Alternative Charge Carriers and the Higgs Boson: Part III

John A. Gowan

(Revised September, 2016)

home page (page 1)
home page (page 2)
E-Book

Symmetries and Broken Symmetries of our Universe

The Charges of Matter are the Symmetry Debts of Light (Noether's Theorem

Abstract

The four forces of physics are considered in terms of the broken symmetry of our "matter only" Universe

The Four Forces of Physics:

1) Electromagnetism/electric charge. *The symmetry of matter vs antimatter - broken by the weak force during the Big Bang to produce our "matter only" universe*. Electric charge is the consequence of this most fundamental of all broken symmetries - matter eternally seeks reunion with antimatter via the attraction between opposite electric charges. Consequent annihilation reactions return both matter and antimatter (individually asymmetric) to the symmetric light which created them. Light is the most symmetric energy form known - massless and carrying no charges, having no time dimension, producing no gravitational field in free flight. Light is a 2-dimensional transverse wave; the photon is the field vector (force carrier) of the electromagnetic force, which, like gravitation, has an infinite range. "Velocity c" is a condition of energetic symmetry, not an actual velocity. There are no forces of acceleration at velocity c (think of the reflection of a photon back and forth between two parallel mirrors), and at velocity c the photon is everywhere simultaneously in spacetime, since time and distance both vanish at "c" (per Einstein and his Special Theory of Relativity). Opposite electric charges attract because that is the antimatter signal. Hence the electron is forever attracted to the proton but cannot annihilate because the proton is not an antimatter positron. Because matter can carry both positive and negative charges, the universe (on average) is electrically neutral despite the absence of antimatter. (See: "Symmetry Principles of the Unified Field Theory".)

2) Gravitational force/"location charge". *The symmetry of the equitable distribution of light's energy (free electromagnetic energy) throughout spacetime, vs the asymmetry of undistributed concentrations of matter (bound electromagnetic energy) in specific spacetime locations*. In consequence of light's "absolute" ("infinite") velocity (see #1), and because at velocity "c" neither time nor distance exists (light is a 2-D transverse electromagnetic wave), light is everywhere within its entropic conservation domain (spacetime) simultaneously. This symmetric distribution of light's energy is broken by the conversion of light into immobile (and hence undistributed) matter during the "Big Bang". Unlike light, matter has no intrinsic (entropic) motion in space, only intrinsic (entropic) motion in time. The "location" charge of gravity identifies the spacetime location of undistributed "lumps" or concentrations of energy in the form of matter (bound electromagnetic energy). Gravity eventually converts matter back to light, beginning with stars, supernovas, quasars, etc., ending with Hawking's "quantum radiance" of black holes, in final satisfaction of Noether's Theorem. Because gravity is universally attractive, it provides a secondary "fail safe" pathway (in addition to electromagnetic matter-antimatter annihilation), for the symmetry-conserving conversion of asymmetric matter into all-symmetric light. *Gravity is matter's memory it once was light*.

The motivation of gravity is the entropic, one-way motion of time into history. History is the entropic, causal conservation domain of matter, just as space is the entropic, a-causal conservation domain of light. Although matter has no intrinsic, entropic motion in space, and so cannot share light's entropic conservation domain, nevertheless matter, as a form of electromagnetic energy, must have an entropic foundation and conservation domain, as provided by matter's intrinsic motion in time and the historical conservation domain of causal information. When light is converted into matter, the intrinsic, entropic spatial motion of light is replaced by the intrinsic, entropic temporal motion of matter. This is the essential meaning of spacetime - an entropic conservation domain that can accommodate both free and bound forms of electromagnetic energy. (See: "Spatial vs Temporal Entropy".)

As time moves along its one-way and one-dimensional time line into history, it pulls space along behind it - because space and time are connected (as spacetime). Time is one-way and one-dimensional because matter is causal/local (whereas light is a-causal/non-local). But space, being three-dimensional, cannot enter the one-dimensional time line of history, and self-annihilates at the gravitational center of mass, liberating as a residue the metrically equivalent temporal component of spacetime. This remaining temporal component continues the entropic, historical march of time, pulling more space into the center of mass, where space again self-annihilates, liberating more time, etc., etc., forever. The entropic motion of time produces gravity, and gravity's entropic motion produces time. Only when matter is reconverted into light does the gravitational entropic cycle stop, light having no time dimension nor gravitational field. *A gravitational field is the spatial consequence of the intrinsic motion of time*.

As Einstein discovered, gravity is a metrical, geometric force, causing the distortion of space and time. (The original spatio/temporal metric is established by the "intrinsic"/entropic motion of light and "gauged" (regulated) by "velocity c".) Gravity "warps" both space and time such that the value of "velocity c" remains the same within any orbital frame of reference (or given, uniform distance from the center of mass), conserving causality and Einstein's "Interval", the mathematical unit of causal influence in spacetime. (See: "A Description of Gravity".)

The "mass due to acceleration" (F = ma) of elementary particles is not due to the "ether wind" interaction with the Higgs boson as proposed in the "Standard Model", but rather to the interaction of the gravitational field of the particle with the local spacetime metric. A primordial version of the Higgs boson determines the original "rest mass" of the particle (E = mcc) in terms of its bound energy content. During accelerated motion, the gravitational field associated with the particle's rest mass (Gm - which is a metric-warping field), is forced through the spacetime metric of its immediate environment. The local metric resists the intrusion of this metric-warping field, producing the observed "mass due to acceleration" of the particle. The reciprocal of this effect produces the gravitational "weight" (gm) of the particle (local spacetime accelerates through the metric-warping field of the stationary particle), preserving/explaining Einstein's "Equivalence Principle". The gravitational field of a particle registers its total bound energy, regardless of the source, and although weak, gravitational fields extend throughout the cosmos. Finally, the gravitational field of a particle (Gm) provides the exact physical connection between the particle's "rest mass" (E = mcc) and mass due to "acceleration" (F = ma). "m" in these several formulas must have the same objective reference, or our explanations of energy conservation fail.

3) Strong Force/"color charge". *Whole (leptonic) unit quantum charges vs the fractional or partial quantum unit charges of the quarks*. In the strong nuclear force, we are dealing with a symmetry on the scale of a quantum particle, rather than the astronomical/cosmological scale (as in #s 1 and 2 above). Consequently, we have little (if any) intuitive feeling for this symmetry. In the strong force, the symmetry concerns a whole leptonic quantum unit of charge (as in an electron), vs the subdivision of that whole unit into parts (as in the quarks of baryons). Quarks are subdivisions of a whole leptonic unit of charge (originating in primordial "leptoquarks"), a fracture which nature seeks to heal or conceal by means of the gluon field of the strong force. The universe is a simpler place and conservation of symmetry and energy is more readily accomplished if charges remain as whole quantum units rather than as fractional subdivisions. While there is an excellent reason for the original subdivision of nuclear particles into quarks (so electrically neutral leptoquarks could form and decay asymmetrically via the weak force into our "matter-only" universe), Nature prefers that her charges (symmetry debts) remain in whole quantum units for ease of accounting, balancing, neutralizing/canceling, and annihilating. Consequently, quarks are permanently confined within baryons by means of the gluons of the color force, a force which grows stronger as quarks try to escape each other (which would destroy the whole quantum charge unit), and weaker as they collapse together (reducing the destructive threat to the whole unit charge - "asymptotic freedom"), always retaining the outward appearance of a whole quantum unit of charge (in leptonic charge units). It is easily seen that the strong color force has just the character one would expect to arise within a too-heavy lepton that had split under the self-repulsion of its own electric charge, but was nevertheless trying to obey the quantum rules of an elementary, rather than a composite, particle - at least as seen by the external world. Indeed, it fooled our best scientists for a long time.

Each quark bears a "color" charge and exchanges virtual, massless "colored gluons" at light speed with the other quarks. Gluon exchange is the basis of the binding character of the strong color force, much as the exchange of virtual, massless photons characterizes the electric force. However, unlike the photons of the electric force, all gluons attract each other. Otherwise, these forces are much alike, and probably derive from the same source (the electric charge of a heavy, primordial, divided lepton - the "leptoquark"s). (See: "The Strong Force: Two Expressions".) There is no alternative charge carrier for the color charge of a baryon, hence its resistance to decay. However, the total color charge of a baryon (carried by a field of 8 "gluons", each composed of a color-anticolor charge) sums to zero, and will self-annihilate if the baryon is symmetrically compressed by a sufficiently powerful force (hence returning it to its original leptoquark configuration). Such a sufficiently powerful, symmetric force is available at the central "singularity" of black holes. Black holes are probably filled with nothing but trapped light, the remains of annihilated baryons. Black holes are baryon graveyards, their likely cosmic function (as there is no other way to achieve the annihilation of large numbers of baryons). Hawking's "quantum radiance" returns the light of annihilated baryons to the symmetric domain of spacetime - the final enforcement of Noether's Theorem. Baryons are born in the "Big Bang", mature in stars, are dispersed by supernovas, and die in black holes. During their productive lifetime, baryons (by virtue of their gravitational fields), create the stars, galaxies, the elements of the periodic table, and via their electron shells and the force of evolution, life itself.

4) Weak Force/"identity charge". *The symmetric anonymity of the massless photons vs the asymmetric identity of massive elementary particles (leptons).* Photons are all alike and have no individual identity, nothing to distinguish one from another. Against this universal "symmetry of anonymity" we find the four massive elementary leptonic species (electron, muon, tau, leptoquark) which are distinguishable one from another and from photons. In consequence of this broken symmetry, these elementary particles carry "identity" charges in two forms: implicitly as "lepton number charge" and explicitly as the (nearly) massless neutrinos, a separate neutrino species for each massive leptonic species. Leptonic particle-antiparticle pairs naturally cancel (balance) each others' implicit "number" (identity) charges; however, no massive lepton/leptoquark can enter this world as a *single* particle unless its implicit number charge is balanced by an opposite explicit number charge carried by an anti-neutrino; likewise, no massive lepton/leptoquark can exit this world as a *single* particle unless the loss of its implicit number charge is balanced by the gain of a corresponding explicit number charge - left behind in the form of a neutrino.

It's a simple accounting system whereby the universe keeps track of the numbers and kinds of (massive, asymmetric) elementary leptonic particles in spacetime. Because the anti-neutrino produced by the in-coming lepton is cancelled by the neutrino left behind by the out-going lepton, the total lepton number of the universe is always zero. This in itself is a charge-anticharge (or matter-antimatter) symmetry, necessary to allow the birth of our asymmetric "matter only" universe. Baryons and the quarks they contain are the remains of primordial leptoquarks and are counted as a single unit by leptoquark neutrinos. Hence leptons (including leptoquarks) are the *only* class of elementary particles, and are distinguished as such by their neutrino identity charges. Quarks are sub-elementary fractional charges, do not have associated individual neutrinos, and are counted inclusively with their parent baryons by primordial leptoquark neutrinos.
(See: "Introduction to the Weak Force".)

Neutrinos are alternative charge carriers for elementary leptonic "particle number", and they are the most interesting and significant of all the charges of physics, since it is only by means of these alternative carriers of identity charge that primordial leptoquarks could decay asymmetrically to produce our "matter only" universe, while still obeying charge conservation in terms of identity charge. "In the Beginning", primordial leptoquarks, which are simply primordial heavy leptons - the heaviest leptons of the leptonic spectrum - split into three parts (quarks) internally (because they were actually too heavy, forming the natural terminus of the "leptonic spectrum"), which allowed the production of electrically neutral leptoquarks by a suitable arrangement of the fractional charges - exactly like heavy neutrons. These primordial, electrically neutral leptoquarks could then live long enough (since they could avoid electromagnetic annihilation reactions) to decay asymmetrically via the weak force "X" IVBs, and so produce our "matter only" universe - but only because anti-neutrinos were available as an alternative charge carrier for the anti-leptoquark's identity charge, providing a "lawful" (charge conserving) pathway even for such an asymmetric decay. For some unknown reason, anti-leptoquarks decayed faster than leptoquarks, which latter were consequently left without antimatter annihilation partners, and so (by the simple expansion of their quarks to the confining limits of the gluon field of their color charges) became the hyperons/baryons of our "matter only" universe (with explicit, conserved color charges that blocked their further decay). The heavy anti-leptoquark neutrinos left behind are now seen as the mysterious "dark matter" of the universe. The implicit number charges of baryons are balanced by these primordial "dark matter" leptoquark anti-neutrinos, so despite the gross "matter only" asymmetry of our universe, its lepton number remains zero. (See: "Identity" as the Charge of the Weak Force".)

Neutrinos are necessary to specifically identify and guarantee that leptons are the genuine article and exactly as they should be, in case they need to replace another similar lepton, or balance, neutralize, or cancel charges, or annihilate with an appropriate antiparticle. All such interactions require precision among the participants. The universe is very careful in its accounting of elementary particles, which reduce in the ground state to the lowly electron and proton. Even the protons originate as split leptons (leptoquarks), so in its essentials, the universe is very simple indeed, and it evidently intends to keep it that way: leptons (1), leptoquarks (1), and their identity charges (2 anti-neutrinos) - which in the ground state reduces to our familiar electron, proton, and their anti-neutrinos. These simple ingredients (plus gravity) produce the 92 elements and information content of the Periodic Table: all the rest, driven by the negentropic force of gravity, is evolutionary history.

There is another symmetry of our "matter only" universe that is maintained (rather than broken) by the weak force (symmetry debts must be maintained in full force/value until they are paid, ultimately via matter-antimatter annihilations). This symmetry subsists in the fact that every electron in the universe today is exactly the same as every other ever created, and any electron can seamlessly replace any other electron, no matter when or where either one was created. Understanding how a *single electron* created today (not a particle-antiparticle pair) can be exactly the same in all respects as its counterpart created eons ago in the "Big Bang", brings us to a consideration of the strange and massive weak force IVBs (Intermediate Vector Bosons) and the equally unlikely and even more massive Higgs Boson. It is only via the mediation of these ultra-massive "particles of interaction" that such an improbable replication becomes possible. Simply put, the massive Higgs and IVBs re-create the primordial environmental conditions (the energy-density) in which the leptonic particles (and quarks) were first created, and produce leptons and quarks today in the same forge and from the same mold as the originals. The Higgs boson provides a standard reservoir of invariant Alternative Charge Carriers (ACCs) (leptons, mesons, neutrinos), from which the IVBs select and distribute appropriate/needful particles to the decays and other reactions/interactions they mediate. (See: The Higgs Boson and the Weak force IVBs.)

Global-Local Gauge Symmetries in the Four Forces

This is a technical subject which can be difficult to understand and explain, and I will take my own route to comprehension through its effect on symmetry-keeping. Symmetry debts acquired via symmetry-breaking during the creation of our "matter only" universe during the "Big Bang" can be redeemed or repaid at any future time - thus providing the universe with an extended (historical) time dimension (unlike energy debts which must be repaid immediately, as in virtual particles) - but these debts (charges) must be maintained at full value, even though entropy and relative (rather than "absolute") motion in local, causal spacetime will threaten to erode, enervate, warp, or otherwise change their initial values. Keeping these charges (symmetry debts) invariant over time until they are paid (typically by antimatter annihilation) is the job of the field vectors of the "four forces".

1) In the electromagnetic force, the value of electric charge is kept invariant by the action of a magnetic field, allowing relative motion in spacetime without changing the value of the electric charge. The combination of electric charge plus magnetic field keeps the value of electric charge invariant when in relative motion in spacetime. This is why ordinary matter remains electrically neutral (even bar magnets), and does not give us a shock when we touch it, despite the fact that the electrons are whirling around stationary protons, and so both charges can't exactly cancel. The magnetic field of the moving electrons compensates for the difference, and the earth we walk on remains electrically neutral.

2) In the gravitational force, time plays the role of the magnetic field seen in the electromagnetic case. Gravity warps spacetime but does not destroy the invariant value of "velocity c" nor the invariant value of Einstein's "Interval", preserving the causal ordering of massive objects in local, causal spacetime (as opposed to a-causal, non-local events in "absolute" space for photons traveling at "c"). Hence the causal ordering of events does not change as we pass from one gravitational domain to another (as on our Earth-Moon expeditions).

3) In the strong force, the quarks of composite baryons are confined to whole quantum unit charges of leptonic magnitude by the action of the gluon field of the color charge. The gluon field grows stronger with increasing separation between the quarks, and weaker as the quarks approach each other ("asymptotic freedom"), resulting in the permanent "confinement" of the partial charges of the quarks within the limits of the baryon. Thus single, partial quark charges are never seen and never threaten the symmetry of the whole quantum unit charges (with respect to balancing, neutralizing, canceling, or annihilating opposite charges), despite the fact that every baryon consists of 3 quarks carrying partial quantum charges. Baryons were long

thought to be elementary, rather than composite particles, so good is this masquerade.

4) In the weak force, we find the massive Intermediate Vector Bosons (IVBs), which, in concert with the Higgs Boson, ensure that every electron ever created is the same as every other electron ever created. Hence any electron can replace any other electron, regardless of when or where either one was created, despite the fact that the universe has endured eons of entropic expansion in both space and time since the first electrons were created. The great mass of the IVBs and Higgs simply recreates the original energy density in which those first electrons were created, and makes electrons today from the original mold and in the original furnace (like Frodo's magic ring).

Hence magnetism, time, the gluon field, and the IVBs/Higgs boson are the local gauge forces/field vectors which maintain and preserve the original values and magnitudes of the "symmetry debts of light" incurred by the creation of matter during the "Big Bang", keeping them invariant until such time as they may find suitable antimatter annihilation partners - perhaps in the depths of a "Black Hole". You will find other, more technical explanations of "global/local gauge symmetries" in the books, but I have listed those of most significance to the theory of symmetry conservation as expounded on this website.

Links:
RETURN TO PART I
Return to Part 2
home page (page 1)
home page (page 2)
E-Book