Proton-Neutron Structure, Renormalisation, & the 24-cell

Christopher C. O'Neill

Independent Researcher
email: chris.ozneill@gmail.com
20 January 2021

Abstract

By graphing the gluons and quarks according to the DGO Standard Model, we arrive at a natural configuration for the proton and neutron. This configuration, it turns out, is the geometric inverse of the current understanding of the structure of the baryons. An explanation for why this might be so is sought after. It is disconcertingly concluded that the DGO model is somehow the inverse model of the conventional baryon model. However, there are other interesting observations to be made regarding extra dimensions. We look at the structural relationship between the nucleon and parts of the electron configuration of the Hydrogen atom, which gives us window into particle mass renormalisation and the energy of the Ground State. It also leads us to think of the nucleon as a single system, devoid of parts. And this, in turn, leads us to the doorstep of the 24-cell. There are a bunch of symmetries and connections to be drawn between the 24-cell and quaternions, GL(2,3) and musical frequencies, suggesting a very musical approach to understanding baryonic matter.

Donut and Dipole

In the DGO Standard Model, gluons are represented as rhombi-dodecahedra (RD) and quarks are either cubes or rhombicuboctahedra (RCO), depending on their mass. The lighter up quark, for example, is modelled by a cube and the heavier down quark is modelled by the RCO.[1] Once we have the *u* and *d* quarks and the gluons, we can arrange them into different hadrons and baryons. The two that we are going to focus on today are the proton (u,u,d) and neutron (u,d,d). In the case of the proton, it is natural to place the polyhedra in a ring (or donut) and connect them with three gluons (See Fig. 1). Alternatively, we could have the quarks in a ring connected to three radial gluons coming out from the centre.

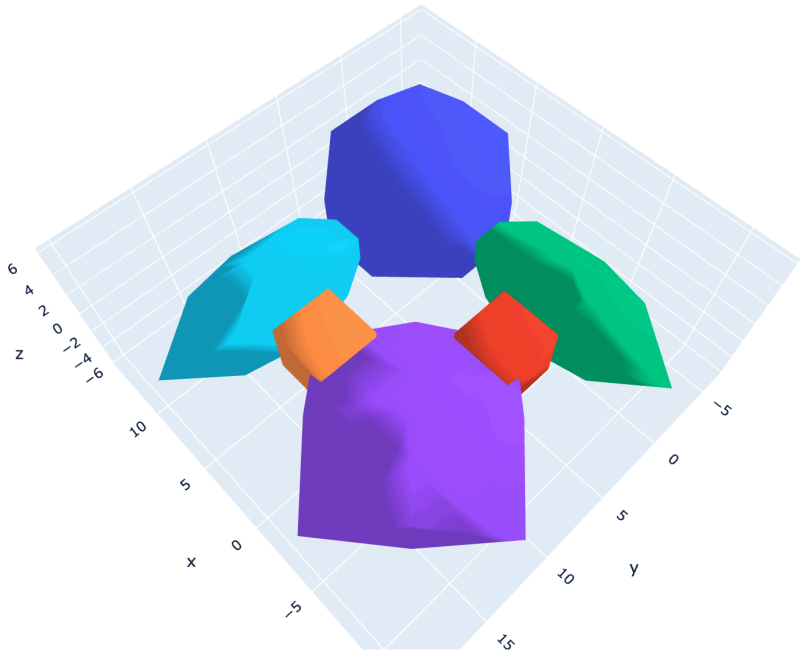

Fig 1: The proton

For the neutron it seems more prudent to have the single up quark in the centre, connected to two down quarks at either end. (See Fig. 2) This is the ‘dumb-bell’ model of the baryon. Consensus opinion has it that the proton and neutron are indeed shaped like rings and dumb bells.[2] However, in the conventional model, it is the proton that is the dumb-bell and the neutron that is the torus. These forms link together to create nucleons and the nuclei of atoms that go together to make baryonic matter, from which the vast majority of the perceivable Universe appears to be comprised.

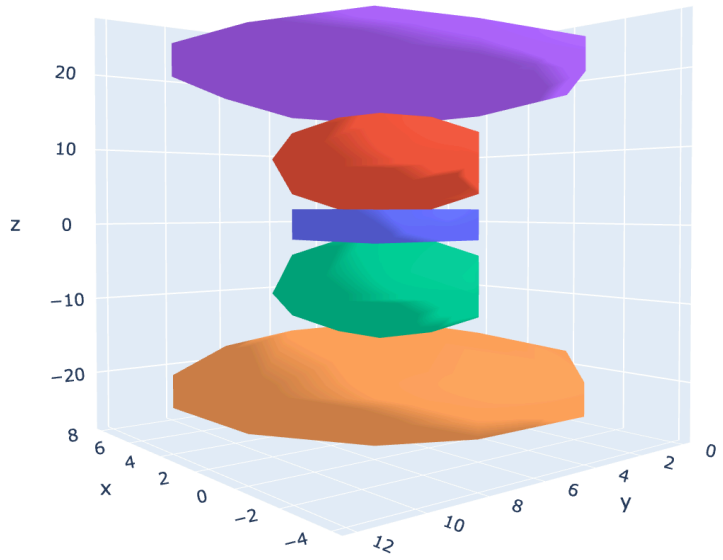

Fig 2: The neutron

If we switch the particles around, they should be in the correct order, although they will no longer exhibit the dumb-bell shape, for example. This suggests that the bulges at the end of the dipole are indicative of the density of the particle. Effectively, the larger the bulge the less dense the particle i.e. the lighter it is. This is disconcerting, as it means our model is spatially inverted somehow. I'm not going to switch the particles around, because I think it will confuse an already confused situation even more.

Since the DGO Standard Model is attempting to represent the particles of the Standard Model with respect to hyper complex matrix multiplications, it is unclear exactly what it is modelling. For starters, we know that the particles in Quantum Field Theory have no dimension or sides. So, how can we say that they are cubes or rectangles or any other shape? The purpose of this geometric representation is to give us something concrete to work with, but the DGO model itself cannot be taken too literally.

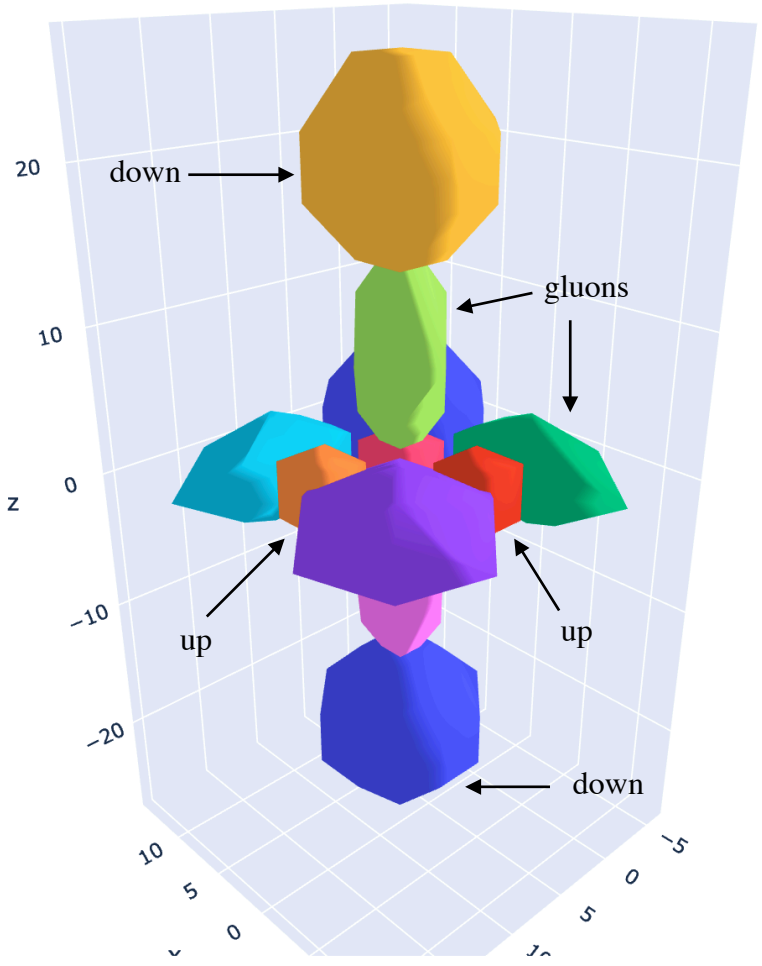

Fig 3: The nucleon

For instance, the particles are usually higher dimensional. They either exist partially outside of our 3-dimensional space, or are perfect projections of higher dimensional objects into 3D space.[3] If the former, then it is possible that they can exist inverted around our

normal 3D physical environment, just as the outer face of a hypercube is inverted and wrapped around the outside of the tesseract. This necessarily forces the inverted object to fill all space around the inner object out to infinity.

This ability of the 4-dimensional polytopes to encompass one another like this explains why the two down quarks in Fig. 2 do not appear to be connected by a gluon, as you might expect. From a 4-dimensional perspective, there could easily be another gluon inverted around the outside of the figure and connecting to each end of the dumb-bell.

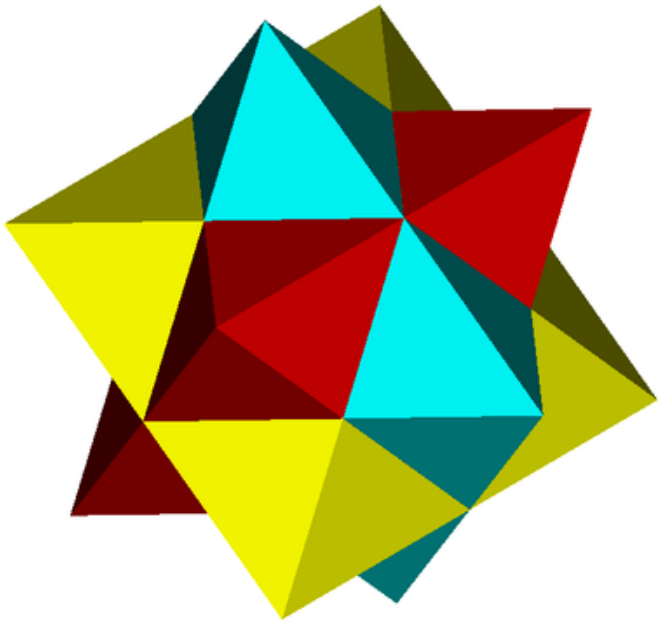

Fig 4: Stellated rhombic dodecahedron shows the inverse of the gluon field

In fact, there is an interesting quirk of the RD geometry, which gives us an exciting way to visualise this inversion. We can dissect the RD into twelve rhombic-based pyramids. [4] These can then be turned inside out and glued to the faces of the RD to create the first stellation of the RD (Fig 4). This shape is known as the stellated rhombic dodecahedron. It is conceivable that the inverted field of the gluon has the stellated RD as its foundation, in some respect.

The gluons in Fig 1 are coloured light blue, green and purple. They can stretch and contract depending on what internal or external forces they are exposed to, but their confinement will never be broken, this because of the associated Strong Force, which binds the nucleon in place.

Depending on the kinds of forces the nucleon is subjected to, the proton ring can either be situated horizontally at the ‘locus point’ of the neutron (See Fig. 3), or at any other orientation around the locus, including from pole to pole.

Stretching the blue and green gluons is a simple enough operation; we simply add more to the x-axis and y-axis ranges. The purple gluon is a little more difficult however, as it is orientated in equal parts along the x and y-axis. Therefore, we must add value to both of these axes in order to 'stretch' the gluon. The result is the square looking gluon, we see in Fig 1. There is no reason to think that this is how this gluon really looks. In reality, it would likely be very similar in appearance to both the green and blue gluons, simply orientated in a different manner. Another fault with the representation lies with the placement of the 2 up quarks in Fig 1. They should be positioned at the ends of the two gluons and not in the middle, like they are. However, this would have greatly increased the distance between the two quarks, and consequently increased the area of the purple gluon to an almost distracting degree (See Fig. 5). Therefore, I made the editorial decision to place the quarks midway along the length of the gluons.

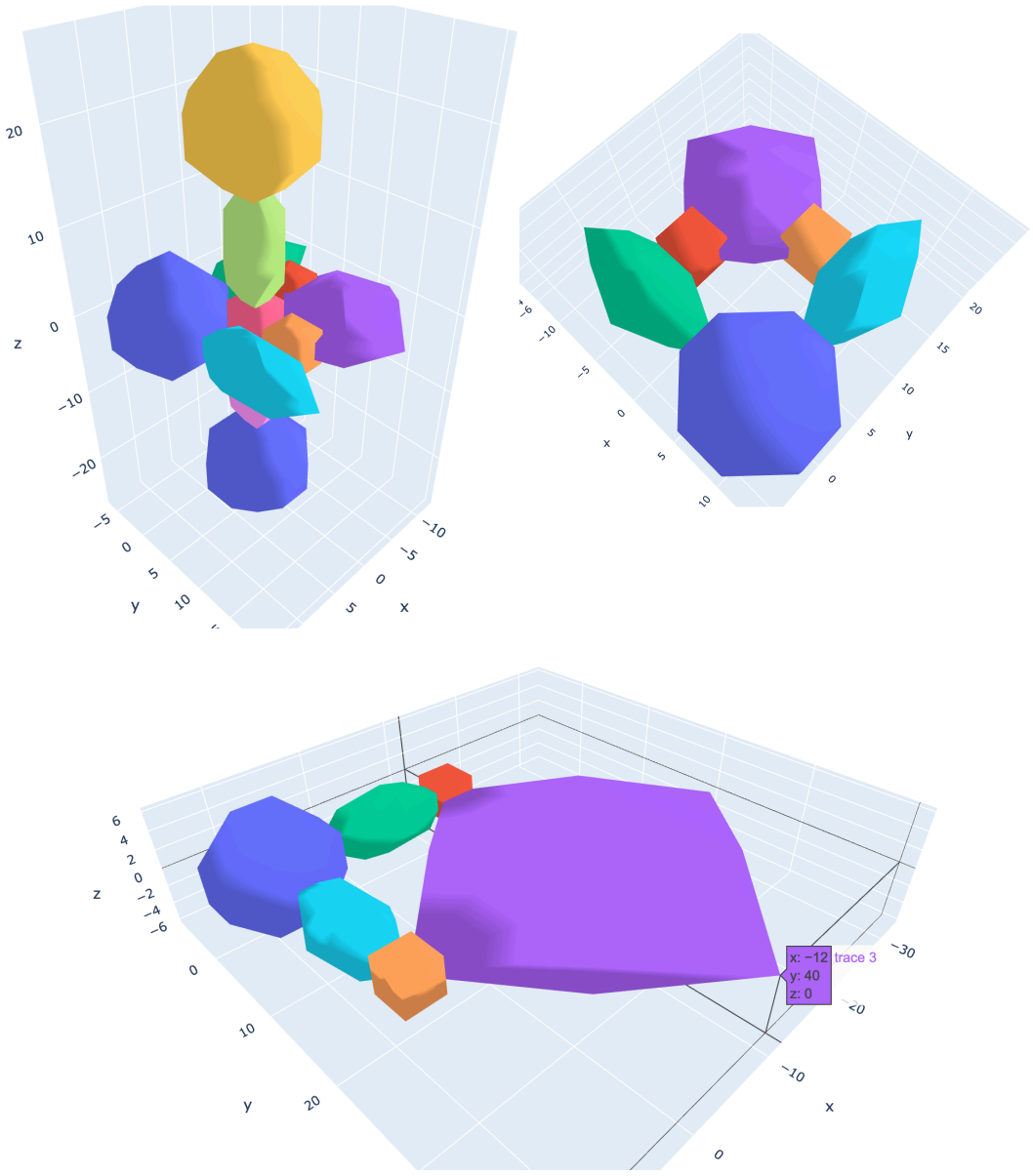

Fig 5: Several different views and versions of the baryon and proton

When the purple gluon is stretched in this manner it has 1461 unique points, which is an interesting number from an astronomical and historical perspective. 1461 is the orbital period of the Sirius star system and the length of an Ancient Egyptian Year.

One beneficial outcome of this haphazard approach was the realisation that under no circumstances do the gluons need to undergo rotation when they are stretched. This was a position that I was forced to entertain in [5], due to a misconception of how the stretching was applied to the matrix form. Somehow, I chose to stretch the matrix object in a dimension that was not visible and which therefore naturally required a rotation in order for it to be perceived. When the stretching is applied to the correct dimension, there is no longer any need for rotation, which greatly simplifies the model.

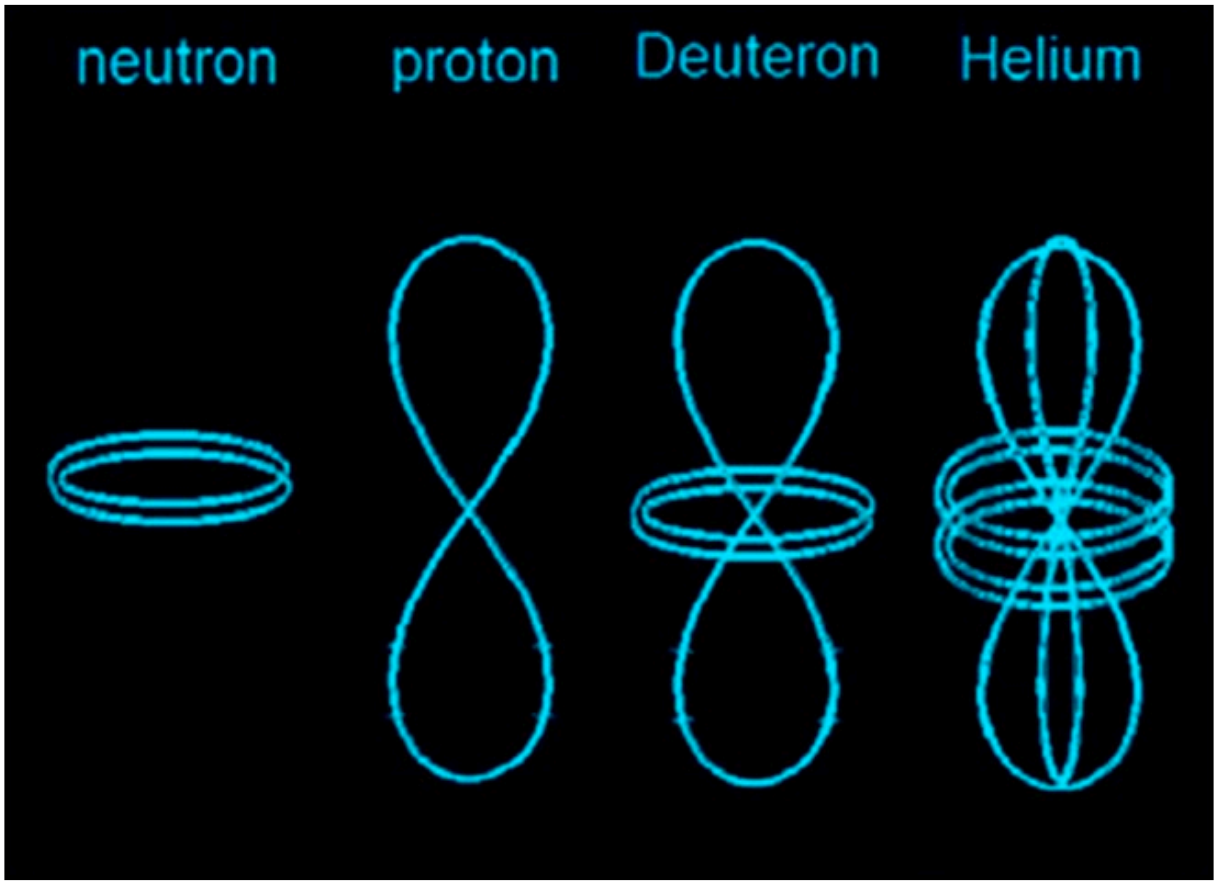

Fig 6: This figure is based on another originally uploaded by Stoyan Sarg Sargoytchev [2]

In Fig 6, we see a graphic depiction of the conventional model of the baryons. This serves as a useful comparison. Notice that the model for helium has two protons overlapping at right angles to one another. This would be hard to reproduce in the DGO model. Unless of course, the right-angle was in the fourth dimension, but I don't think that is what is meant by the structure of Helium in Sargoytchev's model.[2]

These images give the impression that the proton is some kind of looped thread. This interpretation is relayed in Sargoytchev's research and elsewhere. [6, 7, 8] This looped thread is obviously indicative of a waveform, and is therefore consistent with Quantum Mechanics. I have in the past attempted to relate quantum waveforms to the DGO polyhedra by means of 'spherical harmonics' similar to those seen in Greg Egan's excellent animations. [9] Such a configuration would allow for superimposed waveforms; like those seen in Fig. 6. The waveform could also flow across the entire surface of the baryon in an unbroken loop, making it functionally identical to the looped model.

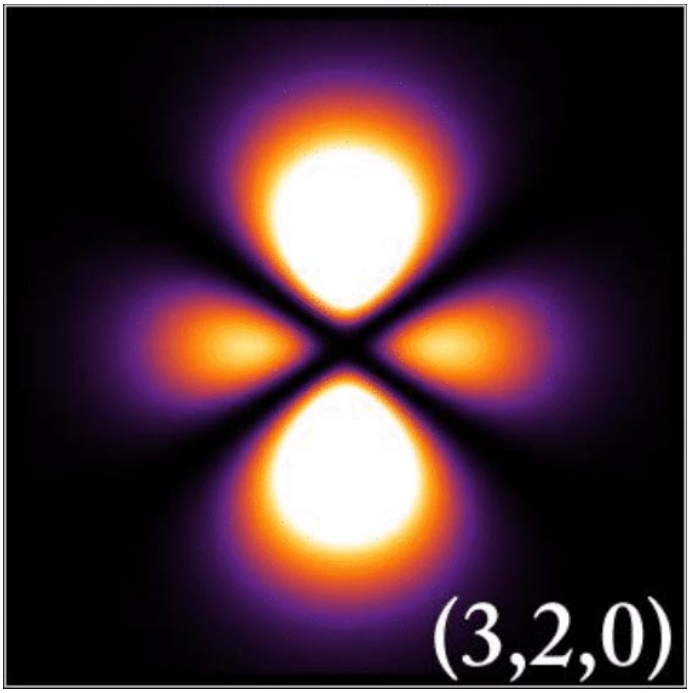

Fig 7: (3,2,0) probability distribution for the electron orbitals of a hydrogen atom

A more familiar and perhaps more accurate depiction of these loops is provided by the (3,2,0) probability distribution for the electron orbitals of a hydrogen atom.[10] While this object is many orders the size of a baryon, its distinctive shape makes it a prime analogue for the nucleic structure. And this is to clarify, what is being depicted in (3,2,0) in Fig 7 is but the cross-section of a dumbell shape and a toroidal ring.

Inner-Outer

Why all this talk of extra-dimensions?

It seems unnecessarily complicated, does it not? But there might be good reasons why the 4-dimensional model is the preferred option.

If we return to our Hydrogen electron configuration, we can begin to play around with the waveforms using polar coordinates to create simplified 4D models of the probability densities (See Fig. 8). For example, in A1, we see the hydrogen distribution for (3,0,0). In A2, we see the polar coordinate inversion of that same distribution. Why is this significant?

If we apply it to the elementary particle case, we see that this formation does have a bearing on particle density renormalisation. In Quantum Physics, a particle is possessed of a non-zero energy contained within a volume, which is effectively zero. A consequence of this is an infinitely dense point of mass, which therefore has infinite energy. This requires the particle's energy to be 'renormalised', so that it agrees with the results of experimental mass measurements. This 'renormalisation' is usually carried out by effectively ignoring the infinities.[11]

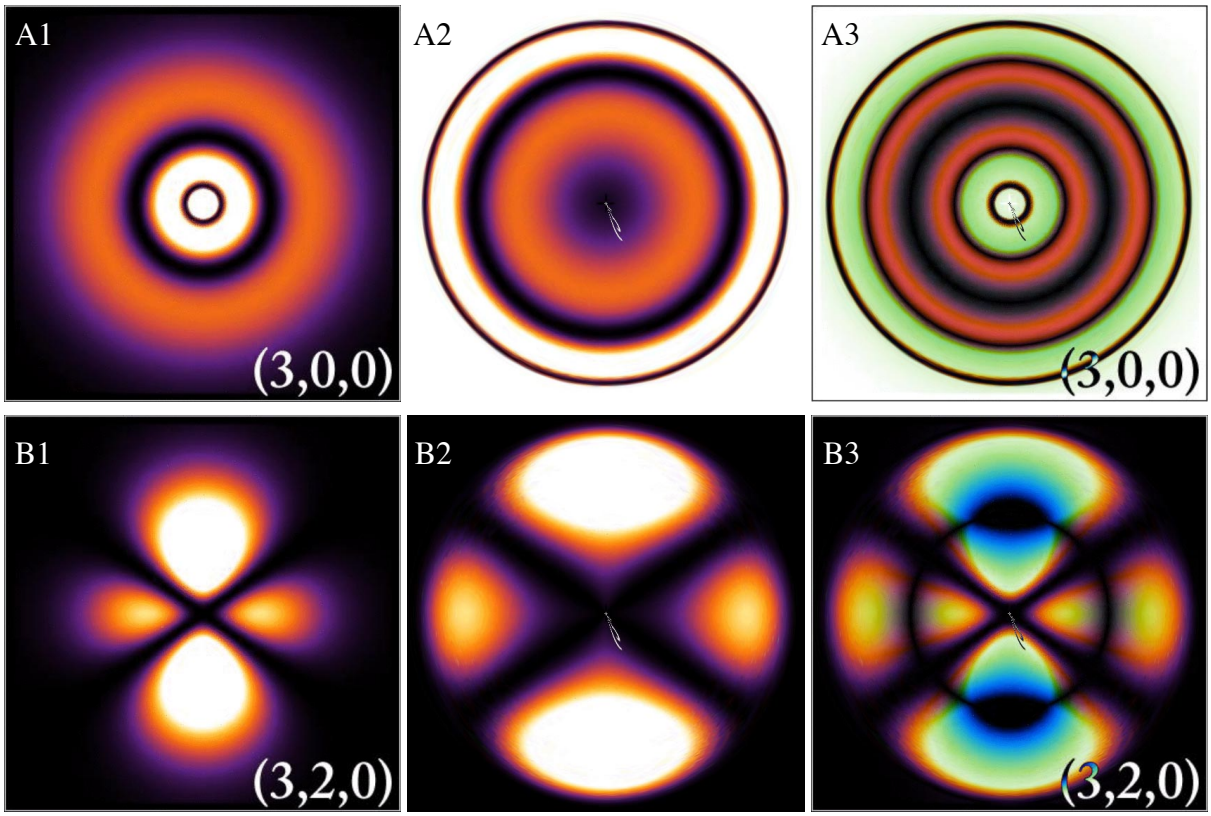

Fig 7: 4-dimensional diagrams of Hydrogen atom probability distributions

A similar situation to the infinitely dense mass can be achieved via the rotation of an elementary particle about a 4th dimensional axis (See A2). Here, the energy dense particle moves to fill all space surrounding the particle infinitely. This helps to explain how an infinitely dense point of energy can exist, in the first place. Although the actual explanation is more complicated, as it includes XOR and XNOR Dimensional Gates.

But Fig.7-A2 also implies that the particle is not infinite. Instead, it simply occupies an inverted universe where zero (the Ground State) now equals infinity and infinity (the dense

particle) now equals zero. But this is true of the Ground State anyway, where it can be said that the zero-point energy is interchangeably zero and infinity. [13]

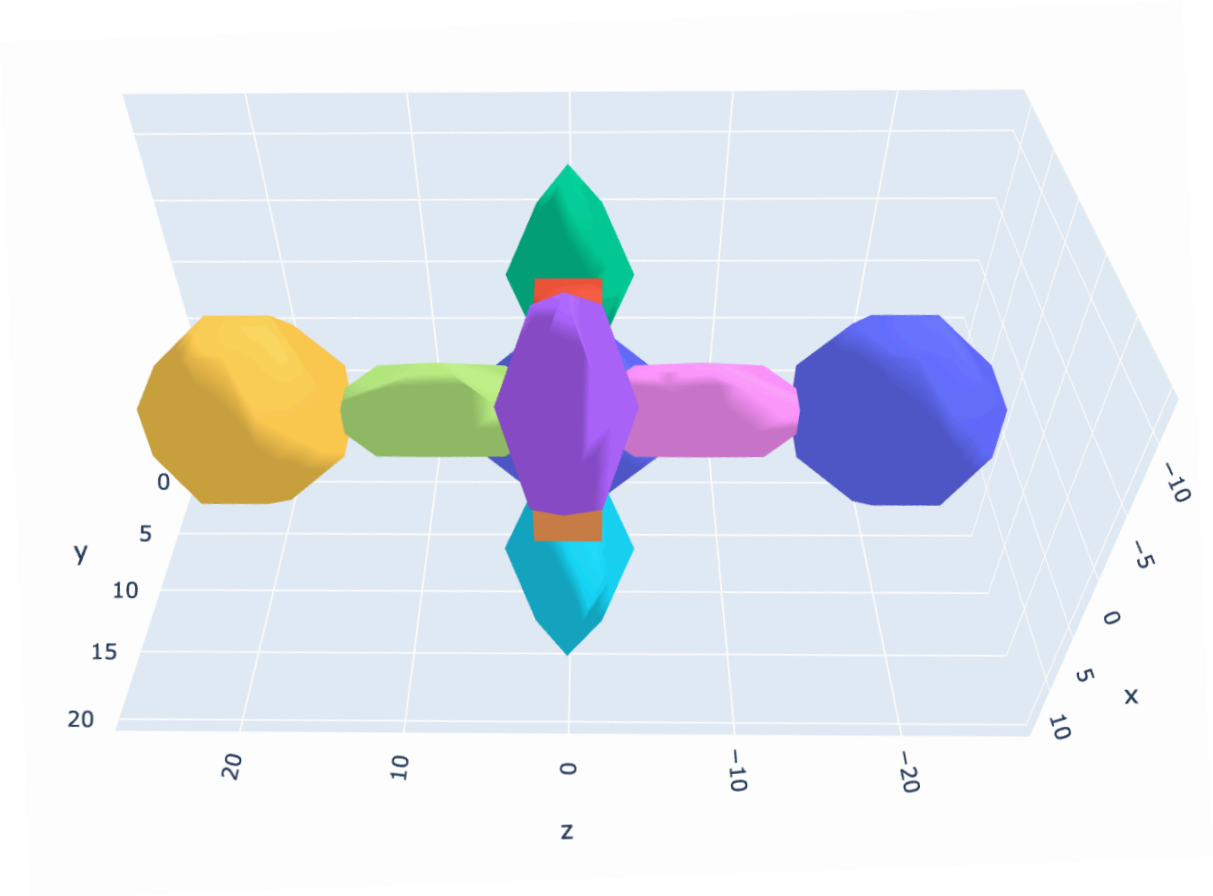

Fig 8: Different view of the baryon

We have already encountered something similar, while investigating the relationship between the Dimensional Gate Operators and the Heisenberg Uncertainty Principle.[12]

By superimposing these two perspectives on top of one another and adjusting the image so that like terms cancel out, we arrive at the image in A3.

Notice how both it and the image in B3 contain distorted copies of their previous two images co-mingled. The black circle bordering the perspectives on these two objects represents the boundary between our 3-dimensional space and that of the 4th dimension. At this boundary, everything cancels out perfectly.

Since B1 serves as an analogue for of our nucleon from Fig 6, and B2 serves as the inverted DGO model, it stands to reason that B3 represents the model of both structures viewed at the same time i.e. from the 4th dimension. Of course, for this to translate to the nucleon model in Fig 3, the inversion would have to take place not on each part individually (i.e. the gluons and quarks), but on the entire nucleon as a whole.

This actually makes sense, since none of the constituent nucleon entities have ever been seen observed outside of the nucleon and indeed their existence outside of its confines is

theoretically prohibited, thus leading us to the conclusion that — for all intents and purposes — there are no 'parts'. There is only the totality of the nucleon.

The Music of the 24-Cell

Since the nucleon could be though of as a single polyhedron, we might as well ask, which one? Well, one worthy avenue of research comes from the Rhombi Dodecahedron (RD) itself. The RD is the basis of the gluon and of the W and Z bosons, so it is definitely important. According to Wikipedia, the 24-cell is the 4D analogue of the Rhombi Dodecahedron. [14] This could mean that the actual shape of the gluon and the W and Z boson is not that of a hypercube, as once thought, but of a 24-cell. The 24-cell is a 4-dimensional polytope with SO(8), or spin 8 symmetry, which is probably why it is related to the 8-dimensional SU(3) symmetry of QCD.

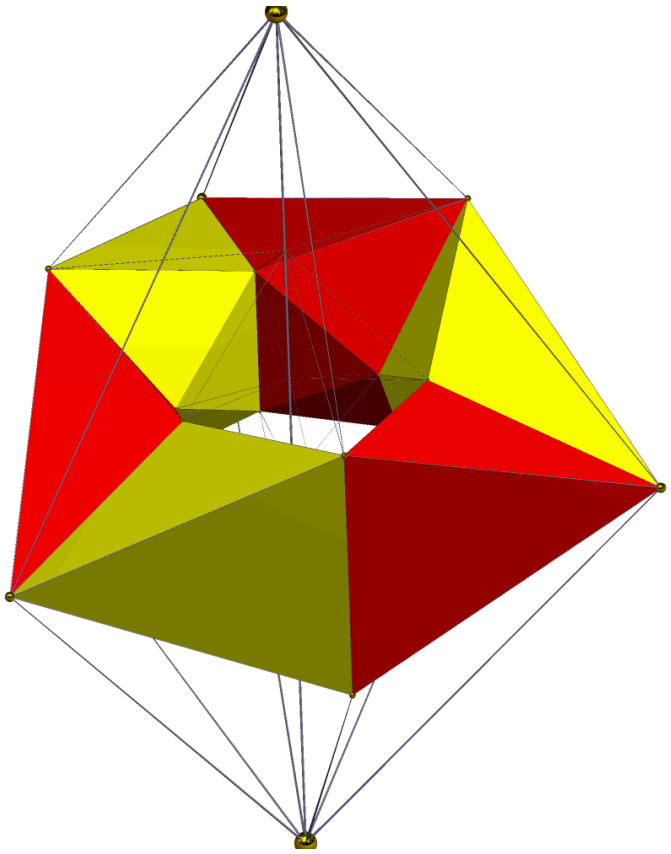

Fig 9: An edge-center perspective projection of the 24-cell [15]

"The boundary of the 24-cell is composed of 24 octahedral cells with six meeting at each vertex, and three at each edge. Together they have 96 triangular faces, 96 edges, and 24 vertices. The vertex figure is a cube. The 24-cell is self-dual. It and

the tesseract are the only convex regular 4-polytopes in which the edge length equals the radius." [15]

In Fig. 9, we see one of four rings of 6 octahedra around the equator. Notice how 2 of these octahedra are 'up' and 4 are 'down' or (u, u, d, d, d, d). This makes it proportional to the neutron (u, d, d) and its ring-shape also confirms this. However, it is equally clear that we could construct a proton ring with (u, u, d). Furthermore, we could create several protonic dipoles, but how the analogy of 'up' and 'down' would transfer to these states is not exactly known to me.

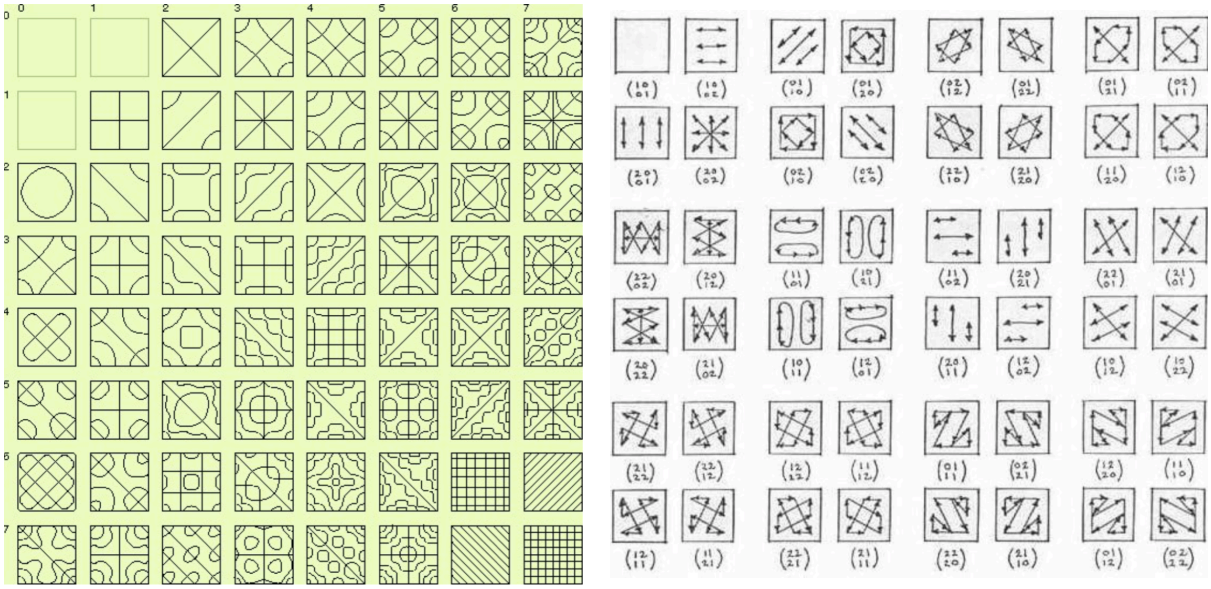

Fig 10: Cymatic waveforms (Source unknown: no copyright infringement intended) and GL(2, 3)[16]

The fact that the 24-cell is self-dual is interesting, especially when we consider that the gluon and Z-bosons are both their own anti-particle. The vertices of the 24-cell can be viewed as the unit Hurwitz quaternions, which implies that they also have right and left handedness used to create the W boson and its anti-particle.

"When interpreted as the quaternions, the F4 root lattice (which is the integral span of the vertices of the 24-cell) is closed under multiplication and is therefore a ring. This is the ring of Hurwitz integral quaternions. The vertices of the 24-cell form the group of units (i.e. the group of invertible elements) in the Hurwitz quaternion ring (this group is also known as the binary tetrahedral group)."[15]

The binary tetrahedral group (BTG) is itself taken from the General Linear group GL(2,3), which has 48 elements (See Fig 10). [16] Since the BTG group relates to the quaternions, could this mean that all 48 elements of GL(2,3) represent the 48 real numbered

matrices of the quaternions? [17] Perhaps this would also make them the same as the 48 root vectors of the F4 root lattice. [18] The 48 elements of GL(2,3) remind me of the combinatorial result for the Cauchy determinant matrices of Order 3.[19] Determinant matrices like these form the basis of these kinds of General Linear groups anyway, so perhaps connection here might not be too surprising.

It would be more surprising, if there is the relationship between all of the previous groups and the 49 modular cymatic waveforms, of the kind that we see on a resonating metal plate with salt (Fig. 10). This brings in the concept of resonant frequency and music into the structure of the baryons.

In order for the correspondence to work one of the cymatic waveforms would have to be eliminated from the group, to achieve 48. You might think it prudent to eliminate either the first or the last of the group. However, this is not the correct approach.

So far all of our matrices have been (3x3) or nine-fold.

49 elements by 9 equals 440.

The number 440 has a special place in sound and music, as it determines the key of C in Hertz. In order to make the two groups correspond, therefore, we need to shift the key of C from (49 x 9) down to (48 x 9), which is equal to 432 Hz. Now all of these two groups have 48 matrices with Order 3 and so we have a direct relationship between musical tones, quaternions, the 24-cell and baryonic matter.

Interestingly, some researchers maintain that the key of C was originally tuned to 432 Hz, before being shifted up to 440 Hz, in the lead up to WWII. The theory goes that the change was intended to create disharmony within the human psyche, promoting ill-health and war-like tendencies. [20] If there really are 432 frequency elements that go into the construction of baryonic matter, then listening to music in 440 Hz could result in a psychologically more dynamic, energetic and ultimately more exhausting experience.

Keywords

DGO, Dimensional Gate Operators, protons, neutrons, quarks, up, down, quaternions, 4-dimensional, hadrons, baryon, GL(2,3), 24-cell, cymatics, music.

References

[1] ‘CONSTRUCTION OF THE 2ND AND 3RD GENERATION QUARK PARTICLES IN THE STANDARD MODEL’, Christopher C. O'Neill, DOI: 10.13140/RG.2.2.20228.35202 https://www.researchgate.net/publication/

348191884_CONSTRUCTION_OF_THE_2ND_AND_3RD_GENERATION_QUARK_PARTICLES_IN_THE_STANDARD_MODEL

[2] 'Theoretical Feasibility of Cold Fusion According to the BSM - Supergravitation Unified Theory' Stoyan Sarg Sargoytchev, https://www.researchgate.net/publication/259190910_Theoretical_Feasibility_of_Cold_Fusion_According_to_the_BSM_-_Supergravitation_Unified_Theory/figures

[3] 'DGO Quaternion Multiplication & Gluon Structure', DOI: 10.13140/RG.2.2.35073.07524, Christopher C. O'Neill, https://www.researchgate.net/publication/347522261_DGO_Quaternion_Multiplication_Gluon_Structure

[4] https://en.wikipedia.org/wiki/Rhombic_dodecahedron#/media/File:R1-stel.gif

[5] 'DGO Quaternion Multiplication & Gluon Structure', DOI: 10.13140/RG.2.2.35073.07524, Christopher C. O'Neill, https://www.researchgate.net/publication/347522261_DGO_Quaternion_Multiplication_Gluon_Structure

[6] 'Nickel-Hydrogen Cold Fusion by Intermediate Rydberg State of Hydrogen: Selection of the Isotopes for Energy Optimization and Radioactive Waste Minimization', Stoyan Sarg Sargoytchev, https://www.researchgate.net/publication/259889185_Nickel-Hydrogen_Cold_Fusion_by_Intermediate_Rydberg_State_of_Hydrogen_Selection_of_the_Isotopes_for_Energy_Optimization_and_Radioactive_Waste_Minimization

[7] 'Shapes of the Proton' Gerald A. Miller, https://cds.cern.ch/record/614068/files/0304076.pdf

[8] https://www.washington.edu/news/2003/04/05/surprise-to-physicists-protons-arent-always-shaped-like-a-basketball/

[9] http://www.gregegan.net/SCIENCE/SymmetricWaves/SymmetricWaves.html

[10] https://kforinas.pages.iu.edu/physlets/quantum/hydrogen.html

[11] 'The search for a quantum field theory', Dr. Chris Oakley, http://www.cgoakley.org/qft/

[12] 'Heisenberg Uncertainty Principle and DGO', December 2020, DOI: 10.13140/RG.

2.2.16600.11524, Christopher C. O'Neill, https://www.researchgate.net/publication/346528123_Heisenberg_Uncertainty_Principle_and_DGO

[13] Quantum Field Theory 2b - Field Quantization II, https://www.youtube.com/watch?v=uD_HKeMbNFc

[14] https://en.wikipedia.org/wiki/Rhombic_dodecahedron

[15] https://en.wikipedia.org/wiki/24-cell

[16] 'Visualizing GL(2,p)', Steven H. Cullinane; http://finitegeometry.org/sc/9/3x3.html

[17] https://en.wikipedia.org/wiki/Quaternion

[18] https://en.wikipedia.org/wiki/F4_(mathematics)

[19] 'Matrices, determinants and the birth of Linear Algebra' | Math History | NJ Wildberger: https://www.youtube.com/watch?v=Vg1e2FEpf9w

[20] https://globalnews.ca/news/4194106/440-hz-conspiracy-music/