The Higgs Boson and the Weak Force IVBs (Intermediate Vector Bosons): A General Systems Perspective (part 3)

(A 4x3 (or 4x4) fractal pattern: a hypothetical scenario of force unification)

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"A man's reach should exceed his grasp..." (Browning)

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Abstract

The large mass of the Higgs and IVBs actually recreates the energy-density of the primordial environment in which the elementary particles whose transformations they now mediate were originally created. A weak force transformation is in effect a "mimi-Big Bang", reproducing locally the conditions of the global "macro-Big Bang", so that the elementary particles produced by each are the same in every respect. This is the only way such a replication could be accomplished after eons of entropic evolution by the Cosmos (because the mass of the Higgs and IVBs (or of particles generally) is not affected by the entropic expansion, spatial or historic, of the Cosmos. This is the fundamental reason why the weak force transformation mechanism employs massive bosons). The role of the Higgs is to select and gauge the appropriate unified-force symmetric energy-density state (usually the electroweak (EW) force-unification energy level) for the transformation at hand; IVBs appropriate for that particular symmetric energy state (the "W" family of IVBs in the electroweak case) then access (energize) the state and perform the requisite transformation. (See: "The 'W' IVB and the Weak Force Mechanism".)

Postscript I:

Connections Between the "Tetrahedron Model" and "Establishment" Physics

Most of my effort toward unification has been concentrated on the "rebound" phase of the Universe, as we find it today, driven by gravitation, symmetry conservation, and evolution, simultaneously building complex structures (both physical and biological), and returning asymmetric matter to its original symmetric state, light. Conversely, most of the effort of the "establishment" toward unification has been concentrated on the "cascade" phase of the Universe, the stepwise descent from the perfect symmetry of the Multiverse and Planck scale unity, as the forces decoupled from one another in an entropy-driven rush toward our familiar electromagnetic "ground" state. The electromagnetic "ground" state is the common domain from which we both started, but I worked forward in time toward the ultimate symmetry of the "Big Crunch", while the "establishment" worked backward in time toward the ultimate symmetry of the "Big Bang". "My" symmetries are mostly intuitive, involving the long-range forces and the macro-world, and (in general) ignore theirs; "their" symmetries are mostly mathematical, involving the short-range forces and the micro-world, and (in general) ignore "mine". Nevertheless, the two systems are neatly joined by the synthetic power of General Systems, both expressed in a 4x3 and 4x4 matrix format. (See: "A Simple 4x4 Table of Forces and Energy States of Physics".)

The micro-world of the Big Bang, symmetry groups, and the weak force in its full energy spectrum and

General Systems format is presented in this and the other "Higgs Cascade" papers. The macro-world is modeled in a General Systems format in such papers as "The Information Pathway", "The Fractal Organization of Nature", and "Nature's Fractal Pathway". The general principles of physical law which underlie all our unification models, whether intuitive, mathematical, macro, or micro, are explored (also in a General Systems format) in the papers "Symmetry Principles of the Unified Field Theory (a "Theory of Everything")" and "A Tetrahedron Model of Light and Conservation Law". The interaction between non-local light and local matter is considered in the "Global vs Local Gauge Symmetry" series of papers, which also suggest connections between my work and "establishment" unification models through the common theme of *charge invariance*. The joining of both micro- and macro-unification models within a common General Systems model illustrates once again the synthetic power of General Systems, as well as the great value of investigating a common problem from more than one direction and perspective. (See also: "The 'Tetrahedron Model' vs the 'Standard Model' of Physics: A Comparison".)

Postscript II: See:

Higgs Table No. I: Unified Force Eras or Symmetric Energy Levels of the "Big Bang"

Addendum and Recapitulation

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In the Beginning

In the primordial crush of the "Big Bang", when all forces are joined in the conversion of light to mass, or free to bound electromagnetic energy, both gravity and the "Y" IVBs apply compressive force to the initial state of energy, producing in addition to the usual leptonic spectrum, an extra-massive, charged leptonic elementary particle which will cap the leptonic series as a leptoquark. As the weak force representative in this 4-force "scrum", the "Y" IVBs may help split the primordial leptoquark into 3 subunits, the nascent quarks, but their main contribution will be the transformation of electrically charged leptoquarks into electrically neutral leptoquarks. In splitting the leptonic material into 3 quarks, the "Y" IVBs are probably aided by electrical self-repulsion between relatively distant parts of this overly massive lepton - an effect which sets a natural upper mass limit to the elementary leptonic spectrum (a "quark soup" may also be produced by this process). Most of these leptoquarks will be electrically charged, and immediately annihilate each other. However, some will be electrically neutral (heavy analogs of the neutron), and will live long enough to pass on to the next lower force-unity energy state (the GUT) where they may undergo a typical leptonic decay mediated by the "X" IVB, with the (net) production of a heavy baryon (hyperon) and a leptoquark antineutrino, conserving and balancing identity charge. The special character of the "X" IVB decays is their asymmetry, with antileptoquarks decaying slightly faster than leptoquarks. Neutral leptoquarks thus deprived of an annihilation partner can only expand their quarks (in the rapidly expanding Universe) and become heavy barons (hyperons). Such baryons are stabilized by the appearance of the conserved color charge, which emerges as the quarks expand to typical baryon size; the conserved color charge prevents any further (total) baryon decays at energies less than the "X" IVB can provide. However, partial decays (transformations) of the baryons are possible via the "W" IVB family at the next lower EW (electroweak) force-unity level. The compressive forces of the massive "X" can still cause "proton decay" on rare occasions (and perhaps quite commonly inside black holes). (See: "The Origin of Matter and Information".)

After the Beginning

Above the electroweak critical or "condensation" temperature, the electric and weak forces are combined in the electroweak symmetric energy state. The energy density of the universe at this time would be greater than an atomic nucleus; in the electroweak symmetric energy state all leptons are equivalent and all quarks are equivalent. There is no spacetime as we know it (with freely moving photons) in such a dense medium;

photons mediate electric charges, but otherwise they are trapped. Below the condensation energy the photon goes its separate way, gauging and creating spacetime (the "spacetime metric"). The Higgs remains at the electroweak force-unity energy level, gauging matter (the "particle metric"), determining the energy level of the electroweak unified-force symmetric energy state, the mass of elementary particles within the state (leptons, quarks), and the mass of the weak force bosons (the IVBs) which must recreate/access the state to perform their transformations. The Higgs establishes a "particle metric" just as the photon establishes a "spacetime metric": in both cases the purpose of these domains is the conservation of their respective energy forms, whether massive matter particles or massless light - conservation of symmetry as well as energy.

The weak force charge is "Identity", which is carried in explicit form by neutrinos and in implicit form in the massive leptons as "lepton number" charge (baryons probably carry this same charge in implicit form as "leptoquark number" charge, and in explicit form as leptoquark neutrinos, which may comprise the mysterious "dark matter"). During the weak force transformation of *single* elementary particles, the IVBs sample the electroweak symmetric energy state to acquire the elementary particles and charges they need (in "virtual" particle/antiparticle form) to effect the transformation of "real" elementary particles whose conserved parameters (such as mass, spin, and charge), must remain invariant and unchanged since their origin in the "Big Bang". (See: "The 'W' IVB and the Weak Force Mechanism".)

In our modern, cold universe, spacetime and matter remain in partial contact through dimensional forces (inertia and gravity), the latter gauged by Newton's universal gravitational constant "G"; and through the exchange of photons with electrically charged particles (as gauged by velocity "c", the electric charge "e", and the fine structure constant "alpha"). Heisenberg/Dirac virtual particles, de Broglie's "matter waves", and other quantum mechanical phenomena also remain as connecting links, and as vestiges of the former unity between spacetime and particles, or between the Higgs and the photon. The former unity of matter and antimatter, and of light and spacetime, is "remembered" through such conserved symmetry debts as gravity's "location" charge and matter's spin and electric charge. Symmetry-breaking by the Higgs is likewise "remembered" in the conserved "identity" charges of the neutrinos, and reflected in the distinctly different masses of the quark and leptonic spectra.

Higgs Conservation Domains

Just as the photon creates a conservation domain for free electromagnetic energy (spacetime), so the Higgs creates conservation domains for bound electromagnetic forms (the several force-unity symmetric energy states). While the neutral Higgs boson scales mass/energy levels only, nevertheless this particle "metric" consists of all types of charges (in neutral particle-antiparticle pairs), including electric charge, color charge, "identity" charge ("number" charge), spin, etc., plus the massive bound energy forms necessary to carry them (leptons, neutrinos, quarks, baryons, mesons, etc.). The charges represent alternative, "abstract" but real (and hence not simply "symbolic") forms of symmetry which can be conserved through time and redeemed for the original symmetry upon demand (just as paper money is an alternative and redeemable form of "hard" currency). The Higgs conservation domains are havens where symmetry, in its various absolute forms in free electromagnetic energy (light), can find temporary conservation in matter, in the invariant form of the various conserved charges of bound electromagnetic energy. There are three levels of these Higgs conservation domains: simplified to a net output, the first and highest energy level produces single electrically neutral leptoquarks; the second produces single baryons; and the third produces single leptons.

The Higgs boson is the scalar or gauge boson for the unified-force symmetric energy states, of which there are three above the EM (electromagnetic) ground state: the TOE, GUT, and EW. These states are conservation domains in which the symmetries of massless, chargeless, timeless, and non-local light (free electromagnetic energy) can be temporarily transferred and conserved in an alternative form, carried by massive, temporal, local particles (bound electromagnetic energy) in the form of various charges, spin, and gravity. These temporal forms of symmetry (the conserved charges of massive particles) can always be redeemed for the "real thing": redemption of symmetry debts occurs when bound, massive energy forms (particles) are converted to light, as in matter-antimatter annihilations, particle and proton decay, or the gravitational conversion of bound to free energy in stars and black holes (Hawking's "quantum radiance").

The three Higgs domains form a decay chain or cascade of successively less energetic conservation domains or energy plateaus where the system condenses to a new state of lower energy and lower symmetry, higher order and higher (total system) entropy, finally arriving in the cold "ground state" of atomic matter, a compound electromagnetic domain composed of both free and bound forms of electromagnetic energy (light and matter), which we and other biological species currently occupy.

Theory of Everything

The first and highest energy domain is the TOE (Theory of Everything) domain or Planck-era energy level corresponding to the union of all four physical forces (hence including gravity), in which the translation of massless light into the massive form of a leptoquark is accomplished as a 4-force joint effort. This is the most primitive conservation of light's energy in alternative massive form, with energy (and symmetry) fully recoverable according to Einstein's E=mcc in matter-antimatter annihilation reactions. Leptoquarks acquire "identity" charge, spin, and electric charge from the photon and its metric as symmetry debts of light, converting the completely general energy conservation function of "mass" to the more specific conservation of a "species" of particle. By means of "identity" charges leptoquarks can discover and pair with their appropriate anti-leptoquarks and annihilate each other, returning their energy and charge to the symmetric form of light. It is also by means of these neutrinos or identity charges that they (or any species of elementary particle associated with a specific neutrino) may be created in the first instance, and later identified and exactly reproduced or annihilated (conserving symmetry).

Grand Unified Theory

In the second unified force level, the GUT (Grand Unified Theory) energy level, gravity disengages, having balanced the positive energy of the "Big Bang" with its own negative energy; gravity now provides negative entropy to the mix of forces. Three particle forces remain unified, the electric, strong, and weak. The GUT symmetric energy state is characterized by the "X" IVB family, whose special function is to produce an excess of matter baryons from electrically neutral leptoquarks. Electrically neutral leptoquarks decay asymmetrically via the "X" IVB, leaving a tiny excess of matter leptoquarks (perhaps only one extra per ten billion). The excess neutral matter leptoquarks, lacking annihilation partners, expand their nascent quarks into the configuration of normal hyperons and baryons, where they are stabilized by the appearance of the conserved color charge. Leptoquark antineutrinos are produced during the asymmetric decay (from the annihilated antileptoquark partner), one per excess leptoquark, balancing the lepton number or identity charge for barons, which all carry a "hidden" leptoquark number charge (AKA "baryon number charge"). These free-roaming leptoquark antineutrinos, which may be quite heavy, are "dark matter" candidates. Conservation options in the form of charges at this level include gravity, electric charge, spin, neutrinos (Identity charge), and color charge. Quarks and gluons are added to the list of particles (such as leptons) suitable to act as massive carriers of symmetry debts. Quarks and gluons are derived from the tripartite splitting of primordial leptons by the "Y" IVBs and other forces, establishing the relationship between the leptons and quarks. Matter-antimatter annihilations return the material particles to massless symmetry via the system of conserved charges which allows matter particles to recognize their appropriate antimatter annihilation partners. As the leptoquarks demonstrate, in the GUT symmetric energy state, all leptons and quarks are joined, equivalent, and interchangeable.

Electroweak Force Unification

The third energy level of the force-unity states is the EW or electroweak unified-force symmetric energy state. In this state all quark "flavors" are equivalent and all lepton species are equivalent, but quarks (hadrons) and leptons remain distinct within their own "generic" identities. Mesons (quark-antiquark combinations) and baryons (three quark combinations) are added to the list of allowed massive charge carriers, along with the full leptonic spectrum of alternative charge carriers (neutrinos and massive leptons). The EW state is characterized by the "W" IVB family, which can transform quarks and leptons, mesons and baryons. "W" IVBs can create and destroy leptons and individual quarks and mesons, but while they can transform baryons, they cannot create or destroy them. Only "X" IVBs are powerful enough (massive enough) to create and destroy baryons; and while the "X" IVBs can destroy leptoquarks (and perhaps create them during "proton decay"), only the "Y" IVBs can create and transform primordial leptoquarks.

A Cascade of Conservation Domains

The three Higgs domains present us with a hierarchy of conservation domains and particle "metrics" capable of translating the symmetry of massless light into the charges of massive carrier particles, a linked chain of quantized symmetric energy states or plateaus, each fully capable in its own right of conserving both the energy and symmetry of light until repayment of matter's symmetry debts is accomplished by antimatter annihilations, proton decay, or (in the "ground" state) the "quantum radiance" of black holes. They serve as transformation stages, stepping down the energy scale from one massive conservation domain to another, handing off the symmetry and energy debts from higher to lower symmetric energy states until the ground electromagnetic state (cold atomic matter) of our daily experience is reached. In this scheme the neutral Higgs bosons serve to scale or gauge the steps of the symmetric energy states, while the charged IVBs native to that state perform the work of transformation within the particular domain selected by the Higgs. *The charges of matter are the symmetry debts of light* (Noether's Theorem).

The various force-unity energy states are necessary to the conservation process because they represent defined states of symmetry which can be consistently identified in terms of energy, and therefore quantized, accessed, and exactly reproduced via the rest mass-energies of the several Higgs bosons. Likewise, the IVBs are a transformation mechanism which can be quantized and also exactly reproduced (the IVBs are physical samples/examples of their native symmetric energy states). The IVBs are able to accomplish their transformations because within the symmetry domain of their native state, all particles belonging to that domain are equivalent, available, and interconvertible. The complex weak force apparatus is necessary because *single* elementary particles created today must be exactly the same in all respects as those created eons ago during the "Big Bang" - in order to conserve symmetry and energy. Because alone among the forces the weak force creates/transforms single elementary particles, the only fail-safe way to produce this invariant result is to return to the original source/energy environment in which the elementary particles were first created - just as Frodo's ring must be returned to the primordial fire in which it was forged. When it comes to conservation, nothing is left to chance in our Universe, which is extremely jealous of its energy content, both with regard to quantity and quality.

References

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