The Higgs Boson and the Weak Force IVBs (Intermediate Vector Bosons): A General Systems Perspective (part 2)

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

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

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Abstract

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. At the electroweak energy level the "W" IVB creates/destroys/transforms single leptons and quarks (and transforms, but does not create or destroy, single baryons). The "X" IVB at the GUT energy level creates/destroys single baryons and transforms/destroys but does not create leptoquarks. The "Y" IVB at the TOE energy level creates/transforms/destroys leptoquarks (including the crucially important electrically neutral leptoquarks). Without the "X" and "Y" IVBs, we have no source for either single baryons or electrically neutral leptoquarks, so we need them both (or their analogs). The primordial heavy leptons or "Ylem" (Gamow's term) are evidently created during the "Big Bang" by a group effort involving all four forces.

The Role of the "Y" IVBs

The role of the "Y" IVB is to help create but especially to transform the primordial massive and electrically charged leptoquark particle-antiparticle pairs into electrically neutral leptoquarks. These electrically neutral leptoquarks survive to the H2 level, where the "X" IVBs proceed with an asymmetric weak force decay, resulting 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 better served by (much) simpler massive elementary leptons with whole quantum unit charges), the primary rationale for the "Y" IVBs appears to be the production of electrically neutral leptoquarks from primordial, massive, electrically charged 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 extreme energetic density, and the "Y" IVB is the most massive of them all, it seems likely that the "Y" IVB participates, along with gravity and the other forces, in the production of bound energy (particles) from free energy (waves in the metric) through extreme compression of the spacetime metric. Because the spacetime metric (the Dirac/Heisenberg "vacuum") is apparently quite capable of creating quarks all by itself (as meson pairs in high-energy collisions, for example), it seems the special contribution of the "Y" IVBs to the group effort in the production of mass-bearing leptoquarks must include a typical weak-force transformation. As modeled here, the compressive force of gravity and the other forces, acting upon the energized spacetime metric at the H3 energy level, supplies primordial electrically charged leptoquark particle-antiparticle pairs

which the massive "Y" IVB transforms into electrically neutral leptoquarks.

Note that, as part of the H3 "particle metric", leptons are already present in the metric (at least potentially/virtually), as gravity and the "Y" IVBs compress it into quantum particle "packages". The notion here is that overly massive primordial leptons are formed which split into three subsets (the nascent quarks), seeking a more stable charge configuration/distribution in response to the self-repulsion of their own electric charge. These too-massive leptons therefore become leptoquarks, and provide a natural upper limit to the leptonic spectrum of elementary particles. A "quark soup" may also be produced from these leptoquarks, but the leptonic elementary particles come first as the primary organizing element. This order is necessary to establish the intimate, "ancestral" relationship between the leptons and quarks.

Once formed, neutral leptoquarks survive long enough to enter the cooler (and larger) H2 domain. Their necessary electrical neutrality, which is anomalous with respect to the lower energy members of their leptonic family (electron, muon, tau), is 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 leptoquarks 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 requiring the cooperative effort of all the forces, acts as a leptoquark "factory", with the "Y" IVBs sending (only) electrically neutral leptoquarks down to the H2 energy level.

The cascade passes from leptoquark genesis (H3) to baryon genesis (H2) to lepton genesis (H1) to atomic/chemical genesis (H0 - ground state). While we do not understand the cascade in detail, something very much like it must have happened or we would not be here to wonder about it. The real miracle is that the spacetime metric is prepared to produce and accommodate the conservation needs of such a large variety of particles and charges - leptoquarks, quarks, leptons, mesons, baryons, neutrinos, and their charges and field vectors (including the heavy flavors of quarks, leptons, neutrinos, and the Higgs and IVBs) - and these are just the ones we know about. Despite this variety, they are no doubt the bare minimum required to produce our universe. All particles, charges, and forces are united by, and originate in, the spacetime/Higgs metric. This metric is a conservation structure which is energized by the electromagnetic and gravitational inputs of the "Creation Event", converting free energy into fully conserved combined forms of free plus bound electromagnetic and gravitational energy.

In the H2 energy level, the "X" IVBs compress the baryon quark 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 anti-partners to undergo (alone) a weak force leptonic decay, exactly like a heavy (but neutral) 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 can only expand its quarks and become a hyperon, at which point it is stabilized by the explicit appearance of the conserved color charge and gluon field. Because of an inherent asymmetry in the weak force with respect to matter-antimatter reactions, greater numbers of electrically neutral matter leptoquarks are isolated from their erstwhile antimatter annihilation partners, and so survive to expand their quarks (in a rapidly expanding Universe), becoming the hyperons (heavy baryons) of the H1 level, where they decay further via the "W" IVBs and their

alternative charge carriers (leptons, mesons, neutrinos). These final H1 decays produce ground state protons, neutrons, neutrinos, and electrons, which eventually form atoms as the Universe continues to expand and cool. Much later, during the symmetry-conserving "rebound" phase of cosmic evolution, galactic systems with life forms, including us, are created via the negentropic action of gravitation. (See: "The Origin of Matter and Information"; see also: "The Information Pathway".)

We have the Sun in our sky to remind us of the proximity, potency, and legacy of the EW era - heat, light, and the creation and transmutation of the elements. (The Sun is not part of the EW era, but the weak force IVBs are heavily, crucially, and continuously involved in its energy production and element-building reactions.) What of the other, earlier, unification eras - do they also have a presence and legacy - perhaps not so obvious - in our sky and daily lives? In the case of the GUT era, the example is the super-massive black hole in the center of our galaxy (in fact, such objects are being discovered in the centers of every galaxy). I presume proton decay via the "X" IVB to be commonplace in the center of black holes - the only place in the universe today where such enormous and symmetrically applied pressures and energy densities can be found. Hence we are reminded that behind the EW transformations ongoing in our Sun is the gravitational force supplying the energy, and gathering the material for the reactions. Furthermore, we are reminded of the negentropic organizational role of gravity on every scale from planet to the macro-structure of the Cosmos. We therefore take our "Milky Way" galaxy with its supermassive central black hole as the analog of the solar presence in the case of the GUT era - and the starlight of our night sky (almost all produced by our own galaxy) as the analog of the light from our Sun. As for the TOE era - we even have a lingering reminder of that remote time in the recently discovered cosmic background radiation (CBR), filling the universe with radiant energy of an effective temperature of 2.7 degrees K. In this case, we are reminded of the dimensions of space and time (created in the "Big Bang") which stand behind even gravity, and the primordial conversion of free to bound electromagnetic energy which stands behind not only the creation of the elements, but even behind the asymmetric creation of matter-only baryons. Historical/evolutionary spacetime and the bound energy content of our universe is the "commonplace" legacy and presence of the TOE era. The analog of sun and star light in the case of the TOE is the infrared radiation of the CBR - although visible only to radio telescopes (or as a contribution to the static on our TV sets). As for the Multiverse which stands behind even the TOE era, we have the legacy of our "life friendly" physical constants and the ultimate source of energy, information, and conservation law. Hence the miracle of life itself should be our daily reminder of the friendly and conserving Multiverse from which we come, and of the absolute rule of Natural Law in our Cosmos. In the gravitationally driven "rebound" of the cosmic system toward the ultimate symmetry of total force reunification in the "Big Crunch", the cosmic system revisits - at least potentially - each of these stages. (The alternative to the gravitational collapse of the Cosmos is the complete conversion of its atomic content to light via proton decay and "Hawking radiation". In either scenario, symmetry conservation drives the process and completes its program.)

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 (leptoquarks, baryons, 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. Thus, the "Y" IVBs produce electrically neutral leptoquarks from primordial charged leptoquarks (Gamow's "Ylem"), sending them 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 create electrically neutral leptoquarks, helping to create particle mass (with the aid of gravity, electromagnetic energy, and the spacetime/Higgs metrics). The "X" IVBs preferentially destroy electrically neutral anti-leptoquarks (with the emission of a leptoquark anti-neutrino), forcing neutral matter leptoquarks

to convert into hyperons, through the expansion of their system of quarks, creating our matter-only Cosmos. The "W" IVBs extract alternative charge carriers from "vacuum" particle-antiparticle pairs, transforming hyperons and heavy leptons into ground state protons, neutrons, neutrinos, and electrons. At the "ground" state EM energy level, photons, gravity and time already begin the "rebound" toward the symmetric energy state of the "Big Bang", creating large-scale historic spacetime with planets, stars, and galaxies, while protons, neutrons, and electrons create atomic matter, chemical information systems, and eventually life itself.

The "W" IVBs (H1 energy level) combine virtual particle-antiparticle pairs (taken from the EW symmetric energy state) 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 in the limit of "asymptotic freedom" (see: "The Origin of Matter and Information"). The "Y" IVBs (H3 energy level) help compress primordial charged leptonic particles (provided by super-dense gravitational/spacetime/Higgs metrics) so powerfully that the leptons are split into 3 quarks, forming the first leptoquarks, charged and neutral. Particles acquire mass during this time when they are conjoined with all aspects of electromagnetic energy, the Higgs particle metric, the weak and strong forces, and the gravitational metric of spacetime. 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, producing our matter-only Cosmos.) (See: "The Strong Force: Two Expressions".)

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, followed by particle transformations), and the fact that all three have distinctly different but necessary parts to play in the creation of matter - the creation of electrically neutral leptoquarks ("Y" IVBs), the asymmetric creation of single baryons ("X" IVBs), and the 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 of course hypothetical, we obviously have to find a source for baryons and their constituent quarks somewhere - and the missing connection between leptons and quarks. (The same argument holds with respect to the "Multiverse" in the case of our life-friendly "given" physical constants - such as c, G, 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 three-level energy hierarchies or resonant forms, but at least in this case we can suggest plausible/practical reasons for its existence.

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 (massive, temporal) or free (massless, spatial). While the origin of energy itself and the "Big Bang" or "Creation Event" will probably forever remain articles of faith for either science or religion (the "First Cause" or "existence" miracle), the lesser miracles of matter, natural law, information, and life are all contained in the conservation functions of electromagnetic energy and the spacetime/Higgs metrics. *The charges of matter are the symmetry debts of light* (Noether's Theorem).

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 (recent reports from CERN place it at approximately 125 GEV). 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 recreate/access. Transformations within a force-unity symmetric energy state are simply a normal characteristic of the state (since all "species" within a "genus" are equivalent, etc). The quantized and charged IVBs perform the required transformation; the quantized but neutral Higgs ensures the proper energy/mass scale, and together they guarantee the invariance of the elementary particles they produce - an invariance, as we have seen, essential for charge, symmetry, and energy conservation.

References

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