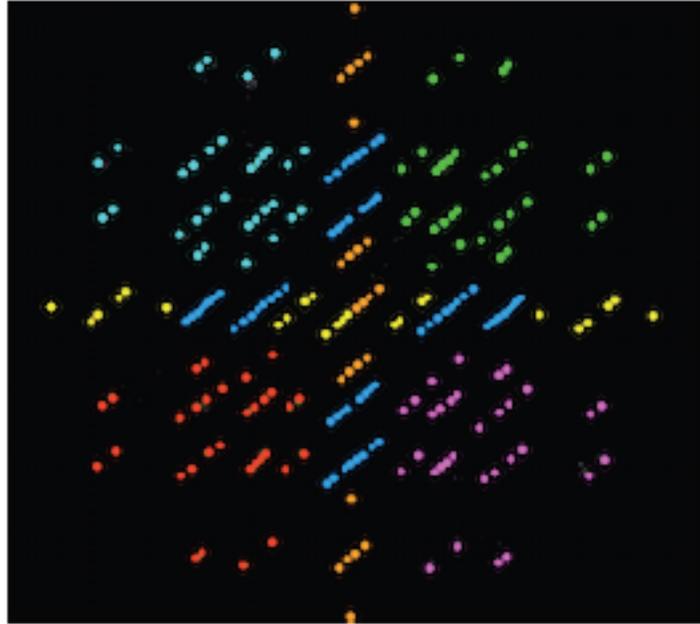


Representing E8 Root Vectors for E8-CI(16) Physics

Frank Dodd (Tony) Smith, Jr. - 2018

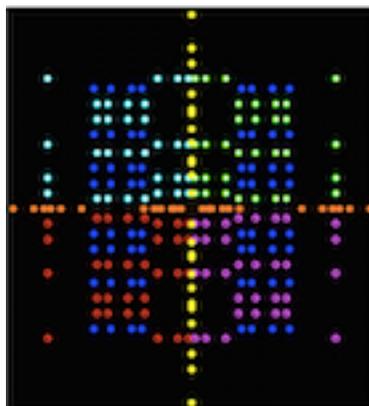
In my E8 - CI(16) Physics model (viXra 1602.0319 and related papers)
I have been as of March 2018 using this 2D picture of the 240 E8 Root Vectors



to explain my physical interpretation of each E8 Root Vector,
but

in discussion at Tellus Museum, Cartersville, Georgia on 11-24 March 2018
with Marcelo Amaral, Marni Sheppard, and Ray Aschheim

I have found that a 2D picture of the 240 E8 Root Vectors by Ray Aschheim
seems to me to be more fundamental, so I am now changing to Ray's picture



which I will describe in this paper after a page of background material
about coordinates for E8 Root Vectors.

David Madore at www1/2madore1/2org/~david/math/e8w1/2html said
 “1/21/21/2 “1/21/21/2 E8 roots can be described 1/21/21/2 as 1/21/21/2
 the 112 points having coordinates $(\pm 1, \pm 1, 0, 0, 0, 0, 0, 0)$
 1/21/21/2
 [and the]1/21/21/2 (128) having coordinates $(\pm 1/2, \pm 1/2)$
 (where ... there must be an even number of minuses) ...”.

$(\pm 1, \pm 1, 0, 0, 0, 0, 0, 0)$ has $(2!8) = 28$ ways to put 2 into $8 \times 2^2 = 4$ signs = 112
 at the full 8-dim Octonionic level of Octonionic Inflation1/2

After Quaternionic M4xCP2 Kaluza-Klein the 8-dim representation
 is broken into two 4-dim parts as the sum of 3 terms:
 $(\pm 1, \pm 1, 0, 0) (0, 0, 0, 0) + (\pm 1, 0, 0, 0) (\pm 1, 0, 0, 0) + (0, 0, 0, 0) (\pm 1, \pm 1, 0, 0)$

As to the 112 root vectors of D8 in E8:

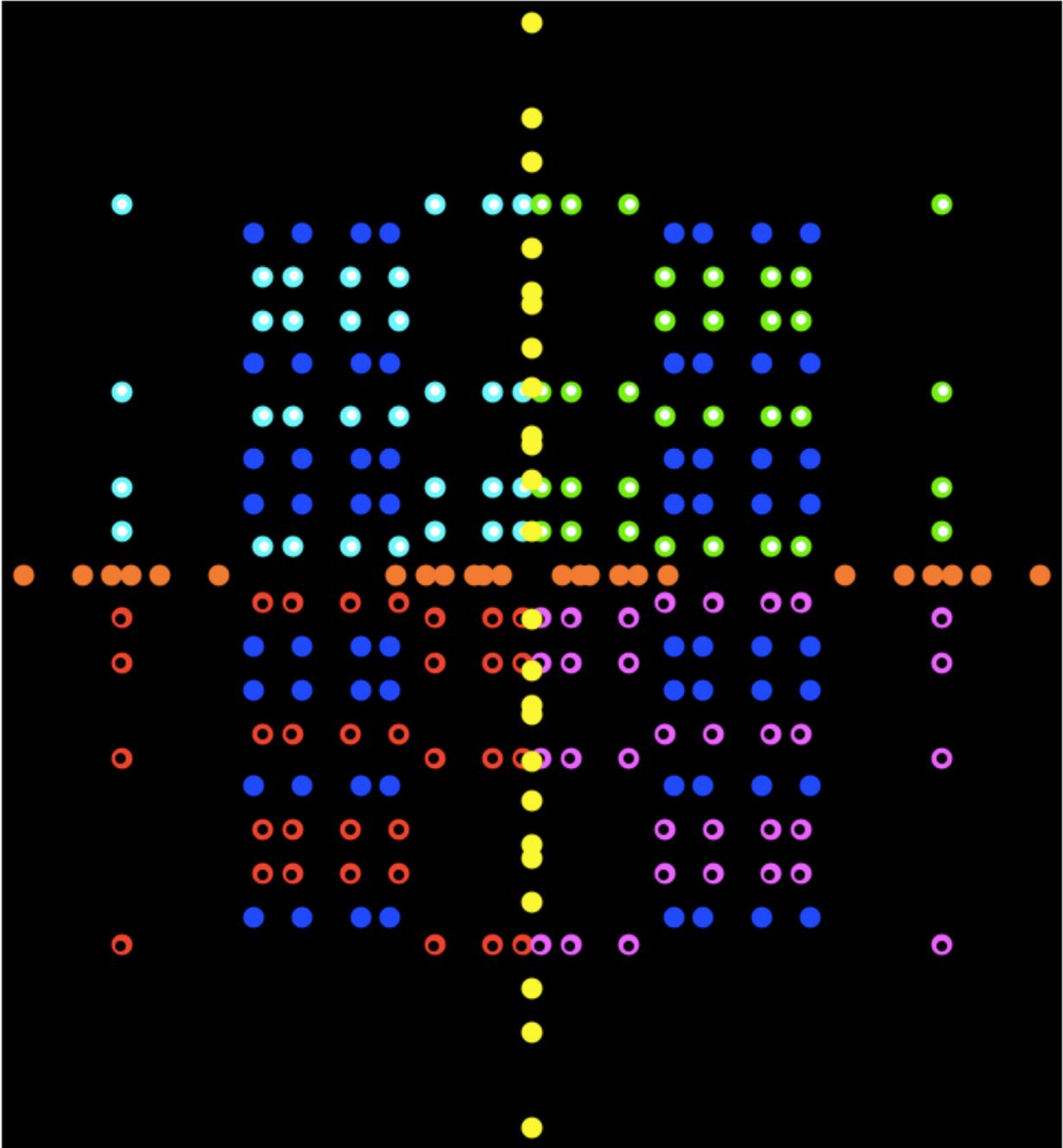
$(\pm 1, \pm 1, 0, 0) (0, 0, 0, 0)$ has $(2!4) \times 2^2 = 6 \times 4 = 24$ elements
 all of which are in the $(x, x, x, x) (0, 0, 0, 0)$ sector which can
 be taken to be the X-axis in a 2-dim representation
 and which physically can represent the D4 of E8 Standard Model + Gravity Ghosts.

$(0, 0, 0, 0) (\pm 1, \pm 1, 0, 0)$ has $(2!4) \times 2^2 = 6 \times 4 = 24$ elements
 all of which are in the $(0, 0, 0, 0) (x, x, x, x)$ sector which can
 be taken to be the Y-axis in a 2-dim representation
 and which physically can represent the D4 of E8 Gravity + Standard Model Ghosts.

$(\pm 1, 0, 0, 0) (\pm 1, 0, 0, 0)$ has $(1!4) \times (1!4) = 4 \times 4 = 16$ times $2^2 = 64$ elements
 which physically can represent 8 position x 8 momentum spacetime
 and/or $A7+1 = \text{Sl}(8)+1$ unimodular E8 gravity.
 They are non-zero in both the X-axis and Y-axis sets of coordinates
 so they live off the X-axis and Y-axis.

As to the remaining 128 of the form $(\pm 1/2, \pm 1/2)$
 (with even number of - signs so there are $(1/2) 2^8 = 2^7 = 128$ of them)
 they are non-zero in all coordinates so they live off the X-axis and Y-axis.

Ray Aschheim wrote a Mathematica Computable Document Format (CDF)
 file GossetProjections.cdf projecting the 8D 240 Root Vectors of E8 into 2D:



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

Orange and Yellow dots correspond to Root Vectors of the two D4 subalgebras of E8 each of which has 24 Root Vectors.

Blue dots correspond to the 64 elements of D8 that make up D8 / D4xD4.

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

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



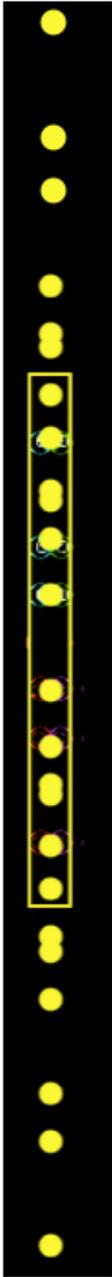
8 of them in the Orange Box represent the 8 Root Vectors of the Standard Model Gauge Groups $SU(3) SU(2) U(1)$.
Their 4 Cartan Subalgebra elements correspond to the 4 Cartan Subalgebra elements of D4 of E8 Standard Model + Gravity Ghosts and to half of the 8 Cartan Subalgebra elements of E8.

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 $CP^2 = SU(3) / SU(2) \times U(1)$
(as described by Batakis in *Class. Quantum Grav.* 3 (1986) L99-L105)

Electroweak $SU(2) \times U(1)$ is gauge group as isotropy group of CP^2 .

$SU(3)$ is global symmetry group of CP^2 but due to Kaluza-Klein $M_4 \times CP^2$ structure of compact CP^2 at every M_4 spacetime point, it acts as Color gauge group with respect to M_4 .



The 24 Yellow Root Vectors of the D4 of E8 Gravity + Standard Model Ghosts are on the Vertical Y-axis.

12 of them in the Yellow 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 $SU(2,2) \times U(1) = U(2,2)$ 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 Appendix - Details of Conformal Gravity and ratio DE : DM : OM)

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

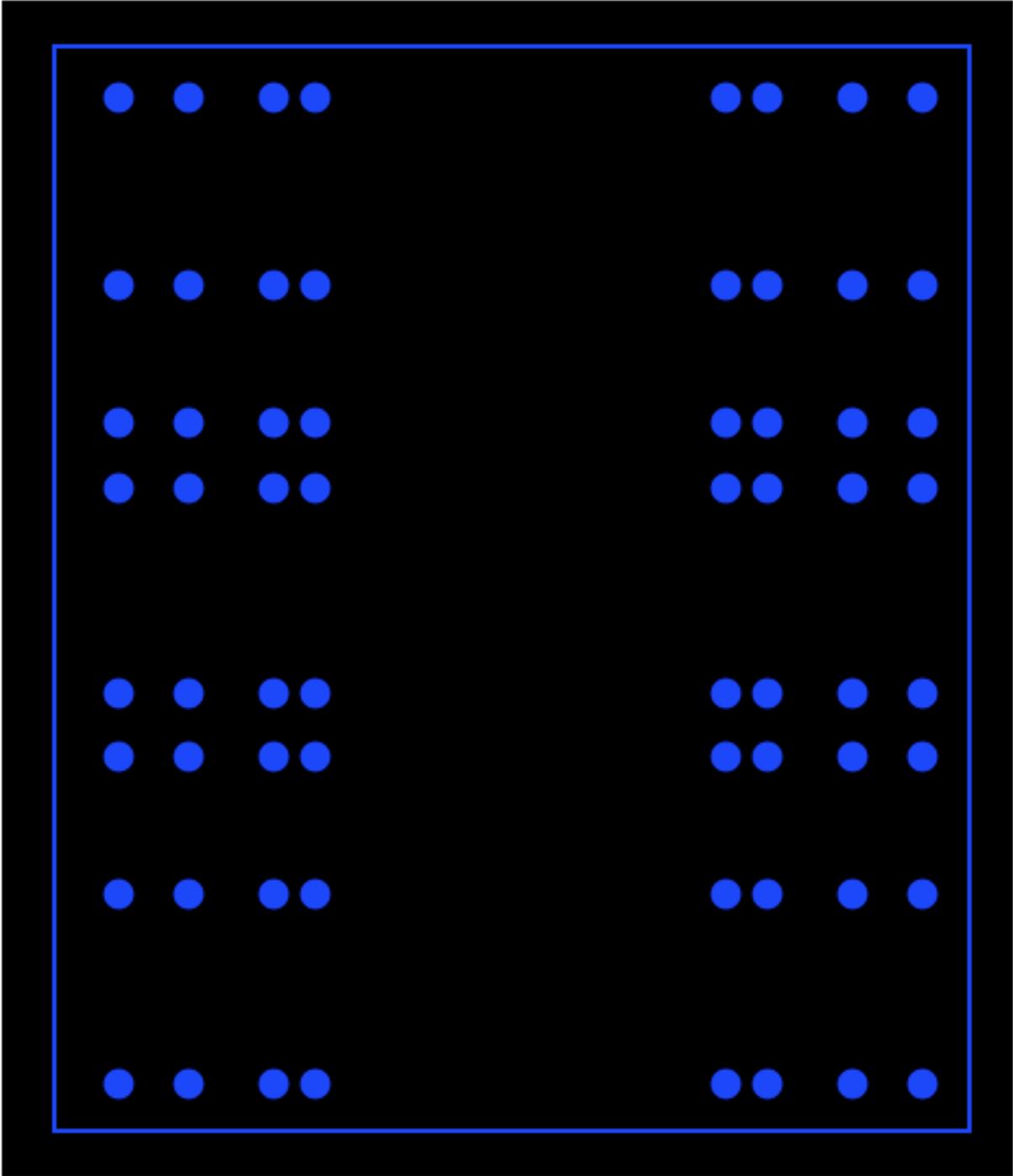
1 Dilation representing Higgs Ordinary Matter

4 Translations representing Primordial Black Hole Dark Matter

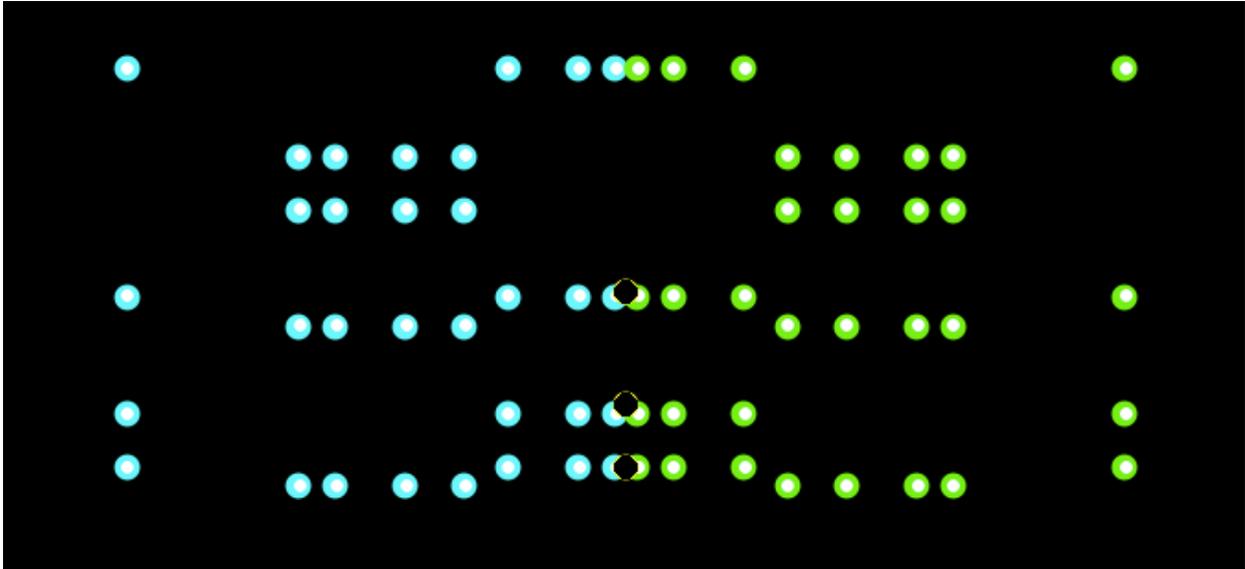
10 = 4 Special Conformal + 6 Lorentz representing Dark Energy
(see Irving Ezra Segal, "Mathematical Cosmology and Extragalactic Astronomy" (Academic 1976))

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**

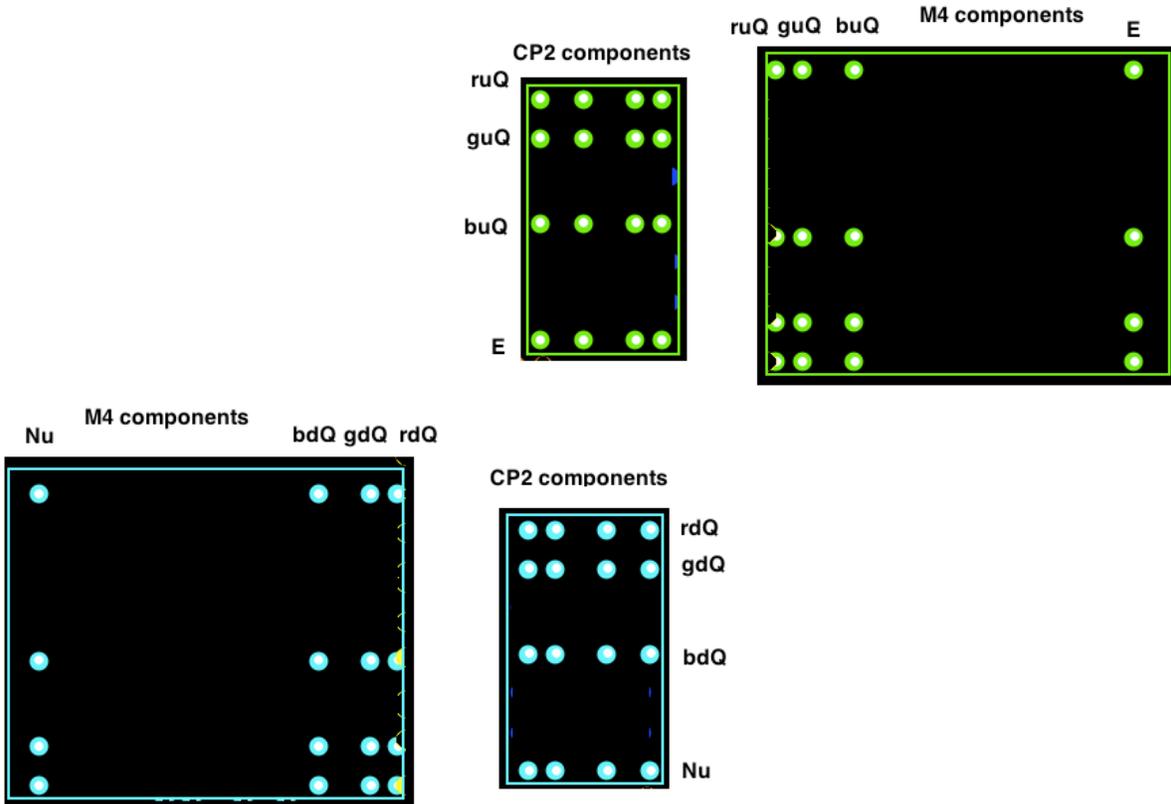
The 64 Blue Root Vectors of the space $D_8 / D_4 \times D_4$ represent 8D Spacetime and its symmetries such as 8 position \times 8 momentum and the $A_7 = SL(8, R)$ of Unimodular Gravity that is in the Maximal Contraction Heisenberg Algebra of E_8 with structure $28 + 64 + (A_7+1) = 64 + 28$.



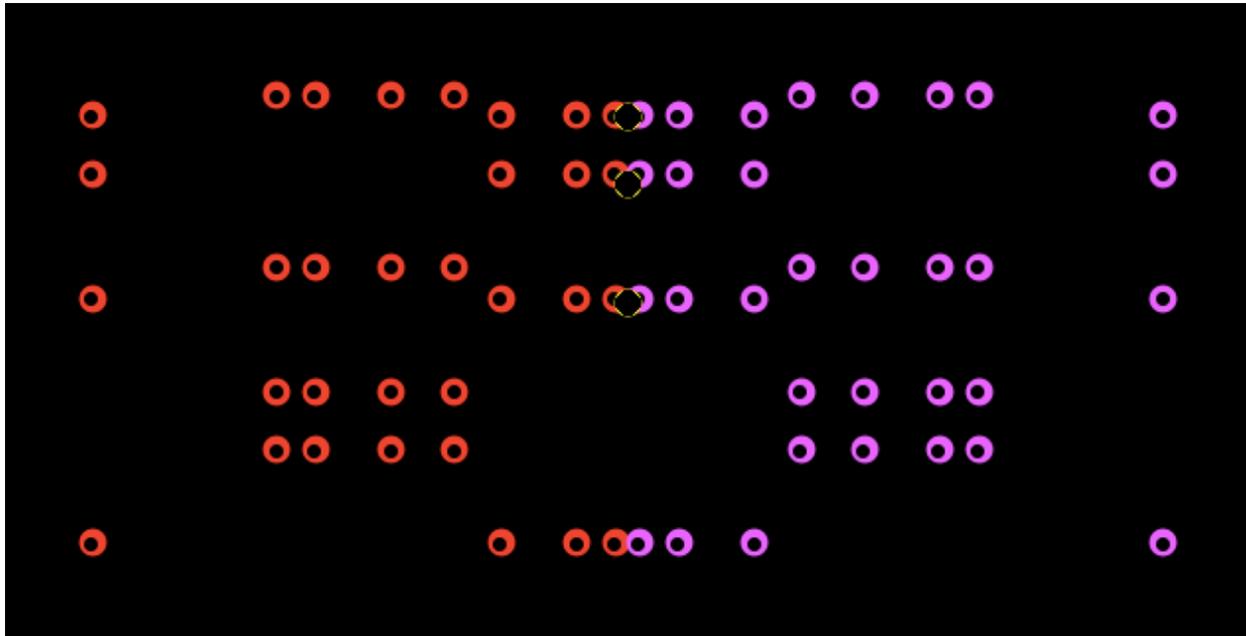
The 64 Green and Cyan Root Vectors represent half of the First Generation Fermions of E8 / D8.
 The White Centers of their dots indicate that they are Particles.



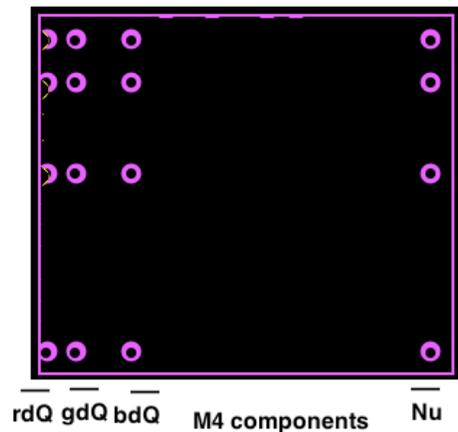
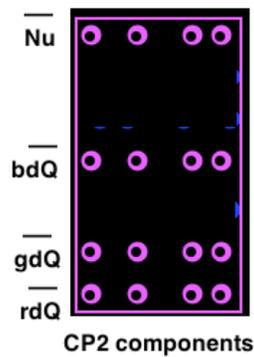
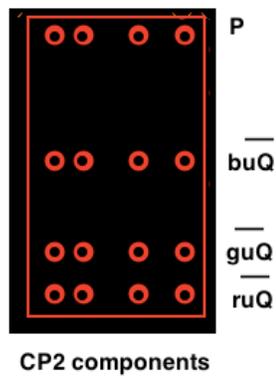
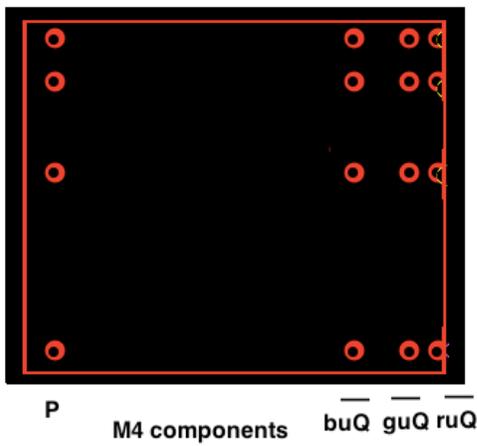
Their physical interpretations are



The 64 Red and Magenta Root Vectors represent the other half of the First Generation Fermions of E8 / D8.
 The Black Centers of their dots indicate that they are AntiParticles.



Their physical interpretations are



The overall picture with physical interpretation boxes is

