

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

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

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Abstract

There is a very good reason why the field vectors of the weak force involve the hugely massive Intermediate Vector Bosons (IVBs) and the associated Higgs boson (while the field vectors of the other forces, the photon, gluon, and graviton, are simple massless energy forms): the weak force is the only force that creates and/or transforms "singlet" elementary particles (single particles without antimatter partners). Single particles cannot be directly produced from the vacuum "zoo" of virtual (and symmetric) particle-antiparticle pairs, as in the case of electromagnetic or strong force particle-pair production (in collisions, for example). Hence some other mechanism for reproducing the original conserved parameters of elementary particles must be employed.

Single elementary particles created today must be the same in all respects as those created eons ago during the "Big Bang", and the massive and elaborate mechanism of the weak force is the only way to accomplish this imperative of energy and symmetry conservation - the invariance of the mass and charge of all elementary particles, wherever and whenever they may be created. It is also for this reason that the whole mechanism is quantized in terms of invariant Higgs boson and IVB mass.

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 the conditions of the 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. The role of the Higgs is to select the appropriate unified force symmetric energy-density state (usually the electroweak force unification energy level) for the transformation at hand; the IVBs associated with that particular symmetric energy state (the "W" family of IVBs in the electroweak case) then perform the transformation. The Higgs provides the mass scalar for the process, the IVBs provide the actual transformation mechanism. (See: ["The 'W' IVB and the Weak Force Mechanism"](#).)

Within a particular unified force symmetric energy state, transformations appropriate to that state are but the natural course of events. At the electroweak level, all quark "flavors" are equivalent (and hence readily swapped or transformed), and all lepton flavors are likewise equivalent, but the quark and lepton families do not intermingle. At the next higher "G.U.T." energy level, quark and lepton families also merge their separate identities and exchange flavors. In addition to our electromagnetic "ground state", there may be three higher unified force energy-density levels - the electroweak, the "G.U.T." and the "T.O.E.", each with its own Higgs boson ("H1", "H2", "H3") and associated IVB "family" ("W", "X", "Y"). (See: ["Table of](#)

[the Higgs Cascade](#)".)

Introduction

Because it is responsible for the creation and transformation of elementary particles and matter, the weak force is the most important - and the most mysterious - of the four forces of physics. In this paper I model the weak force (with associated Higgs bosons) in its full energy spectrum, which spans three symmetric energy states or force unification domains. We are used to thinking of the weak force only in its lowest energy manifestation of "radioactive" nuclear decay, or element building in stars, reactions mediated by the "W" family of Intermediate Vector Bosons (IVBs) of the electroweak (EW) unified force level. However, the weak force also has two (hypothetical) higher energy manifestations at the "Grand Unified Theory" (GUT) energy level (strong force unification level) and the "Theory of Everything" (TOE) energy level (gravitational unification or Planck scale energy level). These higher energy force unification domains or symmetric energy states are mediated by the "X" and "Y" IVB weak force families, respectively. We therefore propose a tri-level mass hierarchy in the weak force IVB families ("W", "X", "Y") that parallels the three-family mass hierarchies seen in the quarks, leptons, and neutrinos.

It should be easier to understand and appreciate the functional activity and role of the weak force (and its associated Higgs bosons) when seen in its full-spectrum array than when glimpsed, as usual, only in its partial, low energy, electroweak domain. Whereas at the electroweak energy level the "W" IVB creates single leptons and mesons (and transforms, but does not create, single baryons), the "X" IVB at the GUT energy level creates single baryons (transforming but not creating leptoquarks), and the "Y" IVB at the TOE energy level creates electrically neutral leptoquarks (transforming but not creating primordial "Ylem"). Without the "X" and "Y" IVBs, we have no source for either single baryons or neutral leptoquarks, so we need them both. The primordial "Ylem" (Gamow's term) is evidently created by a group effort involving all four forces, with gravity playing a major role.

It should also be noted that not only does the weak force play the crucial role in the devolution of our Universe from the Multiverse to its electromagnetic (EM) "ground state" (as driven by entropy), but also figures prominently in the reverse process, the evolutionary "rebound" (as driven by symmetry conservation and gravity) toward our Universe's original symmetric energy state in the Multiverse (progressing through stars, black holes, and the "Big Crunch"). Thus the full range of weak force activity encompasses both the creation and destruction of matter, and the breaking as well as the conservation of symmetry. The weak force model presented below has the 4x3 and 4x4 form of other General Systems models presented on this website (see: "[Introduction to General Systems](#)").

A Hierarchy of Force Unification

(See also: "The Mysteries of Mass" by Gordon Kane, Scientific American, July 2005, pp. 41-48)

In our "ground" electromagnetic state, we do not find a Higgs boson or an IVB; they are characteristics of the higher energy levels of force unification (H1, H2, H3) (see: "[Table of the Higgs Cascade](#)"). However, we can suggest analogs. The photon is the ground state analog of the neutral weak force IVB ("Z"); the spacetime metric is the analog of the Higgs boson regulatory function. In our ground state, the spacetime metric confers upon the photon a type of entropy-energy, an invariant and specific "intrinsic motion", gauged as "velocity c", which is also a symmetry condition of "non-locality". Similarly, at the H1 energy level, the Higgs 1 scalar boson confers upon the IVBs an invariant and specific mass, gauged at about 81 proton masses (for the "W" IVB), which is also a symmetry condition of electroweak (EW) force unification. Among other conservation roles, the spacetime metric functions as a symmetry gauge for massless free energy and inertial forces; the Higgs boson functions as a symmetry gauge for massive particles and force unification. Like all particles, the quantized Higgs and

IVBs are creations of the spacetime metric.

In the electroweak unification scheme, the photon is the 4th member of the electroweak family of bosons (force-carriers), the other three being the "W+", "W-", and "Z" neutral. Both photon and the other Higgs1 IVBs have access to the same vacuum "sea" of virtual particle-antiparticle pairs. The great difference between them is that:

A) the photon can have virtually any energy in the domain less than 81 GEV, whereas the "W" IVB is quantized to a single specific energy of (approx.) 81 GEV (the energy level of EW force unification); (the Z neutral mass is approximately 91 GEV).

B) the photon can only create particle-antiparticle pairs, whereas the "W" IVB can create "singlet" (unpaired) elementary particles.

The spacetime metric acts as a regulatory mechanism, both with respect to the entropy drive and "non-local" symmetric energy state of free energy (all photons travel only at "c"), but also with respect to the mass and charge of elementary particles created by photons in particle-antiparticle pairs (the "particle metric" imposed upon virtual particles, bound energy, and the creative potential of the vacuum "zoo" or "sea"). No virtual particle or particle pair can be materialized from the vacuum "sea" as a "real" particle unless it meets the universal and invariant standard for the mass and charge of that particle. This standard is evidently established during the "Big Bang" and forever afterward maintained by some regulatory aspect of the spacetime metric, a characteristic which is also seen in the mass scalar function of the Higgs, and also like the Higgs, finds its rationale through symmetry, charge, and energy conservation. This same metric regulatory function extends (at higher energy) to the mass of the IVBs and Higgs themselves, as different types of symmetry come into play (the three force-unification symmetric energy levels - H1, H2, H3, with their associated IVB "families": "W", "X", "Y"). The gateway to temporal reality for single, unpaired particles is strictly regulated by the weak force and its conservation mechanisms.

(For a discussion of CERN's Large Hadron Collider see: *Science*, 23 March 2007, page 1657-8.)

The weak force IVBs (Intermediate Vector Bosons), plus their associated "Higgs" (H) bosons, form a 4x3 (or 4x4) "matrix" or pattern that complements the [fractal description of the Cosmos](#) at high energies, essentially describing the weak force creation of matter. The four-part IVB-plus-Higgs pattern occurs in three energy levels or unification regimes (4 "metric" weak force bosons in 3 symmetric energy states), above a fourth level electromagnetic (EM) "ground state". The "ground state" is the decay product of the "Electroweak (EW) Era". (See also: "[Nature's Fractal Pathway](#)".) Note in this regard that the quark and lepton "families" also occur in a hierarchy of three energy or mass levels above the ground state photon. The "metric" particles of the weak force (the IVBs and the Higgs boson) seem to be an analogous tri-level energy or mass hierarchy. All decay to the "ground state" of our familiar spacetime metric and the photon, or charge-carrying leptons (in the absence of antimatter).

Perhaps a more familiar analogy from the hierarchy of biological classification will be helpful (species/genus/family/order). At the ground state electromagnetic level we find completely separate and stable elementary particle "species". At the electroweak level we find the several quark species joined together in their own "genus" (quarks), and likewise the several electron and neutrino species joined together in another genus (the leptons). At this electroweak energy level, transformations may occur within "genera" but not between genera, and single leptons and mesons can be created and destroyed. At the GUT level we find the quark and lepton genera joined together in a "family" (the fermions), and the field vectors (except gravity) joined together in another family (the bosons). Now transformations may occur within the "family" level but not between families (creating and destroying single baryons but not yet creating

leptoquarks). At the final level of force unity, the TOE level, we find the fermion and boson families (including gravity) joined into an "order" (encompassing all free and bound forms of electromagnetic energy - Gamow's "Ylem"), in which transformations between all types of particles are allowed, creating and destroying leptoquarks (primordial leptonic elementary particles split into three components).

IVB "Family" Symmetric Energy Levels

Immediately above the "ground state" of historic spacetime, photons, and cold, atomic matter, is the first IVB "family" level consisting of the W^+ , W^- , and W neutral (or Z neutral), which is associated with the first-level Higgs boson, "H1". This is the energy level of the electroweak (EW) unification, in which all transformations mediated by the "W" IVBs are continuously ongoing (quark-quark and lepton-lepton transformations). This is the level of unification within the lepton and quark "genera" separately, but not between them. In addition, the photon and the IVBs are indistinguishable at the EW unification level: at an energy density of 90 proton masses, photons and the "Z" IVB are one and the same thing. When this level 1 state (H1) decays to the EM ground state, light and the IVBs separate (the photon's wave form becomes dominant over its particle form), and the mesons and leptons spill out as separate quanta like fruit from a cornucopia. (See: "[The Particle Table](#)".) The elementary quark and lepton quanta exist in three families each of four particles, a basic example of a 4×3 and 4×4 resonant, repeating, fractal pattern found throughout the material phenomena of our Cosmos (including, most fundamentally, the 4 dimensions of the spacetime metric). (See: "[Table 1: The Fractal Organization of Nature](#)".)

Neither the photon of the electromagnetic force, nor the "EW" level IVBs of the weak force, carry the charge of their respective forces, electric charge and "identity" charge, even though they are the field vectors or force carriers of those forces. In the case of the photon, its electric charge is neutralized by an exactly compensating magnetic field, and the action of the photon field vector is accomplished by a transfer of pure energy or momentum. The photon's electrical neutrality allows it to range freely through spacetime; if the photon itself carried charge, it would be as restricted in its activities as an electron. In the case of the "EW" family of IVBs, their charge neutrality (with respect to the "identity" charge) allows them to mediate the transformation of a variety of different charges - electric, identity, color, and spin - all via virtual particle-antiparticle pairs which "piggyback" on the massive IVBs. This "lack of agenda" with respect to identity charge allows the EW family IVBs to perform all the various transformations of the lepton and quark families, including those involving heavy leptons, neutrinos, mesons, and baryons (single baryons can be transformed but not created or destroyed at the EW level). (See: "[The 'W' IVB and the Weak Force Mechanism](#)" (pdf); also available in html format: [The "W" IVB and the Weak Force Mechanism](#) (html).)

The second IVB "family" level is the unification level of the GUT (Grand Unified Theory), in which the strong force and electroweak force are unified. This second (hypothetical) IVB family consists of the X^+ , X^- , X neutral heavy bosons, associated with a second-level Higgs boson, "H2". Whereas the E/W level IVBs transform one quark to another and one lepton to another (including the creation and destruction of leptons and mesons), the GUT level IVBs transform quarks to leptons (including the creation and destruction of single baryons). This is the level of leptoquarks, the union of leptons and quarks. "Proton decay" is a GUT level process, which is why we never see it (the "X" IVB is prohibitively massive). Single baryons originate at the "GUT" IVB level, leptons at the "EW" IVB level. (See: Howard Georgi: "A Unified Theory of Elementary Particles and Forces," *Scientific American*, Vol. 242, No. 4, April, 1980, page 104+.)

The third "order" of IVBs (also hypothetical) are at the TOE (Theory of Everything) level of unification, in which gravitation is added to complete our [4x3 fractal scenario](#) of force unification (Planck energy-level unification). We may designate these third-level IVBs as: Y^+ , Y^- , Y neutral, associated with a third-level Higgs boson, "H3". Primordial leptoquarks, quark partial charges, and the gluon field all originate at the H3 level, as well as particle mass. Whereas level two (H2) may be seen today in proton decay (possibly a

commonplace in the interiors of black holes), level three (H3) unification exists only at the very beginning or ending of the Cosmos (the "Big Bang" or "Big Crunch") (the conjoining or dissolution of gravity, spacetime, and particles, positive and negative energy). Black holes do not qualify for level 3 because of their partial and extended nature. The Universe does not begin as a black hole, but as an explosion of spacetime and energy, due to its initial matter-antimatter symmetry and consequent annihilation reactions; nor is there any spacetime external to its "horizon".

The entropy-driven (expansion and cooling) decay phase of level 3 to level 2, in which gravity and the spacetime metric separate from the primordial mass-carrying leptons, may be described by the "inflationary" scenarios of Alan Guth and Andre Linde. Although I don't know what to think about this highly mathematical theory, it certainly describes a bizarre spacetime with which we have no familiarity (a supercooled "false vacuum" with "repulsive gravity"), and *if* it belongs anywhere in the "Higgs Cascade" model, it would either have to be here, or possibly at the even earlier stage of the separation between our Universe and the Multiverse. In my view, "inflation", if it exists at all, may simply represent the actual destruction of the spacetime metric by the too-violent explosion of the "Big Bang". Inflation ends ([in this scenario](#)) when the energy input has expanded and cooled to the point that our familiar spacetime metric can accommodate and regulate it. There are, however, other ways to produce the observational effects of "inflation" (see: ["A Spacetime Map of the Universe"](#)).

The "Higgs Cascade" is driven by entropy, which in its primordial form consists of the intrinsic motions of light, gravity, and time, as "gauged" or regulated by c , G , and T . (See: ["Spatial vs Temporal Entropy"](#).) The activity of the graviton, the field vector of gravity, is essentially the inverse of the photon, collapsing and heating space rather than the reverse. The intrinsic motion of the photon is the entropy drive of free energy, producing space and the expansion and cooling of space. The active principle of the gravitational "location" charge is time, which has its own intrinsic motion as the entropy drive of bound energy (at right angles to all three spatial dimensions), producing the expansion and aging of history. *A gravitational field is the spatial consequence of the intrinsic motion of time.* (See: ["Entropy, Gravity, and Thermodynamics"](#); see also [The Conversion of Space to Time](#).)

The Role of the "Y" IVBs

The role of the "Y" IVB is to extract electrically neutral leptoquark-antileptoquark pairs from the H3 primordial "Ylem" (by splitting primordial leptons), and deliver them to the H2 level as invariant entities. The "X" IVBs of the H2 level then proceed with an asymmetric weak force decay of these electrically neutral leptoquark pairs, which results in a residue of matter hyperons and leptoquark antineutrinos. Because the sub-elementary and fractionally charged quarks with their associated gluon field seem to further an agenda of manifestation rather than conservation (the latter function being equally well-served by (much) simpler massive elementary leptons with whole quantum unit charges), the rationale for the "Y" IVBs appears to be the production of quarks and electrically neutral leptoquark-antileptoquark pairs.

Exactly how these primordial leptons and leptoquarks are created is of course unknown, but according to the logic of our [table](#), their creation requires the participation of gravity, which is to say, a heavily compressed spacetime metric. Since the IVB families all seem to work by a form of metric compression or density, and the "Y" IVB is the most massive of them all, it seems likely that the "Y" IVB acts like a mechanical press upon the structural energy contained in a "leptonic quantum unit" (a primordial, electrically charged leptonic elementary particle, produced by the gravitational spacetime metric), which cleaves under the enormous applied pressure along the 3 dimensional planes of space, into 3 "quark" subunits. In other words, the "Y" IVB acts upon a particle formed directly (with the help of gravity) from the spacetime metric. (This is almost a recursive action, since the IVBs are themselves "metric" particles formed from densely "packaged" spacetime. However, the secret of mass or energy binding may actually be contained in this reflexive feature.) As modeled here, the compressive force of gravity acting upon the

spacetime metric at the H3 energy level supplies the primordial charged lepton, and the additional action of the massive "Y" IVB splits the lepton, which can subsequently rearrange its quarks to form an electrically neutral leptoquark.

Once formed, these neutral leptoquark pairs pass directly to the H2 domain. Their necessary electrical neutrality, which is anomalous with respect to the lower energy members of their leptonic family (electron, muon, tau), is probably due to a selection process (only the neutrals survive annihilation reactions to reach the H2 energy level). Electrical neutrality is necessary to break the symmetry of the primordial matter-antimatter particle pairs, which is why the primordial mass-carrier (the leptoquark) must be a composite particle, able to arrange the partial charges of its quarks into an electrically neutral configuration (like a neutron).

Electrically neutral leptoquark-antileptoquark pairs flow out of the H3 domain to the H2 energy level (as the universe expands and cools), where they may live long enough to be asymmetrically attacked by the "X" IVBs, rather than undergo the more usual matter-antimatter annihilation reactions (which is why their electrical neutrality is so necessary to this whole process - to allow enough time for weak force asymmetric decays to occur). While all this is of course speculative, it is currently the best I can do to set the stage for baryon genesis via the "X" IVBs of the H2 energy level. The H3 energy level, utilizing an unknown process (perhaps splitting primordial leptons), acts as a leptoquark "factory", sending electrically neutral leptoquark pairs down to the H2 energy level.

The cascade passes from leptoquark genesis (H3) to baryon genesis (H2) to lepton genesis (H1) to atomic genesis (H0 - ground state). While we do not understand the cascade in detail, something very like it must have happened or we would not be here to wonder about it.

In the H2 or leptoquark realm, the "X" IVBs compress the baryon combinations so powerfully that their color charges sum to zero and vanish (in the limit of "asymptotic freedom"). A few of these electrically neutral and colorless leptoquarks will survive long enough without annihilation by their antipartner to undergo (alone) a weak force leptonic decay, exactly like a heavy lepton, via the emission of a leptoquark neutrino (or antineutrino), with the mediation of the "X" IVB (this is also the probable pathway of "proton decay"). Such a single decay isolates its former annihilation partner, which in consequence survives to expand its quarks and become a hyperon, at which point it is stabilized by the explicit appearance of the conserved color charge. Because of an inherent asymmetry in the weak force with respect to matter-antimatter reactions, a few more electrically neutral matter leptoquarks are isolated from their erstwhile annihilation partners, and so survive to expand their quarks (in a rapidly expanding Universe), becoming the matter hyperons of the H1 level, where they decay further via the "W" IVBs and their alternative charge carriers to ground state protons and electrons, eventually forming atoms, and much later, during the symmetry-conserving "rebound", galactic systems with life forms, including us.

Summary

The three IVB species, the "Y", "X", and "W", are all "metric" particles composed of the dense metric of their respective force unification realms, and all function by means of compression. The IVB role (in the case of the "X" and "W" IVB families) is the creation of "singlet" bound energy forms (quarks, mesons, baryons, leptoquarks, leptons, neutrinos) peculiar to the IVB's particular force unification level or symmetric energy state, as well as the transformation of "singlets" to the next lower force unification level. The "Y" IVBs produce electrically neutral leptoquark-antileptoquark pairs by splitting primordial leptons (Gamow's "Ylem"), which they send down to the H2 energy level, where the "X" IVB family takes over their decay. The IVBs provide a "lawful" conservation pathway for the decay "cascade" of energy in the material system from the "Big Bang" through three force unification regimes of decreasing symmetry and energy (but increasing entropy) to the electromagnetic "ground state" of cold atomic matter. The "Y" IVBs split

primordial charged leptonic forms into quarks with partial charges, creating particle mass (with gravity, electromagnetic energy, and the spacetime metric); the "X" IVBs asymmetrically transform neutral leptoquarks into baryons (and leptoquark antineutrinos), creating matter; the "W" IVBs create alternative charge carriers from the "vacuum", transforming hyperons, neutrons, and heavy leptons into ground state protons and electrons. At the "ground" state EM energy level, photons and gravity create historic spacetime, and protons and electrons create atomic matter.

The "W" IVBs (H1 energy level) combine virtual particle-antiparticle pairs (from the "vacuum") with "real" particles in a "bear hug" embrace that allows them to exchange charge and energy without offending the conservation laws. The "X" IVBs (H2 energy level) compress the quarks of baryons and leptoquarks until their color charges (which are carried by gluons in all possible color-anticolor combinations), sum to zero color and self-annihilate (see: "[The Origin of Matter and Information](#)"). The "Y" IVBs (H3 energy level) compress primordial leptonic particles (provided by a super-dense, gravitational, spacetime metric) so powerfully that the leptons fracture into 3 parts, the nascent quarks. Presumably, these fractures occur along the "cleavage planes" of the three spatial dimensions of these primordial charged leptonic particles, which are derived from the gravitational metric of spacetime. Particles acquire mass during the time they are conjoined with electromagnetic energy and the gravitational metric of spacetime (H3 energy level). The gluon field of "sticky light" arises as a consequence of symmetry conservation, permanently confining quark partial charges into whole quantum charge units that can be balanced, canceled, and/or annihilated by other elementary leptonic charges or alternative charge carriers. Gluons appear to be a form of "split light", or split electromagnetic field vector (photons), consequent upon the splitting of an elementary leptonic particle and its unit electric charge into sub-elementary quarks with fractional charges. (Quarks are necessary subdivisions of the primordial mass carrier, allowing it to achieve electrical neutrality (like a neutron), and so survive long enough to undergo an asymmetric weak force decay.)

The common mode of action of the three IVB species (metric compression, or the re-creation of the dense metric of a specific force unification symmetric energy state), and the fact that all three have distinctly different but necessary parts to play in the creation of atomic matter - the creation of electrically neutral leptoquarks and the partial charges of the quarks ("Y" IVBs), the asymmetric creation of single baryons ("X" IVBs), and the asymmetric creation of single leptons and other alternative charge carriers ("W" IVBs) - lends a strong plausibility to the hypothetical "Higgs Cascade" outlined above. The "W" IVB level is experimentally observed fact. While the "X" and "Y" IVB levels are hypothetical, we obviously have to find a source for baryons and their constituent quarks somewhere (and for our life-friendly "given" physical constants - such as c , G , e , h , etc.). The "Higgs Cascade" at least provides a consistent hypothesis and "reasonable guess" as to these origins. No one expected or predicted the three mass-energy levels of the lepton and quark "families", and we still don't know why they exist (when one level would seem to be sufficient). The (postulated) three mass-energy levels or metric "families" of the Higgs and IVBs may be another example of Nature's penchant for tri-level energy hierarchies or resonant forms, but at least in this case we can suggest plausible/practical reasons for its existence (for example, the three symmetric energy states of progressively more inclusive force unifications, in addition to the respective origins of leptons, baryons, and quarks).

Finally, we should note that it is the weak force that brings the asymmetric material world into existence, including ourselves. Reality as we experience it is just that form of electromagnetic energy which can be conserved in space and time, whether bound or free. While the origin of energy itself and the "Big Bang" Creation Event will probably forever remain articles of faith for either science or religion, the lesser miracle of matter is contained in the conservation functions of electromagnetic energy and the spacetime metric. For a commentary on the meaning and role of humanity in the Cosmos, see: "[The Human Connection](#)"; also: "[Teilhard de Chardin, Prophet of the Information Age](#)"; and books on my father's memorial website: "[Trance, Art, and Creativity](#)".

The mass of the Higgs boson is probably not much greater than the mass of the IVBs of its associated family. That, at least, would be our expectation from this model, since the Higgs boson is the scalar gauge of the energy density or force unification symmetric energy state which the IVBs represent. The role of the Higgs boson is to gauge or scale the IVBs to the appropriate force unification energy level at which the desired transformation is simply a normal characteristic of the symmetric energy state (all "species" within a "genus" are equivalent, etc). The IVBs perform the required transformation; the Higgs ensures the invariance of the product - an invariance, as we have seen, essential for charge, symmetry, and energy conservation.

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 conceptual, 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 conceptual, mathematical, macro, or micro, are explored (also in a General Systems format) in the papers "[Symmetry Principles of the Unified Field Theory \(a 'Theory of Everything'\) - Part I](#)" 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:

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

Unification Era	Symmetry Group	IVBs (Decay Path)	Type Field Vector Temp/Time/GEV	Charge	Era Role
Planck Era; T.O.E.	Higgs 3; All Forces	"Y" IVBs;	Graviton	"Location" (gravitational	Gravity Provides

"Theory of Everything" (Gravity and Spacetime Unified with Light, Particles) Creation of Leptoquarks	Unified; G2 (?) (Strings?) (Dimensions?) (Massive Particles) Gamow's "Ylem"	Transform Primordial "Ylem" to Leptoquarks; Create and Destroy Leptoquarks	(Gravitational Force); 10(32) k; 10(-43) sec. (Big Crunch) 10(19) GEV	charge); Negative Energy; Total Energy = 0; "Local" Mass Asymmetry	Negative Energy; "Ylem"; Primordial Leptoquarks; Particle Mass; ?Inflation?
Leptoquark Era; G.U.T. "Grand Unified Theory" (Quarks Unified with Leptons) Asymmetric Leptoquark Decay; Creation of Matter, Hyperons	Higgs 2; Strong, E/W Forces Unified; SU(5) (Leptoquarks)	"X" IVBs; Transform Leptoquarks, Create and Destroy Matter and Baryons; Symmetry-Breaking; "Proton Decay"	Gluon (Strong Force); 10(28) k; 10(-35) sec. (Black Hole) 10(16) GEV	Color Charge; Total Color = 0; Partial Charge Asymmetry of Quarks	Asymmetric Decay of Leptoquarks Creates Matter, Hyperon "Singlets", Leptoquark Neutrinos; ?Dark Matter?
Hyperon Era; E/W Electroweak Union (Quarks Unified, Leptons Unified); Creation of Leptons, Alternative Charge Carriers	Higgs 1; E/W, E/M Forces Unified; SU(2), SU(3) (Leptons, Quarks)	"W" IVBs; Transform Hyperons and Heavy Leptons, Create and Destroy Alternative Charge Carriers (lepton, meson, neutrino)	IVB (Weak Force); 10(15) k; 10(-10) sec. (Supernova, Neutron Star) 10(2) GEV	"Identity" ("Number" Charge); Total "Number" = 0; "Identity" Asymmetry of Leptons	Creates and Transforms Leptons, Neutrinos, Mesons, Leptonic "Singlets"; Transforms Baryons
Atomic Era; E/M Electromagnetic Unification; Electric/Magnetic Fields Unified; Creation of Atoms, Space and History	"Ground State"; Spacetime Metric (Scaled by c, G); U(1) (Phase) (Light)	Photons; Transform E/M Fields, Space and Time; Create and Destroy Atomic Structure, Molecules	Photon (Electromagnetic Force); Temp. 2.7 K; Historic Spacetime; 13.7 Billion Yr. (Sun - Star) 10(-3) EV	Electric; Total Electric Charge = 0; 4th Dimension Asymmetry	Creates Space and Spacetime; Atoms; Metric Regulates "c", Vacuum Virtual Particle "sea"

J. A. Gowan and A. T. Jaccaci, Nov., 2010 www.johnagowan.org/index.html

"Multiverse": Non-dimensional "vacuum" source of undefined symmetric energy and creative potential - produces our 4-D universe as a quantum fluctuation of *no net energy or charge*, conserving energy, with "life-friendly" physical constants ("Anthropic Principle"). Balanced pos-neg (gravitational) energy and matter-antimatter charge symmetry. (Cosmos, Multiverse united). "Big Bang": Cosmos devolves from "Multiverse".

Information and Biological Eras evolve as ground state "rebounds" from entropy-driven cascade.

Rebound is driven by symmetry conservation, negentropic gravity, and evolutionary forces, creating planets, stars, black holes, galaxies, "Big Crunch", heavy elements, chemistry, life, thought, experience, symbolic information.

Abstract

We explore the hypothesis that there are 3 "families" or energy levels of the Higgs bosons and their associated Intermediate Vector bosons (IVBs), analogously to the three families or energy levels of the quarks and leptons. With its origin in the "Multiverse", our Universe apparently devolves (rapidly) downward in an asymmetric "Higgs Cascade" to the electromagnetic ground state, and evolves (slowly) upward again in a "rebound" driven by symmetry conservation (Noether's Theorem) toward the Multiverse or a state of pure electromagnetic radiation (light).

Unification Eras (or Symmetric Energy States) of the "Big Bang"

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Force Unity Eras: Multiverse Era

[Multiverse Era](#): A-dimensional, "vacuum" potential of undefined creative energy, producing infinitely (?) many energy-conserving Universes (with various and unique physical constants) via quantum fluctuations of *no net energy or charge*, one of which (constrained by the "Anthropic Principle") becomes our own. "Inflation" from a "false vacuum" state may be involved. Scalar Higgs particles, "Standard Model" symmetry groups, transformative IVB families, and field vectors of the four forces are listed for an entropy driven decay "cascade" through 4 successive levels of force unification. Major roles and productions of the eras are suggested. Unification eras correspond to a specific temperature (absolute degrees Kelvin) and time period (after time zero) of the "Big Bang" decay sequence (For table data see: Brian Greene: *The Fabric of the Cosmos*, P. 270, Knopf, 2004, and Frank Close: *The New Cosmic Onion* Taylor and Francis, 2007, page 196. For symmetry discussion, see : Ian Stewart, *Why Beauty is Truth*, P. 239-73, Basic Books, 2007). (*Creation of Universe, "Big Bang".*)

Force Unity Eras: Planck Era

3) [Planck Era \(quantum gravity era, primordial "Ylem" era\)](#). Y+, Y-, Y neutral IVBs, Higgs 3, - TOE unity (Theory of Everything): unified positive and negative energy ("Yin-Yang"). All forces unified. $10(32)k$; $10(-43)$ sec. Unified gravity, light, spacetime, and bound energy forms (primordial, electrically neutral leptoquarks). "Quantum gravity". Negative gravitational energy exactly balances positive energy of particles. Matter-antimatter symmetry. "Y" IVBs transform primordial elementary leptons ("Ylem") (produced by the energy of light, the structure of metric spacetime, and gravity) to primordial electrically neutral leptoquarks (essentially a trisected heavy lepton), creating particle mass. Decays to level 2 leptoquark era with separation of spacetime metric (including gravity) from primordial leptoquarks (due to activity of "Y" IVBs splitting leptons, and the entropic expansion and cooling of the Cosmos). This separation may correspond to the "inflationary" era of Guth and Linde (?). Matter-antimatter annihilations. (*Creation of primordial leptons, leptoquarks, and particle mass.*)

Force Unity Eras: Leptoquark Era

2) [Leptoquark Era](#). X+, X-, X neutral IVBs, Higgs 2, - GUT unity (Grand Unified Theory):

unified quarks and leptons with separate spacetime and gravity. Strong and electroweak forces unified. 10(28)k; 10(-35) sec. Entropy driven expansion and cooling of spacetime. Quark partial charges allow electrically neutral leptoquarks. "X" IVBs compress and contain leptoquarks, allowing weak force decays with emission of leptoquark neutrinos. Asymmetric weak force decay of electrically neutral leptoquarks vs antileptoquarks produces level H1 Hyperon Era and matter asymmetry of Cosmos. (*Asymmetric creation of matter and single hyperons; leptoquark antineutrinos are "dark matter" candidates.*)

Force Unity Eras: Electroweak Era

1) [Hyperon Era](#). W+, W-, W neutral IVBs, Higgs 1, - E/W unity (Electroweak Unification): hyperons, heavy leptons, and virtual particle "zoo" era. Weak and electromagnetic forces unified. 10(15k); 10(-12) sec. Matter dominated asymmetry. Leptons and quarks separate into unified lepton families and unified quark families. "W" IVBs transform quarks into other quarks and leptons into other leptons (but not leptons into quarks). Hyperons and heavy leptons decay (via "W" IVB family) to "ground state" proton, electron, and photon with emission of leptonic antineutrinos. Leptons, mesons, and neutrinos serve as alternative charge carriers for the decays of hyperons and heavy leptons, avoiding antimatter annihilation reactions. (*Creation of leptons, neutrinos, mesons - alternative charge carriers; creation of leptonic "singlets".*)

Ground State Era: Electromagnetic Era

["Ground State" Atomic Era](#). Historic spacetime, bosons, leptons, hadrons - E/M unity (Electromagnetic Unification). History: currently 13.7 billion years after the "Big Bang"; temperature 2.7 K. Separate leptons, neutrinos, mesons, and baryons. Spacetime, light, and gravity remain unified, electric and magnetic fields remain unified. Virtual vacuum particle "sea". Photon separates from "W" IVBs, creates and energizes space; gravity creates time from space, time creates history. Spacetime metric and photon are the ground state analogs of the Higgs and IVBs. Era of atomic matter, light, gravity, and historic spacetime. (*Creation of space, historic spacetime, and atomic matter; evolution of life.*)

The "Ground State Vacuum" also hosts virtual particle-antiparticle pairs, which are essential for maintaining an active connection between the electromagnetic ground state and higher energy electroweak transformations, for example, the transmutation of atomic nuclei in "radioactive" decays and element-building in stars. Both processes directly and continuously interact with the electromagnetic ground state, whereas interactions at the GUT and TOE energy levels are typically of one-time historic significance (creation of Universe, creation of matter). The "nucleon" is a remnant of the electroweak unification era that persists into the ground state of atomic matter due to strong force binding via the exchange of a virtual meson field.

Symmetry Restoration or "Rebound" Era

[Ground State "Rebound"](#) Information, life, and consciousness Era. Driven by symmetry conservation, gravity, and biological evolutionary forces. Rebound begins with planets and Sun-like stars (ground state); continues through supernovas and neutron stars (level H1); galaxies (including quasars and black holes) (level H2); and cosmic collapse or "Big Crunch" (level H3). (*Creation of planets, stars, black holes, galaxies, the "Big Crunch", heavy elements, molecules, chemistry, life, experience, symbolic information.* (See: ["Nature's Fractal Pathway"](#).)

We have previously (and correctly) understood the gravitational rationale from the point of view of: 1) energy, entropy, and causality conservation (the gravitational creation of time from

space, providing the temporal entropy drive and causal linkages of bound energy); 2) the point of view of symmetry conservation (the gravitational conversion of bound to free energy, as in stars); 3) the source of negative energy (balancing positive energy) in the "Big Bang". (See: "[Entropy, Gravitation, and Thermodynamics](#)"). The gravitational recapitulation of force unification and symmetry states (culminating in the "Big Crunch") allows us to understand the gravitational rationale from a new, fourth perspective embracing only the reunification of the four forces.

Links:

Unified Field Theory

[Symmetry Principles of the Unified Field Theory \(a "Theory of Everything"\) - Part I](#)
[Symmetry Principles of the Unified Field Theory \(a "Theory of Everything"\) - Part 2](#)
[Principles of the Unified Field Theory: A Tetrahedral Model](#)
[\(Postscript and Commentary on paper above\)](#)
[Synopsis of the Unification Theory: The System of Spacetime](#)
[Synopsis of the Unification Theory: The System of Matter](#)
[Light and Matter: A Synopsis](#)
[Global-Local Gauge Symmetries and the "Tetrahedron Model"](#)
[Global-Local Gauge Symmetries: Material Effects of Local Gauge Symmetries](#)
[The "Tetrahedron Model" vs the "Standard Model" of Physics: A Comparison](#)

Weak Force, Intermediate Vector Bosons ("IVBs")

[Section IV: Introduction to the Weak Force](#)
[Section XVI: Introduction to the Higgs Boson](#)
[The "W" Intermediate Vector Boson and the Weak Force Mechanism](#) (pdf file)
[The "W" IVB and the Weak Force Mechanism](#) (html file)
[Global-Local Gauge Symmetries of the Weak Force](#)
[The Weak Force: Identity or Number Charge](#)
[The Weak Force "W" Particle as the Bridge Between Symmetric \(2-D\) and Asymmetric \(4-D\) Reality](#)
[The Strong and Weak Short-Range Particle Forces](#)
[The "Higgs" Boson and the Spacetime Metric](#)
[The "Higgs" Boson and the Weak Force IVBs: Part I](#)
[The "Higgs" Boson and the Weak Force IVBs: Parts II, III, IV](#)
["Dark Matter" and the Weak Force](#) [The Halflife of Proton Decay and the 'Heat Death' of the Cosmos](#)

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