Minimal Math Structures needed for E8 Physics

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This is a rough outline of the minimal math structure needed for my E8 Physics model. It makes clear that a major barrier to understanding it is the amount of not-well-known mathematics of Real Clifford Algebras, Lie Algebras, Bounded Complex Domains, etc. ... No details are given here as they can be found in viXra 1312.0036 and my other viXra papers and my web sites at tony5m17h.net and valdostamuseum.com/hamsmith/ As to why anyone should expend the effort to understand the necessary math, the payoff is the substantially realistic results of E8 Physics calculations set out at the end of this paper. The calculations are mostly tree-level with a few first-order results so further calculation work might bring even closer correspondence with observations.

Cl(8) contains 52-dim F4 = 8-dim vector + 28-dim bivector + 16-dim full spinor

F4 has the basic structure of a realistic physics model:

8-dim M4 x CP2 Kaluza-Klein spacetime
28 = 16-dim U(2,2) Conformal Gravity + 12-dim SU(3)xSU(2)xU(1) Standard Model
8 first-generation fermion +half-spinor particles
8 first-generation fermion -half-spinor antiparticles

but
F4 does not have complex domain structure or spacetime momentum structure or detailed component structure. To get all that structure you must go beyond F4 to 248-dim E8.

E8 is naturally contained in the 8-Periodicity tensor product Cl(8)xCl(8) = Cl(16) as
E8 = 120-dim bivector of Cl(16) +
+ 128-dim half-spinor of Cl(16) =

= 8x8 of Cl(8)xCl(8) + 1x28 of Cl(8)xCl(8) + 28x1 of Cl(8)xCl(8) +

+ 8x8 Cl(8)+half-spinor x Cl(8)+half-spinor + 8x8 Cl(8)-half-spinor x Cl(8)-half-spinor

Local 28-dim Spin(8) symmetry gives Complex Bounded Domain structure by
8-complex-dim Spin(10) / Spin(8)xU(1) with 8-real-dim RP1 x S7 Shilov Boundary.

Triality among 8 Cl(8)+half-spinor and 8 Cl(8)-half-spinor and 8 Cl(8)vector extends that Complex Bounded Domain and RP1 x S7 Shilov Boundary structure to fermion representation spaces.

Gauge boson representation space Complex Bounded Domain structures are:
local D4 and D3=A3 subalgebra B2
    with B3 / B2xU(1) and Shilov RP1xS4
local D4 and A3 subalgebras A2 and A1 and A0=U(1)
    with A3 / A2xU(1) and Shilov S5
    and with B2 / A1xU(1) and Shilov RP1xS2
    and with A0 = U(1) and trivial Shilov

The 8x8 of Cl(8)xCl(8) has 8x8 spacetime position x momentum structure.
8-dim Kaluza-Klein has
CP2 = A2 / A1xA0 Internal Symmetry Space and M4 Physical Spacetime.
M4 has symmetry for each force gauge group:
    S4 = B2 / D2 for B2 Gravity
    CP2 = A2 / A1xS0 for A2 of Color Force
    S2 x S2 = A1/A0 x A1/A0 for A1 Weak Force
    S1 x S1 x S1 x S1 = A0 x A0 x A0 x A0 for A0 ElectroMagnetism

The 64-dim ++half-spinors have 8 components for each of the 8 fermion particles.
The 64-dim - - half-spinors have 8 components for each of the 8 fermion antiparticles.

With World-Lines regarded as Strings, E8 Physics can be represented as
26D Bosonic String Theory with 8+8 = 16 dimensions Orbifolded to represent Fermions
and 26-16 = 10 dimensions representing 4-dim CP2 Internal Symmetry Space
and 6-dim D3 = A3 Conformal Spacetime that effectively reduces to Minkowski M4.
Each cell of its local 26D Lorentz Leech lattice structure has Monster Group symmetry.

These structures, along with a MacDowell-Mansouri mechanism of Gravity,
the Dark Energy of D3 / B2, the emergence of second and third generation fermions
from formation of (4+4)-dim Kaluza-Klein spacetime, and a Mayer mechanism Higgs as
fermion (predominantly Truth quark) condensate allow the construction of a realistic E8
Physics Local Lagrangian associated with Cl(16) with calculation, based on Schwinger
Sources and Hua/Wyler geometry, of particle masses, force strengths, K-M parameters,
and the ratio Dark Energy : Dark Matter : Ordinary Matter
and
a realistic Algebraic Quantum Field Theory by using Real Clifford 8-Periodicity to
construct the completion of the union of all tensor products of Cl(16) thus
producing a generalization of the type II1 hyperfinite von Neumann factor algebra.

Within that AQFT, Creation and Annihilation Operators are described
by the Maximal Contraction of E8 = semidirect product H92 x A7
where

H92 is the Heisenberg Algebra with graded structure 8+28+56+1+56+28+8
with bosonic even part 28+1+28 and fermionic odd part 8+56 + 0 + 56+8:

grade -3 : 8 =(by Triality) = +half-spinor of Cl(8) = Fermion Particle
= Creation of 8-component Neutrino Fermion = R8 in Jordan Algebra R1+R8 = J(Spin(8))
Spin(8) = D4
+
grade -2 : 28 = Creation of Gauge Bosons = Jordan Algebra J(4,Q) with J(4,Q)o = J(3,O)
Aut(J(3,O)) = F4
+
grade -1 : 56 = Creation of 8-component Electron / Quark Fermions = Freudenthal Algebra Fr(3,O)
Aut(Fr(3,O)) = E6
+
grade 0 : 1 = R1 in Jordan Algebra R1+R8 = J(Spin(8))
+
grade +1 : 56 = Annihilation of 8-component Electron / Quark Fermions
+
grade +2 : 28 = Annihilation of Gauge Bosons
+
grade +3 : 8 =(by Triality)= -half-spinor of Cl(8) = Fermion AntiParticle
= Annihilation of 8-component Neutrino Fermion

A7 is the Lie Algebra Sl(8) that by semidirect product goes into grade 0 of H92 x A7 :
grade 0 : 1 + A7 where 1 = R1 in Jordan Algebra R1+R8 = J(Spin(8) and 63-dim A7 = Sl(8)
so that the dimension of H92 x A7 = 8+28+56+(1+63)+56+28+8 = 248

Zero Grade Spacetime Algebra:
grade 0 Spacetime Position / Momentum Algebra = 1+Sl(8)

Odd Grade Fermionic Creation Algebras:
grade -1 Electron / Quark Creation Jordan-type Algebra Fr(3,O)
grade -3 Neutrino Creation Jordan Algebra J(Spin(8)) is in the 2^8 x 2^8 matrix algebra
which is Cl(8) x Cl(8) = Cl(16) the home of E8.

Even Grade Bosonic Creation Algebra:
grade -2 Gauge Boson Creation Jordan Algebra J(4,Q) has J(4,Q)o = J(3,O)

The relative symmetries of the relative grades are:

grade -2 / grade -3 : F4 / D4 = 24-dim OxOxO
grade -1 / grade -2 : E6 / F4 = 26-dim J(3,O)o
total algebra / grade -1 : E8 / E6xA0xA0 = 168-dim PSL(2,7) = SL(3,2)

The payoff for understanding all this math is the substantially realistic E8 Physics
calculation data set listed on the next page.

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.

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

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

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	312.8 MeV	charged pion = 139 MeV
up	312.8 MeV	proton = 938.25 MeV
		neutron - proton = 1.1 MeV
muon	104.8 MeV	106.2 MeV
strange	625 MeV	
charm	2090 MeV	
tauon	1.88 GeV	
beauty	5.63 GeV	
truth(low state)	130 GeV	truth(middle state) = 174 GeV
		truth(high state) = 218 GeV
W+	80.326 GeV	
W-	80.326 GeV	
W0	98.379 GeV	Z0 = 91.862 GeV
Higgs VEV	252.5 GeV (assumed)	Mplanck=1.217x10^19 GeV
		Higgs(low state) = 126 GeV
		Higgs(middle state) = 182 GeV
		Higgs(high state) = 239 GeV
Gravity Gg	1(assumed)	
(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.