Theory of the Baryon Number

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The extension of the SU(3) symmetry is motivated for completion, with the introduction of a U(1)' group as a necessary component. Coupling parameters are derived through GUT recursions, leading to an observable theory for a strong-force partner. Tested parameters remain within experimental constraints, and the proposed particle is consistent with persistent deviations at ATLAS. Analysis of the charge distribution identifies the gauge number as the baryon number B. To address $SU(2)_L$ chiral anomalies inherent in baryon gauging, a solution is proposed requiring only two fermion flavors, termed "Zweigions" in honor of George Zweig. Due to over-damping, these states are treated as mathematical abstractions that align with hadronic surpluses and anomalon signatures at ALICE. The Zweigion mechanism cancels gauge leakages and Higgs coupling degrees of freedom while achieving the ideal GUT unification b-value, ensuring a renormalizable theory. Finally, this work challenges the Standard Model sphaleron interpretation, demonstrating that transitions may persist under B-gauging. This model predicts at least two undiscovered gauge symmetries based on the hypothesis results. Definitive testing of this theory is expected via the HL-LHC by 2030.

PHENOMENOLOGICAL APPROACH TO A UNIFIED MODEL

The very first priority is the need to construct the gauge theory of discussion. In physics, the preference for symmetry isn't just an aesthetic choice; it's rooted in mathematical consistency and predictive power. When we find an "asymmetry" where we expected a pattern, it usually signals that our current map of the universe is missing a piece. Electromagnetism and the Weak Nuclear Force form converge to at high energies: If the universe shall acquire symmetry, then why does the Strong Nuclear Force fail to become a U(3)? The universe ideally needs at least four fundamental vector gauge forces. This hypothesis acquired a similar logical thought process as the 1974 Pati-Salam Model, where they tried to fit a U(1) gauge force with the Strong Nuclear Force [1]. While the Pati-Salam model serves as a foundational inspiration, it possesses severe limitations. The 1974 model predicts a massive amount of new bosons and neutrinos to cancel out the anomalous terms. The fact that it's trying to justify its error by proposing Proton Decay Suppression makes the theory "fine-tuning". A more similar model by J.J. Lodder in 1996, explore a U(3)-extended, U(1)'-sector model where the 9th gluon, associated with the extra factor, acquires mass through spontaneous symmetry breaking [2]. It is philosophically identical to my proposal in principle, but Lodder utilizes curve-fitting techniques. I'm trying to complete the symmetry by trusting math and logic only. I believe that the fundamental attributes of a symmetric gauge field are linked to their unified groups by a mathematical recursion. An algebraic mapping is the only way to establish clear structure.

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Logical Restrictions

To form the nice U(n) that we need, one combines a U(1) group with an SU(n) at high energies. Trying to unify the SU(3) group is the first step to unification that doesn't require new gauge families like SU(5) or SO(10), it stays within the group. This makes sure that our gauge field contains only one type of charge-axis or "color" like the electric charge. Once we know the type of the field, we ask for diverse coupling of the field. What type of particles does the gauge field couples to? Is it quarks, leptons, or both? You must ensure that the triangle diagrams involving a new gauge boson does not lead to a breakdown of gauge invariance. In the Standard Model, the $U(1)_Y$ (hypercharge) charges are perfectly balanced between quarks and leptons. If you create a new U(1) that couples strongly to quarks (to bridge the gap toward the strong force), the lepton charges must be tuned with extreme precision to cancel the $U(1)^3$ and U(1)-gravity anomalies. Coupling to quarks is mandatory because it is the child of the strong parent. Lepton coupling however, is a different story. Coupling to both quarks and leptons causes AJB anomalies where a leakage exists. Any new U(1) charge involved will generate charge from the vacuum regardless of its chirality because the chiral weak force couples to both quarks and leptons. I am continuing the first section because the solution that resolves this discrepancy requires the information developed in section 2.4. For the theory, we'll momentarily put this problem aside and continue the derivation until. Coupling to leptons is fundamentally impossible because the children of the strong U(3) are restricted to the quark sector. While leptonic coupling isn't specifically disallowed, it must avoid electroweak precision data. Therefore it is conclusive to start with a leptophobic gauge field. These are our initial assumptions for the theory.

Gauge Coupling

Once the verbal fence posts have been staked, the empirical theory begins to unravel. The one numerical value that symbolizes and structures an entire gauge field is the gauge coupling g itself. The technique we use in this paper corresponds to a generalized recursive coupling method that is widely accepted in unification theories. The exact proof to this grand evolution recursion was developed as a consequence of Georgi-Glashow's 1974 model [3]. If the U(3) strong force possesses a g_n constant, the singlet U(1) "child" must have g_{n+1}. The explicit form for this recursion is:

$$g_{n+1} = \sqrt{\frac{\sum Q_n^2}{\sum Q_{n+1}^2}} g_n \tag{1}$$

The sum is the addition of group theory weights (the generators), not the physical charge "number" or the "number" of colors. Fortunately, we can apply this formula as a rigorous basis for our unification with the strong force by putting in the values g_3 and g'':

$$g'' = \sqrt{\frac{\sum Q_{strong}^2}{\sum Q_{new}^2}} g_3 \tag{2}$$

A few of the terms in this numerical evaluation are already known constants. For example, the strong charge sum is directly related to its trace and is the sum of the SU(3) color weights over all quarks:

$$\sum Q_{strong}^2 = \frac{1}{2} \tag{3}$$

The next step we take is to set a constraint on what the sum of the square in the denominator can or cannot be. You must ensure the normalization of the generator. In a rigorous gauge theory, enforcing $\sum Q^2 = 1$ is done to eliminate mathematical redundancy and ensure the uniqueness of the coupling constant. In our Lagrangian, the interaction strength is the product of the coupling g'' and the charge Q. Mathematically, you could double all charges and halve the coupling without changing the physical force. By enforcing unitarity, you lock equality. If the sum were anything else, you would have to add an awkward "normalization coefficient". It ensures that the total "interaction probability" is preserved and treats the U(1) generator as a single, complete unit of symmetry that has been extracted from the U(3) parent. That is the only way to define the U(1) generator as a canonically normalized unit operator. Therefore:

$$g'' = \frac{g_3}{\sqrt{2}} \tag{4}$$

At this phase, the new coupling constant can be computed directly. From the PDG 2024 particle data group physical constants chart, the exact value of the strong fine-structure constant is $\alpha = 0.1180(9)$ [4]. Substituting this into the standard relation $g = \sqrt{4\pi\alpha}$ presents:

$$g_3 = 2\sqrt{\pi \cdot 0.1180} = 1.21771578478 \tag{5}$$

Attaining this value gives us the exact value for the g'' coupling constant as a direct multiplication:

$$g'' = \frac{1.21771578478}{\sqrt{2}} = 0.86105508897 \tag{6}$$

The precise gauge coupling result derived here is very strong intrinsically. The 2nd strongest force is hindered because stronger forces with a suppressed range will have shorter ranges. This U(1) is a traditional Newtonian force. U(1) forces do not have the ability to flip flavors because they are self-symmetric. Current detectors often search for lepton jets because the strong QCD quark background noise is too sticky to detect anything. Kinetic mixing could be a theoretical possibility, and this will be specifically discussed in section 2.9. The coupling is not a free parameter, because I interpret it as a strict inheritance from the strong nuclear force itself.

Mass from the Higgs Field

You cannot conclude anything meaningful without understanding the fundamental reach of your field. The mediator is massive because there's no mysterious radiation flying around. Mass is a direct result of symmetry break. The U(3) is a Standard Model symmetry because it is the fully unified strong force. All SM forces attain mass through the Higgs Mechanism. The formula we use is commonly known as the Weinberg's Relation for boson mass, once used to find the values for both the W and Z bosons [5]:

$$M = \frac{1}{2} g v \tag{7}$$

The value v belongs to the Higgs vacuum expectation value at precisely 246.21964 GeV when you plug in the PDG2024 $G_F = 1.1663788 \times 10^{-5}\,\mathrm{GeV}^{-1}$ into $v = (\sqrt{2} G_F)^{-1/2}$ [4]. All we need to do to find the mass is just to place our coupling into the formula. Thus:

$$M'' = \frac{1}{2} \cdot 0.86105508897 \cdot 246.21964 = 106.004337013\,\mathrm{GeV} \tag{8}$$

Every neutral Higgs-coupled massive boson must decay into quark or lepton pairs. Their decay channel must result in 2 fundamental fermions, which are quark-only due to leptophobia. The only signal appears in the "messy" quark jet data, where we already expect huge uncertainties. Any slightly off measurements could easily be QCD background noise or excesses that LHC's recyclers. Lodder's proposal places the U(1) particle at at least 300 GeV. 106 is not even close.

Decay Width and Range

Real credible evidence for superiority does not rely merely on two observables. More physical characteristics are required to be computed flawlessly. We prefer to start with the range because it can be directly calculated by the reduced Compton wavelength:

$$R = \frac{\hbar}{Mc} \tag{9}$$

Here we require the boson's mass in kg. That's multiplying 106.004061476 GeV with the standard conversion unit 1.78266×10^{-27} kg. The particle weighs 1.889692×10^{-25} kg.

$$R = 1.86150597 \times 10^{-18}\,\text{m} \tag{10}$$

It's an interaction range shorter than the weak nuclear force (2×10^{-18} m). The effects of the "Newtonian" force can be only triggered deep inside quark gluon plasma or big-bang GUT environments, which is impossible by current technology. Our conjecture is categorized as a nuclear force because of the physical scale of its interaction radius, even though U(1) is abelian. Then, we can move on to the decay width of our particle. This part is the most important because it defines the shape and distribution of the signal from within the collider. The equation of bosonic decay width was first derived in Peskin and Schroeder's 1995 textbook [6]:

$$\Gamma = \frac{g^2 M}{12\pi}\sqrt{1 - \frac{4m^2}{M^2}}\left(1 + \frac{2m^2}{M^2}\right) \tag{11}$$

The value m represents the mass of each of the quarks in the current decay mode. For our theory, the decay channel is restricted to the quark sector. The top quark is kinetically impossible because it is much heavier than 106 GeV. A full W or Z pair cannot be an option either. The decay into photons is a "loop-level" process, which is quantum-mechanically much less likely to happen without direct coupling. It must first "borrow" energy to create a virtual loop of charged particles (quarks) that then radiate the photons. That's too complex for the system. Then, look towards possible decay into $Z\gamma$ or $Z^* q\bar{q}$ channels. The channel involving a singular photon plus one Z is even rarer, the photonic decay is achieved through a quark loop while the Z-boson's mass drains most of the energy. Z plus quark pair leaves even less kinetic energy. That's the priority loss. Thus it is strictly non-electroweak. Vector bosons will decay into all possible particles with equal likelihood. The effective width is thus the sum of all partial decay widths over the five quark types. The following values are the mass peaks obtained by the PDG Data Group [4]. To begin with, the up quark is cited with the most accurate mass of 2.16 MeV:

$$\Gamma_u = 2.08474654234\,\text{GeV} \tag{12}$$

For the down quark 4.67 MeV, the value is:

$$\Gamma_d = 2.08474654234\,\text{GeV} \tag{13}$$

They're so close together because GeV ranges make MeV particles look like sand. Charm quark is at 1.273 GeV:

$$\Gamma_c = 2.08474628214\,\text{GeV} \tag{14}$$

There it increases a slight bit. Using 93.4 GeV for the strange quark:

$$\Gamma_s = 2.08474654234\,\text{GeV} \tag{15}$$

Finally, we compute a "very similar" decay width again for the heaviest kinematically favorable. The bottom quark at 4.18 GeV:

$$\Gamma_b = 2.08471623679\,\text{GeV} \tag{16}$$

The total decay width is the sum of these distinct values:

$$\Gamma_{all} = 10.423702146\,\text{GeV} \tag{17}$$

This decay width accounts for almost 10% of the boson's rest mass. It decays almost the instant it is born. You would see a massive, blurry "hump" that stretches from roughly 101 GeV to 111 GeV. LHC would see our smooth hill as background noise and delete the entire set of data immediately. You could try using ISR or observing the gauge debris it affects along its way. That is the ideal plan, though not guaranteed.

Boson Lifetime

Obtaining the exact value of the decay width awards us the lifetime:

$$\tau = \frac{\hbar}{\Gamma} \tag{18}$$

The $\hbar$ in the equation has been converted to GeV units to match Γ in the denominator.

$$t = 6.31456989 \times 10^{-26}\,\text{s} \tag{19}$$

It is about 4.75 times more short lived than the W/Z resonances. Instant decays are not much different than a QCD hump. Without a displaced vertex, there is no geometric way to tell our 106 GeV boson apart from noise. As a result, we move on to the mathematical part of the conjecture. The chiral anomaly and renormalization, each and one of these present technical challenges besides physical evidence. Within this short margin of this section, we cannot draw any definite results. Therefore, we must build on our initial hypothesis, and resolve the AJB mathematical anomalies in section 2.

INTERACTIONS AND COSMOLOGICAL CORROBORATION

The current section represents the most important part of the theory. The mathematical proofs, anomaly resolutions, and consistency theories lie here. At the center of the conjecture, the primary threat is the violation of the triangle anomaly. It generates charge leaks and number violations. While the triangle anomaly is the main challenge, many other roadblocks that we must solve lie in alignment. For whatever solution we take, it must maintain natural coherence without irregularity. While the first few sections continue building on the gauge idea, the true explanation on the AJB anomaly is to be discussed in section 2.5 as a major point of interest.

Distribution of Charge

The most first and foremost vertex of analysis that we must start at is charge distribution for each of quarks. You cannot know the interaction properties without obtaining exactly what it interacts with. When you add a new $U(1)'$ force, you aren't just adding a particle; you are adding a new symmetry. For that symmetry to be "gauge invariant" (mathematically consistent), the sum of all internal quantum loops—the Triangle Anomalies—must equal zero. The most famous constraint is an Anomaly Test specifically for new U(1) sector leptophobic forces, called the $SU(3)_c^2 \times U(1)'$ anomaly [7]. If the plug-in of each charge on each quark fails to contain an output of zero, the theory must introduce negative probability to delete the anomalies. From Paul Langacker's 2008 idea on the CKM rotation, any distinct $U(1)'$ gauge sector force that couples to quarks ideally has the charge values uniform across all flavors [8].

$$z_u = z_d = z_c = z_s = z_t = z_b \tag{20}$$

The only way to prevent internal leaks is to define $z_R = z_L$ across both chiralities. We need to plug internal anomalies before we acquire external ones. Self-induced FCNC's would exist if the values were chiral. This conclusion allows us to solve for the quantized unit of this gauge charge. Because a U(1)' charge is uniform across all quarks, we no longer require a varying Q_q^2 value. The sum is over flavors, colors, and chirality. That's $6 \cdot 3 \cdot 2 = 36$ times Q^2:

$$36Q_{new}^2 = 1 \tag{21}$$

Then rearrange to solve for Q_{new}:

$$Q_{new} = \frac{1}{6} \tag{22}$$

The charge number is always an integer multiple of this specific 0.166. It's analogous to e in Coulomb Force. Although weak chirality force creates a major AJB anomaly, this is the necessity to remain self contained. Otherwise, we'd have flavor-changing neutral currents that transform quarks with nonlinear FCNC's. The logic scaffolds the resolution four subsections later.

Production and Decay Channels

According to rules for standard spin-1 gauge fields, like charges repel and opposite ones attract. Because the charge distribution is uniform across all quark flavors, two of which shall repel. The weak force can transform although it's weak. Our nuclear force cannot, so it is negligible. High speed collisions often push quarks closer than the attometer range, wouldn't you think we'd observe some action in energetic smash events? A high collision behaves like a general point interaction. The instantaneous force feels invisible because that excess energy easily climbs the potential barrier or passes through the attractive well. It successfully crosses to the other side without significant energy loss or changes in motion. You could try to slowly compress two nucleons together until they collapse into a dense quark soup at ranges up to 10^{-19} m. The problem is the energy level required for such an event. The local density must surpass black hole pressure for periods of time. It is possible that analyzing its production channels will reveal more about its nature. A virtual gauge boson will be momentarily exchanged between two particles that carry the same type of charge. The fundamental reaction should look something like:

$$q + q \to Z' \to q + q \tag{23}$$

Quarks possess all four types of charge. The probability of our particle forming is distributed equally between the rest of the gauge bosons. Under normal circumstances, the resonance produced in a standard quark collision won't be enough to trigger saves because they would be mistaken. Clearly this doesn't work, thus we resort to innovative ways collisions can trigger data-saves. To formally represent the boson in an interaction, I have decided to label it Zeta standing for the "Zenith" of physics. It is denoted with the symbol $\not{Z}$, and thus the Z-bar Boson. Under revision, the decay reaction is:

$$\not{Z}^0 \to q\bar{q} \tag{24}$$

How many different ways can we manually smash quarks together to reverse the decay process and produce a real boson? This process is camouflaged as step 1 in standard Drell Yan processes [9]. That's a blurry mutually shared channel between all bosons. Thus direct production or decay cannot tell us any new information: So we switch our procedure to a secondary associated production channel. The photon (or standard gluon) comes into play in Associated Productions as an "extra" particle that is radiated away during the collision. It comes from Initial

State Radiation (ISR) that we proposed earlier. Because quarks carry electric charge, they can "spit out" a photon just before they collide:

$$q\bar{q} \to \not{Z}\gamma \tag{25}$$

One of the incoming quarks radiates a photon. This causes the quark to "recoil" slightly before it hits the other quark. If you just produce a $\not{Z}$ from a direct production, it sits relatively still in the detector and decays into two "soft" jets. The LHC triggers (the computers that decide what data to save) usually delete these events because they look like boring, low-energy background noise. If the computer sees a 150 GeV photon, it saves the whole event. Given the 13.6 TeV abilities of the LHC, it should create an abundant amount of these particles every running day. We should be seeing vague signals at the LHC complementing our description. The continuation corresponds to section 3.2, and would remain the most powerful evidence until the high-luminosity LHC in 2030 opens up to confirm my conjecture.

The Importance of the Baryon Number

By continuing to develop the idea of the charge distribution, we come upon a very important point. Look at the available gauge numbers unique to the strong sector. The only two options available are the Baryon Number and Strong Color. The baryon number B is a global symmetry constant and identical across all quarks. Strong Color is a fundamentally distinct set of red, green, and blue flavors that vary over. Empirically, our nuclear charge is equivalent to the baryon number because it is identical over every flavor and chirality. The SM Baryon Number is an "accidental" global symmetry (it's just a byproduct of the math, not a law). By gauging it, the proton stability is reinforced: It can't decay, because it would have to "throw away" the baryon charge. There's nowhere for that charge to go. Current experiments (like Super-Kamiokande) have never seen a proton decay. Traditional GUT's fail to explain the stability of the proton. Each quark must possess $B = +1/3$. The baryon number is in priority. U(3) was the completed nuclear force all along. Therefore, the mass and coupling become g_B and M_B. It's a fulcrum point in our conjecture. With this establishment, we switch our focus to the Triangle Anomaly.

New Fermions Resolving the Flavor-Leak Anomaly

In quantum field theory, "gauging" a symmetry like Baryon Number B leads to "leakage" or anomalies because the Standard Model is chiral. The left-handed and right-handed particles feel the weak force differently, and this "lopsidedness" breaks the gauge symmetry. This consistency is verified through Triangle Diagrams, where three force carriers (gauge bosons) meet at a loop of fermions. The SM weak force only acts on left-handed particles while B is universal for all. The quantum "bookkeeping" between the B-force and the existing weak force creates a non-zero Mixed Anomaly. The first step is to diagnose the leak. The Adler-Bell-Jackiw anomaly equation tells us exactly the amount of residue generated by the vacuum per charge [10][11]:

$$\mathcal{A} = \sum_L (Q_{old})^2 Q_{new} - \sum_R (Q_{old})^2 Q_{new} \tag{26}$$

The leak is the difference between the two sides. The most obvious anomaly belongs to the chiral weak isospin I_3, denoted as $SU(2)_L^2 \times U(1)_B$. Right handed isospin is 0. Up type quarks have isospin of $+1/2$ while down type quarks have $-1/2$. Only the magnitudes matter in a square. Multiplication over all three colors is also required for each type of quark there is:

$$\mathcal{A}_I = 3\times(1/2)^2_{up}\times 1/3 + 3\times(1/2)^2_{down}\times 1/3 = \frac{1}{4}+\frac{1}{4} = +\frac{1}{2} \tag{27}$$

A $+1/2$ amount is generated by the vacuum per generation. Over three generations, it's $+3/2$. One generation is the quantized unit. For antiquark interactions, the leak value is $-1/2$. The next most obvious is the weak hypercharge: $U(1)_Y^2 \times U(1)_B$.

$$\mathcal{A}_Y = \sum_L Y_L^2 B - \sum_R Y_R^2 B \tag{28}$$

Hypercharge is present for both chiral states. Left hand quarks all possess $+1/3$. Right hand up and down types correspond to $+4/3$ and $-2/3$ respectively. The left side is:

$$\sum_L Y_L^2 B = \sum_L N_c Y_L^2 B = (N_c Y_L^2 B)_{up} + (N_c Y_L^2 B)_{down} = 2\cdot 3\cdot \frac{1}{9}\cdot\frac{1}{3} = +\frac{2}{9} \tag{29}$$

Sum up over the right hand side as well:

$$\sum_R Y_R^2 B = N_c(4/3)^2_{up}\cdot 1/3 + N_c(-2/3)^2_{down}\cdot 1/3 = 16/9 + 4/9 = +\frac{20}{9} \tag{30}$$

The difference between the two yields:

$$\mathcal{A}_Y = \frac{2}{9} - \frac{20}{9} = -\frac{18}{9} = -2 \tag{31}$$

A -2 quantity of Hypercharge leaks. Electromagnetism and Strong Nuclear are achiral, therefore do not contribute. The EM and Strong leak is 0. The baryon number itself leaks too when connected with $SU(2)_L$ [10][11][12]:

$$\mathcal{A}_B = \sum_{f \in doublet} B_f C(r_f) \tag{32}$$

For SU(2), $r = 2$. The value of $C(r_f)$ is 1/2. The RHS term is missing because SU(2) is purely left handed. Summing over colors, and one single generation:

$$\mathcal{A}_B = 1/2 \cdot 3 \cdot (1/3)_{up} + 1/2 \cdot 3 \cdot (1/3)_{down} = +1 \tag{33}$$

A +1 baryon number leaks out. These leakages are often resolved by adding new fermions called "anomalons". To save the theory, we create the new particles. The first priority is canceling out the +1/2 isospin component. Isospin is left-handed, so these first fermions have to be left-handed as well. Isospin cannot be 0 because 0 cannot contribute, and cannot be ±1 because it overshoots $1 > 1/2$. The only legal option is isospin $\pm 1/2$. Witten's anomaly rule states that new fermions with isospin must come in a doublet (the number of left hand doublets is to be even) [13]. There exists a 2nd left handed fermion with the exact opposite isospin. So $I_3 = +1/2$ and $I_3 = -1/2$ forms our doublet. Applying the anti-triangle anomaly to the new fermions:

$$\mathcal{A} = (+1/2)^2 B + (-1/2)^2 B = 1/2B = -1/2 \tag{34}$$

It must be equal to $-1/2$ so that $-1/2+1/2 = 0$. The solution of B in this equation is -1. The canceling fermions are fundamental anti-baryons. By the Nielsen-Ninomiya No-Go Theorem [14][15], any consistent, local, and translationally invariant theory defined on a lattice exhibits fermion doubling. The introduction of a new left-handed isospin doublet necessitates the existence of corresponding right-handed states to avoid the doubling problem. Our doublet currently has only left handed particles. The internal Baryon anomaly sum over both sides is:

$$\mathcal{A}_B = \sum B_L - \sum B_R = \sum B_L = -2 \tag{35}$$

Leakage makes the theory "sick." We must add two right handed particles with $B = -1$ to eliminate the baryon oddity $(-2-(-2) = 0)$. The right-handed fermions have $I_3 = 0$ because the isospin has already been patched up: $\mathcal{A} = +1/2 - I_R$. $I_R \neq 0$ disrupts the problem we just fixed. $I = 0$ means the particles are singlets. The total is 4 particles. Now we try to fix the hypercharge leak. It's very possible using a heuristic trick: The doublet acquires hypercharges $Y = -1$ while the singlets have unequal hypercharges +2 and 0. The anti-leak is:

$$\mathcal{A} = \sum_L Y^2 B - \sum_R Y^2 B = (-1)^2 B + (-1)^2 B - (-2)^2 B + (0)^2 B = -1 + -1 + 4 = +2 \tag{36}$$

It is the only combination that outputs the additive inverse to -2. The unequal values of charge numbers between the left and right hands is because the weak isospin and hypercharge are both chiral. Then set the baryon number of the singlets to -1 for both as well: $\mathcal{A}_B = -2 - (-2) = 0$. There the total anomaly disappears, and four fermions are the cure. There cannot be more than 4. Electric charge can subsequently be obtained given the values of Y and I_3. The first fermion of the doublet possesses $I = +1/2$, $Y = -1$. $Q = I_3 + Y/2 = 1/2 - 1/2 = 0$. It is electrically neutral. Its corresponding partner retains: $I = -1/2$ and $Y = -1$. $Q = -1/2 - 1/2 = -1$. It is analogous to an electron. The singlets have electric charges $Q = Y/2$. They do not possess isospin. For the fermion with -2 hypercharge, $Q = -1$. It is negatively charged. For the completely neutral singlet $Q = 0$. It is the right hand version of the neutral doublet. The structure corresponds to exactly one generation of exotic leptons. You have one negatively charged partner, and one neutral partner. The electric charges are uniform across both sides. Therefore:

$$\mathcal{A} = \sum_L Q^2 B - \sum_R Q^2 B = -1\,(0 - 1 - 0 + 1) = 0 \tag{37}$$

There is no leak of electric charge. $0 + 0 = 0$. Even though 3 generations of quark anomalies exist, we only need anomalons for one generation. That is because we can pull three of them out at the same time to cancel over the three leaks. There are only two flavors. These are fundamental baryons without quark structure, color, or coupling to the residual nuclear force. It is identified as a baryonic lepton. I have decided to name the fermions the Zweig-Fermions in honor of George Zweig's legendary ace and deuce envision 52 years ago [16]. They're identified as the "Hearts", and are labeled as Aces and 5's per Zweig's poker naming scheme:

TABLE I. Properties of the Heart-sector Fermions.

Fermion	Weak Isospin	Weak Hypercharge	Electric Charge	Baryon Number
Left Handed Ace of Hearts (A_L^-)	-1/2	-1	-1	-1
Left Handed 5 of Hearts (5_L^0)	+1/2	-1	0	-1
Right Handed Ace of Hearts (A_R^-)	0	-2	-1	-1
Right Handed 5 of Hearts (5_R^0)	0	0	0	-1

We would generally label the particles as A^- and 5_H^0. The anomalons have negative charge while the leakage is explained as its virtual anti-particle forced to be produced during LHC collisions. The remaining is elaborated in section 2.5. The major question is the question of observation. After all, one of these fermions should form pairs in many LHC collisions per day. GUT's like to place these particles with masses in the TeV range, but there is no mathematical evidence for such. It is regarded that our fundamental unit of charge will be altered in the distribution, but that focus enters later.

Dynamics of New Fermions

While the mathematical anomaly was fixed, the dynamical concept is subjected to question. We need to approach the problem using logic, not assumption. The same process is briefly applied to the Zweig-Fermions, identical to that of the $\not{Z}$ Boson. Mass is the foremost component. Is it light or heavy? In a theory of Dirac Fermions, mass is uniform regardless of the chiral symmetry states [17]. Fermions that attain mass through the Higgs Mechanism have:

$$m_f = \frac{y_f v}{\sqrt{2}} \tag{38}$$

The formula for the Yukawa self-coupling is a short hand approximation [18]:

$$y_f^2 = \frac{1}{S}\sum G \cdot g^2 \tag{39}$$

S and G are constants related to the charge numbers of the particle. The Zweig-Fermions are Higgs coupled. The generalized gauge beta factor is $G_{U(1)} = 3(Q_L^2 + Q_R^2)$ [19][20]. These are the charges of each chiral state per gauge field. It applies regardless of singlets or doublets. The left hand ace has -1 hypercharge while the right hand particle has -2. The combined factor is: $G_Y = 3 \times ((-1)^2 + (-2)^2) = 15$. The baryon number is uniform across: $G_B = 3(+1^2 + 1^2) = 6$. For electromagnetism: $G_{EM} = 3 \cdot ((-1)^2 + (-1)^2) = 6$. The factor is $G_{SU(2)} = 3(C_2(R_L) + C_2(R_R))$ for SU(2) theories. The eigenvalue of the Casimir quadratic is: $C_2 = I(I+1)$. I is the total isospin (magnitude of 3rd component). The chiral SU(2) forces the 2nd component to vanish. The only contributor is the Left Hand Ace $I = +1/2$: $G = 3 \cdot \frac{1}{2}(\frac{1}{2}+1) = \frac{3}{2} \cdot \frac{3}{2} = +9/4$. Using values from the PDG 2022 and CODATA: hypercharge, isospin, and electric charge have couplings $g_Y = 0.35742031$, $g_w = 0.6528$ and $e = 0.30282212088$ respectively [21][22]:

$$\begin{aligned} Sy_{f(Ace)}^2 = \sum Gg^2 = 15 \cdot 0.35742031^2 + \\ 6 \cdot (0.86105508897^2 + 0.30282212088^2) + \\ \frac{9}{4} \cdot 0.6528^2 = 7.87377442882 \end{aligned} \tag{40}$$

The simplified one-loop Yukawa Beta-coefficient formula is defined as [23]:

$$S = \frac{3}{2} + N_c \cdot N_f \tag{41}$$

Our fermions are colorless, thus $N_c = 1$. N_f represents the flavors of fermions. There are only two flavors of hearts (aces and 5's), thus $N_f = 2$.

$$S = \frac{3}{2} + 1 \cdot 2 = \frac{3+4}{2} = \frac{7}{2} \tag{42}$$

Then:

$$y_f^2 = \frac{7.87377442882}{7/2} = 2.24964983681 \tag{43}$$

Take the root:

$$y_f = 1.4998832744 \tag{44}$$

Multiplication results in:

$$m_f = 261.135043313\,\text{GeV} \tag{45}$$

That would make it the heaviest fundamental fermion. The same is then applied to the 5's. G_W remains 9/4, and G_B remains 6. $G_{EM} = 0$ because 5's are electrically neutral. The hypercharge is -1 and 0, corresponding to $G_Y = 3 \cdot ((-1)^2 + 0^2) = 3$. Thus:

$$\begin{aligned} Sy_{f(5)}^2 = \sum Gg^2 = \frac{9}{4} \cdot 0.6528^2 + 6 \cdot 0.86105508897^2 + \\ 3 \cdot 0.35742031^2 = 5.79057567145 \end{aligned} \tag{46}$$

Then:

$$y_f^2 = \frac{5.79057567145}{3.5} = 1.65445019184 \tag{47}$$

The root is:

$$y_f = 1.28625432627 \tag{48}$$

Mass can be evaluated:

$$m_f = \frac{1.28625432627 \cdot 246.21964}{\sqrt{2}} = 223.941479271\,\text{GeV} \tag{49}$$

The aces and 5's are a good 45 GeV away from each other. The pair with the lowest mass is produced more frequently at low energies. The mechanism is provided below: The leak is guaranteed to happen, which produces a virtual antifermion in space. It must also simultaneously pull a virtual Zweig-fermion to cancel the leakage out. This forms a particle-antiparticle pair. The LHC produces enough mass-energy to pay the debt of these virtual particles, allowing their annihilation products to be "real" observable particles. If the fermions are hadronic the background noise will discriminate against them. Thus the topic of discussion shifts to decay and lifetime. Decay is a necessity, because we don't see HSCP's floating around (heavy stable charged particles). They have no lepton number, so they cannot decay into leptons. Gluons and Photons are neutral, and that's for shedding energy. Given $B = \pm 1$, they can decay into 3 quarks. Each of the quarks has a strong color, but our fundamental baryon is colorless. The mechanism of proposal is utilization of its extra mass-energy as currency. It trades the field lines and the strong binding potential from the vacuum itself. This way, the decay products attain color. Quarks have color, and the strong binding means the fermion has to be ripped apart internally to decay. It's much more preferable to decay into hadron pairs instead, because hadrons don't have the single-quark instability. They have the freedom of decay here. To create the residual strong field lines around a baryon, you only expend about 5-10% of the baryon's total mass. 100 MeV would be extremely cheap compared to 250 GeV. Donation is not a problem. A meson has no baryon number, while a baryon has exactly ± 1. It is kinematically the most favorable to decay through two body baryon plus meson sequences. If the displaced vertex is 0, the outgoing products are indistinguishable from the strong QCD quark jets. That "if" statement remains yet to be proven. QFT says fermions favor the lightest most stable combination allowed [6]. Lightest baryon-meson combinations are the most abundant. These channels can be found by experimenting with hadron values. Start off with the Left Handed Ace: I found that the lightest combination corresponds to an antiproton plus a neutral pion. Antiprotons have $Q = -1$, $Y = -1$ and isospin of $+1/2$. Pions are completely neutral and thus do not contribute, but they are mandatory because one body decay is impossible. Thus:

$$A^{-} \rightarrow p^{-} + \pi^{0} \tag{50}$$

The second most stable state corresponds to an antineutron plus a negative pion. The Left Handed 5 possesses: $I_3 = +1/2$, $Y = -1$, $Q = 0$, $B = -1$. The perfect combination I found was the antineutron plus neutral pion. Both particles have no electric charge. Antineutrons have $B = -1$, $Y = -1$, and $I_3 = +1/2$ while pions are baryon neutral:

$$5_L^0 \rightarrow \bar{n}^0 + \pi^0 \tag{51}$$

The doublets seem to decay into standard matter. For the singlets, we have a slightly different story. The Right Handed Ace of Hearts must include strangeness. The formula is $Y = B + S$. The baryon has $B = -1$, the only way to achieve $Y = -2$ is to have a meson with $S = -1$. These are anti-strange mesons. The lightest particle with this strangeness number is the negative Kaon with $Q = -1$. Thus its baryon partner is the antineutron. The Kaon accounts for the electric charge, as well as half of the hypercharge. Because antiKaons have $-1/2$ isospin and antineutrons have $+1/2$, the sum maintains a singlet. Therefore:

$$A_R^- \rightarrow \bar{n}^0 + K^- \tag{52}$$

Similarly, the Right Handed 5 also possesses strangeness. The solution is a neutral lambda antibaryon in addition to a neutral pion. $Y = B + S$. Lambda Antibaryons have a strangeness of $+1$, canceling $B = -1$. Both particles are electrically neutral and have 0 isospin, thus remaking the singlet.

$$5_R^0 \rightarrow \bar{\Lambda}^0 + \pi^0 \tag{53}$$

It follows the anti-scheme for antiZweig-fermions. There are mathematically more than 3000 kinematically allowed ways to configure a baryon and a meson together to form the total equivalent to one of our fermions. That's because there is about 500 distinct baryon and meson states (the triplets combined and counted). Per approximation, the decay width is about: $\Gamma_{Zweig} \sim \Gamma_B M_{Zweig}/M_B \sim 26.4\,\text{GeV},\ 21.9\,\text{GeV}$. Multiplication over 3000 channels would explode. The lifetime would be magnitudes of quectosecond. It never reaches its "rest mass" but rather exists only as a mathematical propagator. It's an overly damped "non-particle". I call it a Zweig Abstraction, or a mathematical quasi-ghost like resonance that exists to cancel out irregularities. We cannot statistically observe them, but we can observe their products. Collisions at 13.6 TeV are enough to produce a surplus of Zweig Abstractions (then the abstractions create hadronic surpluses). Here, we have evidence of our conjecture from the LHC data itself. During the particle collision data scans by ALICE at the LHC, the number of produced hadrons anomalously doubled or nearly tripled when compared to the sub-TeV RHIC colliders [24]. Most physicists believe this anomaly is attributed to new ways the quarks and gluons interact, such as color reconnection. Models driven by either color-charge density-saturation or simple extrapolations from lower energies were found to be inadequate at LHC energies. Furthermore, ALICE observed significant excess in unique strange hadrons like Kaons, Lambda Baryons, Xi, and Omega baryons [25][26]. Zweigions decay before annihilating, creating a huge surfeit of hadrons at high energies. The usual amount for a 90% pair production rate is estimated to about $6m_f - 14m_f$ when distributed equally between the other channels. That approximation is based on pair-creation favor and the percentage of the pair mass compared to the total energy. It corresponds to an energy range between $1.6 - 3.8$ TeV of collision. During LHC Runs 1-2, the energy was focused at around $7 - 13$ TeV [24]. That is beyond the 3.8 TeV mark. The production is likely over 95% at maximum energy output. A minimum of 1/8 of the total strange hadronic decay products per interaction should be produced. At higher energies, heavier strange hadrons are preferred to evenly distribute the kinetic energy. The most direct evidence is not the fermions themselves, but the excesses they create. Proof will come with the rest of the paper. As of now, the data sums up, the anomaly is patched up, and we are allowed to continue.

Yukawa Force Interaction

Through prior resolution, we revert back to the main theory. Can we ensure that the force it mediates is within experimental bounds? The main focus is abundant hadrons: nucleons. Nucleons repel because $B = +1$.

Every gauge field obeys the Yukawa Potential. We plan to analyze the interaction magnitude between two particles at various distances. The unit charge Yukawa potential term is:

$$V(r) = -\frac{g^2\hbar c}{4\pi r}e^{-r/r_0} \tag{54}$$

r_0 is in the range. We assign the + sign in front: $V_B(r) = +\frac{g_B^2\hbar c}{4\pi r}e^{-r/r_0}$. Integration over r offers the unit Yukawa Force:

$$F_B(r) = +\frac{g_B^2\hbar c}{4\pi}\left[\frac{1}{r^2}+\frac{1}{r_0 r}\right]e^{-r/r_0} \tag{55}$$

We introduce the multiple B_1B_2. It's analogous to Q_1Q_2 in electrodynamics. Each B must be accompanied by a z quantization unit analogous to e. z is no longer 1/6 with the addition of Zweig Abstractions. The condition is: $36Q_a^2 + 4Q_b^2 = 1$. There are two Zweigions flavors and two chiralities, so $2 \cdot 2 = 4$. The baryon number of the abstractions is 3 times the quark unit: $|Q_2| = 3|Q_1|$. Thus $36Q^2 + 4(3Q)^2 = 72Q^2 = 1$. As a result, $z = \frac{1}{6\sqrt{2}}$.

$$F_B(r) = \frac{B_1B_2z^2g_B^2\hbar c}{4\pi r^2}\left[1+\frac{r}{r_0}\right]e^{-r/r_0} \tag{56}$$

We begin calculating the amount of newtons per interaction. Begin with the most important separation: the nuclear range 10^{-15} m. It is the approximate distance between two baryons in a nucleus (approximately a deuteron). $+1 \cdot +1 = +1$, so B_1B_2 is unity. The value of z^2 is 72 in the denominator. The exponential factor for our 10^{-15} vanishes to extreme scales:

$$e^{-r/r_0} = e^{-537.199459} = 4.9801139166 \times 10^{-234} \tag{57}$$

The magnitude is hundreds of magnitudes too small. Just to continue, compute the $[1 + r/r_0]$ factor by adding one to the prior exponent:

$$[1 + r/r_0] = 538.199458995 \tag{58}$$

Finally compute the coupling term: $g_B^2\hbar c/4\pi r^2 = 1865.3007952049$. We now multiply everything:

$$F_B = 1865.3007952049 \cdot 1/72 \cdot 538.199458995 = 8.30019 \times 10^{-235}\,\text{N} \tag{59}$$

In short, the force is 0. So the next logical step is to ask how effective the force is at QGP scales. The average separation between two quarks was minimally 10^{-19} m. It is within the 1.8 attometer force range. We're dealing with quarks this time ($B = +1/3$). $B_1B_2 = +1/9$ is the charge factor. We have a reduction factor $1/9 \cdot 1/72 = 1/648$. There is no exponential term because the Higgs Field hasn't turned on yet ($M = 0, r_0 = \infty$). We can take out the quantization factor, for normalization simplicity:

$$\frac{(1/648)g_B^2\hbar c}{4\pi \times 10^{-38}} = 2.87855061667 \times 10^8\,\text{N} \tag{60}$$

We now compare the repulsion-attraction force to the other 3 gauge forces back in that era. Based on the particle CODATA values for the coupling constant from prior, $e = 0.30282212088$, $g_3 = 1.21771578478$ and $g_w = 0.6528$ [21]. With all no-ranged forces:

$$F = \frac{g^2\hbar c}{4\pi r^2} \tag{61}$$

At $r = 10^{-19}$ m, electromagnetism yields:

$$F_{EM}(10^{-19}) = 2.30707755090326285375 \times 10^{10}\,\text{N} \tag{62}$$

The strong force follows:

$$F_{strong}(10^{-19}) = 3.73060159046038146972 7 \times 10^{11}\,\text{N} \tag{63}$$

Finally, the weak force:

$$F_{weak}(10^{-19}) = 1.0720963428 \times 10^{11}\,\text{N} \tag{64}$$

Both nuclear forces are nearly 1000 times more powerful. Most GUT theories have superstrong forces or dust-like ones. The new floor of physics almost fits right in like a close family. It did its job under the cover of the super-powerful strong force. This force does not hit the Landau pole, nor is it perturbatively unstable. You can actually calculate what happened in the QGP without breaking equations. This is exactly the new objective to tackle. Seeing exactly what happened to the U(3) symmetry during the early stages of the universe.

SSB and U(3) Convergence

Although the numbers make sense during the electroweak epoch, we want to discuss the reasoning for unification. We've claimed that U(3) unifies into one nuclear force, so now we put that to a test. The two concepts of unification are our holy grail: The convergence and symmetry break. We start with the symmetry break time, it is a finite temperature where the two coupling constants finally diverge. The approximation temperature influenced from Coleman-Weinberg GUT's is [27]:

$$T_c = \sqrt{\frac{12M_B^2}{g_B^2 + 3g_w^2 + 4y_t^2}} = 150.58544670030457\,\text{GeV} \tag{65}$$

$y_t = 0.99078952235$ is the top quark Yukawa self-coupling derived from the PDG 2024 mass of 172.5 GeV [4]. The era in which the universe cooled down to this point can be found using the Friedmann Equations for energy density evolution [28]:

$$t = \sqrt{\frac{45\hbar^3c^5}{16\pi^3 Gg*}}\frac{1}{(k_BT_c)^2} \tag{66}$$

Substitute the temperature we obtained given that the energy scale $g* = 106.75$:

$$t_{break} = 1.03303320444487359013 \times 10^{-11}\,\mathrm{s} \quad (67)$$

The EWSB broke at about 0.92×10^{-12} seconds. U(3) disintegrates about 1.1 picoseconds after EWSB (159.5 GeV Symmetry Break). This creates a naturally logical Phase Transition Hierarchy where both symmetries fit chronologically together. A 1.1% time difference is rarely an accident if derived rigorously, it implies that the two sectors are Co-Dependent. The symmetry "waited" for the SM Higgs field to turn on ($v > 0$). The 1.1 ps delay is the time it took for the g_B coupling to "grab" the Higgs vacuum and crystallize the baryon tether. At 10^{-11} seconds, the universe was a Quark-Gluon Plasma. Leptophobic bosons didn't interact with the photons or leptons that dominated the CMB view. It only interacted with the "Baryon-axis" while keeping the expansion rate and BBN ratios invariant. This process is the numerical evaluation of the proposed U(3) Spontaneous Symmetry Breaking. The second step is the convergence of symmetry. It considers both unification and renormalization. This is done using the RGE Equations. The logarithmic RGE's were developed in 1974 to explain the evolution of gauge coupling constants throughout the universe's expansion [3].

$$\frac{1}{g^2(\mu)} = \frac{1}{g^2(\mu_0)} - \frac{b}{8\pi^2}\ln\left(\frac{\mu}{\mu_0}\right) \quad (68)$$

μ is the energy scale of unification. We choose $\mu_0 = M_B = 106.004061476$ GeV to minimize perturbative errors. Setting the RGE equation equal is equivalent to solving for m in $f(m) = g(m)$:

$$\frac{1}{g_B^2} - \frac{b_B}{8\pi^2}\ln\left(\frac{\mu}{M_B}\right) = \frac{1}{g_3^2} - \frac{b_3}{8\pi^2}\ln\left(\frac{\mu}{M_B}\right) \quad (69)$$

$$\ln\left(\frac{\mu}{M_B}\right) = \frac{8\pi^2\left(\frac{1}{g_3^2} - \frac{1}{g_B^2}\right)}{b_3 - b_B} \quad (70)$$

The value of the strong b_3 is equal to -7, and is negative for all non-abelian forces [30]. We need b_B to solve for μ. Georgi's paper included the beta function formula for any U(1) field [3]:

$$b_{U(1)} = +\frac{2}{3}\sum_f Q_f^2 + \frac{1}{3}\sum_s Q_s^2 \quad (71)$$

Abelian forces typically have $b > 0$. However, the singlet Abelian factor of a U(3) group is subject to non-Abelian renormalization, causing its coupling to decrease at high energies in a manner analogous to the standard gluons. It is a broken gluon, not a distinct U(1), and therefore follows the scaling logic of SM gluons. Standard gauge theory makes it negative: $b_{U(N)\to U(1)} = -\frac{2}{3}\sum Q^2 - \frac{1}{3}\sum_s Q_s^2$. The value is the sum over all possible fermions and bosons. Bosons and leptons do not carry baryon number. Quark-only involvement is enforced. The universal quark charge is $Q^2 = +\frac{1}{9}$. We consider the 6 possible quark flavors, three colors, and two chiral flavors: $sum = 1/9 \cdot 6 \cdot 3 \cdot 2 = 36/9 = 4$. Multiplication by the $-2/3$ factor offers: $b = -\frac{2\cdot 4}{3} = -\frac{8}{3}$. We also need to consider the addition of Zweig-Fermions: The baryon number is uniform, thus $Q^2 = (-1)^2 = 1$. There are two possible flavors, and two chiral states, and therefore: $2 \cdot 2 \cdot 1 = 4$. Multiplication by $-2/3$ hits: $b_{Zweig} = -\frac{8}{3}$. The total is the sum $b_B = -\frac{8}{3} - \frac{8}{3} = -\frac{16}{3}$. While mentioning higher order gauge groups, Langacker's work on U(1)' fields showed that a the magic number of a beta-loop constant at -5.33 is the only way for it to converge with the strong SU(3) [8][29]. By miracle, $-16/3 = -5.33$. It does not require a fourth generation of quarks. Insertion into the denominator offers: $-7 - (-16/3) = -5/3$. Apply the numerical values $g_B = 0.86105508897$ and $g_3 = 1.21771578478$ into the equation to solve for the logarithm:

$$\ln\left(\frac{\mu}{M_B}\right) = -3/5 \cdot 78.9568352087 \cdot (0.67438535208 - 1.34877070418) = -47.3741011252 \cdot -0.674385352087 = 31.9483998671 \quad (72)$$

Raise both sides to the power of e and shift M_B over:

$$\mu = 106.004337013 \cdot e^{31.9483998671} = 7.9494559 \times 10^{15}\,\mathrm{GeV} \quad (73)$$

This is a GUT scale unification. The symmetry is created during the same epoch as electroweak condensation. U(2) and U(3) were likely part of a larger symmetry until they broke at 10^{-36} s, meeting up as distinct unitary gauge groups afterwards. It's a multi-sector split off, relevant to parallel unification. Our U(3) is renormalizable if it's physically convergent. GUT is a physical time period. Because it is now, Lagrangians and further QFT checkups are no longer required. It is to be noted that the experimental idea target value $-16/3$ was hit through derivation, not assumption. The value $b = -5.33$ is the final guarantee of the GUT consistency condition required to unify all four gauge forces at a single scale [31][32]. It is the first evidence for Grand Unification.

Mysterious Coupling Correlation

The Standard Model doesn't explain why the boson is 91 GeV. It's just a measured number. For some unknown reason, the ratio of:

$$\frac{M_Z}{M_B} = \frac{91.1876}{106.004061476} = 0.86022741704 \quad (74)$$

It is almost exactly g_B with no initial correlation. The experimental match with my theoretical value is a 99.9038%

perfect match. Such a close value is never a coincidence, it suggests deeper symmetry. Perhaps the baryon strong force and the electroweak sector were once part of the same "super-group" where the trace of the generators was fixed.

$$\frac{\frac{1}{2}g_z v}{\frac{1}{2}g_B v} = g_B \tag{75}$$

or

$$g_B = \sqrt{g_z} \tag{76}$$

Due to the equality $g_B = \frac{g_3}{\sqrt{2}}$:

$$g_3 = \sqrt{2g_z} \tag{77}$$

They are actually two sides of the same triangle in a higher-dimensional space. This is the strongest evidence possible that they both belong to one "Master Symmetry Group" and that we just haven't observed yet. It fails to work at high energies, perhaps linking to a symmetry during the activation of the Higgs Field. If we were to find the Z-boson's mass with the new deviation:

$$M_Z = \frac{1}{2}g_z v = \frac{1}{2} \cdot g_3^2/2 \cdot 246.21964 = 91.2755738393\,\text{GeV} \tag{78}$$

The standard model deviation is: $\Delta\sigma = \frac{|x_i - \bar{x}|}{\sqrt{\sigma_M^2 + \sigma_P^2}}$. Our deviated value here is a mathematical 100% precision value ($\sigma_M = 0$).The denominator reduces to σ_P. The statistical uncertainty for the Z-mass is very small, about 0.0021 [4]. The deviation is then large:

$$\Delta\sigma = \frac{91.2755738393 - 91.1876}{0.0021} = 41.8923044286\sigma \tag{79}$$

42σ is more than 8 times more significant than an official discovery. So we blame the inaccuracy of the strong coupling. Measuring the strong coupling is known to be inaccurate. Deviations from 0.118 is likely. Using the SM 91.1876 GeV, $g_z = 0.74070319512$. Then the "accurate" strong coupling looks like:

$$g_3' = 1.21713039163 \tag{80}$$

Convert this value to the coupling α_s:

$$\alpha_s' = \frac{g_3^{2'}}{4\pi} = 0.11788657486 \tag{81}$$

The PDG value of ± 0.0009 of the 0.118 value offers a range: $\alpha_s \in [0.1171, 0.1189]$ [4]. 0.11789 is extremely near the average, and is contained within the interval perfectly. The difference is negligible compared to the uncertainty (1σ is average uncertainty). That's one secret of unification.

Kinetic Mixing

The mixing angle is coupling leaking to other sectors through quantum loops. Can we prove that the leakage of kinetic mixing into the Z boson stays below the 0.1% difference threshold for detectors? In 1986, Bob Holdom found the modern formula for kinetic mixing between two sectors [33]:

$$\epsilon \approx \frac{g_a g_b}{16\pi^2} \sum_f Q_a Q_b \; ln\left(\frac{M_a}{M_b}\right) \tag{82}$$

The target is between the Z-bar and Z bosons, so Hypercharge and Baryon Number are required:

$$\epsilon \approx \frac{g_Y g_B}{16\pi^2} \sum_f YB \; ln\left(\frac{M_B}{M_Z}\right) \tag{83}$$

The constant factor $B = +1/3$ is moved outside the summation. The internal sum is the hypercharge only. The Y values for each quark are: $+1/3$ for LHS, $+4/3$ for RHS up types, and $-2/3$ for RHS down types. $1/3 + 1/3 + 4/3 - 2/3 = 4/3$. Over all 3 colors offers $+4$. Multiplication by the baryon number grants $+4/3$. The values of the Zweig-Fermions are required too. The left ace has $YB = -1 \cdot -1 = +1$, the right one has $YB = -1 \cdot -2 = +2$. The right handed 5 of hearts makes no contribution because $Y = 0$, while the LHS 5 of hearts possesses $YB = -1 \cdot -1 = +1$. The Zweig contribution requires $+1 + 2 + 1 = +4$. The total is: $4/3 + 4 = 16/3$. The 16 above cancels the 16 in the denominator. The $+1/3$ factor travels to the bottom:

$$\epsilon \approx \frac{g_Y g_B}{3\pi^2} ln\left(\frac{M_B}{M_Z}\right) \tag{84}$$

We know both couplings. Thus:

$$\epsilon \approx \frac{0.35742031 \cdot 0.86105508897}{3\pi^2} ln\left(\frac{106.004337013}{91.1876}\right) = 0.00156495517 \tag{85}$$

This result is a theoretical "sweet spot". It is now a serious candidate for a "Beyond Standard Model" theory. At 0.1% resolution, that's where the current LHC probing limit ends and the next generation of experiments begins. 0.15% is just a tiny bit more than the limit. They provide a specific clear "target" for the High-Luminosity HL-LHC or the Future Circular Collider FCC-ee who have highly advanced and precise probing capabilities. If they see a tiny deviation in baryonic boson behavior at the level, our theory is the only one that predicts that specific deviation. Furthermore, there is no need to see whether the interference surplus with the Z-boson stays in bounds. That is because the total interference for Z-Z' is multiplied by the square of the kinetic mixing [29]. The surplus percentage cannot be greater than 1, and $1 \cdot \epsilon_{Z-Z'}^2 \to 2.25 \times 10^{-6}$. The value is non-existent, and thus consistent.

Extra Degrees of Freedom in the Strong Force

We must now discuss the effects of the Higgs Mechanism. Without the baryon gauge field, there are no more scalars because SU(3) stays decoupled. The existence of the Higgs-Coupled Zbar Boson drags the empty slots of the gluons into physical scalars. There should be 8 massive particles leftover. A massless vector boson interacts with the Higgs field to eat a goldstone boson and attain mass. In 9 goldstone DOF's in a U(3) symmetry, the math predicts 8 DOF's are left uneaten if the Z-bar swallows one. Based on Okubo's work on U(3) fields, every fermion that couples to the ninth gluon must attain a new degree of freedom in order to interact. Every quark should have 13 degrees of freedom $(12 + 1)$ to interact with the baryon field. The quarks would not collapse into a single point because $B = +1/3$ is uniform. Even if they attain an extra DOF, they remain indistinguishable. The entirety is invisible. Furthermore, we need to include the Zweig-Fermions. To interact, the Hearts also take 1 DOF each because $B = -1$. There exists 2 flavors of hearts, thus $8 - (6 + 2) = 0$. Our anomalons naturally absorb the remaining DOF's. No new Higgs Particles are added in our model. Our anomalons are restricted to one generation, and thus we have a working saturated theory.

Significance of the Baryon Theory

This gauge field is directly coupled to the baryon number, so would it correlate to the antimatter asymmetry? The baryon-antibaryon asymmetry is the observed, unexplained excess of matter over antimatter in the universe, which contradicts the Standard Model's prediction that equal amounts should have been created in the Big Bang. Now that B is a vector-like gauge symmetry, you cannot "create" a net baryon number B without simultaneously creating an equal and opposite "anti-baryon" gauge charge. As predicted by the Standard Model Sphaleron interpretation, you cannot have a source for the Baryon-Antibaryon asymmetry problem if you gauge either the B or L numbers. Sphaleron interpretations oppose our idea. In favor of the opposer, t'Hooft proved that it's topologically required to transform 9 quarks into 3 leptons [12]. That clearly forbids our theory. To that, I have a way out. If B is a gauge number, then the identity is no longer a label. A gauge number is subjected to quantum superposition and is defined as an overlap of all possible states before it is observed in a lab. The total sum must be neutral $\frac{1}{\sqrt{2}}(1/3 - 1/3) = 0$. It is also why neutral meson triplets are always superpositions. It lies in a state of both quark, antiquark and a lepton because it is subjected to virtual interactions. We can't actually see a Sphaleron transition happen on a detector, but it's still mathematically allowed. The transitions continue, except the B,L numbers remain inviolated because they've yet to be defined. We can also start with 3 quarks and end up with one lepton if we look away. If both B and $B - L$ is conserved, then L is a local symmetry too:

$$\frac{dB}{dt} - \frac{dL}{dt} = 0 \tag{86}$$

Because $\frac{dB}{dt} = 0$:

$$0 - \frac{dL}{dt} = 0 \tag{87}$$

One cannot physically be violated unless the other is too if and only if $B - L$ is conserved. Standard physics assumes that $B + L$ is violated. The $B + L$ value cannot be violated in our model, because both B and L are forced to be conserved. A local symmetry is always a gauge number. While it is agreed that lepton gauging is highly anomalous, it could be done with the right amount of anomalons, or the exact distribution of chirality. It's allowed to be SU(2) or SU(5) or SO(6) if it wants to. The direction of the arrow points towards unification groups larger than SO(10) in order to conserve both $B + L$ and $B - L$. While it doesn't explain the asymmetry, it provides BSM's as a necessity. We prefer theories with more predictive power, given that they both do the same job. Sphaleron violations are bottlenecks. Possible obstructions have been completely resolved, emphasizing on the success of our mathematically empirical approach. Here the point is proved over the SM interpretation. In the end, a theory without data predictions is useless. That is the next and final point of interest.

EXPERIMENTAL PREDICTIONS

A real theory is about what it can predict. It is the question of whether our theory explains mysterious SM occurrences or not, including results deduced from applying it.

Partial Results from Lithium-7 Suppression

I was convinced that U(3) symmetry was adequate for the lithium 7 mystery. The Li-7 problem was where the produced amount of lithium in the universe was found to be about 1/3 of the predicted amount. Our Yukawa potential generates repulsion at intense helium-deuterium nucleon fusion events that form Li-7. Koonin's paper demonstrates a decrease of total fusion probabilities when in the presence of an internal repulsive potential (Coulomb for Koonin, but Baryonic for mine) [36]. A repulsive core causes the radial wavefunction to be suppressed or "quenched" because the wave has to tunnel from $r = 10^{-15}$ m to $r = 0$. Everything in between can obstruct. Why not test it on our potential? Based on Sommerfeld fusion enhancement (used interchangeably with suppression) within the nucleus [37]:

$$P \propto e^{-2\sqrt{\frac{4\pi\mu\alpha_{gauge}}{M_{gauge}}}} \quad (88)$$

μ parameter is the reduced mass of the fusion elements. Lithium-7 is the fusion of Deuterons and Helium-3 nuclei, with masses of 2.79 and 3.73 GeV respectively.

$$\mu = \frac{2.97 \cdot 3.73}{2.97 + 3.73} = 1.67090497738\,\text{GeV} \quad (89)$$

The baryon potential has: $\alpha_4 = \frac{g_4^2}{4\pi} = 0.059$. Our gauge mass is the denominator in the exponent. Thus:

$$P \propto e^{-2\sqrt{\frac{4\pi \cdot 0.059 \cdot 1.67090497738}{106.004337013}}} = 0.80556642964 \quad (90)$$

This reduces about 20% of the total lithium-7. It does not strike the 66% suppression we observe. 47% is missing, and the source has yet to be defined. The proportional-to Gamow factor does not represent the exact physical quantity. It is merely a proportional estimate. U(3) definitely contributes, but to an unknown extent. There is a possibility that a stronger baryonically-deviated gauge symmetry is out there.

Potential Signatures at the LHC

I mentioned that the Zbar is almost impossible to detect, but we may have a chance. From ATLAS data scouting, we have observed a persistent hadronic wrinkle attributed between $110 - 110$ GeV to a hadronic abelian U(1)' Z' alongside the more prominent excess of 650 GeV [38]. It is attributed at a local 2σ and is consistently showing up vaguely in our data. Phenomenologically, it is the first evidence of the Z-bar boson. The decay width is 10.4 GeV, which corresponds to a wobble from $100.8 - 111.4\,GeV$. That overlaps with the ATLAS Data scouting, as well as being an abelian leptophobic U(1) mediator. While the 650 GeV is being actively investigated, the $100 - 110$ GeV Z' remains a significant "wrinkle" that is difficult to distinguish from background modeling errors. It is the responsibility of the HL-LHC to prove my hypothesis once and for all.

CONCLUSION

What we see here is a mathematical necessity ensured for closure. It is phenomenologically consistent, and devoid of approximations. The logical constraints forced a heavy abelian boson. It was nearly impossible to detect. The model resolves famous anomalies of gauging the baryon number. The discrepancies were resolved with quasi-fermions which act as abstract propagators. There exists only one generation of mathematical fermions to cancel the leak. The existence of these fermions perfectly removes extra DOF's. It also hit the perfect b constant for strong-converging U(3) grand unification. Empirical correlation is also linked to a deeper symmetry between U(3) and U(2) in their couplings. Every following observable was analyzed within experimental boundaries. It concludes with the ultimate mathematical thesis: Sphaleron topology can continue in my conjecture, but the number violation was not mandatory. This model demonstrates significant predictive power. It is then that this predictive power was demonstrated in applications. I tested a candidate for the lithium-7 problem, but my hypothesis only affected 30% of the total. The lack of closure and prior evidence show mandatory existence of BSM's and GUT's. The most direct evidence came as a wrinkled anomaly around $100 - 110$ GeV from the ATLAS TLA Scouting alongside a 650 GeV resonance. While Run 3 has provided more data, and was expected to either prove or disprove the 650 and 105 GeV anomalies, they still remain loud and unconfirmed. Although standard theories believe that these Z'-bosons attain mass through a different Higgs VEV (because a 105 GeV particle has a 0.85 coupling), it is different in our case. Its kinetic mixing is extremely small with Z, so its production is suppressed in the LHC. Its decay width makes it a persistent wide peak, but never completely sure. Thus $g = 0.85$ is allowed if your constraints hit the goldilocks zone. Here, being found alongside another bosonic resonance means that the Zbar particle fundamentally scaffolds other BSM theories. I am encouraged to believe that evidence providing closure will be revealed in early 2030 at the HL-LHC.

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