernova

z = 0.587   z = 0.145   z = 0
7 Gy BP   2 Gy BP   NOW = 0 BP
q = 0

The result can be compared with data from WMAP and Planck:

evolution E8 calculation: DE : DM : OM = 75 : 20 : 05
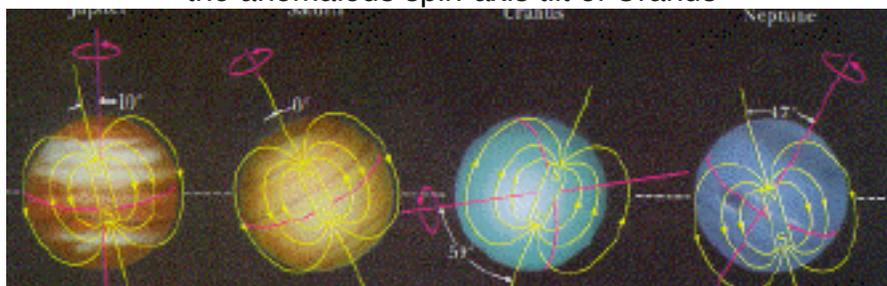WMAP: DE : DM : OM = 73 : 23 : 04
Planck: DE : DM : OM = 69 : 26 : 05
basic E8 Conformal calculation: DE : DM : OM = 67 : 27 : 06

20 - Dark Energy explanations for Pioneer Anomaly and Uranus spin-axis tilt
Conformal Dark Energy can explain the Pioneer Anomaly
and
the anomalous spin-axis tilt of Uranus

by taking the orbit of Uranus as a boundary between an outer region in which Conformal
Gravity is fully effective and an inner region in which the Conformal degrees of freedom
are frozen out, similarly to the 2-phases-of-gravity proposal of Irving Ezra Segal.

The Energy Gap of our Universe as superconductor condensate spacetime is from 3×10^{-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 Tc of BSCCO superconducting crystals.
Neutrino masses are involved because their mass is zero at tree level and their masses that we observe come from virtual graviphotons becoming virtual neutrino-antineutrino pairs.
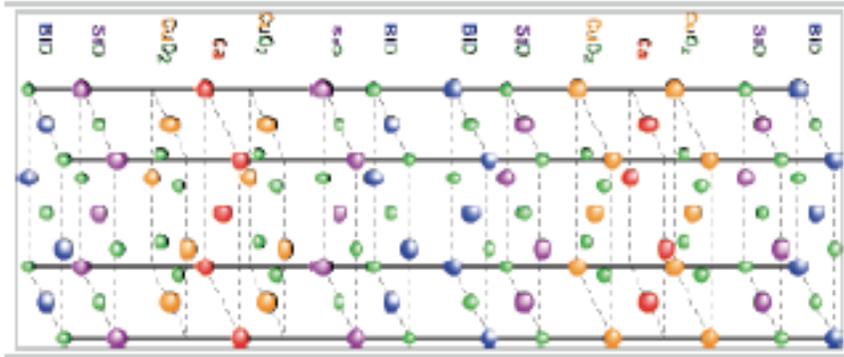
BSCCO superconducting crystals are natural Josephson Junctions.
Dark Energy accumulates in the superconducting layers of BSCCO.
The basic idea of Dark Energy from BSCCO Josephson Junctions is based on the 600-cell each of whose 720 edge-lines would be made of a single BSCCO crystal. It may be useful to use a Jitterbug-type transformation between a 600-cell configuration and a configuration based on icosahedral 120-cells which also have 720 edge-lines:
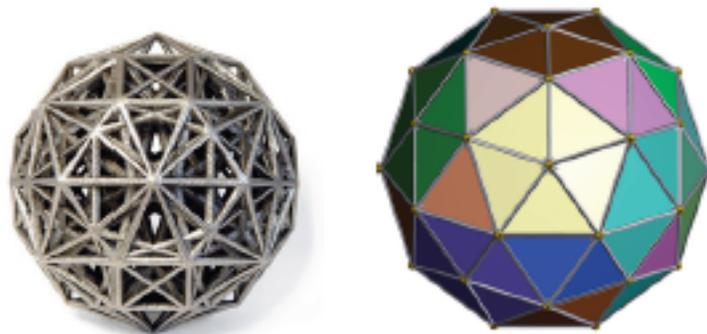
Since the E8 classical Lagrangian is Local, it is necessary to patch together Local Lagrangian Regions to form a Global Structure describing a Global E8 Algebraic Quantum Field Theory (AQFT).
This is done by using Clifford Algebras to embed E8 into Cl(16)
and using a copy of Cl(16) to represent each Local Lagrangian Region,
and then taking the tensor products of the copies of Cl(16).
Due to Real Clifford Algebra 8-periodicity, Cl(16) = Cl(8)xCl(8) ,
and any Real Clifford Algebra, no matter how large, can be embedded in a tensor product of factors of Cl(8), and therefore of Cl(8)xCl(8) = Cl(16).

Just as the completion of
the union of all tensor products of 2x2 complex Clifford algebra matrices
produces the usual Hyperfinite II1 von Neumann factor
that describes
creation and annihilation operators on fermionic Fock space over C^(2n)

the completion of the union of all tensor products of Cl(16) = Cl(8)xCl(8)
produces a generalized Hyperfinite II1 von Neumann factor
that gives a natural
                    E8 Physics Algebraic Quantum Field Theory.

23 - maximal contraction of E8 = semidirect product A7 x h92
gives a creation/annihilation algebra
where h92 = 92+1+92 = 185-dim Heisenberg algebra and A7 = 63-dim SL(8)

A Fundamental Building Block of E8 Physics AQFT is the
Maximal Contraction of E8
which can be written
as a 5-Graded Lie Algebra with structure

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

The Central Even Grade 0 = SL(8,R) + 1
The 1 is an anticommuting scalar and SL(8,R) has bosonic commutators.
As Polar Coordinates, SL(8,R) represents a local 8-dim spacetime
as SL(8,R) = Spin(8) + Traceless Symmetric 8x8 Matrices.

Odd Grades -1 and +1 each = 64 = 8x8 = Creation/Annihilation Operators
for
8 components of 8 fundamental fermions with fermionic anticommutators.

Even Grades -2 and +2 each = Creation/Annihilation Operators
for
28 Gauge Bosons with bosonic commutators.

Three Grothendieck Universes:

1 - Empty Set - the seed from which everything grows.

2 - Hereditarily Finite Sets - computer programs, discrete lattices, discrete Clifford algebras, cellular automata, Feynman Checkerboards.

3 - Completion of Union of all tensor products of Cl(16) real Clifford algebra which gives a generalized hyperfinite II1 von Neumann factor algebra that, through its Cl(16) structure, contains math structures that are sufficient to describe E8 Physics.

Spinor Doubling and Evolution of Our Universe
Frank Dodd Tony Smith Jr - 2013

E8 Physics based on a Cl(k) -> Cl(Cl(k)) Clifford Algebra process (vixra 1312.0036) can also be described based on
Spinors and their doubling up to Cl(16) 64+64-dim half-spinors:

In the beginning there was Cl(0) spinor fermion void

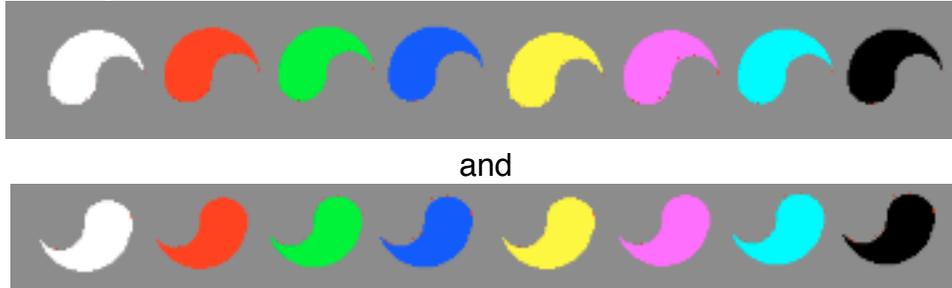from which emerged 2 = sqrt(2^2) = 1+1 Cl(2) half-spinor fermions/antifermions

 and

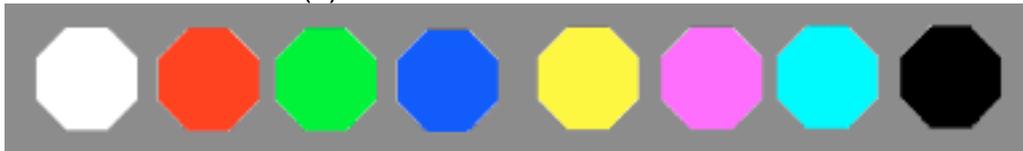from which emerged 4 = sqrt(2^4) = 2+2 Cl(4) half-spinor fermions/antifermions

 and

from which emerged 8 = sqrt(2^6) = 4+4 Cl(6) half-spinor fermions/antifermions

 and

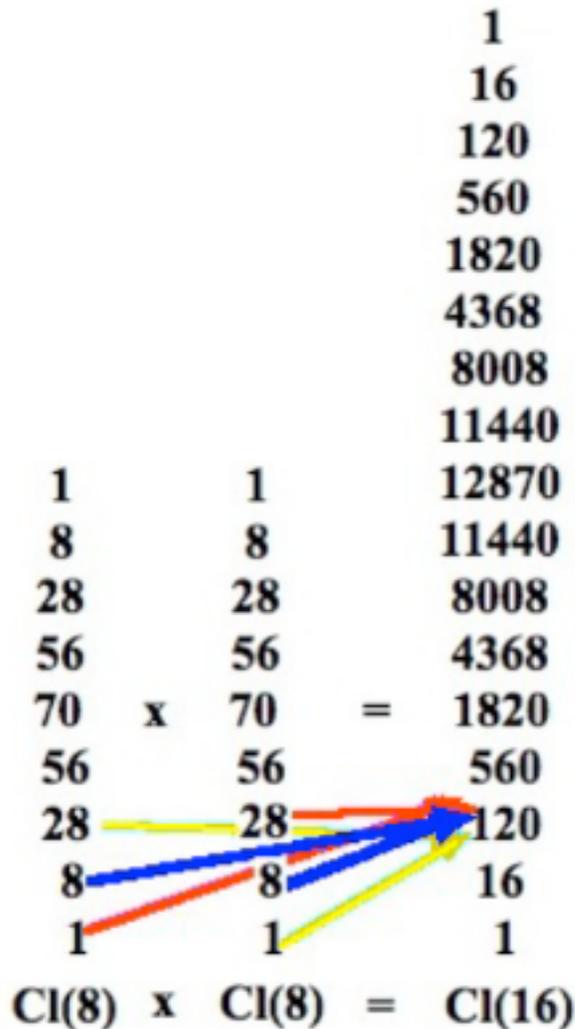from which emerged 16 = sqrt(2^8) = 8+8 Cl(8) half-spinor fermions/antifermions

and

8 half-spinor fermions and 8 half-spinor antifermions are isomorphic by Cl(8) Triality to each other and to the 8 Cl(8) vectors

so that the 28 antisymmetric pairs of half-spinors are the 28 Cl(8) bivectors of a D4 Lie Algebra:
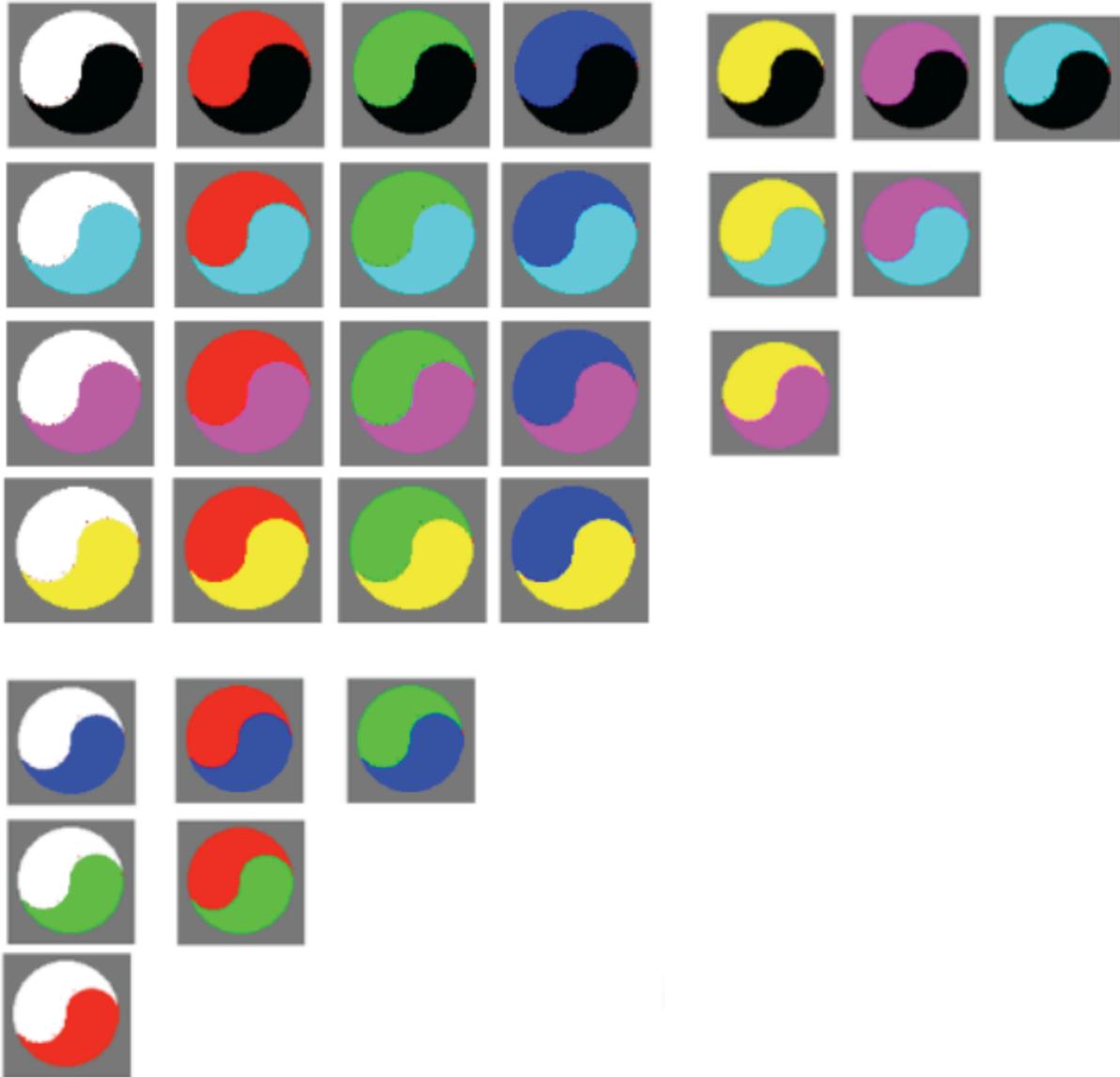
By Real Clifford Algebra Periodicity, the tensor product Cl(8) x Cl(8) = Cl(16):

$$
\begin{array}{cccc}
 & & & 1 \\
 & & & 16 \\
 & & & 120 \\
 & & & 560 \\
 & & & 1820 \\
 & & & 4368 \\
 & & & 8008 \\
 & & & 11440 \\
1 & 1 & & 12870 \\
8 & 8 & & 11440 \\
28 & 28 & & 8008 \\
56 & 56 & & 4368 \\
70 \quad \mathbf{x} & 70 \quad = & & 1820 \\
56 & 56 & & 560 \\
28 & 28 & & 120 \\
8 & 8 & & 16 \\
1 & 1 & & 1 \\
\end{array}
$$

$$\text{Cl(8)} \quad \mathbf{x} \quad \text{Cl(8)} \quad = \quad \text{Cl(16)}$$

Spinors:

$$(8s+8c) \;\text{x}\; (8s+8c) = \begin{array}{c} (\boxed{8s_x8s} + \boxed{8c_x8c}) \\ + \\ (8s_x8c + 8c_x8s) \end{array}$$

256 = sqrt(2^16) = 128 + 128 Cl(16) half-spinor generation/antigeneration
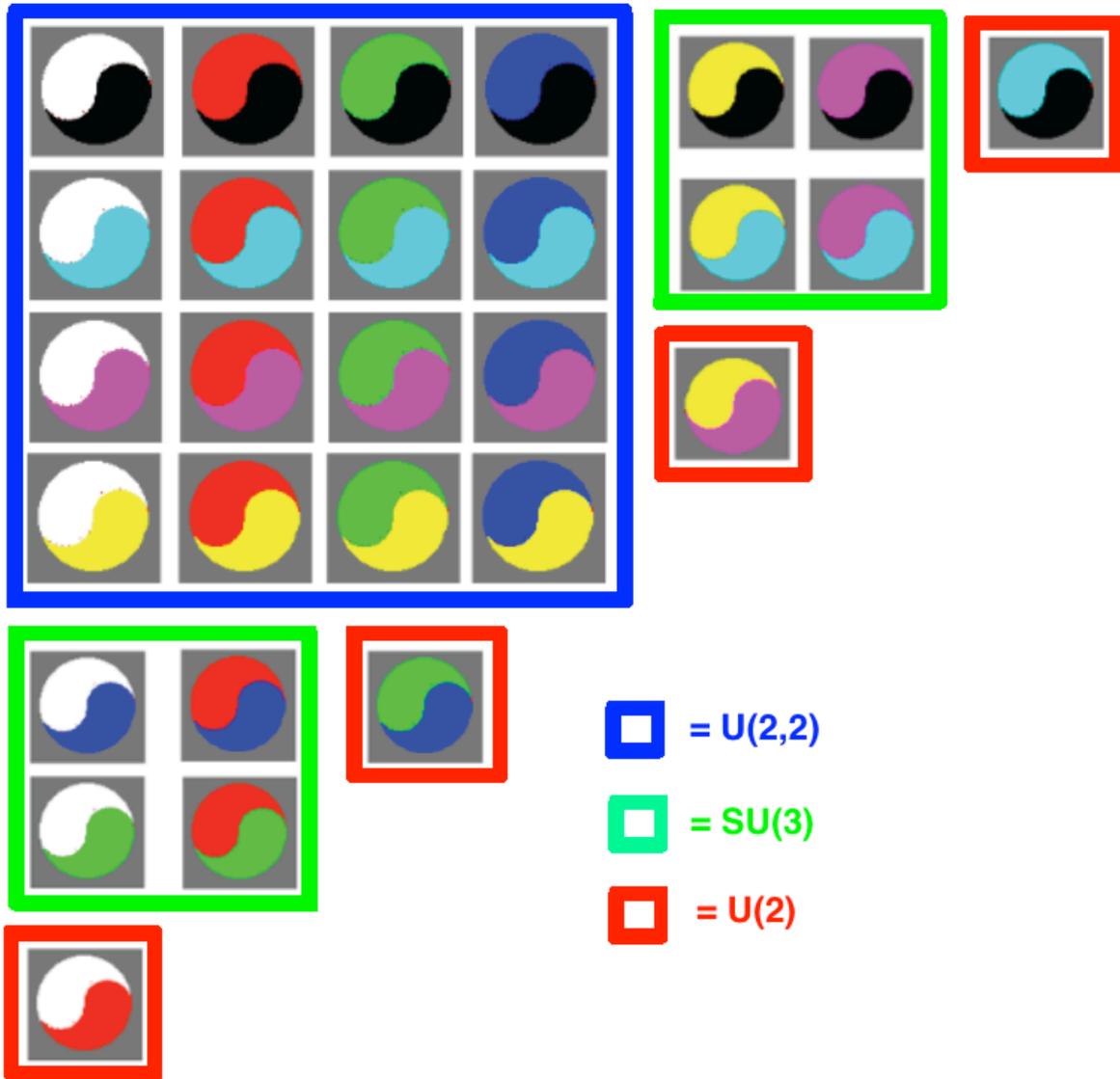128 Cl(16) generation = 64 + 64 quarter-spinor fermions/antifermions
120 + 64 + 64 = E8
E8 root vectors = 112 + 64 + 64
E8 contains 120 = D8 = 8x8 + 1x28 + 28x1
D8 contains 28 + 28 = D4 x D4
one D4 gives Gravity - other D4 gives the Standard Model

D4 acting on M4 of M4xCP2 4+4 = 8-dim Kaluza-Klein for Gravity:


□ = U(2,2)

□ = SU(3)

□ = U(2)

16-dim **U(2,2)** contains 15-dim SU(2,2) = Spin(2,4) Conformal Group Algebra acting as Gauge Group Algebra on 4-dim M4 physical spacetime of 4+4 Kaluza-Klein that gives Gravity by the MacDowell-Mansouri mechanism
and
also contains 1-dim U(1) Propagator Phase.

D4 / U(2+2) = 12-dim rank 2 Symmetric Space corresponding to **SU(3)** and **U(2)** but not directly acting on M4 of M4xCP2 Kaluza-Klein.

D4 acting on CP2 of M4xCP2 4+4 = 8-dim Kaluza-Klein for the Standard Model:

16-dim **U(4)** contains 15-dim SU(4) which contains 8-dim **SU(3)** Color Force Algebra acting as Gauge Group Algebra on 4-dim CP2 internal symmetry space of Kaluza-Klein that gives the Standard Model Color Force by the Batakis mechanism and also contains 4-dim **U(2)** of CP2 = SU(3)/U(2) for Batakis ElectroWeak Force and also contains the 4 T-generators of **U(2,2)** T-generators that propagate in MacDowell-Mansouri to describe Einstein-Hilbert Curvature and Dark Matter Black Holes.

D4 / U(4) = 12-dim rank 2 Symmetric Space for AntideSitter Dark Energy + Dilaton + Propagator Phase of **U(2,2)** but not directly acting on CP2 of M4xCP2 Kaluza-Klein.

One Cl(16) containing one E8 gives a Lagrangian description of only one local spacetime neighborhood. To get a realistic global spacetime structure, take the tensor product Cl(16) x ... x Cl(16) with all E8 local 8-dim Octonionic spacetimes consistently aligned as described by 64-dim D8 / D4xD4 (blue dots)
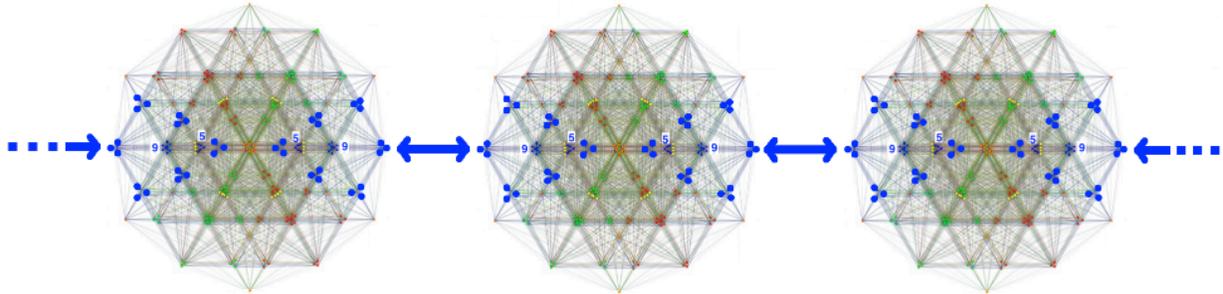
which then fill up spacetime according to Gray Code Hilbert's curves:
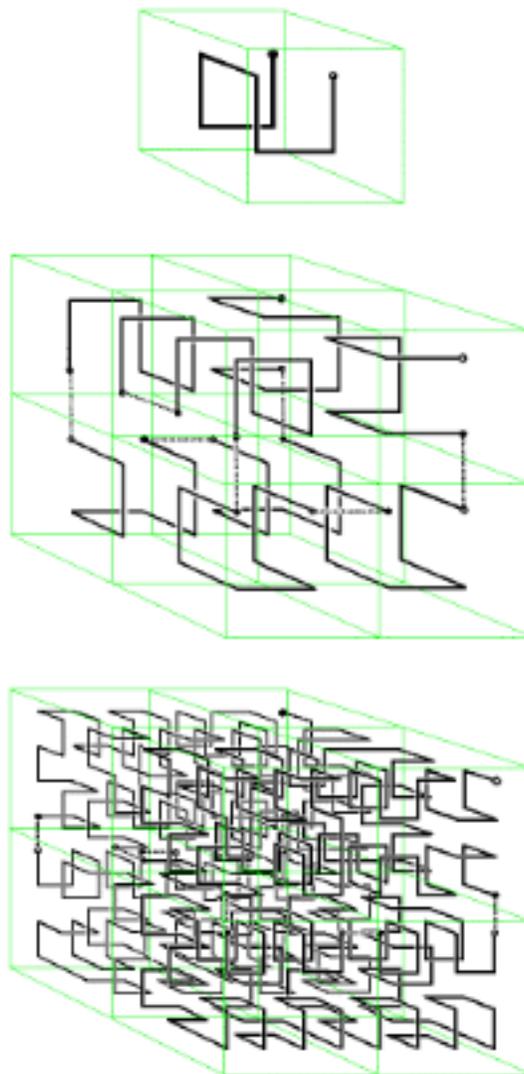
As our Universe evolves, there are some Special Times in its history:

1 - the Big Bang Beginning of Non-Unitary Octonionic Inflation (about 13.7 Gy BP)
during which Non-Unitary processes produce about 10^89 particles;

2 - the End of Inflation = Beginning of Unitary Quaternionic Expansion
that initially is Decelerating (beginning of green line also about 13.7 Gy BP);

3 - the End of Deceleration (q=0) = Inflection Point =
= Beginning of Accelerating Expansion (purple vertical line at about 7 Gy BP);

4 - the Last Intersection of the Accelerating Expansion of our Universe
of Linear Expansion (green line) with the Third Intersection
(at red vertical line at about 2 Gy BP);

5 - Now.
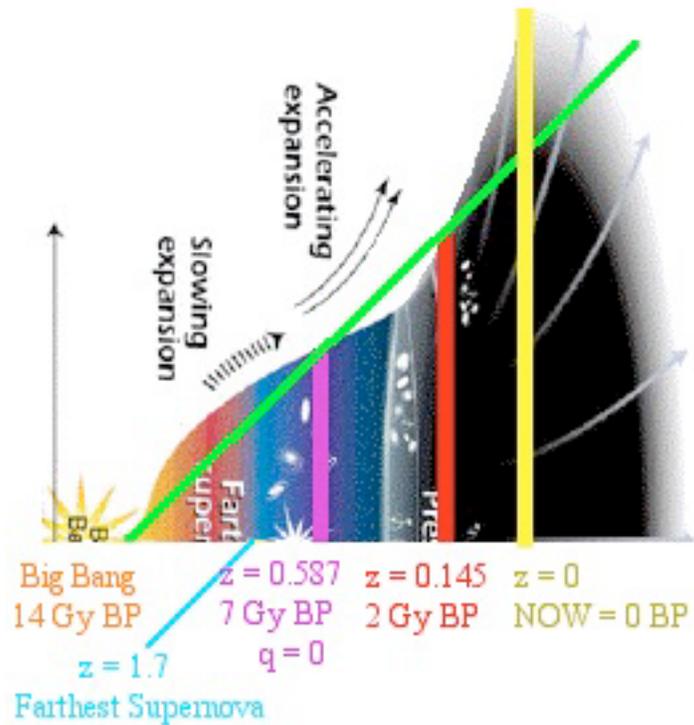
In E8 Physics the Conformal Group structure and the history of our Universe give the
ratio Dark Energy : Dark Matter : Ordinary Matter that is roughly
$$DE : DM : OM = 75 : 20 : 05$$

.

The Cl(8) Clifford Algebra structure of our Universe was in ancient times encoded in
African IFA Divination based on 16x16 = 256 elements (tony5m17h.net/VoudouFA.html)
It corresponds mathematically to the Cl(8) Real Clifford Algebra
with graded structure 256 = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1
and algebraic structure of M(16,R) = 16x16 Matrices of Real Numbers.

Here is how E8 Physics of Gravity and the Standard Model is encoded in IFA:

256-dim 16x16 =
= 120-dim Antisymmetric16x16 + 136-dim Symmetric 16x16
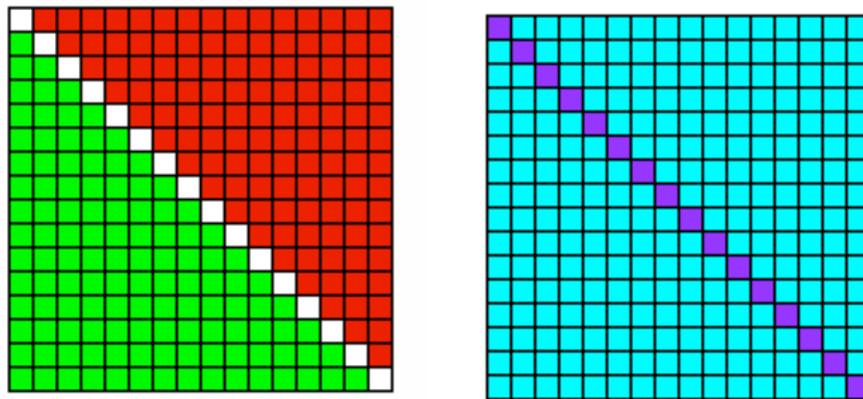
For Antisymmetric 16x16 each red entry above the diagonal is the negative of the
corresponding green entry below the diagonal and the 16 diagonal entries are zero
so the number of Antisymmetric entries is 120 corresponding to the D8 Lie Algebra.

For Symmetric 16x16 each cyan entry above the diagonal is equal to the
corresponding cyan entry below the diagonal and the 16 diagonal entries are non-zero
so the number of Symmetric entries is 120+16 = 136.
8 of the 136 Symmetric entries of the IFA Cl(8) 16x16 Matrix do not correspond to E8
but
the other 136-8 = 128 = 64 + 64 correspond to 128-dim half-spinor of D8.

Since 248-dim E8 = 120-dim D8 + 128-dim half-spinor of D8
by E8 / D8 rank 8 Type EVIII space (OxO)P2 the Octo-Octonionic Projective Plane

256-dim IFA Cl(8) contains 120+128 = 248-dim E8
and
encodes the structure of E8 Physics of Gravity and the Standard Model.

African IFA to RigVeda-Pachisi

From its home in Africa the IFA Information System spread, like humanity itself,

throughout the Earth. Some of its descendant systems, such as

128-element Shinto Divination
64-element I Ching
16-element Ilm Al Raml

are straightforward subsets of 256-element IFA
but
the Rig Veda and its related game Pachisi has a more intricate relationship to IFA.

Within its African home IFA was never written down but was oral tradition
but
when humans left Africa they had less of the direct contact with their Ancestral Home
that is useful for preservation of oral tradition.

India was settled from Africa via the Arabian Sea in very early times.
(map adapted from "Past Worlds, The Times Atlas of Archaeology" (Crescent Books 1995))
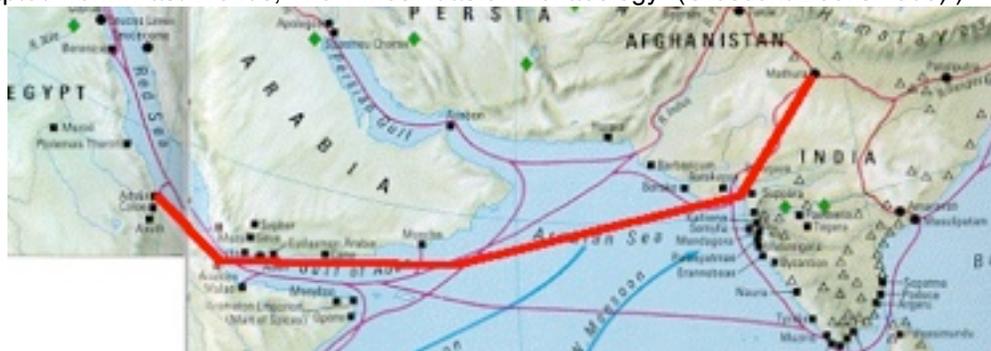
Indian priests of IFA chose to put the IFA Information System into writing,
so they developed Sanskrit from the African Geez language.

In a 16 October 2010 post to his blog at bafsudralam.blogspot.com Clyde Winters said:
"... The Naga were Semitic speaking people from Ethiopia …
The major gift of the Naga to India was the writing system: Deva-Nagari.

Nagari is the name for the Sanskrit script ... the ancient Ethiopic and Sanskrit writing are one and the same ... the name Nagari for Sanskrit betrays the Ethiopia origin of this form of writing. In Geez, the term nagar means 'speech, to speak'. ...".

Feuerstein, Kak, and Frawley, in their book In Search of the Cradle of Civilization (Quest 1995), say "... The principal and, taken in its totality, the oldest of the four Vedic hymnbodies is the Rig-Veda. ... The Sanskrit word ric, which for euphonic reasons is changed to rig, means literally "praise". ... The Sanskrit word veda means literally "knowledge" or "wisdom". ... **The Rig-Veda is** the oldest book in the Sanskrit language ... More than that, if we are correct, it is **the oldest book in the world** ...".

The Indian National Science Academy web site insaindia.org says
"... The Vedic Civilization ... evolved around ... the Vedas ... Vedic meters ... permutations and combinations of long and short sounds ... led ... to discover[y of] the Meru Prastara ...
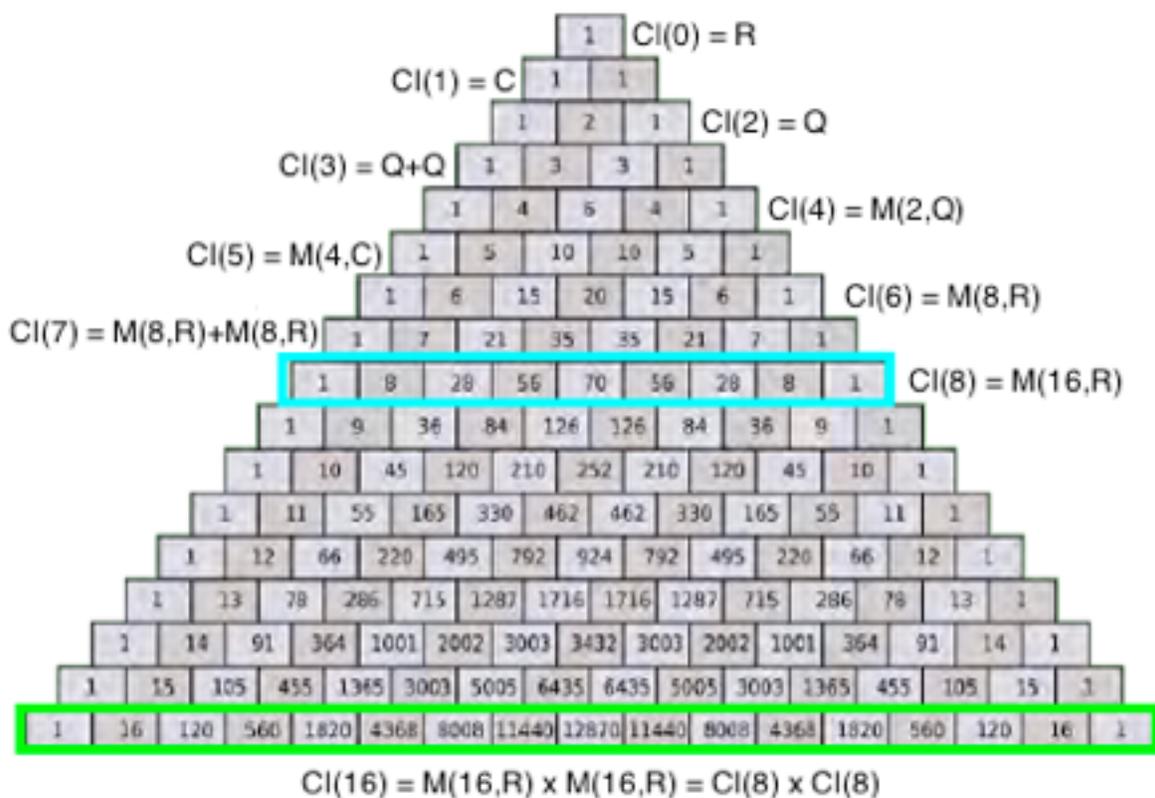

now known as Pascal's Triangle ...".

The row I have outlined in cyan contains the 1+8+28+56+70+56+28+8+1 = 256 = 16x16 elements of the Cl(8) Real Clifford Algebra of African IFA divination.
The other rows contain the 2^N elements of Cl(N) where N is the second number from the left in each row, so that the Meru Prastara describes all Real Clifford Algebras Cl(N), with the figure above showing Cl(0) through Cl(16) which I have outlined in green.
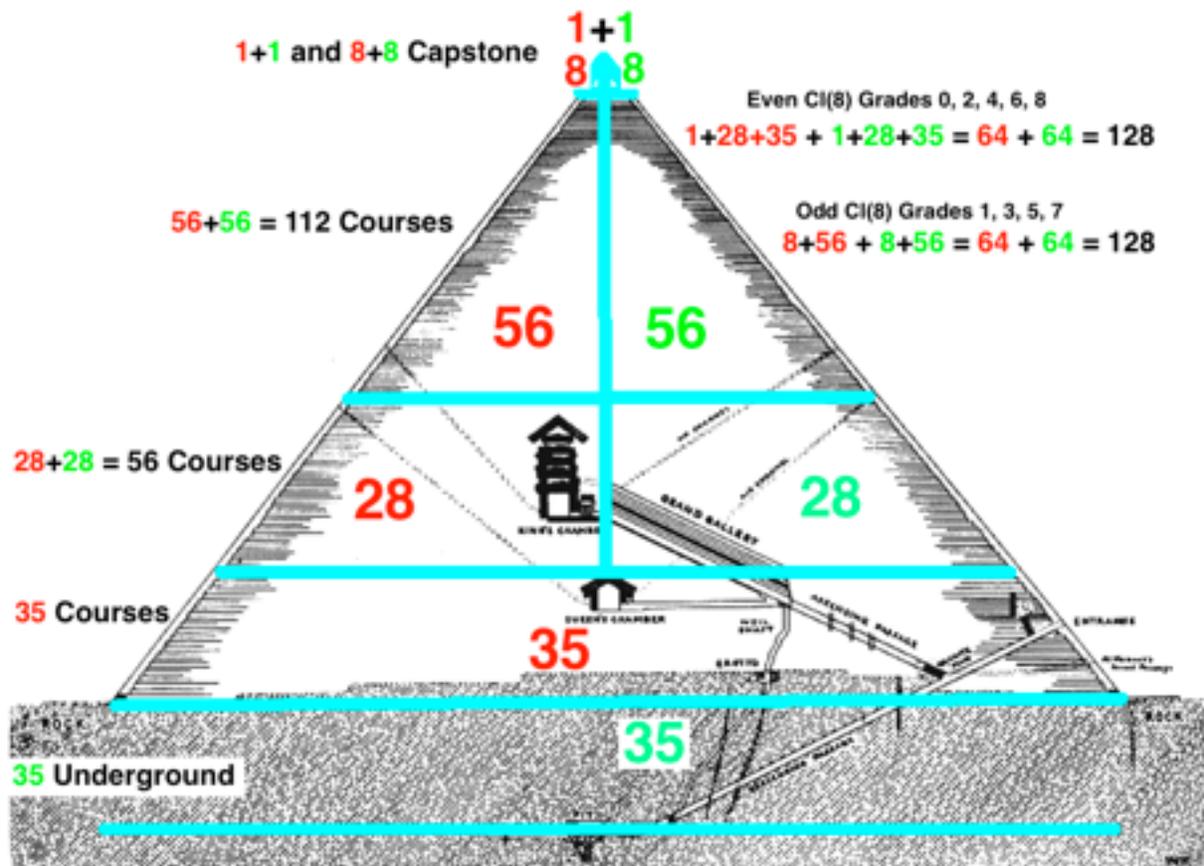
The Golden Ratio structure and pyramidal shape show that the representation of
Ancient African IFA by the Meru Prastara of African Migrants to India 50,000 years ago
(about 4 Vedic Semi-Precession periods of 4800 + 3600 + 2400 + 1200 = 12,000 years
with the 4th 1200 year Dark Iron Kali Yuga ending about 2012 / 2013 to be followed by a
Bright Golden 4800 year Satya Yuga of reconciliation of technology and spirituality)
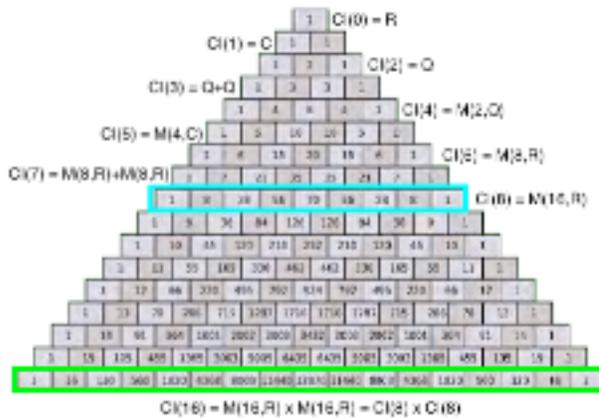
corresponds to its representation
by the Great Pyramid of Giza of African Nile Migrants of 40,000 years ago
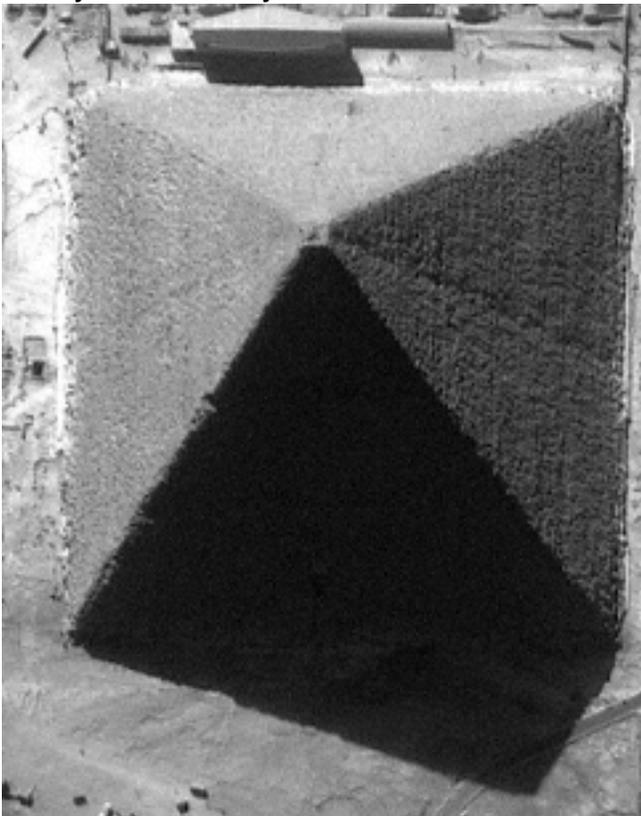
The migration from Africa to the Mouth of the Nile about 40,000 years ago
can be seen in terms of the chronology of the Egyptian historian Manetho
who lived about 2,000 years ago in which the African Nile migration would be seen as
occurring about 36,525 years ago, when the Geminga SuperNova Shock Wave hit Earth

1+1 and 8+8 Capstone

1+1
8 8

Even Cl(8) Grades 0, 2, 4, 6, 8
1+28+35 + 1+28+35 = 64 + 64 = 128

Odd Cl(8) Grades 1, 3, 5, 7
8+56 + 8+56 = 64 + 64 = 128

56+56 = 112 Courses

56   56

28+28 = 56 Courses

28   28

35 Courses

35

35

35 Underground

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

(image adapted from David Davidson image -
for a larger version of this image go to tony5m17h.net/GreatPyrCl8.png
or valdostamuseum.com/hamsmith/GreatPyrCl8.png)

Here is how the structure of the IFA Information System has been simplified for transmission to Pachisi:

First, due to the diagonal-reflection symmetry of Antisymmetric and Symmetric matrices, only the upper triangular parts of the matrices need to be preserved:

The Symmetric part was simplified by ignoring the part of Cl(8) not in E8
and then using only 32 entries (from outer shell and diagonal) of those 128 entries
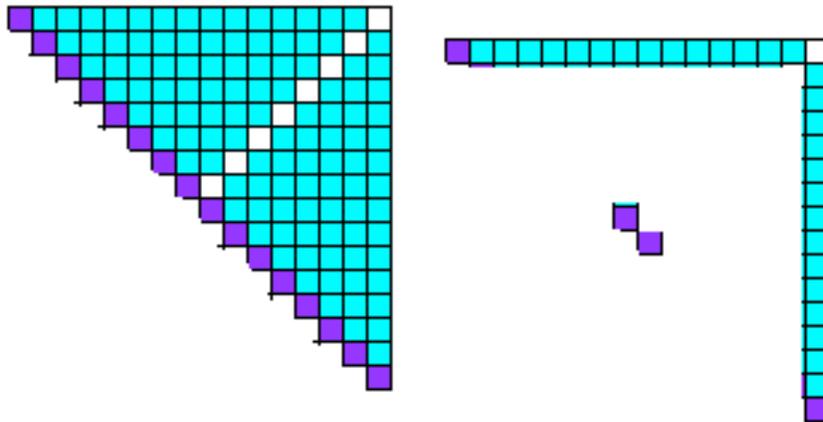
The Antisymmetric part was first cut into 3 sections
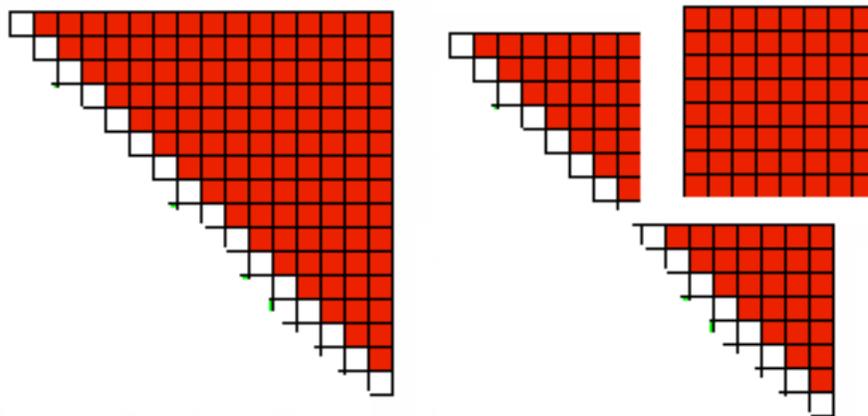
two similar triangular each with 28 entries and one square with 64 entries.
Using only one of the two similar 28-entry triangles plus 16 from the square (outer shell)
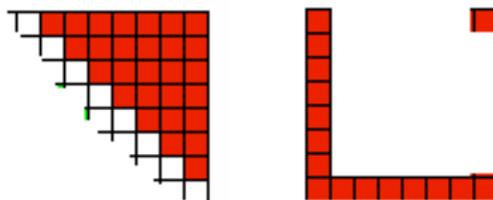
reduced the 120 Antisymmetric entries to 28 + (64-49) = 28+16 = 44 entries

thus reducing 248-dim E8 to 28 + 16 + 32 = 76 entries.
Since most of the IFA E8 structures are outer boundaries of square regions
it is natural to construct Pachisi as a boundary-progession board game
so the 30-entry Symmetric outer shell is broken into two parts which,
when added to the 28-entry and 15-entry Antisymmetric parts,
naturally fit together in this configuration
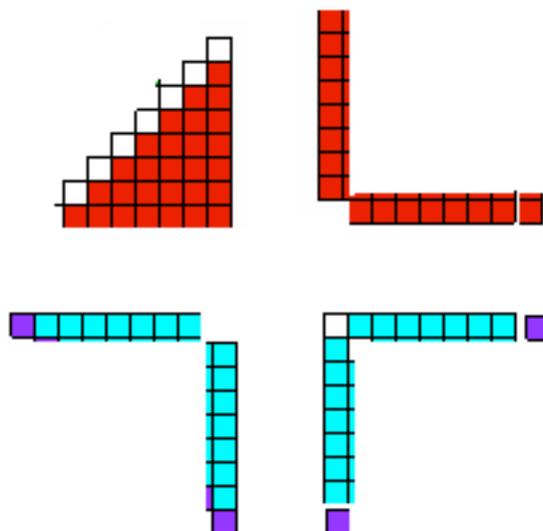
with 3 quadrants that look like a boundary-progression board game
but with one triangular quadrant that looks out of place. To make the board look more
nearly consistent, move the interior 15 elements of the triangle to the interior of the
board to get
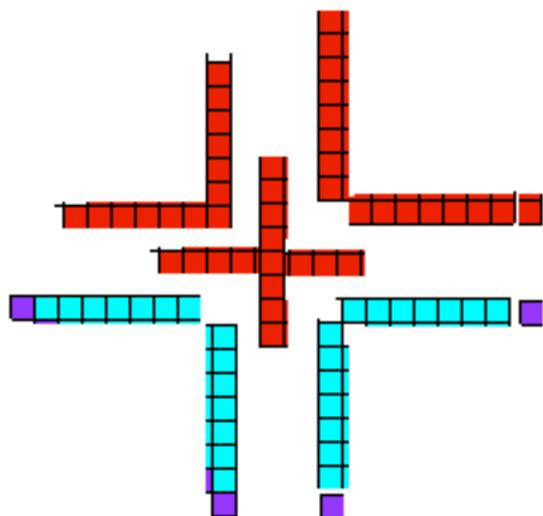
with 8+8+8+8+8+8+7+6 = 61 outer plus 15 inner = 76 entries

In order to fill out the Pachisi board 29 more entries are needed as filler
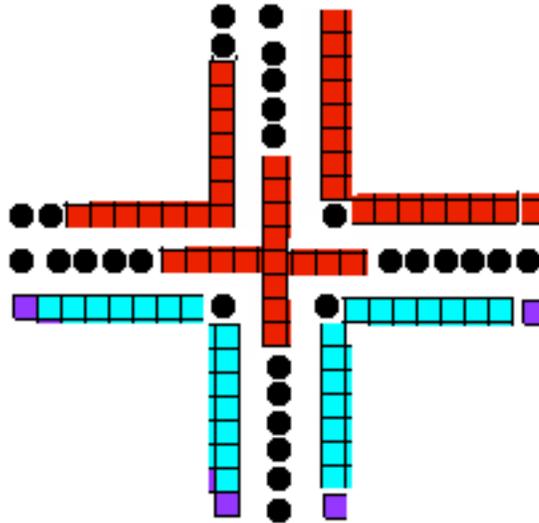
to get the total of 105 entries on the full game board for Pachisi.

RigVeda-Pachisi to Tarot

Tarot was developed from Pachisi by getting rid of 26 filler entries
and using the 15 inner entries: 4 to complete the exterior arms of D4;
4 to bridge between arms; 1 as an inner corner; and 6 in central configuration,
with the remaining 2 filler entries used for the U(1) of D5 / D4xU(1) and E6 / D5xU(1)
The red entry at the corner of the left-side blue pair of arms corresponds to
the Antisymmetric U(1) in the U(2,2) = U(1)xSpin(2,4) subalgebra of the D4 which
physically represents the propagator phase of Fermions from the Symmetric sector.
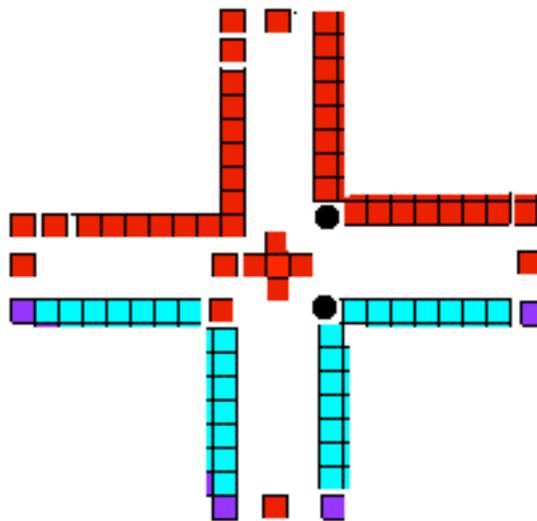
Tarot has 105 - 27 = 78 cards, corresponding to the 78-dim E6 Lie Algebra.

Tarot to Llull

Ramon Llull (1232-1316) of Mallorca lived in a time and place of
a unique confluence of Islamic, Christian, and Jewish mystical ideas
on a Mediterranean island between Iberia and Africa
so
he was exposed to ideas including
Islamic 16-element Ilm al Raml derived from African 256-element IFA,
Christian-Crusader Troubadour 78-element Tarot,
Jewish Urim v'Thummim system revealed to Moses for decoding the 72 letters
on the 12 stones of the Breastplate of Judgment,
and
he was able to travel easily to Africa, the home of 256-element IFA.

According to Anthony Bonner's book Doctor Illuminatus (Princeton 1993):
"... In the history of Western mysticism,
there is nothing quite like ...[Llull's Quaternary Phase (1274-89)]...
with its curious blend of Troubadour, Franciscan, and Islamic influences,
mixed with Llull's own special outlook based on the Art ...".

"Llull's own special outlook" may have been to see that

72 letters of the Urim v'Thummim Breastplate are contained in the 78-element Tarot

the 78-element Tarot fits inside the 256-element IFA D4 Real Clifford Algebra as

$$1 + 8 + 28 + ... + 8 + 1$$
fits inside
$$256 = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1$$
and as

$$(8+8) + (8+8)$$
fits inside
$$256 = (8+8)\times(8+8)$$

Troubadours propagated songs, poetry, and games such as Tarot.
Ramon Llull (1232-1316) of Mallorca studied the Islamic 16-element Ilm al Raml,
the Troubadour 78-element Tarot,
and the 256-element IFA
and
found a structure that he summarized in Wheel Diagrams with 16 vertices
connected to each other by lines such as (some images adapted from lullianarts.net web site)

Of **the 120-dim Antisymmetric Part of 16x16 Real matrices**
the 78-dim Tarot contains only a 16-dim partial boundary of its 64-dim U(8) square
and one 28-dim D4 triangle plus a single 1-dim U(1) from D5 / D4xU(1)
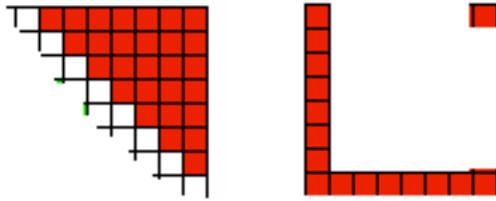
Llull expanded that 45-dim part of the Tarot to include the second D4 triangle
and to represent them in his Wheel Diagram X as two sets of 8 vertices,
for a total of 16 vertices, around the X-Wheel within which each set of 8 vertices
was connected with the other 7 of that set by 28 lines,
each line representing one generator of each of the two copies of 28-dim
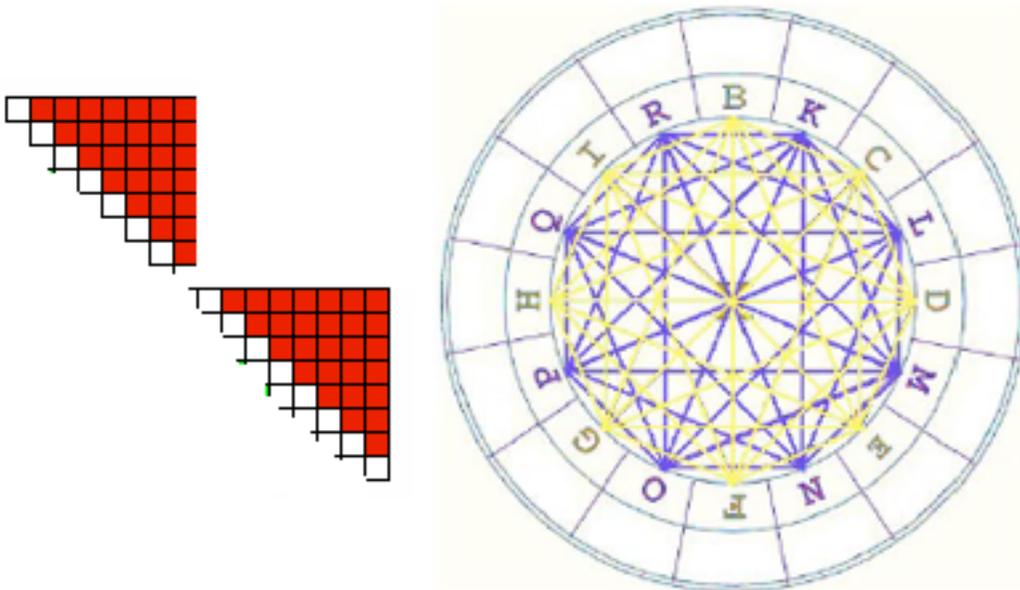
The 28 gold lines represent the D4 containing U(2,2) that gives Conformal Gravity
and
the 28 purple lines represent second D4 containing the SU(3)
that when combined with Kaluza-Klein Internal Symmetry Space CP2 = SU(3) / U(2)
gives by the Batakis mechanism the Standard Model Gauge Groups SU(3)xSU(2)xU(1).

Llull further expanded the 16-dim square-partial-boundary to full square 64-dim size
by adding the 64 blue lines that connect a vertex of one D4 with a vertex of the other D4
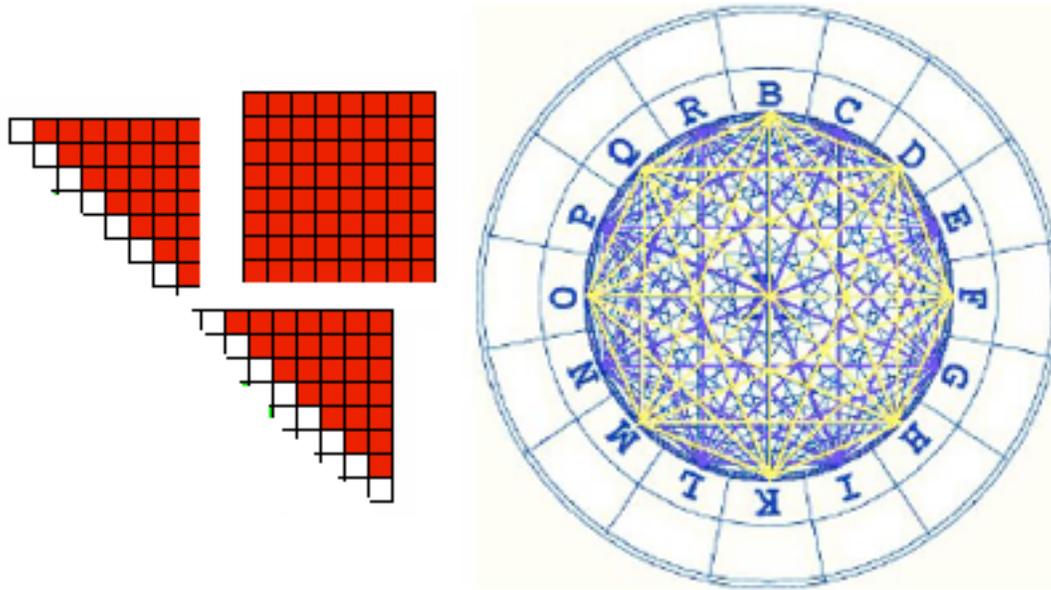

Adding in 64 blue lines gives 28+28+64 = 120 lines of the Llullian A-'wheel
that represents the Spin(16) bivector Lie Algebra D8
of the Clifford Algebra Cl(16) = Cl(8) x Cl(8)

As to **the 136-dim Symmetric part of 16x16 Real matrices**
the 78-dim Tarot does not contain any of the 8 antidiagonal elements
but contains a single 1-dim U(1) from E6 / D5xU(1)
plus 16 of 64 entries in each of two 64-element triangular blocks
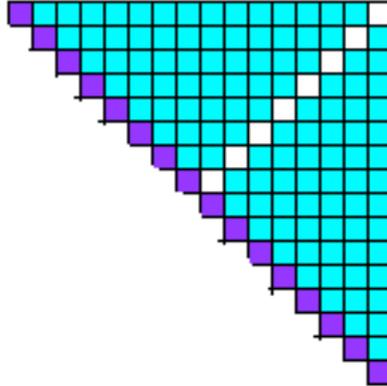
Physically one of the 64-element blocks of the Symmetric Part of Tarot corresponds to
the 8 components (with respect to 8-dim Kaluza-Klein spacetime)
of the 8 First-Generation Fundamental Fermion Particles
and
the other 64-element block corresponds to the components of the Fermion Antiparticles.

Ramon Llull's 64-element Elemental Figure is effectively an 8x8 matrix corresponding to
(image from quisestlullus.narpan.net web site)
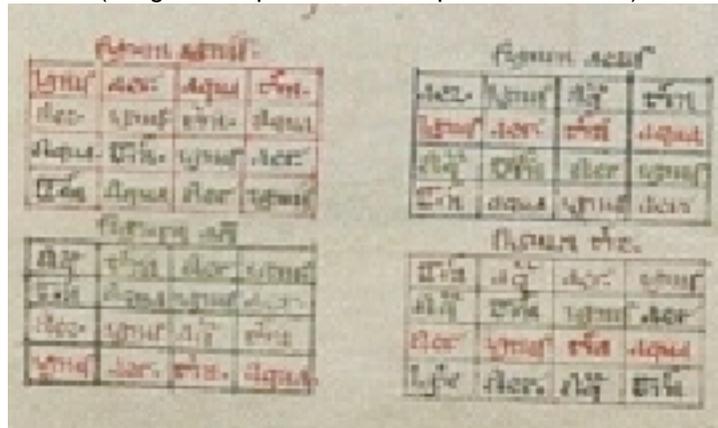
the Fermion Particle and Fermion Antiparticle 64-element Symmetric Tarot blocks
thus
constructing a 64+64 = 128-dimensional D8 half-Spinor space
that when combined with the 120-dimensional D8 of the Llullian A-Wheel produces
120-dim D8 + 128-dim D8 half-Spinor = 248-dim E8 Lie Algebra

In his time around 1300 A.D. Ramon Llull could not use the language of 2000 A.D. math and physics to explain his Tarot-type model to the world. As Anthony Bonner' said in his book Doctor Illuminatus (Princeton 1993):

"... Even ...[Llull's]... disciple, le Myesier, complained ... about "the confusion caused by the meanings of the alphabet of the Ars demonstrativa and its sixteen figures, which confound the mind." ...

Llull ... tr[ied] to persuade the Parisian schoolmen ...[by]... us[ing] the bizarre vocabulary more sparingly, and modify[ing] the Art itself so that it would not look so alarming. ...

Towards the beginning of 1290 in Montpelier, therefore, Llull set about ... beginning a new phase of the Art ...

As a result of the "weakness of human intellect", the number of figures [wa]s reduced and the algebraic notation vanishe[d] ...

Llull's last works were written in December 1315 in Tunis, at which point he disappears from history. ... he must have died sometime between then and March 1316

...

the Dominican inquisitor general of Aragon, Nicholas Eymerich (1320-99), began a campaign against the doctrines of Ramon Llull ...[that]... culminated ... in two events: The first was the publication in January ... 1376 ... of the Directorium inquisitorum, his notorious manual on inquisitorial methods ... it contained a list of a hundred errors of Ramon Llull ... on February 6, a papal bull was promulgated censuring Llull and condemning twenty of his books ... Llull's followers ... won in 1416 ... the promulgation by the Papal Court ... invalidating the bull of forty years earlier. ... Veneration of Llull was ... permitted within the Franciscan Order and locally in Majorca ... his feast day was set on 3 July ...

The second condemnation of Llullist doctrines came from ... the Faculty of Theology of the University of Paris. In 1390 ... the Faculty of Theology publish[ed] an edict prohibiting the teaching of Llullist doctrines. ...[It]... cut off ... considerable interest in Llull in Paris ...".

In short:

Ramon Llull expanded the 78-dim Tarot outline structure to the old full 256-dim IFA including the E8 Lie Algebra and the realistic structure of E8 Physics
but
he was 600 years ahead of rediscovery of his mathematics
and
700 years ahead of the time of detailed experimental confirmation
with the result that
the Paris-based Establishment of his time ignored and attacked his work
even when he tried to dumb it down to their level.

Llull to Cartan-Dirac-Riesz-E8Physics

Llull's description of the D8 Lie Algebra of dimension 120 = 8 (16-1)
remained undeveloped and unappreciated for 600 years
until Killing and Cartan classified Lie Groups.
Roger Penrose in his book "The Road to Reality" (Knopf 2004) said:
"... classification ...[of]... Lie groups ... started with Wilhelm Killing ... whose basic papers
appeared in 1888-1890, and was essentially completed in 1894 ... by ... Elie Cartan ...
It turns out that there are four families, known as Am, Bm, Cm, Dm ... of respective
dimension m(m+2), m(2m+1), m(2m+1), m(2m-1), called the classical groups ...
and five exceptional groups known as E6, E7, E8, F4, G2,
of respective dimension 78, 133, 248, 52, 14. ...".
The connection of the 248-dim Lie Algebra E8 with the Clifford Algebra Cl(16)
and its 120-dim bivector algebra D8 and 128-dim half-spinor space
only became clear in the 1900s based on the work of Cartan
as further developed by Jovet, Sauter, and Riesz mathematically
and applied by Dirac to physics.
Pertti Lounesto in his article on "History of Clifford Algebras"
in the book "Clifford Numbers and Spinors" by Marcel Riesz (Kluwer 1993) said:
"... E. Cartan 1908 ... identified the Clifford algebras Cl(p,q) as matrix algebras with
entries in R [Real Numbers], C [Complex Numbers], H [Quaternions], R+R, H+H
and found a periodicity of 8 ...
Cartan also observed spinor modules of orthogonal Lie algebras in 1913 ...
Jovet 1930 and Sauter 1930 replaced column spinors by square matrices in which only
the first column was non-zero -
thus spinor spaces became minimal left ideals in a matrix algebra.
Riesz 1947 used primitive idempotents of Clifford algebras to construct spinor spaces
as minimal left ideals in Clifford algebras ...".

Roger Penrose in his book "The Road to Reality" (Knopf 2004) said:
"... One reason that Clifford Algebras are important is for their role in defining spinors.
In physics, spinors made their appearance in Dirac's equation for the electron (Dirac
1928), the electron's state being a spinor quantity ...".
In the 1900s, Irving Ezra Segal showed the connection between the Conformal Group
and the Dark Energy of Gravity; MacDowell and Mansouri showed how gauging the
Conformal Group produces Gravity; and the Dirac Equation was generalized to the
Standard Model. During the 2000s Dark Energy was observed by WMAP and Planck
and the LHC discovered a Higgs state, confirming the basic Standard Model structure
so

**it is only now (the 2000s) that the formal Written Human Culture
has caught up with the informal Oral Ancient African Culture
and the 700-year old model of Ramon Llull
in understanding a realistic Unified Theory of the Laws of Nature.**