

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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Revised Oct., 2010

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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" which reproduces 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-density 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 is the mass scalar of the process, the IVBs are 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 unified force level. However, the weak force also has two (hypothetical) higher energy manifestations at the "Grand Unified" energy level (strong force unification level) and the "Theory of Everything" 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 single leptoquarks (transforming but not creating primordial "Ylem"). Without the "X" and "Y" IVBs, we have no source for either single baryons or single leptoquarks, so we need them both.

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 "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: Part I

(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 mechanism ("Z"), effecting scattering (bouncing) interactions, and 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 a

type of entropy-energy, an invariant and specific mass, gauged at about 81 proton masses (for the "W" IVB), which is also a symmetry condition of electroweak (E/W) 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 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 E/W 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 symmetry-state 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 symmetry states) above a fourth level electromagnetic (E/M) "ground state". The "ground state" is the decay product of the "Electroweak (E/W) 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. At the G.U.T. 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 single baryons but not yet single leptoquarks). At the final level of force unity, the T.O.E. level, we find the fermion and boson families (plus gravity) joined into an "order" (encompassing free and bound electromagnetic energy - Gamow's "Ylem"), in which transformations between all types of particles are allowed, creating single leptoquarks (primordial leptonic elementary particles split into three components).

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 (E/W) 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 E/W 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 E/M 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 4x3 and 4x4 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 "E/W" 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 "E/W" 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 E/W 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 E/W 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). Baryons originate at the "GUT" IVB level, leptons at the "E/W" 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, electrically neutral leptoquarks, quark partial charges, and the gluon field all

originate at the H3 level, as well as particle mass (possibly including some form of "dark matter"). 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 leptiquarks, 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 ["A Spacetime Map of the Universe"](#).)

Inflections in the Energy Profile of Spacetime

Because we don't understand the exact mechanism of weak force transformation, we have to speak in general terms, which can nevertheless help us grasp the major features of the process. While of course the product of the process is important (say, an electron), the uniformity of that product is just as important - all electrons must be exactly the same in mass and charge, whenever and wherever produced - for obvious reasons of energy, charge, and symmetry conservation. Uniformity over time and space is the reason why the whole weak force transformation process is quantized into particle form, and why it is divided into two interactive parts, the Higgs boson and the IVBs. The Higgs is responsible for the uniformity of the IVBs and by extension, their products (quantized scalar "quality control"), while the IVBs provide the actual transformation/translation mechanism. Particle creation and transformation did not end with the Big Bang creation of matter, but continues with the creation and transformation of leptons, neutrinos, quarks, and mesons (including the creation, transformation, and destruction of the elements in stars and via "radioactive" processes). This ongoing creation/transformation process is why we find a functional weak force mechanism still operating in the Cosmos today.

As for details, one can only surmise that at a critical "phase transition" temperature or energy density, at which one force joins (or decouples from) another, spacetime takes on the IVB form, which at the "W" level is capable of performing lepton-lepton and quark-quark transformations. This IVB form is simply representative of the energy density of a specific force unification level or symmetric energy state. The

Higgs scalar determines the mass of the IVB, which makes the IVB an effective "citizen" of a specific force unification realm, and therefore capable of participating in and performing the typical transformations which characterize that force unification regime, or symmetric energy state. The IVB mechanism or form may consist of nothing more than a quantized sample of the typically dense metric of a specific symmetry realm - as selected, determined, or "gauged" by the Higgs. (When one force joins another, and/or when particles lose their separate identities to a more inclusive union, a symmetric energy state (a state of higher symmetry) is realized.)

IVBs function by reprising the "Big Bang" energy density of the force unification regime or symmetric energy state in which the transformation they are mediating originally took place. This is a "fail-safe" method for reproducing the original values of charge, mass, and energy of elementary particles when the latter are created as "singlets" rather than as particle-antiparticle pairs. Quantization (of the Higgs and IVBs) makes the whole mechanism reliably and indefinitely repeatable at a specific energy, charge, and mass, without inflation or depreciation due to entropy, gravitation, relative motion, the passage of time, or any other factor. The quantized Higgs scalar is necessary to meet the conservation requirement for invariance through time in the creation and transformation of the charge, mass, energy, and other conserved parameters of elementary particles. Conservation of energy, symmetry, and charge demands that "singlet" electrons created today be the same in all respects as "singlet" electrons created eons ago in the "Big Bang". This is the conservation challenge posed to and surmounted by the weak force Higgs and IVB mechanism.

The connection between the photon and the IVBs is metric; the photon (light) both creates and energizes the spacetime metric, providing its entropic, expansive force, and the IVBs are "metric" particles (compressed, quantized fragments of the spacetime metric). When the photon becomes energetic enough (for example, at an energy equivalent to 90 proton masses (90 GEVs)), the photon itself becomes a "Z" IVB, a densely compressed quantized fragment of the spacetime metric (at this high energy, the particle aspect of light becomes not only dominant, but quantized and fixed into particle form, "crystallizing" or "freezing" at a critical temperature of the metric (a "point of inflection" in the energy profile of the spacetime metric). This first level (H1) phase transition, symmetry state, or force unification regime, always occurs at the same energy level, and it is the job of the Higgs boson to gauge or scale the "E/W" IVBs to an equivalent energy density. The whole point of the exercise is that at the proper energy level, the transformation to be performed by the IVB will occur naturally and effortlessly as part of the realized symmetry state or force unification regime, and moreover with an invariant result.

Three Symmetry Levels of Force Unification

At the Higgs 1 unification energy (E/W), the quark families are all unified among themselves, and similarly, the lepton families are all unified among themselves (but quarks remain separated from leptons). The "W" IVBs can make any transformations involving changes of "flavor" or "identity" within the lepton or quark families (but not changes between lepton and quark families). These changes include transformations of baryons, hyperons, and heavy leptons, because the "W" IVBs are part of the critical force unification energy in which all such transformations take place as a matter of course, simply as a symmetry characteristic of that particular energy level. While leptons and mesons can be transformed, created, and destroyed at the "E/W" IVB energy level (H1), baryons and hyperons can only be transformed. The creation of alternative charge carriers (leptons, neutrinos, and mesons), which allow the decay and transformation of hyperons and heavy leptons without antimatter annihilation reactions, is the unique and crucial role of the "E/W" IVBs. (See: ["The 'W' IVB and the Weak Force Mechanism"](#).)

Analogously to the Higgs 1 unification scale, the Higgs 2 (GUT) is the scale of unification between the "W" IVBs and the much heavier "X" IVBs, which are capable of producing "proton decay" and creating and destroying baryons. At the H2 energy level, all leptons and quarks are unified: the quarks of baryons are compressed by the "X" IVB until their color charges vanish, rendering baryons indistinguishable from heavy

leptons (the "leptoquark" era). We presume a leptoquark neutrino also exists at this level, enabling leptoquark and "proton decay" (leptoquark neutrinos are an obvious candidate for "dark matter"). Single, electrically neutral leptoquarks (isolated by the asymmetric weak force decay of their erstwhile annihilation partners) produce hyperons by the simple expansion of their nascent quarks, to reveal explicit and conserved color charges. The vanishing of the quark's color charges via compression, the asymmetric decay of electrically neutral leptoquarks via leptoquark neutrinos, and the creation and destruction of baryons and matter, is the unique and crucial role of the "X" IVBs. The origin of leptoquarks themselves lies at the next higher energy level, H3 (TOE).

The final level of unification occurs between the "X" IVBs and the "Y" IVBs, the unification of particles with gravity, light, and the spacetime metric at the "Planck" energy density level (TOE). Primordial, neutral, single leptoquarks originate at this level by the combined interaction of light, the spacetime metric, gravity, and the "Y" IVBs. This is the level of primordial elementary particles (primordial charged leptons and neutral leptoquarks), and perfectly balanced positive and negative (gravitational) energy and matter-antimatter charges. "Y" IVBs create electrically neutral leptoquarks and quark partial charges by splitting charged primordial leptonic particles into three parts. The creation of single neutral leptoquarks (including their neutrinos) by the transformation (splitting) of primordial charged leptons is the crucial and unique role of the "Y" IVBs. These primordial, charged, and massive leptons are produced by the interaction of the energy of light with the structure of metric spacetime, and the intense pressure of gravity.

In the "Big Bang" this primordial "substance" (Gamow's "Ylem") goes through an entropy-driven "cascade" decay of three successively reduced stages of force unification, each produced by spontaneous "symmetry-breaking". The cascade descends from H3 and the Planck Era of primordial leptonic particles and the creation of single leptoquarks, to the H2 level of "singlet" (asymmetric) baryon creation, then the H1 level of alternative charge carrier and "singlet" lepton creation, finally producing our "ground state" with the creation of atoms consisting only of matter. This last is the electromagnetic unification regime, in which the photon and "W" IVBs separate, creating the era of historic spacetime and atomic structure we currently occupy. (The Biological or Information Era is actually created during a negentropic "rebound" phase (driven by symmetry conservation, gravity, and evolutionary forces) after the entropy-driven "cascade" phase has "bottomed out".) (See: ["Nature's Fractal Pathway"](#).)

The energy creating the masses of the particles produced along this "cascade" decay pathway is thought to be generated by a sort of "heat of crystallization" or "heat of condensation" (resulting from a loss of symmetry, a loss of "degrees of freedom", and an increase in entropy), generated at the symmetry-breaking or unification points ("inflections" in the curve of the energy profile of the spacetime metric as the forces successively decouple from one another), inflection points which the Higgs reflects as it scales or "gauges" (regulates) the various IVB masses. The gravitational, electromagnetic, strong, and weak forces immediately convert some of this released energy into the conserved forms of particles, while some is entropically dispersed as light and heat. This energy release begins with the separation of our Universe from the "Multiverse", the symmetry of the Multiverse being broken by the specification of the "life-friendly" physical constants which uniquely characterize our Universe (the "Anthropic Principle"). Positive energy is quantized as particle-antiparticle pairs (primordial elementary "leptonic" forms), and is exactly balanced by the negative gravitational energy associated with their mass, producing a "genesis substance" (Gamow's "yelm") of no net energy or charge. (According to Brian Greene, the notion of the genesis of our Universe as a quantum fluctuation of no net energy or charge is due to Edward Tryon.) (See: Brian Greene, *"The Fabric of the Cosmos"*, Knopf, 2004. See also: *Nature*, December, 1973).

The "Y", "X", and "W" IVBs

The role of the IVBs is to provide a conserved, "lawful" pathway for the material system to decay (as driven by entropy) from the "Big Bang" to the "ground state" of cold atomic matter, the state of least bound energy

(greater symmetry) and lowest temperature (greater entropy). For rather obvious reasons of energy and charge conservation, the charge, mass, and energy of elementary particles created and/or transformed along this "cascade" or weak force decay pathway must be invariant whenever and wherever the pathway operates. The conservation issue is especially acute with the weak force production of unreferenced "singlets" rather than the electromagnetic or strong force production of balanced particle-antiparticle pairs, resulting in the special form of the massive IVBs. IVBs simply reprise (in quantized form) the original "Big Bang" metric density, energy level, and symmetry state of the force unification regime they are mediating. This is a "fail-safe" method for reproducing the original (and hence invariant) values of charge, mass, and energy of elementary particles. The Higgs scales or "gauges" the IVBs to the proper energy level to access the desired force unification or symmetric energy state; the IVBs then produce the required and invariant transformations.

The "W" and "X" IVBs are very similar, except for mass. Both appear to be asymmetric in their interactions with matter vs antimatter, and both use neutrinos as alternate charge carriers of "identity" charge - the "X" in the case of leptoquarks (leptoquark neutrinos), and the "W" for leptons (three leptonic neutrinos). The asymmetric "Y" IVB creates single leptoquarks and leptoquark neutrinos. (The use of alternative charge carriers (leptons, neutrinos, and mesons) at all energy levels circumvents the use of antimatter to achieve charge balance/cancellation. Alternative charge carriers balance charges but avoid annihilation reactions, allowing "singlets" or unpaired elementary particles to be produced.)

All three IVB families are conceived as "metric" particles - particles composed of the dense spacetime metric of their respective symmetry eras - and all three function through compression, varying only in intensity (proportional to their mass) and product (which must be representative of their respective force unification symmetry regimes). This mass triplet of "metric" particles is clearly analogous to the mass triplets of the lepton and quark families, and may be another resonant form of the spatial dimensional triplet.

The Role of the "Y" IVBs

The role of the "Y" IVBs is the creation of mass or bound energy in the form of single, electrically neutral leptoquarks. A "leptoquark" is a heavy leptonic primordial elementary particle that has been "split" into 3 parts (the quarks) by the "Y" IVB. Once created, leptoquarks immediately become members of the H2 energy level, where their electrical neutrality makes them susceptible to leptonic decays, as mediated by the "X" IVBs.

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 single neutral leptoquarks 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 single leptoquarks flow out of the H3 domain to the H2 energy level (as the universe expands and cools), where they may be asymmetrically attacked by the "X" IVBs before they have a chance to 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, acts as a leptoquark "factory", sending electrically neutral single leptoquarks 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"). Most of these colorless leptoquarks will simply annihilate with an antiparticle "mate". However, some baryon quark combinations will be electrically neutral, an impossibility for ordinary leptonic particles (the criterion of electrical neutrality is the reason why the primordial mass carrier must be a composite particle). These electrically neutral and colorless leptoquarks can survive long enough without annihilation by an antipartner to undergo a weak force leptonic decay, exactly like a heavy lepton, via the emission of a leptoquark neutrino (or antineutrino), and the mediation of the "X" IVB (this is also the probable pathway of "proton decay"). Because of an inherent asymmetry in the weak force with respect to matter-antimatter reactions, a few more electrically neutral matter leptoquarks fail to decay, 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.

Particles, Forces, and Metric Spacetime

Below the H1 energy level is the realm of the "ground state" and the "spacetime metric" gauged by the electromagnetic constant "c". The photon and the "W" family IVBs separate below the electroweak unification energy, and go their (mostly) separate ways. Photons create and energize spacetime, while the "W" family IVBs create the alternative charge carriers (leptons, neutrinos, mesons) from the vacuum virtual particle "sea". While light, spacetime, and particles continue to interact in various ways in the "ground state", they have rather distinctive identities. However, these distinctions are blurred at the H1 energy level and above, where we leave spacetime as we know it and enter the realm of the "particle metric", gauged by Higgs bosons in three mass or energy levels corresponding to a hierarchy of symmetry states or unification regimes of the forces. At the H1 energy level and above, the metric is expressed in mixed terms of particles as well as photons, gravity, and spacetime.

At the H3 energy level, the spacetime metric and particles are completely joined in "quantum gravity", with the gravitational metric completely contained within particles. Quantum gravity and the "Y" IVB family create quarks and single leptoquarks by splitting primordial charged leptons, and confer mass (bound metric/electromagnetic energy) upon the resulting particles.

At the H2 energy level the annihilation of particle-antiparticle pairs creates photons which establish an external spacetime metric and allow the separation of gravity from any surviving neutral leptoquarks. The expansion of spacetime, driven by entropy (expressed through the intrinsic motion of the photons), allows the expansion of quarks within neutral leptoquarks and the creation of hyperons and baryons as the quark's conserved color charges become explicit. Reflecting their metric and leptonic origin, baryons look like split leptons containing an internal spacetime, with massless bosons traveling at velocity c (the gluon field of the strong force has been compared to "sticky light").

At the H1 energy level, the "W" IVBs create leptons, neutrinos, and mesons as alternative charge carriers (from the virtual particle-antiparticle "zoo" of the vacuum), while gravity creates time from space. The intrinsic motion of time is an alternative form of entropy, servicing bound energy, causing the expansion and dilution of history and the aging and decay of matter and information. The intrinsic motion of light is the analogous entropy drive of free energy, causing the expansion and cooling of space. Alternative charge carriers (leptons, neutrinos, and mesons, created by "W" IVBs from the "vacuum zoo") are the particle analog of time, the alternative entropy carrier. Time is created by gravity via the annihilation of space, extracting a temporal residue, reflecting again the interrelationship and shared ancestry of the spacetime and particle "metrics". Gravity and the IVBs act together at the H3 energy level to create quarks from primordial leptons; they continue to act together to make the "ground state" possible through the creation of alternative charge and entropy carriers from the "vacuum" of spacetime.

The IVBs are "metric" particles, originating in the dense metric of the early Universe, and they reflect the structure of the spacetime metric from which they are derived: the four bosons of the electroweak unified force correspond in some way to the four dimensions. For example, there are three massive IVBs (W_+ , W_- , W neutral (or Z neutral)) and one massless boson (the photon), corresponding to the three spatial dimensions and time. Furthermore, the time dimension has intrinsic, entropic motion, just as the photon has intrinsic, entropic motion. Finally, the two massive and charged IVBs (W_+ and W_-) correspond to the transverse dimensions (y , z), while the neutral massive " Z " IVB corresponds to the x dimension, the direction of propagation (in which time and distance vanish at velocity c , whereas y , z are unaffected). Although we don't know how all this is arranged, the correspondence is suggestive and actually quite clear in the case of the intrinsic motions of the photon and time, the entropy drives of free and bound energy. This is why I place the spacetime dimensions and the photon in the "ground state" IVB cell of the 4x4 Higgs Cascade Table.

The symmetry loss in passing from the H3 to the H2 energy regime is the consequence of the separation of the primordial bound energy forms (the elementary leptonic and leptoquark particles) from their associated gravitational metric. This gravitational metric is the source of the negative energy, expressed as a contractile binding force, which balances the positive energy contained in the rest mass of the elementary particle-antiparticle pairs, allowing the Universe to be created as a quantum-mechanical fluctuation of no net energy or charge. This primordial union of particles and the gravitational metric and has left its mark upon the structure of particles and their forces, as we have noted above in the case of the IVBs, the photon, and time. It is also probable that the 3 quarks of baryons reflect this structural origin, the primordial leptons apparently splitting along the "cleavage planes" of the x , y , z spatial dimensions. The three "families" of quarks and leptons are another probable example of the structural impress of the metric origin of particles. The structure of baryons with their internal miniature "cosmos" of "sticky light" - the massless gluon field exchanging color charges at velocity c - is a further example, already noted.

Finding the origin of baryons in "fractured" leptons of course explains why quark partial charges sum to exactly leptonic whole charges, and why baryons and leptons react so readily with each other. It seems fairly clear that not only is the baryon derived from a split "primordial" lepton, but that the gluon field is

derived from the split field vector of that same lepton's electric charge: "split light". The strong force is therefore directly derived from the electromagnetic force (via the "Y" IVBs), and the two have much in common, including perfectly symmetric reactions with matter vs antimatter, and massless field vectors moving at velocity c .

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 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 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 (via leptoquark neutrinos) into baryons, creating matter; the "W" IVBs create alternative charge carriers from the "vacuum", transforming hyperons and heavy leptons into ground state protons and electrons. Meanwhile, 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, 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 asymmetric creation of single 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 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. 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:

Force Unification Eras or Symmetric Energy States of the "Big Bang"

"Multiverse": Non-dimensional "vacuum" source of undefined symmetric energy and creative potential - produces our 4-D universe as a quantum fluctuation of <i>no net energy or charge</i> , 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 evolves from "Multiverse".					
Unification Era (Symmetry Hierarchy) (Energy Level)	Higgs Boson; Symmetry Group	Intermediate Vector Bosons (Decay Path)	Type Field Vector (for Unity Era) Temp., Time (Rebound Stage)	Charge (Symmetry Debt)	Era Role or Major Production
Planck Era; T.O.E. "Theory of Everything" (Gravity and Spacetime Unified with Light, Particles) Creation of Quarks, Bound Energy	Higgs 3; All Forces Unified; G2 (?) (Strings?) (Dimensions?) (Massive Particles)	"Y" IVBs; Transform Primordial Leptons to Leptoquarks; Create and Destroy Quarks and Leptoquarks	Graviton (Gravitational Force); 10(32) k; 10(-43) sec. (Big Crunch)	"Location" (Time) (gravitational charge); Negative Energy; Total Energy = 0; "Local" Mass Asymmetry	Provides Negative Energy, Primordial Leptons, Leptoquarks; Creates Particle Mass; ?Dark Matter? ?Inflation?
Leptoquark Era; G.U.T. "Grand Unified Theory" (Quarks Unified with Leptons) Asymmetric Leptoquark Decay; Creation of Matter, Hyperons, Baryons	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)	Color; Total Color = 0; Partial Charge Asymmetry of Quarks	Asymmetric Weak Force Decay of Leptoquarks Creates Matter, Hyperons, Leptoquark Neutrinos, Baryon "Singlets"
Hyperon Era; E/W Electroweak Union (Quarks Unified, Leptons Unified); Creation of	Higgs 1; E/W, E/M Forces Unified; SU(2), SU(3)	"W" IVBs; Transform Hyperons and Heavy Leptons, Create and Destroy	IVB (Weak Force); 10(15) k; 10(-12) sec.	"Identity" ("Number" Charge); Total "Number" = 0;	Creates and Transforms Leptons, Neutrinos, Mesons, Leptonic

Creation of Leptons, Alternative Charge Carriers	(Leptons, Quarks)	Alternative Charge Carriers (lepton, meson, neutrino)	$10^{(-12)}$ sec. (Supernova, Neutron Star)	"Identity" Asymmetry of Leptons	Leptonic "Singlets"; Transforms Baryons
Atomic Era; E/M Electromagnetic Unification; Gravity and Light Unified with Spacetime; 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	Photon (Electromagnetic Force); Temperature 2.7 K; Historic Spacetime; 13.7 Billion Yr. (Sun - Star)	Electric; Total Electric Charge = 0; 4th Dimension Asymmetry (time)	Creates Space and Spacetime; Atoms; Metric Regulates "c", Vacuum Virtual Particle "sea"

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.

J. A. Gowan and A. T. Jaccaci, Oct., 2008

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

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. 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 (See: Brian Greene, *The Fabric of the Cosmos*, P. 270, Knopf, 2004; See: Ian Stewart, *Why Beauty is Truth*, P. 239-73, Basic Books, 2007). (*Creation of Universe*, "Big Bang".)

3) Planck Era (quantum gravity era, primordial lepton 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 charged elementary leptons, neutral leptoquarks, and possibly "dark matter"). "Quantum gravity". Negative gravitational energy exactly balances positive energy of particles. Matter-antimatter symmetry. "Y" IVBs transform primordial charged leptons (produced by the energy of light, the structure of metric spacetime, and gravity) to primordial, single, neutral leptoquarks (essentially a trisected heavy lepton), creating quarks, quark partial charges, the gluon field, and particle mass. Decays to level 2 leptoquark era with separation of spacetime (including gravity) from primordial leptoquarks (due to 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 charged leptons, quarks, neutral single leptoquarks, quark partial charges, gluon field, and particle mass, perhaps including "dark matter"*.)

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, vanishing color charge ("asymptotic freedom"), allowing weak force decays via leptoquark neutrinos. Asymmetric weak force decay of electrically neutral leptoquarks (with emission of leptoquark neutrinos and/or antineutrinos) to level H1 Hyperon Era produces matter asymmetry of Cosmos (via "X" IVB family). (*Asymmetric creation of matter, hyperons, baryons, leptoquark neutrinos; creation of baryon "singlets".*)

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. $10^{15}k$; 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" 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 photons, leptons, neutrinos, and baryons. Spacetime, light, and gravity remain unified, electric and magnetic fields remain unified. Virtual vacuum particle "sea". Photon separates from 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 (free and bound electromagnetic energy), gravity, and historic spacetime. (*Creation of space, historic spacetime, and atomic matter.*)

It has been discovered that neutrinos are not stable, but "oscillate" between their several possible identities (electron, muon, tau) (see: *Science*, Vol. 298, 20 Dec. 2002, page 2297). But this type of fluid charge or identity transformation is exactly what we expect to occur in other force unification or symmetric energy states, such as H1, H2, or H3. So it would appear that the "ground state" E/M is also a very low-energy force unification symmetry state, not only for electric and magnetic fields, spacetime and gravity, but also for neutrinos, which, excepting the totally massless bosons, are the lightest of all particles. Apparently, the vacuum energy of spacetime does not completely "bottom out" in its electromagnetic ground state, but remains in a slightly elevated position, just sufficient to maintain a symmetric energy state in which the oscillation of neutrino identity is allowed. The source of this elevated vacuum energy, for which neutrino oscillation is the apparent evidence (at least in the context of the "Higgs Cascade" energy hierarchy presented above), may be an inherent positive entropy drive in the spacetime metric, the same entropy drive that confers upon the photon its invariant and intrinsic "velocity c ".

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 apparently of one-time historic significance (creation of Universe, creation of matter).

[Ground State "Rebound"](#)) Information, Life, and Consciousness Era. Driven by symmetry

conservation, gravity, and 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](#)
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