Symmetry Debts: the "Tetrahedron Model" VS the "Standard Model"

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Both the "Standard" and the "Tetrahedron Model" rely on symmetry principles (in the sense of Emmy Noether's great theorem relating symmetry and conservation) to create unified theories of the "four forces of physics". But in general I use the symmetries of the "forest", while the standard model uses the symmetries of the "trees". Obviously, these cannot be mutually exclusive categories; in most respects the two theories complement each other. Another major difference is that I use the concept of symmetry "debts" to solve qualitative "why" or conservation problems (Why gravity? What is the conservation reason that gravity must exist as a force in the universe?), whereas the "establishment" uses the concept of symmetry-in-action to solve quantitative "how" or mechanistic problems (how does gravity produce its effects and how can we calculate them?). (See: "The 'Tetrahedron Model' VS the 'Standard Model' of Physics: A Comparison".)

The Electromagnetic Force

Our universe is an electromagnetic universe, composed of bound and free forms of electromagnetic energy (matter and light), which are inter-convertible, as demonstrated by the creation and annihilation of particle-antiparticle pairs in our accelerators and colliders, as well as numerous astrophysical processes. This relationships is also theoretically illuminated by such celebrated formulas as E=mcc (Einstein), E=h*v* (Planck-Einstein), and h*v*=mcc (de Broglie-Planck-Einstein). Therefore, principles of symmetry in the electromagnetic force (in both its bound and free forms) are of primary significance for any theory of force unification.

The most fundamental of these electromagnetic phenomena is the symmetry gauge "velocity c", the velocity of light, the universal electromagnetic constant. Einstein showed that "velocity c" characterizes a symmetric state of free energy. The photon, or quantum of light (the boson, field vector, or force-carrier of the electromagnetic field), traveling freely in vacuum at "velocity c", is the most symmetric state of energy known, carrying no charges, having no mass, producing no gravitational field, having no time dimension, and having no spatial dimension in the direction of motion. In short, the photon has forever to go nowhere, "traveling" with an effectively infinite velocity. This is the origin of the photon's "non-local" energy state, a state of pure spatio-temporal symmetry. The loss of this symmetric non-local energy state (when free electromagnetic energy - light - is converted into massive, local, immobile forms of bound electromagnetic energy - matter) is the root cause of the gravitational "location" charge, and indeed all the other charges of matter.

The charges of matter are the symmetry debts of light (per Noether's theorem). To see this directly, imagine an electron-positron pair. Now (by some miracle of the weak force) take the positron away and look at the remaining electron. The energy of the electron is conserved by its mass, but what is the electric charge for? It was supposed to produce an annihilation reaction with the positron, returning the particle pair to the symmetry of light, but now the charge is "hung", preserved indefinitely by the symmetry principle of charge conservation. This charge, isolated from its antimatter complement, is what I refer to as a symmetry debt. Charges produce forces which demand repayment of the symmetry debt they represent. And just in case the electric charge should fail to produce the expected annihilation, there is a "plan B": the gravitational charge of the electron's mass. This "fail safe" charge will eventually return the electron's mass to light, if only via the "Hawking Radiation" of a black hole. It's all very simple, and it applies directly to our asymmetric universe because antimatter went missing after the "Big Bang".

The evolution of the universe is the story of the safeguarding and conservation of matter's energy and symmetry debts (conserving the quality as well as the quantity of matter's energy content), and the ongoing conversion of asymmetric bound electromagnetic energy back to its original symmetric form of light (free electromagnetic energy) - as in our Sun, the stars, supernovas, quasars, and many other astrophysical processes. This is the "big picture" of the symmetry of the "forest" (the Cosmos), over and above the symmetry of the "trees" (the atoms), and it provides a road map to a theory of force unification. With this overview we don't get lost working our way through an unconnected maze of atomic details. Naturally, we need the atomic detail (the puzzle pieces), but we also need a clear prospect of our goal, or we cannot fit the pieces together.

After "velocity c" and the photon, the second most important electromagnetic symmetry condition, phenomenon, or symmetry debt to consider is the electric charge itself (of which the photon is the "field vector" or force carrier). Electric charge is a major expression of the symmetry debt of matter, so what is it telling us? It is (in terms of the "forest") telling us that the entire realm of antimatter is missing from our universe ("someone has stolen our tent") - that is, if antimatter were present, charge symmetry would be restored and the universe of matter and antimatter would dissolve (explosively) into a universe of perfect symmetry and light. Another way of looking at this is to recognize that electric charge is telling us the entire realm of matter is asymmetric, because it comes with mass, time, gravity, and charge. Electric charge is a protest against these asymmetric conditions, and is trying to avoid them by producing annihilation reactions. The electric charge continues to search for antimatter, and it will conserve its charge until it finds antimatter and cancels the electromagnetic debt of matter. This search for symmetry, combined with energy conservation and entropy (the intrinsic motions of light, time, and gravity), are the fundamental motivating forces of the universe.

There are many other symmetries of the electromagnetic field and of electromagnetic bound energy that have been known and studied since the time of Maxwell, beginning of course, with the symmetry between electric and magnetic fields. There is the global and local "gauge" symmetry of voltage, phase, and the exchange of photons (field vectors) between charged particles, the invariance of Maxwell's equations, the invariance of velocity c, the invariance and conservation of electric charge, and other effects due to symmetry at the atomic level of the "trees" which I need not go into because the "establishment" has already done it so thoroughly. I'm more interested in the "forest" symmetries the "establishment" has either ignored or simply not emphasized, apparently because they tend to be of a more philosophical, rather than practical, nature (you can't make money or bombs with them). (For a technical insight into the connections between the symmetry phenomena of electromagnetism and spacetime, see the classic text by: Robert Resnick *Introduction to Special Relativity* (Chapt. IV) John Wiley and Sons, Inc. 1968.)

Gravity

Another major symmetry debt of matter is expressed through the gravitational "location" charge. The "location" charge of gravity derives from the lost "non-local" symmetric energy state of light when free electromagnetic energy is converted to bound electromagnetic energy (in any form). Bound energy (atoms, matter) is massive, immobile, and local, carrying various charges (symmetry debts) including the gravitational symmetry debt. Bound energy is 4-dimensional, including the asymmetric time dimension, whereas free energy (light) is 2-dimensional - lacking both a time dimension and one spatial dimension in the direction of motion. The asymmetric time dimension fixes the location of bound energy in 3-D space (because time is one-way, every point in time is unique), and the time dimension itself is in fact the active principle of gravity's "location" charge. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "Introduction to Gravity".)

Time moves into history at right angles to all three spatial dimensions, pulling space along with it. But 3-D space cannot enter the point-like beginning of the one-D time line of history, and so the spatial dimensions self-annihilate at the center of every mass, leaving behind a temporal residue, the metric equivalent of the annihilated space. The intrinsic (entropic) one-way motion of this temporal residue into history continues this self-feeding process forever, or until bound energy is completely converted to free energy (light) - which has no time dimension nor the gravitational field to produce one. (See: "A Description of Gravity".) Time and history are an alternative entropic drive and domain to space, replacing the intrinsic (entropic) motion of the photon - to accommodate the unique entropic requirements of bound energy. (See: "Spatial vs Temporal Entropy".)

Gravity will eventually completely convert bound to free energy (via the nucleosynthetic pathway of stars, supernovas, quasars, and finally and completely, via "Hawking Radiation" of black holes), returning the Cosmos to its original state of symmetric free energy (light). (Note that gravity always tells us exactly where the center of mass of any form of bound energy is located, and exactly how much is present. It will also tell us the average density if we know the size.)

There are two important (and astonishing) things to recognize about the time dimension with respect to its gravitational role as the "location" dimension, the dimension which specifies the spatial location of bound energy: 1) time is one-way, hence always new, never repeating (because of its role in causality); 2) the universe begins with a "Big Bang" at time zero everywhere in space, simultaneously. Hence a 4-dimensional point ("event") in spacetime can be absolutely unique.

Using a financial metaphor, we can think of gravity in its low energy stages (here on planet Earth) as simply paying the "interest" on the symmetry debt of mass. That is, gravity works away continuously but no change in the Earth's mass or its gravitational force ever occurs. However, at higher energy levels, as on our Sun, gravity begins to "pay down" the "principle" on the symmetry debt of mass - mass is actually converted to light and the gravitational field of the Sun is reduced in consequence. This process goes to completion (eventually but inexorably) via the "Hawking Radiation" of black holes.

The electromagnetic and gravitational symmetry debts are related in that both are long-range force debts that are indifferent to the specific nature of the matter involved. Furthermore, the negative energy of the gravitational debt exactly balances the positive energy of electromagnetic energy, allowing the universe to be born as a quantum fluctuation of the "multiverse", containing zero net energy and zero net charge (due to the compensating presence of antimatter). The ongoing conversion (in stars, etc.) of bound to free energy continues to reduce the total gravitation energy of the universe (since light, having no "location", produces no gravitation field), resulting in the apparent "acceleration" of cosmic expansion (as recently observed).

The remain charges of matter (strong and weak) are short-range force debts which play the major role of converting free to bound energy in the early universe - and continuing today in such phenomena as heavy element building in stars and the radioactive decay of heavy atomic nuclei. These are symmetry debts of the "trees" rather than the "forest", and here my ideas more closely follow "establishment" lines. I turn to them next.

The Strong and Weak Nuclear Forces

While the long-range electromagnetic and gravitational forces are primarily forces concerned with establishing, maintaining, and conserving the metric and energetic symmetry of spacetime, the strong and weak nuclear forces are primarily concerned with breaking the primordial symmetry of light and its particle-antiparticle pairs, and creating a matter-only Cosmos of bound electromagnetic energy. (See: "The Origin of Matter and Information".) Atomic nuclei contain almost all of the visible, baryonic, bound electromagnetic energy in the Cosmos, and atomic nuclei are held together by the strong force. The obvious questions are: 1) how does the free energy of light become bound into the mass of an atomic nucleus; and 2) what are the conservation consequence of the conversion of free to bound energy?

We can only speculate about the first question, as this conversion takes place at the unthinkable (and unreproducible) energies of the early micro-moments of the "Big Bang". Briefly, my presumption is that all four forces participate in the creation of a primordial "leptoquark" - a heavy lepton (charged particle similar to a very heavy electron) which splits into three parts (the nascent quarks) under its own weight. The weak force rearranges these quarks into electrically neutral threesomes (similar to a heavy neutron), which then decays asymmetrically to produce a matter-only Universe. The electrical neutrality of the primordial leptoquarks is essential to allow the weak force enough time to produce an asymmetric decay - otherwise everything simply vanishes into photons via matter-antimatter electrical annihilation reactions (returning to the unbroken symmetry of light and matter-antimatter particle pairs). Hence the necessity for a primordial particle composed of quark sub-units that can begin as a charged leptoquark-anti-leptoquark pair, but undergo an internal rearrangement of its subunits to become an electrically neutral leptoquark subject to an asymmetric weak force decay. We insist on the leptoquark designation (which amounts to an internally fractured heavy lepton) to establish the link between leptons and baryons (a baryon is derived from an internally fractured heavy lepton). During the primordial asymmetric weak force decay, a leptoquark anti-neutrino is emitted, balancing the number charge of the surviving baryon; this heavy anti-neutrino is a prime candidate for the mysterious "dark matter" of the Cosmos. (See: "The Higgs Boson and the Weak Force IVBs".)

The Strong Force

The strong force arises completely naturally to hold the fractured parts of the leptoquark together. (See: "The Strong Force: Two Expressions".) This fractional elementary charge of the quarks has also been seen in the "fractional quantum Hall effect", for which the 1998 Nobel Prize was awarded (See: Robert B. Laughlin *A Different Universe* Basic Books 2005). The strong force also naturally grows stronger as the quarks try to expand, since a free fractionally charged particle would threaten the quantum rules of symmetry conservation - only whole quantum unit charges are allowed. Fractional charges are allowed only if they remain permanently confined within whole unit charge entities - that is, as virtual fractional charges inside baryons. By the same token, the strong force grows weaker as the quarks crowd closer together, since the threat to symmetry conservation posed by their fractional charges is thereby reduced. This is the celebrated effect of "asymptotic freedom" - also awarded a Nobel Prize (Gross, Politzer, Wilczek, 2004 - see: *Science* 15 Oct. 2004 page 400). The strong force is perfectly understandable from the point of view of symmetry conservation, and the gluon field is a perfectly composed invariant "gauge" field of local symmetry. Just as the quarks appear to be the fractured massive parts of an elementary lepton, so the gluons seem to be fractional parts of photons - fractured field vectors of the lepton's electric charge (reminiscent of the fractional quantum Hall effect). The actual mass of the nucleus is not contained in the quarks themselves, but rather in the huge energy of the gluon field which binds them together. (For a discussion of gravitational VS inertial mass, see: "The Higgs Boson VS the Spacetime Metric".) Further discussions of the role of the Higgs boson as a gauge of particle mass may be found in: "The Higgs Boson and the Weak Force IVBs"; see also "Table of the Higgs Cascade").

Conservation Consequences of the Conversion of Free Electromagnetic Energy (light) to Bound Electromagnetic Energy (matter)

Light is the most symmetric form of electromagnetic energy, and when it is converted to any form of bound electromagnetic energy, the loss of light's non-local symmetry must have consequences - according to Noether's Theorem. Light's symmetry (quality) is conserved no less than its energy (quantity). Light's energy is conserved in bound form as mass (h*v*=mcc), while light's symmetry is conserved in the form of charge. *The charges of matter are the symmetry debts of light*. Electric charge and gravity are the two most general forms of these symmetry debts. Both are long-range forces and both have a single ultimate purpose and conservation role - to return bound energy to its original symmetric form. The electric charge does this through matter-antimatter annihilation, the gravitational charge does this through astrophysical processes such as stars, supernovas, quasars, and finally and completely, through Hawking's "quantum radiance" of black holes. (See: "Symmetry Principles of the Unified Field Theory"; see: "A Description of Gravity".) Gravity and the electromagnetic force are related through time, velocity c, and the spacetime metric. Time is the asymmetric dimension which electric charge is trying to avoid in its annihilation reactions (light has no time dimension but matter does), but once matter is formed, time itself becomes the active or motivating principle of the gravitational "location" charge. Time and gravity modify the spatial metric established by light, and in the extreme case of the black hole, the spatial electromagnetic metric is completely converted to a gravitational temporal metric, in which matter moves at velocity c while light stands still (g = c). Time and gravity create history, which functions as an alternative entropy domain for matter's causal information field, replacing the acausal spatial entropy domain of light. (See: "Spatial VS Temporal Entropy".) The intrinsic motion of light is the spatial entropy drive of free energy, the intrinsic motion of time is the historical entropy drive of bound energy. The intrinsic motion of gravity connects these two entropy drives by converting space into time.

Weak Force

Whereas the strong force holds atomic nuclei together, the weak force tears them apart. Acting together, the strong and weak forces create matter both *De Novo* in the "Big Bang", and produce all the heavy elements of the periodic table - in stars and supernovas, as well as during the later stages of the "Big Bang ". The weak force produces the asymmetric decay of electrically neutral leptoquarks during the early moments of the "Big Bang", creating matter-only baryons (heavy particles containing

3 quarks) that fuse together to produce all the atomic elements of our cosmos. The weak force is the only force that can produce asymmetric decays, and it is likewise the only force that can produce and/or transform the identity of a *single* elementary particle - other forces produce only particle-antiparticle pairs (excepting only gravity in the extreme case of "Hawking Radiation" in black holes). It is precisely the capability of the weak force to produce elementary particle "singlets" that requires the bizarre form/mechanism of this force, with its massive "IVBs" ("Intermediate Vector Bosons").

It is a universal fact (a "global" symmetry) that every electron is absolutely identical to every other electron in the Cosmos - and must be, if energy, charge, and symmetry are to be conserved. And it's not only electrons: every elementary particle must be absolutely identical to every other (of its type) no matter when or where it was, is, or will be created. It is the task of the weak force (and only the weak force) to produce these particles as "singlets", that is, as individual particles, not as particle-antiparticle pairs. The method used by the weak force involves the very massive IVBs, which recreate the original primordial conditions of energy-density in which these particles were first produced. Every weak force transformation involving an IVB is therefore a mini "Big Bang", a recreation of the birth trauma of the Cosmos but reduced to the scale of an individual elementary particle. (See: "The 'W' IVBs and the Weak Force Mechanism"; see: "Introduction to the Weak Force").

The weak force charge is "identity" charge, also known as lepton "number" (or "flavor") charge. (See: "Identity Charge and the Weak Force".) The (nearly) massless neutrinos carry this charge in its explicit form, while the massive leptons (the electron, muon, tau) carry this charge in "hidden" form (hidden because the identity charge involves handedness, which cannot be strictly conserved by a massive particle). The neutrino's explicit identity charge nevertheless balances the hidden identity charge of the heavy leptons. Any newly created massive lepton must be accompanied by the appropriate neutrino to balance its identity charge; hence the neutrino functions as a sort of certificate which guarantees the mass, charge, spin, etc., of the newly minted elementary particle conforms to the universal standard. Neutrinos must also be emitted when leptons are destroyed - the relationship between the massive lepton and its paired neutrino is curiously analogous to the commonly presumed relationship between the human body and soul.

Only elementary particles are paired with neutrinos; quarks have none, as they are sub-elementary particles with fractional charges. Their identity charges, like their fractional electric charges, are conserved by the composite baryons which comprise them ("baryon number" charge, which as we have seen is balanced by a leptoquark anti-neutrino). In the modern universe, the baryon neutrino can only be seen during proton decay - which (fortunately) commonly occurs only inside black holes. The symmetry constraining the weak force is just the global symmetry of identity (within type) among all elementary particles ever created. An electron created during the "Big Bang" can be "swapped out" with an electron created today and no one can tell the difference. It should be obvious that this symmetry is completely necessary for energy and charge conservation and the orderly functioning of the Cosmos.

For the role of the Higgs boson in all this, see: "The Higgs Boson and the Weak Force IVBs"; see also "Table of the Higgs Cascade"; see also "Introduction to the Higgs Boson Papers". For a discussion of the **Life Force** (Information Force) and the Information Pathway see: "The Information Pathway"; "The Information Ladder"; "The Human Connection"; "The Fractal Organization of Nature". For a discussion of cosmological issues, see: "A Spacetime Map of the Universe".

The Maintenance of Charge Values Through Time

Closely related to symmetry conservation via absolute charge conservation (charge annihilation) is the phenomenon of charge maintenance - the safeguarding of the value, magnitude, quality and quantity of charge for an indefinite period of time until full conservation (as via antimatter annihilation) can be accomplished. The great and significant difference between energy/entropy debts and symmetry debts is that the latter, as carried by charge/spin/handedness, may be carried undamaged through an indefinite duration of time until they are paid, whereas the former must be paid immediately. Hence the mechanism of symmetry debts as carried by absolutely conserved charges through time is essential to a Cosmos such as ours that enjoys an evolutionary development through an extended historical dimension.

But how are these charges carried unchanged through aeons of time - from the "Big Bang" to the present? While this is a much more complex function than simple charge conservation via annihilation, it is nevertheless the specific and daily task of each of the field vectors of the four forces. Our universe is built to deal with this problem from the outset, or it could not function - it could not conserve energy. It is why we have such dualities as spacetime and electromagnetism, and why the field vectors all seem to have one foot in the universe of matter and the other in the universe of antimatter. The photon of electromagnetism is its own antiparticle; likewise the graviton (a quantum unit of time or negative entropy); also the IVBs and the Higgs boson of the weak force, taken together; and again as seen in the gluon field of the strong force, which is composed of color-anticolor charges in all combinations (Gell-Mann's strong force), even including the meson field of quark-antiquark pairs (Yukawa's strong force). These are the "gauge" fields of local symmetry, which all act to maintain invariant the particular symmetry they represent despite the uncertain and changing environment in our realm of warped/curved metric and relative (rather than absolute) motion, massive (rather than massless) particles, and our "real" (historical) world of 4 dimensional spacetime and causal (rather than acausal) relations among particles.

We have seen how the massive IVB field vectors of the weak force accomplish their task of safeguarding the identity charge and invariant mass of elementary particles through the recreation of the primordial environment of the "Big Bang"; other field vectors have analogous compensatory effects and actions. The exchange of the strong force gluon field permanently confines the fractionally charged quarks to whole quantum-unit charge "packages" - the baryons; the co-variance of time and space in relative motion produces magnetic effects which compensate moving electrical charges, while "warped" gravitational metrics maintain the invariance of velocity "c", the "Interval", and causality via similar mechanisms ("Lorentz Invariance").

All the field vectors operate by exchanging force carriers, field vectors, or bosons of their particular field, and all can be represented by simple Feynman diagrams as well as complex mathematical equations. Thus electrically charged particles exchange photons, massive particles exchange gravitons (time quanta) with spacetime, quarks exchange gluons, IVBs are exchanged between weakly interacting (decaying, transforming) particles. All these activities of the field vectors have a simple function: to maintain the magnitude, quantity, and integrity of charges and the symmetry debts they represent through time, including such fundamental gauges of charge as velocity c, the final arbiter of causality and symmetry.

But these "local gauge symmetries" - the symmetries of the "trees" - have been extensively studied and formalized by the "establishment". The reader should consult standard textbooks (or Wikipedia - Google-search "local gauge symmetry") on these subjects for further and more detailed mathematical information regarding the action of the field vectors of the four forces with regard to "Yang-Mills" theories of "local gauge symmetry", "renormalized" force fields, and their crucial role in the maintenance of charge and gauge magnitudes through time.

Links

Gravitation

Entropy

The Fractal Organization of Nature

Information

Weak Force, Intermediate Vector Bosons ("IVBs"); Strong Force

General Systems and Metaphysics

Books by my late father Prof. John Curtis Gowan

E-Book:

Introduction to the E-Book
General Systems and a "Theory of Everything": Essays on Physics and the Nature of Reality
(html files)

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