

## Standard Model Higgs compared to E8 Physics Higgs

The conventional Standard Model has structure:

spacetime is a base manifold;

particles are representations of gauge groups

gauge bosons are in the adjoint representation

fermions are in other representations (analogous to spinor)

Higgs boson is in scalar representation.

E8 Physics has structure:

spacetime is in the adjoint D8 part of E8 (64 of 120 D8 adjoints)

gauge bosons are in the adjoint D8 part of E8 (56 of the 120 D8 adjoints)

fermions are in the half-spinor D8 part of E8 (64+64 of the 128 D8 half-spinors).

There is no room for a fundamental Higgs in the E8 of E8 Physics.

However,

for E8 Physics to include the observed results of the Standard Model

it must have something that acts like the Standard Model Higgs

even though it will NOT be a fundamental particle.

To see how the E8 Physics Higgs works,

embed E8 into the 256-dimensional real Clifford algebra Cl(8):

$$\text{Cl}(8) \quad 256 = 1 + 8 + 28 + 56 + 70 + 56 + 28 + 8 + 1$$

$$\text{Primitive} \quad 16 = 1 \quad + 6 \quad + 1$$

$$\text{Idempotent} \quad + 8$$

$$\text{E8 Root Vectors} \quad 240 = 8 + 28 + 56 + 56 + 28 + 8$$

The Cl(8) Primitive Idempotent is 16-dimensional and can be decomposed into two 8-dimensional half-spinor parts each of which is related by Triality to 8-dimensional spacetime and has Octonionic structure. In that decomposition the  $1+6+1 = (1+3)+(3+1)$  is related to two copies of a 4-dimensional Associative Quaternionic subspace of the Octonionic structure and

the  $8 = 4+4$  is related to two copies of

a 4-dimensional Co-Associative subspace of the Octonionic structure

(see the book “Spinors and Calibrations” by F. Reese Harvey)

The  $8 = 4+4$  Co-Associative part of the  $Cl(8)$  Primitive Idempotent when combined with the 240 E8 Root Vectors forms the full 248-dimensional E8. It represents a Cartan subalgebra of the E8 Lie algebra.

**The  $(1+3)+(3+1)$  Associative part of the  $Cl(8)$  Primitive Idempotent is the Higgs of E8 Physics.**

The half-spinors generated by the E8 Higgs part of the  $Cl(8)$  Primitive Idempotent represent:

neutrino; red, green, blue down quarks; red, green, blue up quarks; electron  
so  
the E8 Higgs effectively creates/annihilates the fundamental fermions and  
**the E8 Higgs is effectively a condensate of fundamental fermions.**

In E8 Physics the high-energy 8-dimensional Octonionic spacetime reduces, by freezing out a preferred 4-dim Associative Quaternionic subspace, to a  $4+4$  -dimensional Batakis Kaluza-Klein of the form  $M4 \times CP2$  with 4-dim  $M4$  physical spacetime.

Since the  $(1+3)+(3+1)$  part of the  $Cl(8)$  Primitive Idempotent includes the  $Cl(8)$  grade-0 scalar 1 and  $3+3 = 6$  of the  $Cl(8)$  grade-4 which act as pseudoscalars for 4-dim spacetime and the  $Cl(8)$  grade-8 pseudoscalar 1

**the E8 Higgs transforms with respect to 4-dim spacetime as a scalar (or pseudoscalar) and in that respect is similar to Standard Model Higgs.**

Not only does the E8 Higgs fermion condensate transform with respect to 4-dim physical spacetime like the Standard Model Higgs but

**the geometry of the reduction from 8-dim Octonionic spacetime to  $4+4$  -dimensional Batakis Kaluza-Klein, by the Mayer mechanism, gives the E8 Higgs the necessary Ginzburg-Landau structure.**

Since the second and third fermion generations emerge dynamically from the reduction from 8-dim to  $4+4$  -dim Kaluza-Klein, they are also created/annihilated by the Primitive Idempotent E8 Higgs and are present in the fermion condensate. Since the Truth Quark is so much more massive than the other fermions,

**the E8 Higgs is effectively a Truth Quark condensate.**

When Triviality and Vacuum Stability are taken into account,

**the E8 Higgs and Truth Quark system has 3 mass states.**