Polyhedral Particle Interaction Paths & Dark Matter

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Abstract

All 32 particles of the Standard Model can be assigned a vertex angle or face on a rhombic dodecahedron. This gives a new way to model for all particles in the Standard Model and reveals that an eight (possibly dark matter) boson is required to complete the system.

Particle Path Finder

In 'DGO Quaternion Multiplication Gluon Structure, we noted that the rhombic dodecahedron can serve as the model for the gluons, as well as the W and Z bosons.[1] Given that collectively the gluons and W and Z bosons interact with all of the leptons and quarks in the Standard Model (SM), it suggests that there is something about this geometry which encapsulates all of these particles, in one compact form. [4] The first indication of this emerges, when we add up the absolute values of the charged particles in the SM to get 14. This is the same number of vertices in the RD.

Where exactly the 32 particles of the SM are to fit into this geometric form is arbitrary, to some degree. However, there are certain guidelines indicating a general kind of placement, which should be adhered to, for the model to make any sense.

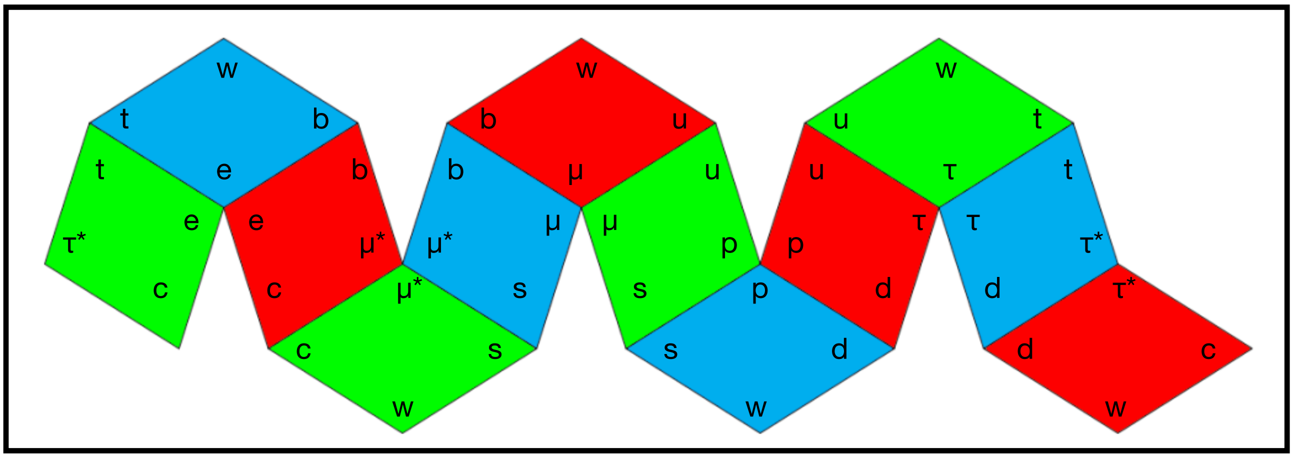

Fig 1: The first step in placing the charged leptons and quarks, and their mediating boson, on the vertices of the rhombic dodecahedron.

To begin to understand these, we must first understand some of the more intricate connections between the RD and the SM. The charges of quarks can be related to the 24 arctan(1/3) angles of the rhombic dodecahedron (RD). [1] The long diagonal of the faces of the RD equals $\sqrt{2}$. Relating this to the probabilities of spin-1/2 leptons (i.e. $^{1}/_{\sqrt{2}}$), allows us to put six of the leptons on the six axes of the 12 faces of the RD. The other six leptons (the charged leptons), along with the two charged W bosons can be placed on the eight vertices that make this $\sqrt{2}$ angle. These vertices are order 3, so it infers that the charges of the W bosons and the charged leptons are actually formed from three ±1/3 charges, just as the quarks are. This fact may be another factor in explaining why the W boson can interact with both colour-charged quarks and the colourless leptons.

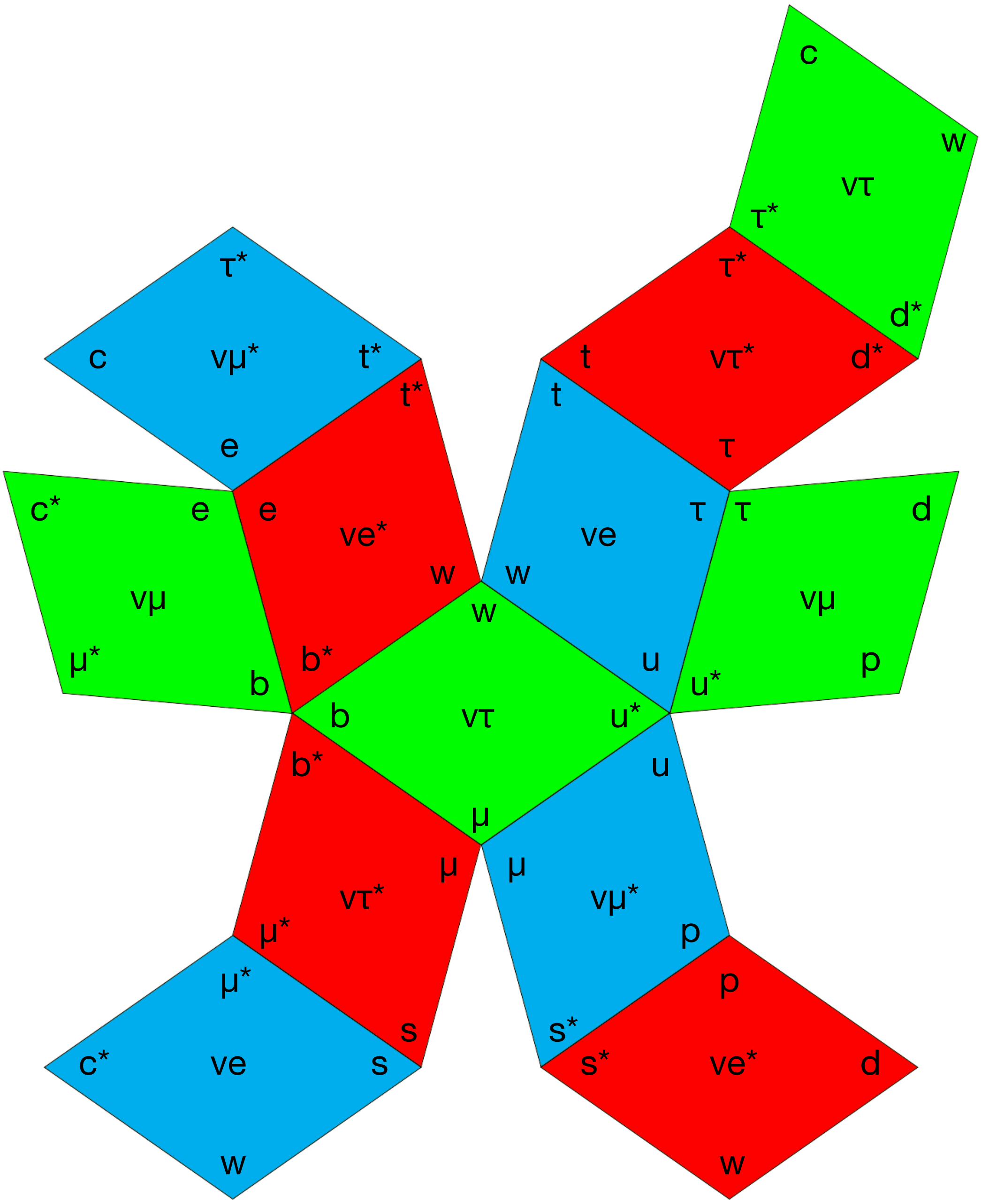

Fig 2: The net of the RD. The Weakly interaction leptons are included on the faces.

Either way, the fact that they both occupy the order 4 and 3 vertices suggests a link between the two kinds of particles via the W bosons.

The non-charged leptons occupy the faces of the RD. They have no angle associated with them and are therefore without charge.

RD Azimuthal Projection

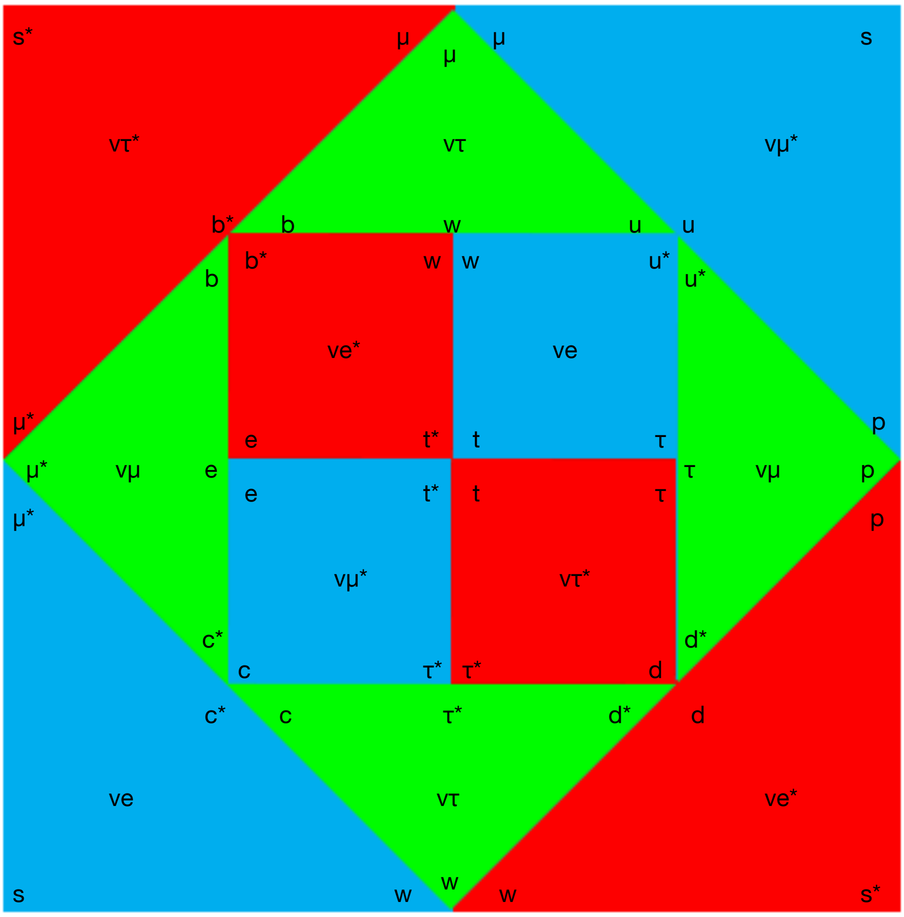

Fig 3: Azimuthal projection of the rhombic dodecahedron with the SM particles.

As you can imagine these graphs were a joy to make. One of the biggest difficulties I encountered was where to place the W bosons. The main problem arises, when figuring out which of the vertices should be W^+ and which W^-. My solution to this is simple. The variable 'w' now stands for any boson in the SM and all of the bosons are placed at the central vertex of the RD.

The reason why they can all occupy the same vertex comes about as a result of the RD being analogous to the vertex-first projection of a 4cube (Fig. 4). [2]

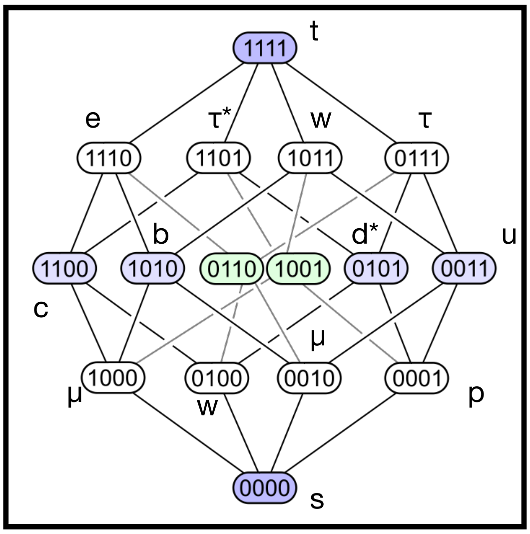

Fig 4: A mockup of the vertex-first projection of rhombic dodecahedron and the SM particles.

According to this view, the central vertex can be considered as two overlapping points. But since the hypercube is actually made of eight cubes converging on this vertex, we may as well drop the entire set of bosons into the centre.

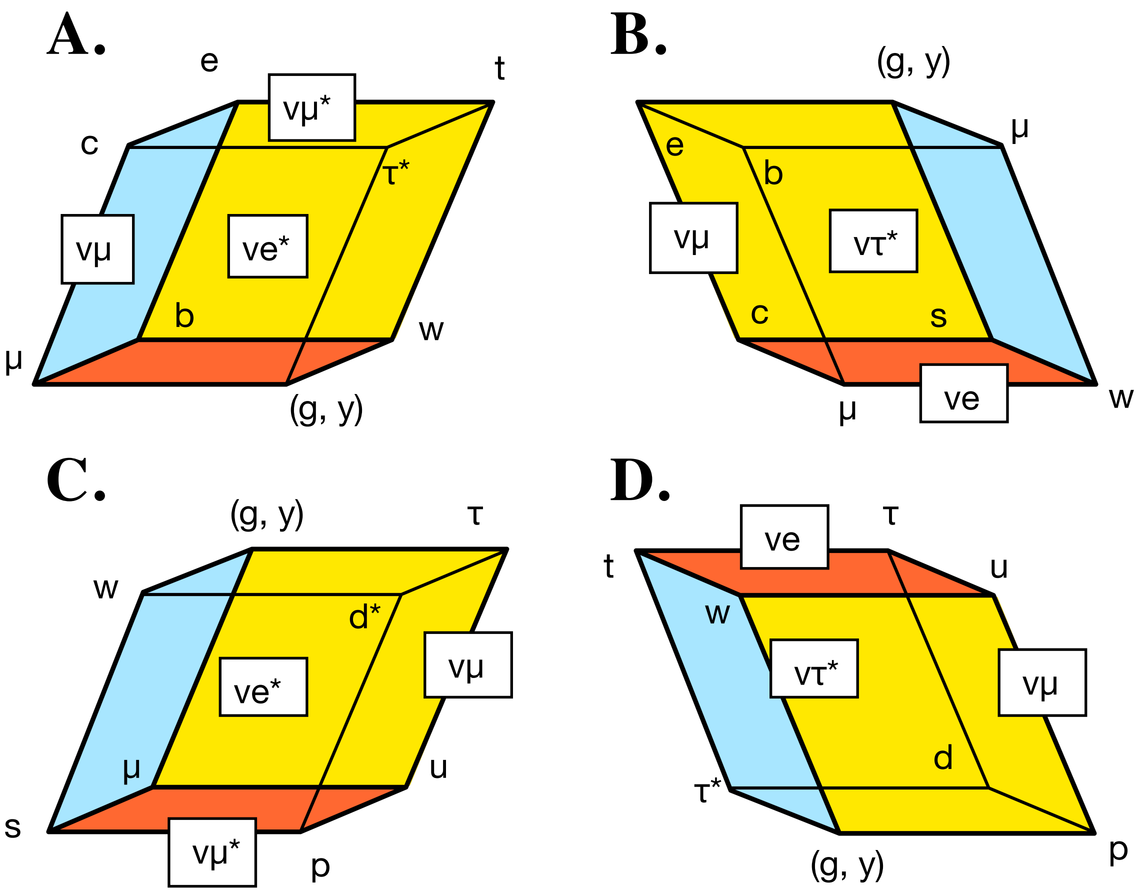

Fig 5: The first four hexahedrons that form the rhombic dodecahedron.

Now we can move from any particle on the surface to the central vertex and pick up the necessary virtual boson along the way, before moving back out to the surface and thereby complete the interaction. The quantity ‘w’ is now a variable that can stand in for any of these virtual bosons, on the surface level.

The Hidden Boson

The RD can be tiled with 4 hexahedrons in 2 different ways, for a total of 8, which—of course—is analogous to the eight different hexahedrons contained in the hypercube. This allows us to create 8 new groups of particles following Hamiltonian paths on the different cubes (Fig. 5). These groups are listed below. The neutrinos on the faces appear in the square brackets. The bosons at the vertex appear as the bracketed values.

A: (y), w, t, [ve*, vμ, vμ*], τ, c, e, b, μ
B: μ, b, e, c, s, [ve, vτ, vμ], (W^+), μ, w,
C: w, μ, (W^-), [ve*, vμ, vμ*], s, d*, τ, u, p
D: p, u, τ, d*, [ve, vτ, vμ], τ* t, w, (Z)

E: (g), w, u, p, [vτ*, vτ, vμ], w, μ, b, μ
F: μ, c, s, w, [ve*, vτ, vμ*], p, d*, τ*, (H)
G: (G) w, c, e, [vτ, vτ*, vμ*], t, τ*, d*, τ
H: τ, u, w, t, [ve, ve*, vτ], e, b, μ, (?)

Notice that our list ends with a question mark. This is because there are 8 shared points at the central vertex, but only 7 unique bosons. The obvious conclusion is that there exists an 8th boson outside of the Standard Model. What is the nature of this boson? The obvious candidate lies in the as yet unknown quantity of Dark Matter (DM) and means that our list is actually a question and one of the most profound questions of our time.

Wherein lies all the missing matter in the Universe? See my paper ‘Octonions the Three Flavours of Matter & a New Kind of Super-Symmetry’ for a more information on Dark Matter. [5]

Beta and Strange Decay Paths

Using azimuthal projections, we can attempt to show the results of Beta decay, wherein a down quark decays into an up quark and emits an electron and anti-neutrino (See

Fig. 6). Along the way, the line will have to pass through the centre of the RD, which also allows for a photon or two to be added into the mix.

Beta Decay

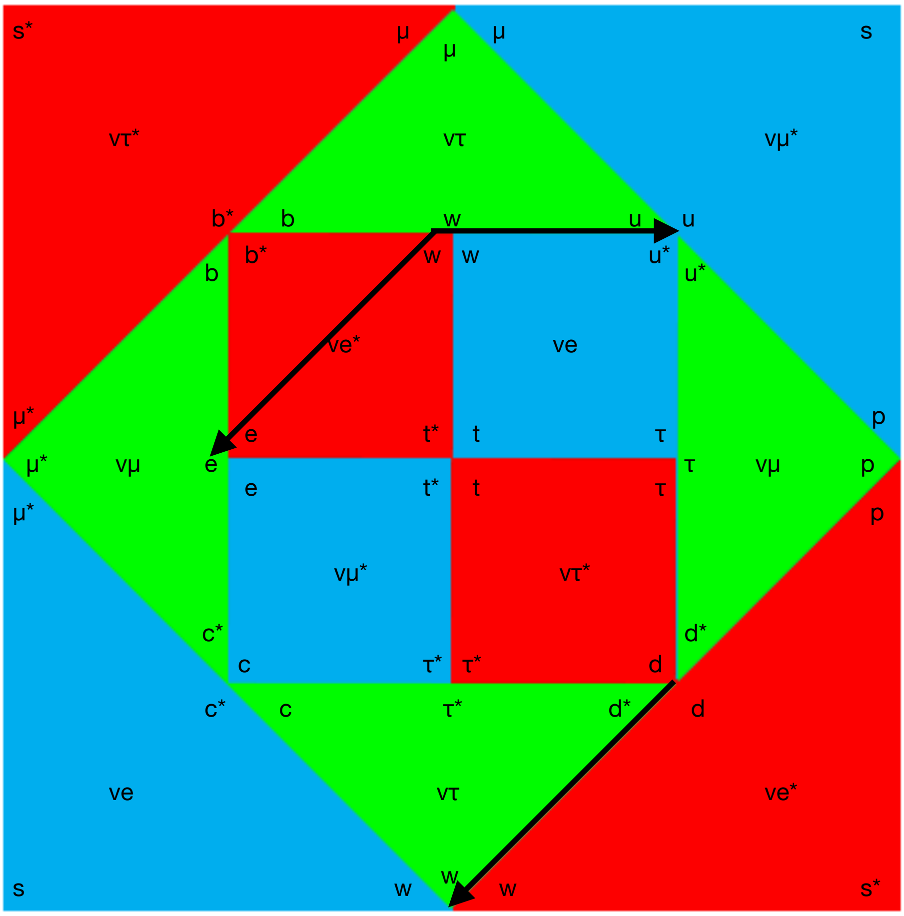

Fig 6: Beta Decay path.

In this next example, we see a strange quark decaying into an up and a down quark, via a W-boson (Fig. 7). By continuing this process with various other kinds of particle interactions, a complete set of pathways could be built up and categorised.

Applications

The similarity between the Rhombic Dodecahedron Standard Model (RDSM) and Garret Lisi's E8 model are apparent. Both models attempt to assign all of the particles in the SM to a higher-dimensional polytope. However, while Lisi's model is highly complicated, requires 240 dimensions and at least as many particles, the RDSM can be modelled in 3D,. This obviously makes it much simpler, and only requires one extra boson, the existence of which has all but been confirmed by observations of the rotations of distant galaxies.

The inspiration for the RDSM came about from the various numeric and geometric relationships between the RD and the particles. But, the vertex-first projection model certainly helped in this process. [2] As did the visual content of another paper , by Andrew J. Landahl, describing a surface code inscribed on surface of the rhombic dodecahedron. This code may have some application in quantum computational error correction, which suggests that the RD Standard Model might serve a similar computational purpose.

Strange quark decay

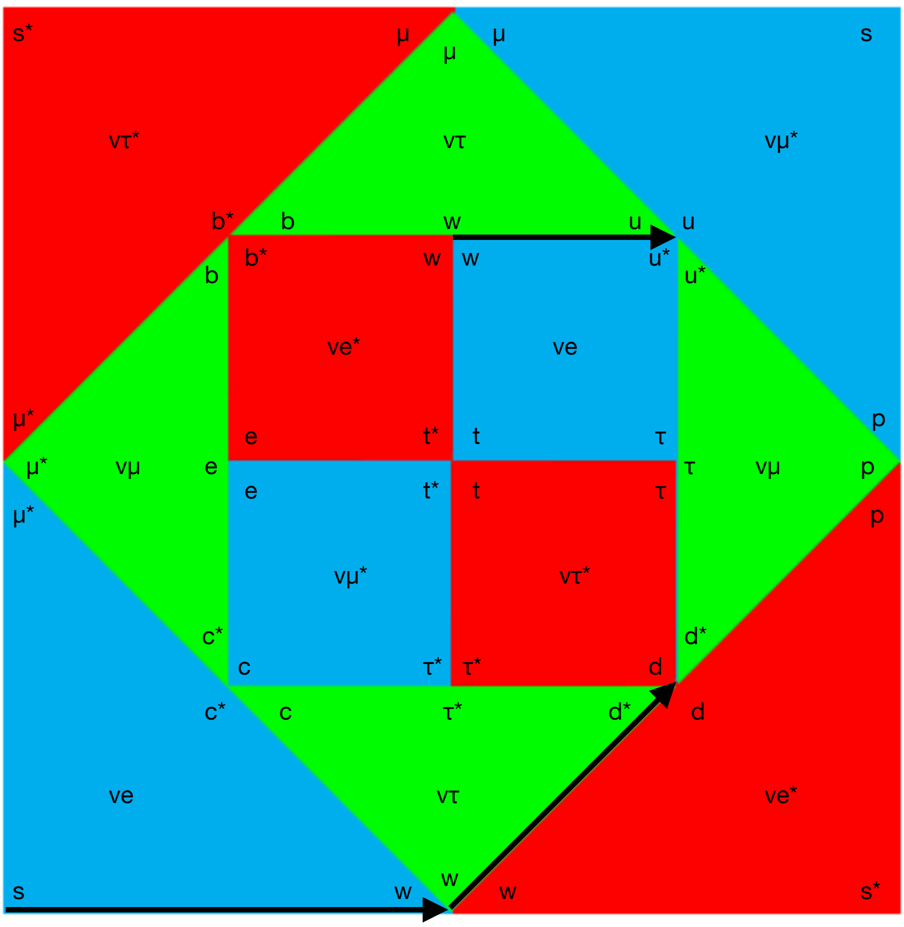

Fig 7: Strange quark decay path

Landahl’s surface code has 11 sets of 14 elements. The RDSM has 8 sets of 11 elements. So, it may be possible to directly unify them, with each particle being a set. Whether this would have any practical use in Quantum Physics, I’m not well-versed enough in the discipline of Quantum Computing to accurately say. However, it is clear that the model has definite applications in the realm of conventional computer technology. In principle, it should be fairly straightforward to write a BFS (or similar) program to map out all possible first, second and third order particle interactions; map their probability distribution to the Hamiltonian pathways, and check whether the particle interactions themselves are valid or not.

Given that there are 7 bosons at the central vertex, this provides a high degree of interconnectivity, making it almost certain that all interactions can be accounted for. If necessary interactions could be extended into a 4-dimensional model. [6] However, if non-viable interactions do emerge, then these paths could either be forbidden in future versions of the program or — more likely — the current order of the particles would be rearranged until only viable interactions are permitted. Note, the idea for the creation of such a program only presented itself to me fairly recently, and it will be some time, before I can make any headway with this project.

Conclusion

The unique hyper-dimensional aspects of the rhombic dodecahedron make it an ideal candidate for representing all 32 particles of the standard model. It allows us to group the particles into 8 different sets, reveal the need for an 8th boson. This brings the total particles of the Standard Model up to 33, which has a nice ring to it. Finally, the RDSM puts order on the Standard Model and therefore has significant applications in computation and in deriving new graphs and models of particle interactions.

Citations

[1] ‘DGO Quaternion Multiplication Gluon Structure’, Christopher C. O’Neill, https://www.researchgate.net/publication/347522261_DGO_Quaternion_Multiplication_Gluon_Structure

[2] https://en.wikipedia.org/wiki/Rhombic_dodecahedron#/media/File:Hypercubeorder.svg

[3] ‘The surface code on the rhombic dodecahedron’, Andrew J. Landahl: https://arxiv.org/pdf/2010.06628.pdf

[4] ‘Construction of the 2nd and 3rd Generation of Quark Particles in the Standard Model’, Christopher C. O’Neill, https://www.researchgate.net/publication/

348191884_CONSTRUCTION_OF_THE_2ND_AND_3RD_GENERATION_OF_QUARK_PARTICLES_IN_THE_STANDARD_MODEL
[5] https://www.researchgate.net/publication/348305661_OCTONIONS_THE_THREE_FLAVOURS_OF_MATTER_A_NEW_KIND_OF_SUPER-SYMMETRY
[6] https://www.researchgate.net/publication/348305308_THE_HIGGS_BOSON_THE_GRAVITON