# Global-Local Gauge Symmetry: Part III: The Weak Force

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## Abstract

The local gauge symmetry transformation of the weak force is the conversion of one single elementary particle into another, identical in all respects with others of its species, in which the mass of the IVB (intermediate vector boson) serves as the local gauge symmetry "current" or field vector. (See: "The 'W' IVB and the Weak Force Mechanism".)

The most significant effect of the massive weak force IVBs is that they create a specific energy level, a particular unified force symmetric energy state (as "gauged" or scaled by the mass of the Higgs boson), that recreates the original energy-dense primordial environment in which particles were first created and transformed during the early micro-moments of the "Big Bang". This recapitulation ensures that the original and strictly conserved values of charge, mass, energy, etc. are handed on invariant to the next generation of elementary particles: single elementary particles created today must be exactly the same in every respect as elementary particles created eons ago during the "Big Bang". These unified force symmetric energy states (for example, the electroweak unified force state, as produced by the "W" IVB) - within which identity transformations are the normal course of events - appear to us as the quantized masses of the IVBs.

At the electroweak energy level mediated by the "W" IVB, "ground state" or electromagnetic species-level "flavor" identities (electrons vs u, d quarks) are subsumed within a broader

generic-level identity (leptons vs hadrons); at the next higher GUT (grand unified theory) energy level (in which the electroweak and strong forces are unified), generic-level identities are subsumed within family-level identities - leptons and hadrons become simply fermions or leptoquarks. The final force unification level, the TOE (theory of everything) or Planck energy level, incorporates gravity, in which fermions and bosons, particles, light, gravity, and spacetime, are all subsumed within the elemental order-level of electromagnetic energy - Gamow's "ylem". (Here I have deliberately employed the terms of the familiar biological taxonomic hierarchy (species, genus, family, order), as it provides a good analogy for the way particle identities and categories (which may be less familiar to the general reader) are subsumed within the physics hierarchy or energy levels of the unified force symmetric energy states - electromagnetic (ground state), electroweak, GUT, and TOE.) (See: "The Higgs Boson and the Weak Force IVBs".)

## Preface

There is a crucial difference between the electromagnetic or strong force creation of particle-pairs via symmetric particle-antiparticle formation, and the weak force creation or transformation of asymmetric "singlet" particles to other elementary forms. ("Singlets" are matter particles without antimatter "mates".) In the case of particle-antiparticle pair creation, there can be no question of the suitability of either partner for a subsequent annihilation reaction which will conserve their original symmetry. Both particles are referenced against each other and gauged or scaled by universal electromagnetic constants such as c, e, and h. However, in the case of the weak force creation or transformation of a "singlet" elementary particle to another form, alternative charge carriers must be used to balance charges, since using actual antiparticles for this purpose can only produce annihilations. But how can the weak force guarantee that the alternative charge carriers - which may be a meson, a neutrino, or a massive lepton - will have the correct charge in kind and magnitude to conserve symmetry at some future date in some future reaction, or with an unknown partner which is not even its antiparticle? Furthermore, quark charges are both partial and hidden (because they are "confined"), and number charges of the massive leptons and baryons are also hidden (because they are "implicit") - they have no long-range projection (such as the magnetic field of electric charge) to indicate to a potential reaction partner the relative condition of their energy or charge state. Conservation of energy, mass, charge, and symmetry all require that elementary particles created today or tomorrow be exactly the same in every respect as those created eons ago in the "Big Bang".

These conservation problems are all solved by a return to the original environmental conditions (the original electroweak force unification energy level or symmetric energy state) in which these particles and transformations were first produced, much as we return and refer to the Bureau of Standards when we need to re-calibrate our instruments. The necessity for charge and mass invariance in the service of symmetry and energy conservation therefore offers a plausible explanation for the otherwise enigmatic large mass of the weak force IVBs. Weak force "singlets" can only be referenced against their original creation energy, as "gauged" or scaled by a universal weak force constant, the Higgs boson. The IVB mass serves to recreate the original environmental conditions - metric and energetic, particle and charge - in which the reactions they now mediate first took place, ensuring charge invariance and hence symmetry conservation regardless of when or where weak force reactions and the creation of new elementary particles occur, or the type of alternative charge carrier that may be required. (See: "Table of the Higgs Cascade".)

## Introduction

The enduring mystery of the weak force is the creation of matter from light during the "Big Bang". This mystery encompasses not only how the free energy of light is transformed into the bound energy of matter - which would be difficult enough - but also, how is matter separated from antimatter? These two questions - the binding of energy into massive forms, and the asymmetry of the process - are at the heart of the mystery of creation. The issue can also be formulated as the origin of mass and the source of charge. Mass is typically a problem for the electromagnetic force and the Higgs boson, charge is typically a problem for the weak force and the IVBs (Intermediate Vector Bosons). The fact that particles usually have both mass and charge is one manifestation of the electroweak unification.

The creation of matter is necessarily (at the current stage in the evolution of our understanding) a subject rife with speculation, so let the reader be warned. What can be offered now is a "reasonable" scenario, but we don't know what we don't know, and nature is often inclined to be unreasonable (from a human perspective) - as the paradoxes of Einstein's relativity and Heisenberg's quantum mechanics have taught us.

There are (at least) two other papers on this website which consider the "creation" issue: "The Origin of Matter and Information" and "The Higgs Boson vs the Weak Force IVBs".

**Mass**

It is my assumption that matter is created by an asymmetric interaction ("mediated", structured, regulated, by the weak force) between high-energy light and the metric structure of spacetime, during the birth of the universe in the "Big Bang". I think the binding principle involves tying a "knot" in the dimensional (metric) structure of spacetime - matter has a specific dimensional topology, and perhaps more than one (leptons vs hadrons). Tying the dimensional knot (via the weak force) requires both a very dense, compacted metric and very high-energy light, so this process occurs only during the Big Bang. The mass component of matter consists simply of the energy invested in the dense metric and the "knot" (E = mcc). Certain characteristics of matter retain clues to its origin - the 3 families of 4 elementary particles, the 3 quarks carrying 4 charges, the massless gluon field moving at "velocity c", the four IVBs of the electroweak unification (which includes the photon), all suggest a resonant or fractal relation between matter and the 4-dimensional structure of the spacetime metric.

Spacetime transmits 2-dimensional energy forms (like light) simply as symmetric vibrations of its metric structure, but it cannot similarly transmit the 4-dimensional structures of atomic matter. Matter therefore has no "intrinsic" spatial motion but acquires instead an intrinsic motion in time (the time dimension is actually produced by the activity of a massive particle's gravitational field. See: "The Conversion of Space to Time", and Gravity Diagram No. 2".) The intrinsic motion of the time dimension serves as the primordial entropy drive of bound electromagnetic energy (creating history), just as the intrinsic motion of light serves as the primordial entropy drive of free electromagnetic energy (creating space). (See: "Spatial vs Temporal Entropy".)

The "standard model" view of "establishment" physics (concerning the creation of mass) is not necessarily different from the above, but associates the binding and/or mass principle, whatever it may be, with a definite particle, the "Higgs" boson. The "Higgs" is a particle predicted by the mathematics of "group theory", which has so far proven to be a reliable guide in these dark waters. The "Higgs" is currently being actively sought by the accelerator research communities and facilities at both Fermilab and CERN. (See: Science: 2 June 2006 page 1302 vol. 312.)

In the "standard model" scenario (as nearly as I can decipher it), there is a mass hierarchy in the weak force which begins (at the lowest level) with three "families" of leptons, proceeds upward in a large jump to the IVBs (about 80 - 90 times heavier than the proton), and then jumps again to the (hypothetical) Higgs mass - which is unknown but thought to be less than 1000 proton masses - perhaps between two to ten times heavier than the IVBs. Much heavier yet are the (hypothetical) "X" IVBs of the electroweak-strong force unification or GUT - Grand Unified Theory. The highest energy level includes gravity, and is designated the TOE (Theory of Everything), or Planck energy level. The general idea is that the transformative mechanisms of the several IVB "families" get their mass from quantized Higgs scalars: there is a distinct

Higgs boson (or a Higgs "family") specific to each force unification energy level, whether electroweak, GUT, or TOE. (See: "The 'W' IVB and the Weak Force Mechanism".)

I am not against the general outlines of this scheme (at least the IVBs are well established, "real" particles), but I want to enlarge it to include the "leptoquark" in the overall scenario (at the GUT energy level). The leptoquark, as its name implies, is the (hypothetical) ancestor particle of the leptons and quarks. It is of unknown but large mass - probably much more massive than the electroweak "Higgs" is thought to be (but less massive than the "X" IVB). The leptoquark is essentially the most massive lepton of the leptonic series (much heavier than the tau), forming the end of the leptonic elementary particle spectrum or series. Presumably, the leptoquark originates from a primordial, heavy lepton that is split into three parts (the nascent quarks) by the enormous pressures of the first micro-moments of the "Big Bang" (or perhaps its overly large mass simply cannot hold together as the universe expands and cools). In any event, their common origin in the leptoquark explains why the quark partial charges add up to exactly a leptonic whole quantum unit charge. The name and concept of the "leptoquark" and the "X" IVBs are not original with me, although the way I interpret these particles may perhaps be unique. (See: Howard Georgi: "A Unified Theory of Elementary Particles and Forces," *Scientific American*, Vol. 242, No. 4, April, 1980, page 104+.) The leptoquark mass (or at least the mass of the "X" IVB - see below) must be very large indeed to explain the exceptionally long half-life of proton decay - thought to be greater than 10 (35) years (10 raised to the 35th power). (See: "The Half-Life of Proton Decay and the 'Heat Death' of the Cosmos".)

## Charge

Returning to the Big Bang: because the partial charges of a leptoquark can arrange themselves into electrically neutral configurations (like a neutron), the leptoquark can escape an immediate electrical annihilation with its antimatter partner. The necessity for electrical neutrality is why the primordial mass-bearing particles (baryons) must be composites. Before its nascent quarks have separated (under their mutual electrical and quantum mechanical repulsion), the neutral leptoquark can undergo a typical leptonic decay with the emission of a leptoquark neutrino. Neutrinos are the explicit form of the weak force "identity" charge - also known as "number" charge (see: "The Weak Force Identity Charge"). The leptoquark neutrino is the only neutrino for the whole class of baryons, and its conservation is why baryon number is conserved, just like lepton number charge. Once a leptoquark's quarks have expanded (perhaps initially with the expansion of the Cosmos), the color charge becomes explicit, and the leptoquark becomes a heavy baryon ("hyperon"). Since color is a conserved charge, but neutrinos do not carry color, the baryon is stable against any leptonic decay while its quarks are normally expanded and their color charge is explicitly present.

It is hard to escape the impression that the simplest way to form a baryon is to split a lepton into three pieces, but require that nevertheless, the whole quantum unit charge of the lepton remain intact - at least to all outward appearances (to facilitate charge and symmetry conservation). Quark confinement via the color charges of the gluon field follows as a natural consequence; even the gluons seem to be a form of "split" light (the split field vector of the leptoquark's split electric charge). My conception of the leptoquark and the lepton/quark/baryon relationship is based upon this notion of the "splitting" of a primordial leptonic mass/charge quantum unit. (The "standard model" theory of "asymptotic freedom" among the quarks is perfectly compatible with this interpretation: forces between the quarks vanish as they approach each other, crowding together to return to their original unified state in the leptoquark configuration, hence no longer threatening the unity of the whole quantum charge state.)

## The "X" IVB

Leptoquark decay is thought to be mediated by the "X" IVBs, "big brothers" to the "W" IVBs, the latter being only heavy enough to mediate decays among the less massive baryons and leptons. Presumably, the

"X" IVB is much more massive still than the leptoquark, just as the "W" IVB is much more massive than the proton. In this conception then, the leptoquark expands to become an ordinary heavy baryon (hyperon) composed of heavy quark flavors (perhaps bbt), which decays via the "W" IVB to the ground state proton, producing other (intermediate) baryons, leptons, mesons, and neutrinos along the decay pathway ("cascade"). The leptons, mesons, and neutrinos function as *alternative charge carriers,* all acquired from the spacetime reservoir or "vacuum zoo" of virtual particle-antiparticle pairs (see: "The Particle Table"). The IVBs distribute the mass and charge of the decaying leptoquark among the product leptons and hadrons, and the conservation symmetry loop is closed (eventually) by proton decay, which may occur via the mediation of an "X" IVB, or in the interior of a black hole - the only other place in the modern universe where equivalent and sufficiently symmetric compressive forces are routinely available. (See: "Table of the Higgs Cascade".)

The asymmetry that produces matter consists of a very slight excess decay of electrically neutral antimatter leptoquarks over electrically neutral matter leptoquarks (about one part per ten billion). The mechanism of this asymmetry is unknown, but it is known that the weak force is asymmetric in the decay rates of neutral kaons (see: Cronin, J. W. *Science* 1981, Vol. 212, pp 1221-8) (see also: *Science* 13 Oct. 2006, vol. 314, page 248). Therefore, the precedent for asymmetric weak force decay among neutral hadrons is already established, although we do not understand why this occurs. The value (magnitude) of the primordial weak force asymmetry parameter may simply be one of the unexplainable "anthropic" constants of our Universe like the values of c and G (and many others), favoring the evolution of our life form for no apparent reason other than a chance selection among the permutations and combinations of physical law in the endless experiments and trials of an eternally creative "Multiverse". (For a further discussion of the weak force in its full energy spectrum, see: "The Higgs Boson and the Weak Force IVBs".)

**An IVB "Bridge"**

On the assumption that the value of the original weak force asymmetry parameter is a natural constant like c or G, we can say little about it, nor is there much to say about the mechanism of asymmetry other than to document its occurrence and magnitude. However, conversion of free energy into bound energy (mass) is a physical process (perhaps topological) which we may eventually understand. Meanwhile, the weak force global-local gauge symmetry conservation loop can be understood as passing from the global "anonymity" symmetry (of light) to the local "Identity" asymmetry (of matter), and returning eventually to the original global anonymity symmetry via particle and proton decay through the mediating agency of the IVBs and the neutrinos, the latter acting as alternative charge carriers for the weak force "identity" charge. The IVB weak force field vectors act as bridges between the realm of global symmetry (photons and the vacuum "zoo" of virtual particle-antiparticle pairs) and the "real" (temporal) world of local asymmetric (matter only) particles. (See: "The 'W' IVB as a Bridge Between Symmetric (2-D) and Asymmetric (4-D) Reality".)

The (hypothetical) weak force conservation/symmetry loop operates as follows: one member (the antileptoquark) of a primordial, electrically neutral leptoquark-antileptoquark particle pair undergoes a leptonic decay via a "X" IVB, liberating an antileptoquark neutrino (neutrinos are the alternative charge carriers of weak force "Identity" charge). The remaining member of the primordial particle pair (the leptoquark) is left without an annihilation partner, but does not similarly decay before its quarks expand under their mutual repulsion to reveal their conserved color charge. By this simple act of expansion (in a rapidly expanding newborn universe), the leptoquark is converted to a hyperon (heavy baryon - perhaps of quark composition bbt). The presence of the conserved color charge prevents any leptonic decay by the expanded hyperon, as neutrinos do not carry, and hence cannot cancel, color charge. The now familiar, lower energy IVBs (W+, W-) mediate the decay of this hyperon to the ground state proton, producing leptons, mesons, neutrinos, and other (intermediate) baryons along the decay pathway. Proton decay eventually completes the conservation loop, producing a leptoquark neutrino which annihilates the original antileptoquark neutrino (see below).

Neutrinos carry *explicit* identity charges, while their massive leptonic counterparts carry *implicit* identity charges. The massive IVBs act to conserve the invariant magnitude and integrity of identity (and other) charges, and indeed, of all conserved quantities of elementary particles, just as time and the magnetic field act to protect the invariant parameters of their force domains (the "Interval", velocity c, causality, and electric charge). The IVBs conserve the charge/mass invariance of elementary particles through their large, constant, and quantized mass (as scaled by the Higgs boson), which recreates the original environmental conditions of the energy-dense metric in which the reacting and transforming elementary particles (and their alternative charge carriers) were first formed during the "Big Bang". (The Higgs and IVBs recreate a specific unified force symmetric energy state - the electroweak unified force energy level in the case of the "W" IVBs.)

The role of the IVBs is to provide a bridge between specific global, invariant, symmetric charge states in the spacetime vacuum "zoo" of *virtual particle-antiparticle pairs* (gauged or scaled by universal electromagnetic constants such as c, e, h), and the local (but also invariant) asymmetric charge states in temporal particles - where charges are necessarily balanced by *real alternative charge carriers*. (See: "The 'W' IVB and the Weak Force Mechanism".) To accomplish their role, the IVBs (gauged or scaled by universal weak force constants such as the Higgs boson), use their great mass to recreate the original unified force energy level or symmetry state in which particle creation, destruction, and transformation first occurred during the "Big Bang". In this way, the charge/mass invariance of elementary particles and charge, symmetry, and energy conservation is assured in the asymmetric, local realm of matter and alternative charge carriers, no less than in the symmetric, global realm of light and virtual matter-antimatter particle pairs. A single elementary particle is transformed, but global charges remain invariant; the new particle is identical to all others of its species. The two realms are also kept in equilibrated harmonious contact by swarms of virtual particle-antiparticle pairs surrounding and interacting with every "real" (temporal) charge. Single elementary particles created today are (and must be) the same in every respect as those created eons ago in the "Big Bang". Maintaining the necessary uniformity of all elementary particles and the production mechanism (for "singlets") throughout time and space is the fundamental conservation role of the massive Higgs scalar and the heavy weak force IVBs, and why all such processes involve quantized particles, masses, and charges. (See: "Table of the Higgs Cascade".)

## Proton Decay and Alternative Charge Carriers

Proton decay can occur only if the proton can be compressed to its original leptoquark density. Such a compression effectively sums up the color charges of the gluon field to zero (the color charge self-annihilates in the limit of "asymptotic freedom"), and proton decay can occur by the original weak force leptonic route (via the "X" IVBs) with the emission of a leptoquark neutrino. (The color charge can self-annihilate because the gluon field consists of paired color-anticolor charges in every possible combination, and so in aggregate sums to zero color. This makes perfect sense because leptons have zero color, so when they become leptoquarks - splitting into three quarks - their color charges must sum to the original zero value.)

Eventually (due to energy fluctuations in the quantum-scale "vacuum" of spacetime), the "X" IVB will again compress the proton to its original leptoquark state, vanishing the color charge (which self-annihilates in the limit of "asymptotic freedom"). When sufficiently compressed (perhaps to "leptonic size"), the proton decays like its original antipartner, liberating its leptoquark neutrino, which cancels the antileptoquark neutrino of its long-lost antimatter mate (from the era of the "Big Bang"), reestablishing the primordial global symmetry state of the photon's "anonymity".

The role of the alternative charge carriers in the creation of matter is crucial, for they allow the balancing of charges and charge conservation without the use of antiparticles, which would only cause total annihilation. The leptons function as alternative charge carriers for the quarks; the quarks function as the primary mass carriers. The massive leptons function as alternative charge carriers of electric charge; the neutrinos function as alternative charge carriers of weak force "identity" charge (also known as "number " charge). Mesons also function as alternative charge carriers of partial charges for quark transformations in baryons, and as alternative carriers of electric charge and/or neutral mass-energy. The alternative charge carriers are all derived from the reservoir of the global vacuum "zoo" of spacetime (via the "W" IVB), and constitute a weak force local gauge symmetry "current" which flows (in both directions) between global 2-D virtual particles and local 4-D "real" particles. (See: "The 'W' IVB and the Weak Force Mechanism".)

Alternative charge carriers are the manifestation or carriers of local symmetry, replacing the global symmetry represented by matter-antimatter charge pairs. The familiar electron-proton pair is the prototypical example of a local charge symmetry state which is nevertheless incomplete because neither charge partner is the other's antiparticle (which is why the atom cannot self-annihilate). The locally imperfect symmetry state of the electron-proton pair is devolved and derived from the globally perfect symmetry state of virtual matter-antimatter particle pairs via the mediating asymmetric agency of the weak force "X" and "W" IVBs. Similar examples include the electron-electron antineutrino pair (balancing lepton number or "identity" charge), and the presumed proton-leptoquark antineutrino pair (balancing baryon number charge).

## Role of the "Identity" Charge/Symmetry Debt of the Weak Force

Light is the most symmetric form of energy, bearing no charges of any kind, having no time dimension and producing no gravitational field. Noether's Theorem states that the symmetries of light must be conserved - but what are these symmetries? We can only observe Nature to discover what symmetries she considers worthy of being conserved. Perhaps the most important of these symmetries is the "anonymity" symmetry of the photon, conserved (in debt form) as the weak force "identity" charge (also known as lepton "number" charge, or baryon number charge among the hadrons). (See: "Symmetry Principles of the Unified Field Theory".)

*The charges of matter are the symmetry debts of light*, and there is at least one charge for each of the four forces of physics. The weak force symmetry debt, "identity", is in observance of the "anonymity" symmetry of light. Every photon is identical - one cannot be distinguished from another, and so light enjoys a "symmetry of anonymity" with respect to its quanta, the photons. However, this is not true of the elementary particles, the leptons. Lepton families can be distinguished from one another and from the photon, and there are only three of them, the electron, muon, and tau (four if we count the hypothetical leptoquark). For each of these massive leptons there exists a separate neutrino, and an antineutrino distinguishable by its spin (all neutrinos have left-handed spin, all antineutrinos have right-handed spin). The role of identity charge in symmetry conservation is not only to allow the creation of "singlets" by providing alternative charge carriers (neutrinos) for identity charge, but also to identify particles to their antiparticle mates, so they may find appropriate annihilation partners in a timely fashion (within the Heisenberg time limit for virtual reality, for example).

Note the difference between the complete annihilation of charges, as in matter-antimatter reactions, and the simple balancing of charges, as in the familiar electron-proton combination of atomic matter. The former is an example of symmetry conservation or restoration completed, the return of the local charge-conserved symmetry state to its original global symmetry condition (light), while the latter is an example of a local "symmetry" condition as we typically experience it, charges neutralized and conserved through time by alternative charge carriers in the indefinite, local (temporal) interim between global symmetry-breaking and global symmetry-restoration. (Even though cold atomic matter is charge-neutral, matter is nevertheless asymmetric in terms of its local mass, inertial status, time dimension, gravitational field, non-zero "Interval", and lack of antimatter charge partners.)

## The Mass of the IVBs

It is the existence of the long-range magnetic field that allows the electric charge and its photon field vector to interact so freely with atomic matter, achieving an overall electrical neutrality in atoms which we have identified as the ground state of a local gauge symmetry of electric charge. The global symmetry state is expressed as the universal constant of electric charge (e), whatever its origin or carrier, and in the electrical neutrality of the vacuum with its manifold virtual particle-antiparticle pairs, as well as in the electrical neutrality of light. But how is this ideal, global condition (electrical neutrality and charge invariance) maintained in the local hurly-burly of the relative motions of matter? The magnetic-electric combination protects the absolute value, magnitude, and invariance of electric charge despite the relative (rather than absolute) motions of electrons, protons, pions, or other charged particles - including electrons in atomic orbits (the latter additionally regulated by special quantum-mechanical rules).

The ordinary material state of electrical neutrality obviously means that all charges, whether positive or negative, and of whatever origin (lepton or quark), are of equal and invariant magnitude and value, regardless of their relative motion (in electron shells, etc.). Electrical neutrality is therefore the physical expression or realization of a local symmetry state in matter which retains the ability of charges to annihilate each other in matter-antimatter reactions, if the opportunity arose - a reaction which could not take place if their charge magnitudes did not remain invariant and equivalent. This is important for reasons of charge, symmetry, and energy conservation, as required by Noether's Theorem.

Now we must ask where is the analog of the compensating magnetic field in the case of the weak force identity charge, for which the neutrino is the explicit carrier? The answer is there is none, and this is precisely why the neutrino almost never interacts with matter. The only way the neutrino can interact with matter is through the IVBs, because only through the IVBs can it protect the invariance of its identity charges. Hence it is the IVBs, and specifically their great mass, which is the analog of the photon's magnetic field. This is a realization of the electroweak unification. Now we can understand something else - why the IVB has its great and invariant mass - it is to protect the local invariance of weak force identity charge, but exactly how is this accomplished?

The IVB is a "metric" particle - its great mass is composed of the dense and (perhaps) convoluted metric of spacetime, and the energy required to bind it into a specific, quantized particle. The IVB is essentially a "wormhole" back to a time in the very early universe when the metric of the whole universe was as dense as that of an IVB. At this early stage of the universe (the Electroweak Unification Era), all the elementary particle transformations regulated by the "W" IVB (lepton-lepton and quark-quark) would have occurred freely simply by virtue of the ambient temperature and energy density of the environment of spacetime. There is, also due to this energy density, a veritable "zoo" of particle-antiparticle charge pairs of all types of leptons, neutrinos, and mesons available in the "vacuum" for making various transformations of identity, electric charge, color, and flavor among the elementary leptons and quarks. This is the symmetric energy state or energy-density level of the electroweak force unification era; this specific symmetric energy state appears to us as a quantized particle (the "W" IVB) in the current low temperature and low energy-density environment of the Cosmos and planet Earth. It is this "genus" level of particle identity (all quark flavors are equivalent (among themselves) and likewise, all leptonic flavors are equivalent among themselves) for which the electroweak Higgs boson provides a "gauge" or scale.

## The IVBs as a "Safe House"

The IVBs provide a bridge between "real" temporal particles and the virtual (atemporal) particle-antiparticle pairs of the primordial spacetime "vacuum". The role of the weak force is the creation, destruction, and transformation of (single) elementary particle identity, including the creation, destruction, transformation, and swapping of elementary charges and associated mass-energy quanta. Just as charge invariance is a critical issue for charge and symmetry conservation, so also must be the mechanism of elementary and alternative charge carrier transformations (transformations of quarks, leptons, and neutrinos). The role of the weak force and the massive IVBs is to ensure that charge invariance, charge conservation, and energy conservation are all scrupulously observed in the creation, destruction, or transformation of elementary particle charge, mass, and identity. To this end, the massive IVBs provide a "conservation containment" or "safe house" in which charge and energy can be transferred between "real" and virtual particles in very close proximity (perhaps essentially "touching" each other), such that no conservation laws are threatened or actually broken by risky long-range transfers. Perhaps a more satisfactory (but parallel) theoretical interpretation is that the "W" IVB recapitulates the original unified force symmetric energy state, era, or energy level of the "Big Bang", in which all such transformations and creations took place simply as the normal course of events - the electroweak unified force symmetric energy state or "era". (See: "The Higgs Boson and the Weak Force IVBs".).

## "Hidden" Charges

The advantage of the "hidden" identity charges of the massive leptons (and perhaps of the baryons) is that it allows the carrier (lepton or baryon) freedom of motion between the times of its creation and destruction. Leptons do not need to constantly adjust the value and magnitude of their identity charges to accommodate their relative motions. Indeed, in the absence of an analog of the long-range magnetic field of the electric charge, identity charge cannot adjust its hidden value except through the intervention of an IVB, whenever it actually needs to confront and match up with another balancing anti-identity charge. Hence the reason for the mass of the IVBs is the lack of a long-range field analog of magnetism in the weak force identity charge. The mass of the IVBs becomes the functional analog (the local gauge symmetry field vector) of the electric charge's magnetic field.

We can see the analogous process at work in the strong force. Quarks are permanently confined to whole quantum charge units to protect the value and integrity of the original whole "leptonic" charge units, which are threatened by the partial charges of the quarks. Quarks are simply not allowed "out to play" - they can never interact with the other charges of matter, only among themselves. Their partial charges simply can not be neutralized by any charge in nature except that of another quark. Hence quarks are permanently confined to whole quantum charge units which *can* be neutralized by other elementary particles, protecting symmetry and charge conservation, and achieving a local state of charge neutrality despite the quarks' partial charges. The gluon field of the strong force color charge is therefore the functional analog of the magnetic field of electric charge, protecting general charge invariance by protecting the quantum wholeness of elementary charge units.

## Symmetry Conservation = Charge Conservation

Symmetry conservation = charge conservation; we see the invariant value of charge protected by the magnetic field of the photon, the mass of the IVBs, and the permanent confinement of quarks by gluons. The gravitational charge ("location") is unique in that it is a charge of both metric symmetry and entropy, *whose active principle is time*. Through the creation of time and the covariance of space and time ("Lorentz Invariance"), gravity protects the invariance of velocity c, the "Interval", and causality, in the locally variable and asymmetric metric produced by matter, just as these parameters are protected in the globally symmetric metric produced by light (Special VS General Relativity).

Just as charge is a conserved form of light's symmetry, so time is a conserved form of light's entropy: light's intrinsic motion converted to time's intrinsic motion (the entropy drive of free energy converted (by gravitation) to the entropy drive of bound energy). The gravitational conversion of spatial to historical entropy is reversible: through the conversion of bound to free energy (as in stars), gravity conserves (restores) the original global symmetry and spatial entropy drive of light. (See: "The Conversion of Space to Time".)

We can at least begin to appreciate just how fundamentally different the 4 forces and their charges actually are; nevertheless, all are related as various symmetry debts of light. All forces and charges work together to return the local asymmetric material system to its original global form of free and symmetric electromagnetic energy - this is the message the radiance of the Sun brings to us daily. Sunlight announces the completion of a global symmetry circuit. (See: "The Solar Archetype"; see also: "Currents of Symmetry and Entropy".)

**Neutrinos - Alternative Charge Carriers of "Identity" Charge**

Neutrinos are the explicit form of nature's "identity" charge, the charge associated with the weak force. Neutrinos exist only for the truly elementary particles, the leptonic series. There are no quark neutrinos, as quarks are sub-elementary particles. The (hypothetical) leptoquark neutrino suffices as the identity charge of the entire class of baryons and their permanently confined sub-elementary quarks - just as would the tau, muon, or electron neutrinos, if these leptons had similarly been split into sub-elementary and permanently confined quarks.

The neutrino is the distinguishing feature (the "hallmark") of an elementary particle. The leptons carry identity charge in two forms, a "hidden" local form carried by the massive lepton itself, and the explicit global form carried by the (nearly) massless neutrino. The neutrino is the alternative charge carrier for weak force identity charge; the hidden and the alternative carrier always occur together, producing a balanced identity charge which sums to zero - as for example in the electron-electron antineutrino pair (producing the "local" symmetry condition of identity charge neutrality).

The identity charge is the most important charge in nature, and it is the neutrino, the least of all particles, that is responsible for the creation of matter, since without the alternative carrier of identify charge, no elementary particles could manifest - identity charge could only be balanced by an antiparticle, and all attempts at manifestation would end in matter-antimatter annihilations. The neutrino is the mouse that nibbles the net, setting free the lion of the manifest universe.

The relationship between a lepton and its hidden (and local) vs explicit (and global) identity charge is remarkably analogous to that presumed to exist (in some religious systems) between the human body and soul. The soul (an invariant, timeless, "virtual", massless, or "global" form of identity) is "hidden" (implicit) in the body (the variable, temporal, "real", massive, local form) in life, but becomes explicit at death, and comprises the essential and eternal identity of the individual (or species?), which actually preexists (at least virtually) and permits physical existence. The individual soul is drawn from the "global" realm of spiritual reality, and closes the conservation/symmetry loop when the "local temporal current" of individual identity returns to the global spiritual conservation domain ("heaven") at death and/or through "enlightenment". The global-local analogy here is obvious, but also includes the idea that only through the various "relative" motions (in time) of local individual life and consciousness can the Absolute gain experience about itself and its own creative potentialities. It becomes obvious, therefore, why we should respect life, love one another, and celebrate the beauty of the Universe. Human life is obviously a high form (locally) of the Universe's resonant, reflexive, and fractal information potential for creative exploration, self-awareness, self-experience, self-understanding, and self-appreciation. We are the universe become self-aware, and reflexively creative, forming a new iteration of the creative cosmic information fractal.

As in the massive leptons, individual freedom of motion during life ("free choice") is gained by the "hidden" character of the local identity charge or soul, which only has to "match up" with the ideal global form of its origin after death - a scenario uncannily similar to the ancient Egyptian notion of the karmic judgment of the deceased person's "ka" (against a feather) in the balancing scales of the spiritual realm.

It is our ancient and continuing intuitive awareness of such close analogies between physical and metaphysical systems of thought that sustains our interest in a spiritual interpretation of life, nature, and the special significance of human experience for the Cosmos.

(See: "The Human Connection" and "Chardin: Prophet of the Information Age".

A diagrammatic representation of the global-local gauge symmetry structure of natural law and the physical forces can be seen in: "The Tetrahedron Model of Light and Conservation Law" (and see below).

**Links**

**Weak Force, Intermediate Vector Bosons ("IVBs")**

- Section IV: Introduction to the Weak Force
- 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
- Section XVIII: The Strong Force: Two Expressions
- Section XVI: Introduction to the Higgs Boson
- 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
- The Higgs Boson and the Evolutionary Eras of the Cosmos
- "Dark Matter" and the Weak Force
- The Particle Table
- 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
- Symmetry Principles of the Unified Field Theory (a "Theory of Everything") - Part 3 (summary)

home page

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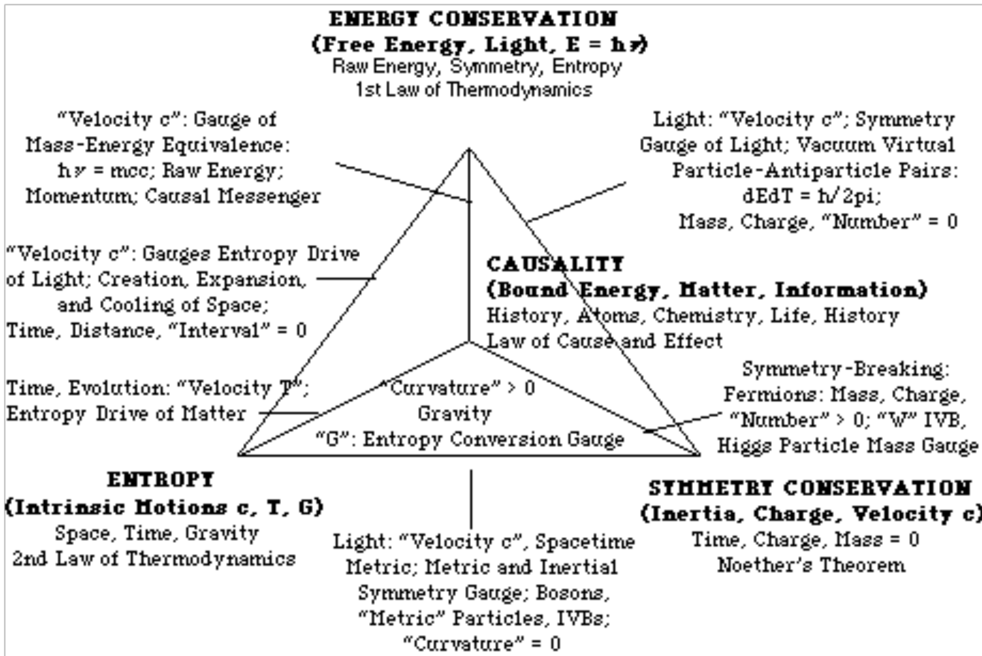
**Fig. 1: The Tetrahedron Model**




**The Tetrahedron Model of Light and Conservation Law**
Conceptual Geometry: a 4x3 General Systems Model of the Conservation Laws Underlying the Unified Field Theory
John A. Gowan and August T. Jaccaci Jan., 2009
http://www.johnagowan.org/index.html
Global vs Local Gauge Symmetries = "External" vs "Internal Lines"

1) Energy conservation: 1st law of thermodynamics. Free energy, light. E = h ν (Planck's energy quantum); h ν = mcc (Einstein-deBroglie mass-energy equivalence); dEdT = h/2pi (Heisenberg's uncertainty relation). Three aspects of light's energy are conserved: raw energy, symmetry, and entropy (all gauged by velocity c: Special Relativity). Mass, gravity, "Interval", charge, and particle "Number" of light all = 0. Light is non-local, atemporal, acausal. Among its other gauge and entropic functions, light is the invariant messenger of causality.

2) Symmetry conservation: Noether's Theorem. Spacetime "Interval", charge, and particle "Number" = 0. Inertial forces, metric symmetry, virtual particles. Velocity c gauges the entropy drive and nonlocal distributional symmetry of light. Intermediate Vector Bosons (IVBs): W, Z, X (?). Fermions, virtual particle-antiparticle pairs, and other particles are formed from the interaction of high-energy light with the spacetime metric. *The charges of matter are the symmetry debts of light.*

3) Entropy: 2nd law of thermodynamics. Intrinsic motions c, T, G (light, time, gravity). Dimensionality: space, time, spacetime. Dimensions are entropy/conservation domains created by the entropy drives c, T, G. Gravitational conversion of space and drive of spatial entropy (S) to time and drive of temporal entropy (T): -Gm(S) = (T)m; -Gm(S) - (T)m = 0. Light's intrinsic motion (light's entropy drive) is conserved as time's intrinsic motion (matter's entropy drive). "Bottom" line: absent mass, spacetime's metric "curvature" = 0; with mass, spacetime's metric "curvature" > 0 (= gravity).

4) Causality: law of cause and effect; raw energy, charge, and historic information conservation; weak force symmetry-breaking. Bound energy, matter, life, evolution. Charge, mass, time. Information is conserved in historic spacetime = matter's "causal matrix". Matter is local, causal, temporal.