The "Tetrahedron Model" vs the "Standard Model" of Physics: a Comparison with respect to the Unification of Forces

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Abstract

Generally speaking, the "Tetrahedron Model" addresses symmetry-breaking and symmetry conservation in the macrophysical "rebound" phase of cosmic evolution (the current era of symmetry restoration, in which we live), while the "establishment's" "Standard Model" addresses symmetry-breaking and symmetry conservation in the microphysical "cascade" phase of cosmic devolution, the period of the "Big Bang" which brings the material Cosmos into being. (See: "Table of the Higgs Cascade".)

The Charges of matter are the symmetry debts of light (Noether's Theorem). All forces spontaneously work together to return the asymmetric material system of bound electromagnetic energy to its original state, free electromagnetic energy, or perfectly symmetric light.

General Discussion of the "Standard Model" and the "Tetrahedron Model"

Symmetry Principles

Both my own "Tetrahedron Model" and the "Standard Model" of "establishment" physics use symmetry principles in their attempts to achieve a unified theory of the four forces of physics. The major difference in our approaches is that I look at the "forest", "they" look at the "trees". "They" tend to look at the beginning of time, I tend to look at the end of time; they tend to look at the short-range particle (nuclear) forces, I tend to look at the long-range spacetime (metric) forces (in both cases these are only general tendencies). "They" use mathematics and particle accelerators, I use general conservation principles and the popular literature. I have achieved a conceptual unification without quantification, they have achieved quantification without unification. If the two theories can be joined, perhaps our common goal of a conceptual and quantifiable unification may be achieved.

Despite impressive successes in particle physics, the "Standard Model" fails to the extent that it lacks an overarching principle linking gravity with the other forces and with quantum mechanics. But this grand and much-sought principle is simply symmetry conservation itself, viewed in its largest application, the evolutionary dynamics of the Cosmos. *The charges of matter are the symmetry debts of light:* this straightforward interpretation of Noether's Theorem provides a clue of sufficient breadth to unify the forces, if we but realize that gravity, like the other forces, arises from a charge ("location" charge) which is also a symmetry debt of light.

(In my humble opinion) the failure of the physics "establishment" (to incorporate gravity in the unity of forces) can be attributed to a single, central misconception. "They" believe that light produces a gravitational field (even when traveling freely in vacuum or space). This misconception, which is due to an overzealous interpretation of Einstein's E = mcc, prevents "them" from realizing that light is a perfectly symmetric energy form, and therefore prevents them from applying Noether's symmetry conservation theorem to light as stringently as they might. If you think gravity is an attribute of both light and mass, then you won't realize that gravity is instead one of the several symmetry debts of light (arising from another "charge"), occasioned by the conversion of perfectly symmetric light to grossly asymmetric matter (or free electromagnetic energy to bound electromagnetic energy). The physics establishment certainly respects Noether's Theorem; they just don't push it hard enough in the case of light, because thinking light produces a gravitational field, they think light has less than perfect symmetry. (See: "Does Light Produce a Gravitational Field?")

In the "Tetrahedron Model", light is assumed to be an energy form of perfect symmetry, having no time dimension, no spatial "location", no mass, carrying no charges, and producing no gravitational field. Time, spatial "location", mass, charge, and gravity are all forms of symmetry debt consequent upon the conversion of a perfectly symmetric, free electromagnetic energy form (light) to an asymmetric, bound electromagnetic energy form (matter). Once this fundamental point is understood, a (conceptual) unification is readily achieved. All forces arise as symmetry/entropy debts of light, and are seen to act in symmetry/entropy-conserving roles, ultimately returning the bound energy of the Cosmos to its original and perfectly symmetric form of light - as required by Noether's Theorem.

Of course the "standard model" has notable successes to its credit, especially in the high energy realm of particle physics and the unification of the electric, weak, and strong forces. This is largely due to the application of the mathematical symmetry principles of "group theory". Group theory is essentially an abstract form of geometry, which is why it is so powerful in quantitative models of symmetry conservation. Transformations of particles are modeled (in the abstract, mathematically) as transformations of appropriate geometric forms, transformations which conserve the critical symmetries of the geometry and corresponding, analogous parameters of the particles. If group theory works for particles, it obviously will also work for spacetime, including gravity and light. For example, "inertial forces" energetically define a symmetry "group" of spatial transformations and translations. Likewise, the intrinsic motions of light, gravity, and time define a related "entropy group" of gauge functions, coefficients, or "drives" that create and regulate spacetime and its metric.

The general idea is that space (which is created by light's "intrinsic" (entropic) motion) is the original, geometric, symmetric conservation domain of light, and that gravity and time are introduced as symmetry debts "warping" this symmetric form when light is converted to bound energy such as matter. The "warpage" of space by gravity is actually caused by the intrinsic motion of time.

Gravity

Gravity creates time by the annihilation of space, leaving behind a metrically equivalent temporal residue. The intrinsic motion of time serves as the entropy drive of bound energy, replacing (and hence conserving) the intrinsic motion of light which had been resident in the annihilated space, and which served as the entropy drive of free energy (causing the expansion and cooling of space). The action of the negative entropy drive of gravity causes the replacement of the positive entropy drive of light with the positive entropy drive of time. Gravity "pays the interest" on the symmetry debt of matter by creating time from space, converting the entropy drive of light ("the intrinsic motion of light") to the entropy drive of history and matter ("the intrinsic motion of time"). The spatial expansion of the universe slows in consequence, as energy is gravitationally shunted from the expansion of space to the expansion of history (historical spacetime), via the actual annihilation of space and its replacement with a metrically equivalent temporal residue. (See: "A Description of Gravitation".)

Charge conservation implies the existence of a time dimension, a "future" in which symmetry debts held as conserved charges can be redeemed (by annihilation with antimatter). Gravity ("intrinsic motion G") provides the time dimension of matter through the annihilation of space and the deceleration of the spatial expansion of the Cosmos, thus paying the energetic entropy-interest on the symmetry debt of matter by debiting the expansive entropy-energy account of light and space.

The weakness of gravity is due to the tangential connection (experienced as the ephemeral "present moment") between matter and the historical conservation domain of information (matter's "causal matrix" of historic spacetime). (See: "The Half-Life of 'Proton Decay' and the 'Heat Death' of the Cosmos".) This tangential connection reflects the fact that it is matter's time dimension that has intrinsic, entropic motion, and not matter itself. Matter has no (net) intrinsic motion in either space or time, although matter's associated gravitational field (Gm) consumes space to produce matter's moving temporal dimension. Matter's gravitational field represents bound energy's primordial, intrinsic entropy drive, producing time via the annihilation of a metrically equivalent quantity of space. Time marches on to produce historic spacetime, the conservation domain of information and matter's causal network, web, or "matrix".

The separation between matter and its historical conservation domain is the root cause of human anxiety regarding our fleeting experience of life, but is necessary to protect both the energy and charge of atoms from the vitiating action of temporal entropy (aging). In consequence of this protection, atoms retain the full value of their energy content and charge magnitudes until their energy and symmetry debts are paid in full - either gravitationally by Hawking's "quantum radiance" of black holes, or electromagnetically by matter-antimatter annihilation, or by the strong and weak nuclear forces through fission, fusion, or "proton decay".

Symmetry-Breaking and Symmetry-Keeping

The intrinsic, entropic motions c, G, T (time) form an "entropy group" of spacetime, which is connected to the "inertial force" symmetry group, as the spacetime dimensions are actually created by these entropy drives. The dimensions of spacetime are conservation domains created by the primordial entropic drives of free and bound electromagnetic energy. Finally, the charges of matter form other related "symmetry debt" subgroups (leptons and hadrons), with connections to the inertial group through bosons. It therefore seems that something could be done (mathematically) with symmetry groups at these larger scales, not just at the micro-scales of the particles and initial moments of the "Big Bang". (See: " Currents of Entropy and Symmetry".)

While all these charges and forces are related through symmetry groups and symmetry-conserving functions and roles, they also have another function in an apparently opposite direction: the breaking of symmetry in the initial burst of manifestation that we recognize as the "Big Bang". The particular combination of forces and charges comprising our Universe must not only be able to conserve and restore the symmetry of light at the end of time, but also to break the symmetry of light at the beginning of time. The role of the weak force, especially, must be understood from the point of view of symmetry breaking, as well as symmetry conservation. However, the electric, strong, and gravitational forces appear to be wholly symmetry-conserving in their roles (gravity also has an entropy-conserving role). (See: " Entropy, Gravity, and Thermodynamics"; see also: "The Double Conservation Role of Gravity".)

The Octonion Number System

(See: Ian Stewart: "*Why Beauty is Truth*" (2007 Basic Books) for a discussion of the "octonion" and other number systems)

It is possible to construct a number system and do meaningful mathematics in up to 8 dimensions (the "normed division algebra" of the "octonion" number system), but not more. This suggests that conservation domains of up to 8 dimensions may be physically possible. Indeed, our own Universe may be just such a domain. We live in 4 familiar spacetime dimensions, but there appears to be another set of 4 "historical spacetime" dimensions which we cannot see or access. For example, we see the Andromeda galaxy not as it is "now" in our time, but as it was more than two million years ago. ("Now" or "universal time" is physically real and meaningful, due to the simple fact that all baryons in the Universe began exactly together in the Big Bang, hence all nuclear material in the Universe is exactly the same age.) Similarly, Andromeda observers (if any) see us (or could see us) more than two million years in our past.

This "missing" 2 million year chunk of 4-D spacetime between us and the Andromeda galaxy is what I refer to as "historical spacetime". (We cannot see or access our own past, and likewise, Andromeda cannot see or access its past. We can, however, see a constantly advancing record of each others' histories.) Historical spacetime seems to constitute an additional set of 4 large but invisible dimensions, in fact constituting the "bulk content" of the universe, by far the largest portion of spacetime, perfectly real but completely inaccessible and invisible to us. Other observers do (or could) live in this spacetime (which includes a moving record of our past) and experience it, just as we live in and experience our own "present moment" of spacetime, which includes a moving record of their past. A view of our past is a portion of their present reality, and vice versa. Although our past has receded into historical spacetime which we cannot access directly (because time travels into history as fast as light travels into space - both intrinsic motions are metrically equilibrated entropy drives of effectively "infinite" velocity), our past nevertheless remains causally active and thus real - both to us and to other observers. Today is real only because yesterday remains real.

Every observer in the Universe is reciprocally related to every other, and while each exists in a "present moment" that is of the same universal age, all see only the 4-D "surface" of an 8-dimensional "bulk" historical spacetime formed of the past history of all events which have ever occurred, everywhere, since the common beginning of time in the "Big Bang". (See: "A Spacetime Map of the Universe" for a diagrammatic representation of our "present moment", the universal "present moment", "bulk" historical spacetime, and where we are located in, and how we see, our Universe.) Elsewhere I have referred to this historical spacetime as a 5th dimension, but now, having learned (from Ian Stewart's splendid book) of the "octonion" number system mentioned above, I am inclined to believe it represents a full extra set of 4 spacetime dimensions - because the octonions represent a formal conservation mechanism (both a geometric and an accounting system) which can accommodate them.

The fact that these extra astronomical dimensions are apparently only light and space, without particulate reality (we can see them but not touch them), also seems to accord well with the loss of mathematical rigor in the octonions as compared to number systems of lesser dimensionality.

Others have suggested that these extra dimensions (implied by the existence of the octonions' number system) might be used to construct "strings" - that is, these are micro rather than macro dimensions. Could they possibly be used for both? For example, during the "Planck Era", when spacetime, particles, light, and gravity are all joined together in Gamow's primordial "Ylem"?

Lie Symmetry Groups

Thinking in terms of "Lie groups" or mathematical symmetry groups and their role in the cosmic drama: we recognize in the largest sense 2 universal "groups" - the "matter" group and the "antimatter" group - and their two universal roles - symmetry-breaking ("manifestation"), and conservation (including both energy and symmetry conservation). (See Ian Stewart's book "Why Beauty is Truth" (2007 Basic books) for a discussion of Lie groups in physics and mathematics.) The Universe is a complicated place, in which both symmetry-breaking and symmetry-conservation play fundamental roles - sometimes even by the same forces.

The matter-antimatter "groups" are more fully characterized as a Universe-Antiuniverse pair, because we intend to include everything in these groups: spacetime, light, and gravity, as well as particles and their spin and charges. Within each universal "group" we recognize "subgroups" of particles defined by various charges (leptons and hadrons), and a subgroup of dimensions defined by inertial forces and intrinsic motions (entropy "drives"). The particle and dimensional groups appear to be related through another shared subgroup, the bosons (photons gravitons, IVBs, gluons). The entropy drives (c, G, T) and inertial forces are to the dimensions somewhat as the charges are to the particles - symmetry and entropy gauges or debts of light whose ultimate role/purpose is energy/symmetry conservation.

We recognize the dimensions as large conservation domains created by energy and the primordial entropy drives of free and bound energy - dimensions characterized by the spacetime metric, Einstein's "Interval", inertial forces, and the "intrinsic motions" (entropy drives) of light, time, and gravity. We recognize particles as small conservation domains created by energy and symmetry conservation, taking the form of mass and charge conservation (energy and symmetry debts). We have two great classes of electromagnetic energy: free energy, characterized as electromagnetic radiation (referred to herein as "light"); and bound electromagnetic energy, typically seen as particles (mass-matter). Light and matter are energetically related through Einstein's equation (E = mcc) and interconvertible. An intermediate form also exists as "virtual" particle-antiparticle pairs.

Each type of energy is associated with an entropy drive or "intrinsic motion", light or free energy with "velocity c", and particles or bound energy with time or "velocity T", including gravity as the force which converts either entropy drive into the other. Entropy is a corollary of energy conservation, and functions (in its thermal mode) to allow the conversion of energy into "work", and (in its temporal mode) to allow the conversion of energy into information, all without violating energy conservation. Particles are associated with charges, which are a form of quantized symmetry conservation, acting through history. Charges convert energy and symmetry into information. The role of energy, symmetry, and entropy conservation in the dimensional realm is played by the spacetime metric, time, gravity, inertial forces, all gauged by "velocity c". (See: "Spatial vs Temporal Entropy".)

The two great groups - matter and antimatter (or the universe and antiuniverse) - are nearly but not quite symmetric with each other. This lack of perfect symmetry has the consequence that upon their interaction (in a matter-antimatter annihilation reaction during the "Big Bang") they do not quite cancel each other, but a small bit of matter is left over, as if the geometries of the great cosmic groups do not quite match up perfectly. (The slight mismatch is in the weak force, apparently affecting the rate of the weak force decay of electrically neutral leptoquarks vs antileptoquarks.)

We can think of the combined universal groups as the "manifestation" supergroup (derived from the all-symmetric "Multiverse" with unique, life-friendly physical constants), since the material Universe we inhabit is clearly the consequence of their combination. Following "Big Bang" symmetry-breaking, we see (and participate in) the second great role of the combined manifestation supergroup, which is energy and symmetry conservation. This secondary role functions to return the small remaining piece of matter (which did not get converted into light in the initial "Big Bang" matter-antimatter annihilation event), to the symmetric form of light, sharing the common fate of the vast bulk of the original combined group. (Essentially a "mopping up" operation, cleaning up the asymmetric matter residue remaining after the incomplete annihilation event that was the "Big Bang".) The Sun is our most common example of this universal symmetry-conserving activity - the conversion of bound to free energy, matter to light, the gravitational payment of the energy, entropy, and symmetry debt of matter (mass, time, charge).

The gravitational conversion of bound to free energy begins in stars, supernovas, and quasars, and goes to completion in the "Hawking Radiation" of black holes. We see the electromagnetic force following the same path in chemical reactions, and especially in particle-antiparticle annihilation reactions. The strong and weak nuclear forces participate in the universal conversion of bound to free energy through nuclear fusion and fission reactions (in stars), radioactivity (in atoms), and particle and proton decay (in nuclear and subatomic particles). (See: "Symmetry Principles of the Unified Field Theory"; see also: "Proton Decay and the 'Heat Death' of the Cosmos".)

The Four Forces of Physics in the "Tetrahedron Model"

Electromagnetic and Gravitational Forces

Electromagnetism is the best understood of the four forces of physics. Electromagnetism is most conveniently discussed together with gravity because of the way these forces are unified in the "Tetrahedron Model". Although in the "Standard Model" it is Feynman's "quantum electrodynamics" which is the centerpiece of the modern understanding of the electromagnetic force, I am nevertheless more interested in Einstein's and Noether's emphasis on the symmetric properties of light and the "gauge" (regulatory) properties and invariance of "velocity c" in Special Relativity.

The symmetric properties of light are the mainspring of force unification as developed in the "Tetrahedron Model". The unified field theory is the story of the conservation of light's energy and symmetry. The Universe begins as light (free electromagnetic energy), devolves into matter (bound electromagnetic energy), and evolves back again into light, conserving and restoring its original energetic form, symmetry, and total energy. (See: "Symmetry Principles of the Unified Field Theory: Part One"; and "Part Two".)

We know that high-energy light creates particle-antiparticle pairs of matter and antimatter

(Heisenberg/Dirac virtual "pair production"), which immediately annihilate each other and reproduce the light which created them. This is straightforward, immediate, "brute force" symmetry conservation by the electromagnetic force (conserving the "non-local" symmetric energy state of light). If just the matter partner of such a pair somehow survives while the antimatter partner self-annihilates, then we have the "Big Bang" asymmetric creation of matter. Exactly how this asymmetric reaction is arranged at the Cosmic Beginning is still a mystery, but I make some suggestions in the paper: "The Origin of Matter and Information". Basically, it appears that even though electrically neutral leptoquark-antileptoquark pairs are created symmetrically, they nevertheless undergo asymmetric weak force decays, the antimatter partners decaying more rapidly than the matter partners, leaving the latter isolated to further decay into our familiar proton, electron, and electron antineutrino.

Light has perfect symmetry; light is the most symmetric of all energy forms, the "perfect sphere" of energy. Light carries no charges of any kind, so when light produces particle-antiparticle pairs, the charges carried by these pairs must sum to zero, since light begins with zero charge. Hence particle-antiparticle pairs carry charges in equal but opposite amounts, charges whose sole function is to motivate and facilitate an annihilation reaction which returns the material particle-antiparticle pairs to the original symmetric energy state of light. The raw energy of light is fully conserved by the mass and momentum of the particle-antiparticle pairs; so the only function of particle charge is symmetry conservation, the motivation and facilitation of the annihilation reaction restoring the original symmetric energy state of light.

The charges of matter are the symmetry debts of light. This is the essential interpretation of "Noether's Theorem", which states that in a multi-component field, such as the electromagnetic field (or the metric field of spacetime), wherever we find a symmetry we will also find an associated conservation law, and vice versa. (This is the "Truth and Beauty" theorem, where truth = conservation and beauty = symmetry.) In practice, we find Noether's Theorem fulfilled in the particle realm through charge conservation, and in the dimensional realm through inertial forces. One thing we have learned about inertial forces (from Einstein) is that they are related to gravitational forces through the "Equivalence Principle". We intend to show that gravitation is also a symmetry debt of light, taking its place with the other four forces of physics under the conservation umbrella of "Noether's Theorem".

But gravity is more than just a symmetry debt of light, it is also an entropy debt of light. (See: "The Double Conservation role of Gravitation".)

The Double Conservation Role of Gravity

Einstein showed that light has no time dimension; light's "clock is stopped". Light also has no spatial extension in the direction of its propagation (no "x" or "length" spatial dimension). Light is a two-dimensional transverse wave whose "intrinsic motion" sweeps out a third spatial dimension. The intrinsic motion of light is the primordial entropy drive of free energy, both creating space and causing the expansion and cooling of space. Space is the conservation domain of light, created by the entropy drive ("intrinsic motion") of free electromagnetic energy. Having no time dimension, and no "x" or "distance" dimension in the direction of travel, light has forever to go nowhere - in other words, light's intrinsic motion, "gauged" (regulated) as "velocity c", is effectively an infinite velocity. As a consequence, in its own reference frame, light is everywhere within its conservation domain (space) simultaneously, which is effectively a symmetry condition with respect to the equitable distribution of light's energy throughout space. This "infinite velocity" is the source of light's "non-local" characterization. Hence we see that "velocity c" is a universal gauge regulating both the entropy drive ("intrinsic motion") of light, and the symmetric energy state of light (the "non-local" distribution of light's energy). Among the many symmetries exhibited by light are light's complete lack of charge, unitary spin, lack of a time dimension, "non-local" distribution (lack of asymmetric dimensional "location"), lack of mass, and lack of a gravitational field (among other symmetries). (See: "Does Light Produce a Gravitational Field"?).

The fact that light lacks a gravitational field follows directly from the "non-local" character of light. A gravitational field must be spherically centered, otherwise it violates the conservation of energy (because it would produce "rogue", unbalanced, unaccountable, inertial forces - and a net motion in spacetime of the gravitating body). Because light is "non-local", light cannot provide a center for a gravitational field, hence it cannot produce one without violating energy conservation. This simple fact is the great stumbling point for the "Standard Model", which could otherwise find its way to the inclusion of gravity with the other forces as a symmetry debt of light, just as I do in the "Tetrahedron Model". The physics "establishment" thinks that light produces a gravitational field, due to their overzealous interpretation of Einstein's E = mcc. But this justly famous equation states a proportional energetic equivalence, not an energetic identity. Light is not the same as bowling balls. Try reflecting or bouncing bowling balls back and forth between two mirrors at velocity c, and you will quickly discover the difference - despite E = mcc. Light has energy, momentum, a proportional mass equivalence, and light is bent in a gravitational field, because spacetime is "bent" (accelerated). But light does not itself have mass or produce a gravitational field. Only mass produces a gravitational field, since only "local" mass can provide a center for such a field. (See: "Gravity, Entropy, and Thermodynamics".)

"Velocity c" is therefore (at least) a double gauge regulating (among other parameters) light's entropy drive and the non-local distributional symmetry of light's energy. "Noether's Theorem" states that all the symmetries of light must be conserved, no less than all of light's energy. Gravitation is the force which conserves these two gauge aspects of "velocity c": 1) light's entropy drive - by immediately converting the entropy drive of free electromagnetic energy (light's intrinsic motion) into the entropy drive of bound electromagnetic energy (time's intrinsic motion); 2) light's "non-local" distributional symmetry - by eventually converting bound energy back into light (in stars and through Hawking's "quantum radiance" of black holes). See: "The Double Conservation Role of Gravitation".

Special and General Relativity

The invariance of "velocity c" is the special feature of Einstein's Special Relativity theory. The invariance of c is usually explained as a consequence of Maxwell's equations, but of course there are also compelling physical (conservation) reasons why velocity c must be an invariant. As we have seen, c is the "gauge" (regulator) of both light's spatial entropy drive ("intrinsic motion") and light's non-local spatial distributional symmetry. These two regulatory gauge functions alone would require the invariance of c. More than this, c is the gauge of the mass equivalence of energy (E = mcc). Finally, light is the messenger and "c" is the gauge of causality; the gauge of the metric of spacetime and Einstein's "Interval"; and the gauge of electric charge and Heisenberg's virtual reality. Any one of these gauge functions would require the invariance of c. As Einstein discovered, the constancy of the dimensions themselves must yield precedence to the invariance of c ("Lorentz Invariance"). To think of c as only or primarily a "velocity" is to entirely miss the physical significance of the electromagnetic constant c, which is the principle regulatory gauge of the primary energy form of our Universe. As most authors have emphasized, Einstein's theory of relative dimensions and reference frames is actually the theory of the invariance of the "Interval", causality, and "velocity c".

The other principle gauge or regulatory constant of spacetime is of course the universal gravitational constant "G" ("big G" - to distinguish it from "little g", the variable inertial force of accelerated motion or the variable local gravitational field ("surface gravity"). G is the gauge constant or regulatory function which determines how much time (historical entropy drive) must be associated with a given mass. Since space must be annihilated to create or extract this time dimension, we can also think of G as regulating how much space must be annihilated to provide a time dimension or entropy drive per given mass. (See: "The Conversion of Space to Time".) Earth's gravitational field, as we commonly experience it, is a spherically symmetric collapsing field of spacetime which self-annihilates at the center of mass, yielding a metrically equivalent temporal residue. This temporal residue rushes off into history, at right angles to all three spatial dimensions, pulling more space after it, which likewise self-annihilates at the point-like entrance to the time line or historical dimension, repeating the endless, self-feeding, entropic cycle. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "A Description of Gravitation".)

Gravity has two major conservation roles, because "velocity c" has two intertwined dimensional gauge functions, and gravity conserves both simultaneously - it cannot conserve one without conserving the other. (See: " The Double Conservation Role of Gravitation".) Velocity c, as we have seen, is both light's non-local distributional symmetry gauge, and the gauge of light's temporal entropy drive. Intrinsic motion c causes the creation, expansion, and cooling of spacetime (entropy function), and also causes the "non-local" distributional symmetry of light's energy (symmetry function). Noether's theorem requires the conservation of the distributional symmetry of light's energy, a service which gravity performs via the "location" charge of mass. This "location" charge is gauged by "velocity G", which creates the time dimension of mass, sometimes simultaneously with the conservation of the non-local symmetry of light (via the conversion of mass to light in stars, for example).

Gravity's "Location" Charge

The location charge of gravity is so named because it acts to locate asymmetric (undistributed) mass energy in space by assigning it a 4th (temporal) dimension. Time is the active principle of gravity's "location" charge. Time's intrinsic motion, at right angles to all three spatial dimensions, physically locates mass in space by collapsing the spatial dimensions symmetrically, spherically, upon the mass center. This unambiguously, energetically, inertially, and dimensionally locates the spatial position of the asymmetric, undistributed, offending lump of bound energy, moreover indicating its total amount and concentration. Simultaneously, matter is given a time dimension or temporal entropy drive. The intrinsic motion of time is metrically equivalent to the intrinsic motion of light, and is derived (extracted) by the gravitational annihilation of space, revealing a temporal residue which is the metric equivalent of the annihilated space. This derivation is equivalent to exchanging the entropy drive of space (the intrinsic motion of light) for the entropy drive of matter (the intrinsic motion of time), which are both gauged by the electromagnetic constant c as the metric of spacetime: one second of temporal duration is metrically equivalent to 300,000 kilometers of linear distance. Hence gravity conserves light's spatial entropy drive or intrinsic motion by converting "velocity c" to the intrinsic motion of matter's historical entropy drive, "velocity T" (time). The expansive or entropic component of light and space is actually visible (through large telescopes) as the cosmological "red shift" of distant galaxies. (See: "Spatial vs Temporal Entropy".)

Because entropy is a corollary of energy, and functionally related to energy conservation, gravity must conserve the spatial entropy component of light immediately (by converting it to matter's entropy drive, time). All energy forms, free or bound, must have an entropy drive (intrinsic motion c or T), for reasons of energy conservation. However, the "non-local" distributional symmetry debt of light (also carried by gravity's "location" charge), like all symmetry debts, is time-deferred, and can be paid at any future time, so long as it is secured and guaranteed by a conserved charge. Gravity will eventually pay off light's "non-local" distributional symmetry debt (carried by matter in the form of "location" charge), when it has accumulated enough mass and hence gravitational energy to do so. Repayment begins in the Sun and stars (the gravitational conversion of mass to light via the nucleosynthetic pathway), and goes to completion in Hawking's "quantum radiance" of black holes.

At lower gravitational energies, such as on planet Earth, gravity simply contents itself with the creation of time (the entropy drive of bound energy), an energy conservation role it must satisfy immediately for mass of any size, from atoms to stars. But we see that gravity's ultimate task is the conservation of light's non-local distributional symmetry via the conversion of mass to light, since only then does the gravitational force actually vanish when its task is accomplished (the Sun's gravitational field is diminished as its mass is diminished, and the light it produces carries no gravitational field). We note that in the conversion of mass to light, not only is the non-local distributional symmetry of light's energy restored, but because the intrinsic motion of matter's time dimension is converted back to the intrinsic spatial motion of light, the symmetry of the primordial entropy forms is also restored. The spatial entropy drive of light, being "all way", has greater symmetry than matter's entropy drive of "one-way" time.

Entropy "Interest" and Energy "Principle"

The double conservation role of gravity makes this force especially difficult to understand. At low energies (such as on planet Earth) we see only gravity's immediate entropy conservation role, the creation of matter's time dimension via the annihilation of space. At higher energies (stars, quasars, black holes), we see gravity's time-deferred symmetry conservation role asserting itself, operating simultaneously with its entropy conservation role. It is in fact the conflict between these two roles, one spatially contractile and the other spatially expansive, that stabilizes the Sun and similar stars. In black holes, gravity's entropy conservation role appears to overwhelm its symmetry conservation role, but as Stephen Hawking's theory of "Quantum Radiance" has shown, it is the symmetry conservation role which wins out in the end - demonstrating that even the symmetry of light's spatial entropy drive is conserved.

Gravity pays the entropy "interest" on the symmetry debt of matter, creating time, so that a future exists in which the temporally conserved symmetry debt (charge) may be redeemed (annihilated). Symmetry debts are held through time as quantized, invariant, conserved charges. Charge conservation = symmetry conservation. Charge conservation and entropy work together to allow the conversion of energy to information and "work". Gravity makes both possible by creating matter's time dimension - the entropy drive of matter plus the necessary historical dimension for time-deferred payments of (charge-conserved) symmetry debts. The Universe runs on the "credit card" of charge-conserved symmetry debts, but only because gravity continuously pays the entropy-energy interest on matter's symmetry debt, creating bound energy's time dimension (in which the historically deferred symmetry debts have meaning and can be paid).

Because gravity creates time via the annihilation of space, the entropy drive of matter is automatically created in units which are metrically equivalent to the entropy drive of light. We move in time as fast as light moves in space - in metrically equivalent units. "Time flies"; and free and bound energy can interact because their entropy drives are naturally equilibrated. Furthermore, the energy to create matter's time dimension and expanding historical domain is withdrawn from light's entropy drive (which causes the spatial expansion of the Universe), via the gravitational annihilation of space: the Cosmic spatial expansion decelerates accordingly. The expansion of history is paid for by decelerating the expansion of space. Both space and history continue to expand together (more slowly) as the gravitational combination "historical spacetime". (See: "A Spacetime Map of the Universe".)

Finally, as gravity gradually converts matter back to light (in stars, supernovas, quasars, etc.), the total gravitational field of the Cosmos is attenuated - since light produces no gravitational field and no new matter has ever been created since the "Big Bang". Hence the gravitational deceleration of the Cosmos is diminished, resulting in the recently observed "acceleration" of the expansion of the Universe. (This "acceleration" (rebound) constitutes observational evidence favoring the assertion of the "Tetrahedron

Model" that light produces no gravitational field.) (See: "'Dark Energy': Does Light Produce a Gravitational Field?")

The Weakness of Gravity

The magnitude of "G", the universal gravitational constant, may have no explanation other than the "Anthropic Principle". In this case it is simply a "God-given" constant of nature, as is the universal electromagnetic constant, "c". Nevertheless, without actually explaining or deriving G's value, we can make a few observations concerning G's weakness.

The first observation is that the "Tetrahedron Model" associates gravity with time. Gravity creates time by the annihilation of space, extracting thereby a temporal residue that is the metric equivalent of the annihilated space. This means that gravity is weak because only a small amount of space, per given mass, need be annihilated to supply matter with its requisite primordial entropy drive, time.

The question therefore becomes: why does matter need so little time (per given mass) for its historical entropy drive? If we look at the association between matter and time (equivalently, ourselves and time), we can make several salient observations right away. The first is that we live in and experience only the "present moment". The past and the future are both closed to us. Our experience of time is only in the present moment, essentially a "tangential hit" upon the great bulk of historical spacetime. (See: "The Half-Life of Proton Decay and the 'Heat Death' of the Cosmos".)

The second observation is that in our experience of time, it is not we who move through time, but time itself that moves. Unlike space, time is a moving dimension, so far as mass (bound electromagnetic energy) is concerned. Next Tuesday will come to me even if I just sit quietly here in my armchair - I don't have to go out and get it. In fact I can't "go out and get" either next Tuesday or last Tuesday (as I can "get" an object in space), which is why I say that it is not we who move in time, but rather time itself that moves. (See: "The Time Train".)

The third observation is that our inertial status with respect to the spacetime dimensions is essentially the reverse of that of light's. Whereas we have intrinsic motion in time (due to our moving time dimension), but not in space, light has intrinsic motion in space but not in time. As Einstein discovered, light's "clock is stopped". It seems this difference in the inertial status of light and matter is necessitated by the inability of matter to travel at velocity c, even though matter must somehow have an entropy drive which is the metric equivalent of light's. The accommodation reached (by nature) is that the time dimension of matter moves at the metric equivalent velocity of light, rather than matter itself moving. The mountain goes to Mohammed. The "time train" moves and we are simply passengers on the moving dimension, watching the days go by.

An advantage of this accommodation (matter's moving time dimension) is that matter does not participate in the aging and enervation of its historical entropy domain, as light participates in the entropic expansion and cooling of space. This means that the energy content of matter (such as atoms) is not affected by the entropic expansion and aging of history, whereas the energy of light is rapidly diminished by the entropic expansion and cooling of space (as driven by light's own intrinsic motion). Furthermore, and perhaps more to the point, because matter does not participate in the entropic dilution of its historical and causal information domain, the quantized charges of matter, which carry matter's symmetry debts, are also not affected by entropy, retaining their full force and magnitude until such time as the debts they represent can be repaid in full, in their original coin and at their original value. "Diamonds are forever"; atoms created in the Big Bang retain all their mass energy (E = mcc), and all their quantized charge, undiminished since the beginning of time. Meanwhile, the temperature of the light universe has cooled to 2.7 Kelvin. Electrons created in the "Big Bang" carry the same value and magnitude of electric charge as electrons created today - as they must, if symmetry and charge conservation are to have any physical significance.

All these observations suggest that the weakness of gravity is a consequence of the peculiar inertial relationship that exists between matter and its historical conservation domain, entropy drive, and time. Gravity has only to provide enough temporal entropy drive to satisfy matter's "tangential" connection to historical spacetime. We are connected to history by the thinnest of threads, the ephemeral "present moment", the right angle between moving time and all three stationary spatial dimensions. But this is necessary to protect not only the energy of atoms, but the value of their quantized symmetry debts (charges) from entropy's vitiating influence. Blink and the "present moment" is gone, never to be retrieved. P. A. M. Dirac noticed that the ratio of the strength of the gravitational force to the electromagnetic force was similar to the ratio of the radius of an electron to the radius of the Universe. But what is this but the analog of the ratio of the tangential "contact point" of the present moment to the bulk universe of historical spacetime? (See: "A Spacetime Map of the Universe".)

Black Holes

In a black hole, where g = c, we see what happens when matter actually moves at velocity c and time stands still - just the reverse of the usual inertial relationship between time, space, and matter, and the analog of the normal inertial relationship between light and space. Light is fully integrated with its conservation domain and entropy drive; one can hardly distinguish light from its intrinsic motion or from space. But matter is easily distinguished from time and history - except in a black hole. In a black hole, according to the Bekenstein-Hawking theorem, even temporal entropy takes a spatial dimensional form (the surface area of the hole). Hence we may assume that G and c would in fact be equal if the inertial relation between time/matter and light/space were equal - as indeed they are in a black hole. In a black hole, matter is fully integrated with and occupies its historical domain - just as light usually occupies its spatial domain.

The weakness of gravity therefore appears to be a direct consequence of the fact that:
1) gravity creates time, the historical entropy drive of matter.
2) Although massive objects have intrinsic motion in time (due to the entropic motion of their time dimension), they are connected to the conservation domain of historical spacetime only tangentially through the "present moment": history recedes from us and our present moment at right angles to all three spatial dimensions.
3) Gravity creates only enough time, per given mass, to satisfy the entropy drive of matter's tangential, point-like connection to historical spacetime.
4) If the mass of the Earth were reduced to the density of a black hole, it would have an event horizon approximately equal to the size of a Ping-Pong ball. I assume that the surface area of this "Ping-Pong ball" represents the actual size of the "tangential" contact point between historical spacetime and the entire mass-energy of planet Earth. (The fact that this contact point is greater than zero means that the temporal entropy drive of matter will actually have a very small vitiating effect upon atoms, as realized through "proton decay".) (See: "Proton Decay and the 'Heat Death' of the Cosmos.")

See also:

Entropy, Gravitation, and Thermodynamics
Spatial vs Temporal Entropy
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
"The Conversion of Space to Time"

Strong Force (Color Charge)

We find two levels of unification in the "standard model" of the strong force, one at the "Electroweak" level - SU(2) (leptons) and SU(3) (quarks) - in which the 6 quark flavors are unified among themselves (allowing the transformation of one baryon into another, such as proton into neutron and vice versa), and a higher level of unification at the "GUT" level - SU(5) - in which quarks are unified with leptons (the "Leptoquark Era"). There is an alternative representation of the quark-lepton unification known as "asymptotic freedom", which shows the tendency of the strong force to disappear as the quarks get closer together within the confines of the atomic nucleus. The theory of "asymptotic freedom" won a Nobel prize for its authors in 2004 (Gross, Politzer, and Wilczek). The electroweak and GUT unifications are part of the symmetry-breaking "cascade" as modeled in the "Higgs Cascade" table, and provide no overarching theory of unification other than the temperature gradient of the expanding Cosmos - essentially nothing more than a theory of thermal condensation. However, "asymptotic freedom" goes much further in the direction of a final theory which might exhibit an actual conservation principle of unification, and provides some common ground between the "Standard Model" and the "Tetrahedron Model".

In the "Tetrahedron Model", I see the origin of all forces as "symmetry debts of light"; this is my overarching conservation principle of unification, and I show how the charges act through their associated forces to conserve and restore their original symmetric energy state (light). The forces which these charges create constitute the demand, motivation, and mechanism for repayment of the symmetry debt. (The "Tetrahedron Model" provides a conceptual unification only; I have not attempted a quantitative or mathematical formulation of the theory.)

In the case of the strong force, the broken symmetry is quite literal, consisting of the broken or fractured charge quanta of elementary particles. Quarks carry fractional charges which must always sum to whole, elementary, quantum unit charges, and can never appear alone or "naked" in their partially charged state. The electric charge carried by quarks, for example, is either 1/3 or 2/3 of the elementary unit electric charge carried by the electron and other leptons. The notion here is that quarks are derived primordially from leptons which are simply fractured into three parts by the huge pressures of the Big Bang in its initial micro-moments (Planck Era). This common origin with the leptons of course solves the mysterious relationship between the quarks and leptons, and explains why the fractured quark charges add exactly to leptonic charge quantum units. Leptons are the only elementary particles; quarks are sub-elementary particles, created from fractured leptons. In this conception, the ancestral "leptoquark" becomes the heaviest member of the leptonic family of elementary particles.

"Asymptotic Freedom"

Because charges are time-conserved symmetry debts (charge is a temporal rather than spatial form of symmetry, just as mass is a temporal rather than spatial form of energy), which must eventually be repaid in full by cancellation or annihilation, the fractional charges of quarks are an actual threat to symmetry and charge conservation unless they are kept together in their original whole quantum units, since fractional charges cannot be cancelled, neutralized, annihilated, or balanced by any elementary (leptonic) charge carrier. (Quark partial charges can of course be canceled by antiquark partial charges in mesons, but these are ephemeral combinations of matter and antimatter.) The symmetry threat of free-roaming fractional charges mandates the symmetry-keeping role of the strong force: to permanently confine the partial charges of the quarks, maintaining the integrity of whole quantum unit charges, so they can eventually be cancelled or annihilated in full satisfaction of the symmetry debts they represent. It is therefore readily seen that as the individual quarks separate from one another, they threaten the symmetry-keeping function of the strong force, and provoke it to more vigorous enforcement of its role; conversely, when the individual quarks move closer together, they pose less of a threat to symmetry-keeping as they more nearly reflect their original unitary state, and the strong force enforcement role relaxes - exactly the result of the "asymptotic freedom" theory.

Continuing in the same vein, we furthermore understand that the gluon field of the strong force color charge is composed of color-anticolor charge pairs in all possible combinations (excepting doubly neutral "green-antigreen"), and so gluons naturally tend to sum to zero color as they physically crowd together. In fact, if the gluons crowd together (or are forced together) strongly enough (perhaps to "leptonic size"), the color charge will actually sum to zero and self-annihilate, leaving a colorless baryon - essentially a heavy lepton. This is the condition of the "leptoquark", which in this colorless condition unites the leptons, quarks, and baryons, and with the emission of a leptoquark neutrino can undergo leptoquark decay, the equivalent of "proton decay". In proton decay, the strong and weak force acting together return nuclear matter to its original symmetric state of light. Hence the "Tetrahedron Model" and the "Standard Model" find common ground in the symmetry-keeping theory of "asymptotic freedom".

Gluons

Just as the quarks carry fractional electric charges, which appear to be derived from a primordial, shattered, leptonic electric charge, so the gluon field, which is massless and moves at velocity c, gives the impression of being a fractured photon - the partitioned field vector of the shattered electric charge. Hence the unity of the strong and electric charges and forces subsists in the derivation of the strong force from the electric force through the division of elementary leptonic charge carriers in the intense pressures of the early mico-moments of the Big Bang. Supporting this relationship scenario, the two forces show many similarities, including their extremely symmetric composition and behavior. Finally, the internal constitution of a baron looks like a miniature cosmos, with massless gluons being exchanged between "colored" quarks at velocity c, much as massless photons are exchanged between electric charges in our macro-world.

The creation of matter by symmetry-breaking during the "Big Bang" is a joint production of the weak and strong forces. Although the strong force is perfectly symmetric itself, it is nevertheless essential for the creation of matter that the principal mass-carrying particle (the baryon) be composed of sub-elementary units (the quarks), which can arrange their fractional electrical charges into combinations which sum to neutrality (such as in the neutron). Because the baryons are derived from primordial massive leptons (the leptoquark), and because all massive leptons carry unit elementary electric charges (as a symmetry debt reflecting the dimensional asymmetry of time), the only way to produce an electrically neutral lepton (or leptoquark) is by subdividing the unit electric charge into fractional, partial charges - such as those carried by the quarks of neutrons.

The reason why quark partial charges are essential for the creation of matter is that electrically neutral leptoquark-antileptoquark particle pairs can then be formed, pairs whose lifetime is long enough for them to decay asymmetrically via a weak force interaction. Electrically charged leptoquark pairs annihilate each other immediately via the electric force, and do not live long enough to undergo weak force decays. The necessity for electrical neutrality during the creation of matter is the reason why baryons must be composite particles - symmetry-breaking would otherwise be impossible. The other requisite, of course, is the self-annihilation of the conserved color charge. But this is possible because of "asymptotic freedom", and because the gluon field sums to zero color, having been derived originally from a unitary "fractured" photon - the field vector of a fractured electric charge.

Matter is complex - but it is only as complex as it has to be to achieve both symmetry-breaking and symmetry conservation - the "simplest sufficient complexity" ("the Lord is subtle but He is not malicious"). The above is an example of the strong and weak forces working together to achieve manifestation and symmetry-breaking, just as proton decay is an example of both working together to achieve symmetry-keeping - the latter cooperative effort is also seen in fission-fusion reactions of element building in the Sun and stars, where mass is converted to light.

"Flavor" Charge The Strong Force - Two Expressions

The strong force has two structural levels of expression, quite different, one *within* the individual baryon (mediated by a "gluon" exchange field), and one *between* individual baryons (mediated by a "meson" exchange field - the "Yukawa" field). While the internal baryon level of the strong force consists of an interaction among three quarks carrying 3 "color" charges ("red, green, blue") exchanging a color-carrying gluon field, the strong force at the compound nuclear level consists of an interaction between two or more baryons carrying 2 quark "flavor" charges ("up, down"), exchanging a flavor-carrying meson field. The gluon field is composed of virtual color-anticolor charges, and the meson field is composed of virtual flavor-antiflavor charges, so the analogy is complete, except that the gluon field is massless while the meson field is massive. The massless gluon field nevertheless produces a short-range field because unlike photons, the gluons attract each other (gluons have been compared to "sticky light").

Two particle charges unique to the quarks, "flavor" and "color", each produce a version of the strong force, expressed at different structural levels of the nuclear material. The color version of the strong force is expressed within the baryon, producing absolute quark confinement, while the flavor version of the strong force is expressed between baryons in a compound atomic nucleus, producing a very powerful (but not absolute) binding of baryons within the collective boundary of a compound nucleus.

The role of the color charge is to protect charge invariance, charge conservation, and symmetry conservation by maintaining the integrity of whole quantum charge units, hence explaining the absolute character of the confinement of quark partial charges. The role of the flavor charge is also symmetry-keeping, but with respect to energy states rather than charge, which is a more variable function (since energy can be conserved in many forms - as mass, light, heat, entropy, linear and angular momentum, nuclear binding energy, chemical binding energy, kinetic and potential energy, magnetic and electrical energy, sound, information, charge, etc.) The primordial role of flavor charge is to quantize and regulate, scale, or "gauge" the mass of quark and leptonic elementary particles, ensuring the invariance of elementary particle mass - an energy conservation function. In the compound nucleus, however, flavor charge plays a secondary symmetry conservation role, reducing the amount of bound energy contained in the baryon ground state as far as possible, while not violating the absolute parameters of charge conservation (electric charge, color charge, baryon number charge, spin).

It is the fact that we have two ground state flavor charges (up-down), that allows us to have two ground state baryons (neutron and proton), which can share their virtual meson fields and so bond together by reducing their total bound energy content. Because neutrons spontaneously decay into protons (half-life of about 15 minutes), and protons - given a sufficient energy boost - will revert to neutrons, we see that these two particles are in a real sense simply differently charged versions of one another. This close "family" relationship (as demonstrated by these weak force transformations) is the basic reason why these particles can form a combined "resonance" or "superposition" - the "nucleon" (as demonstrated by strong force bonding).

The Nucleosynthetic Pathway

It is remarkable what a variety of compound atomic nuclei can be produced by the exchange of a simple meson particle-antiparticle pair between proton and neutron (92 natural elements plus hundreds of isotopes). Another remarkable fact is that it requires the input of gravitational energy (as in the stars) to force these nucleons into such close proximity that they will actually bond. They will not bond spontaneously (unlike the gluons), but require some additional external coercion. Hence the nucleosynthetic pathway conversion of bound to free energy is actually the role of gravitational symmetry conservation, not actually an "agenda" of the flavor charge, although we can see it as a combined role (flavor charge plus gravitational force). As we have seen, the gravitational force is produced by the time dimension or entropy drive of matter. Therefore, the stellar conversion of bound to free energy is ultimately a consequence of the temporal entropy drive of matter, eroding and vitiating the energy content of atoms via gravity. Entropy increase and symmetry conservation work hand in hand.

The meson field of the strong force succeeds in reducing the energy level of most heavy atomic nuclei to a quiescent ground state. Radioactive decay is not a common phenomenon in our ordinary elements - one has to look rather hard to find it, as the Curies discovered. The local activity of the meson field provides us with a non-radioactive spectrum of stable heavy elements capable of producing and sustaining life.

Nucleons

The color charge of the strong force clearly has an "agenda" of quark confinement in the service of symmetry and charge conservation, through the protection of whole quantum charge units. The flavor charge of the strong force also has an agenda of symmetry conservation, but not through charge conservation, rather through the release of bound to free energy via nuclear fusion and element building in the nucleosynthetic pathway (of stars, etc.). However, we must recognize the associated role of time and gravitation (the temporal entropy drive of bound energy) to comprehend the complete mechanism of the flavor charge in reducing the bound energy levels of the ground state nucleons within the compound atomic nucleus - this because nucleons will not bound spontaneously, but require the external force input of powerful gravitational fields, as in the center of stars. The spontaneous character of the flavor charge "agenda" is only apparent when we take into consideration the gravitational field which is naturally associated with any massive elementary particle.

The miracle of the (nuclear level) strong force is of course the 92 elements of the periodic table (and their many isotopes). These exist only because the proton and neutron can coexist as a "doublet", a paired bound state of nuclear matter which achieves in its combined form (the "nucleon") a state of lower bound energy than either partner could alone. The origin of this miracle goes back to the paired quark families and the ground state "up, down" flavor pairs. Why do quarks come in paired families, anyway? The pairing phenomenon is also seen in the lepton families, and in the pairing of quark families with lepton families, of meson and gluon charge-anticharge pairs, of matter and antimatter, and even of space and time. The ultimate source of all this pairing is probably electrical, originating with the dipoles of both electric and magnetic fields in the primordial source of cosmic energy, light. When light interacts with the metric of spacetime to produce particles (during the Big Bang), the electromagnetic dipole of light, the tripole of space, and the quadrupole of spacetime are carried into the structural fabric of particles. (See: "Nature's Fractal Pathway".)

The "nucleon" is a combined, bound state of both the proton and neutron. Because in the combined state the baryons can share their load of "parasitic" virtual mesons, a significant reduction of their total bound energy is possible. This reduced energy is the "binding energy" of the atomic nucleus released in nuclear fusion. The quark composition of the proton is "uud+", while that of the neutron is "udd". The exchange of a (virtual) meson particle-antiparticle pair, ud+ or ud- (antiparticles underlined), changes a proton into a neutron and vice versa. If two protons and two neutrons combine, they can position themselves at the corners of a tetrahedron in which all partners are equidistant. In the tetrahedral configuration meson exchange is especially efficient, as each proton has two equidistant neutrons to play the round-robin exchange game with, and vice versa. This 4-baryon tetrahedron is the alpha particle or helium nucleus, an especially tightly bound and favored nuclear configuration (the "brick" of the nucleosynthetic pathway), and it is easy to see why. The exchange of mesons between neutron and proton is exactly the "sharing of differences" that epitomizes the third stage of the General Systems model. It leads directly to the 4x3 tetrahedral bonding of the alpha particle (4 nucleons each of 3 quarks), and thence to the carbon atom - 3 alpha particles each of 4 nucleons; and so on up the nucleosynthetic pathway in alpha particle increments. (See: "The Fractal Organization of Nature".)

Isotropic Spin Symmetry

The "nucleon" can also be seen as a state of higher symmetry than either the proton or neutron alone - the particle analog of a force unification symmetry state, but expressed at a lower organizational level among the "flavor" charges of just the first quark "family" (whereas the complete E/W electroweak force unification energy level includes all quark and lepton flavors). This minor symmetry state was originally given the name of "isospin" symmetry or "isotropic spin" symmetry, and was conceived as a global symmetry state of hypothetical spin for which meson exchange between protons and neutrons formed a compensating, local gauge symmetry "current" or field vector.

"Isotropic spin" symmetry or "isospin" symmetry leaves the strong force unaltered when protons and neutrons are interchanged. So far as the strong force is concerned, protons are the same as neutrons - hence the symmetry (and this is true for either flavor or color). The name derives from assigning a completely imaginary state of "spin" to the nucleon ("up" for the proton and "down" for the neutron). This theoretical spin state is isotropic (invariant) insofar as the strong force is concerned, whether it is in the up or down "phase". Isospin symmetry was understood as a natural consequence of strong force meson exchange between the nucleons. When the quark model was developed by Gell-Mann and Zweig, the "up" and "down" designations were retained for the ground state quark flavors. The isospin model was then applied to the actual (rather than virtual) weak force transformations of neutrons to protons. Like the strong force, the weak force is a short-range force with massive field vectors, the IVBs. Also like the (nuclear level) strong force, meson exchange occurs in weak force baryon transformations, but is mediated by the much more massive IVBs. (See: "The 'W' IVB and the Weak force Mechanism".) (See: Robert Oerter: *The Theory of Almost Everything*. Penguin (Plume) 2006.) (See: James Trefil: *The Moment of Creation*. Macmillian (Collier) 1983.)

Weak Force

Because the weak force is primarily responsible for symmetry-breaking and the creation of matter during the Big Bang, one might suppose that the weak force has little to do with symmetry conservation - but such is not the case. In particular, charge conservation is equivalent to (a temporal mode of) symmetry conservation, and it is through "identity" charge that the weak force contributes to symmetry conservation.

All photons are identical, one cannot be distinguished from another, which constitutes a conserved symmetry of light I call "anonymity". However, elementary particles such as the leptons (electron, muon, tau, leptoquark) can be distinguished from one another and from photons, so they break the anonymity symmetry of the photon. Conserving the photon's anonymity symmetry is the role of the weak force "identity" charge, which is carried in two forms, explicitly by neutrinos, and implicitly by the massive leptons. The symmetry-keeping function of identity charge (also known as " lepton number" charge) is to allow particles to identify their appropriate antimatter annihilation partners in a timely fashion, so that, in the case of virtual particles for example, they do not violate the time limit of Heisenberg's virtual reality.

Identity charge is also an identification tag or "passport" for every elementary particle, ensuring that as it enters the manifest realm, it is accounted for, and bears a charge that ensures it will (eventually) exit the manifest realm.

The unique role of the weak force is the creation of "singlet" elementary particles, particles created without antimatter partners. No other force can do this (they create particle-antiparticle pairs instead), so it is the weak force and its identity charge that is responsible for the initial creation of matter in the "Big Bang", as well as the creation of singlet "alternative charge carriers" (the leptons and mesons), which allow the transformation of baryons and leptons in the post-Big Bang Cosmos. The mechanism of these creations and transformations is the subject of several papers on my website, including: "The Creation of Matter and Information"; "The "W" IVB and the Weak force Mechanism"; and "The Higgs Boson and the Weak Force IVBs."

IVBs

Briefly, the "W" IVB recapitulates the energy density of the primordial "Big Bang" electroweak symmetric energy state (the energy level at which the electromagnetic and weak forces are unified), in which the quarks and leptons were united within their own family groups. Recreating this electroweak unification energy level allows the transformation of quarks into other quarks, or leptons into other leptons, simply as the natural course of events at that energy level and symmetry state. In effect, every weak force reaction involving an IVB is a mini-Big Bang, recapitulating the cosmic birth of particles. It is no different with humans: when new humans are created, we have to go back to the primordial molecular origins of life and start again from the beginning - single cells, haploid chromosomes, and naked DNA. In the case of the weak force, this procedure guarantees that the new elementary particle will be the same as all others of its kind ever created, ensuring charge invariance, a crucial corollary of symmetry conservation, just as entropy is a crucial corollary of energy conservation. Charge invariance is also the reason why charges must be quantized - nature's "digital" quality control. The role of the Higgs bosons (there may be several) in these weak force reactions is simply to establish an invariant energy scale, which selects a particular force unification energy level and a specific IVB "family" and transformation mechanism (there may be several). (See: "The Higgs Boson and the Weak Force IVBs.")

Hence we see that the weak force is extremely scrupulous in its creation of "singlet" elementary particles , ensuring through the Higgs scalar and IVB mechanism that electrons created today are exactly the same as electrons created during the "Big Bang", and that due to charge invariance, electrons of any "age" can swap places with each other, or annihilate with antimatter partners of any age, if the opportunity should arise - both symmetry-keeping transactions. Creation could not occur without the weak force identity charge, which guarantees that the material elementary particles will someday have to redeem that charge through annihilation and conserve the photon's "anonymity" symmetry. We therefore see that the weak force both creates and destroys, breaks and conserves symmetry. Weak force symmetry-breaking could not happen unless it occurred simultaneously with weak force symmetry-keeping, via the identity charge. Charge conservation is just symmetry conservation in massive form, quantized and deferred indefinitely through the time dimension.

Leptoquarks

The leptoquark neutrino performs the same function for baryons as the leptonic neutrinos perform for leptons. The leptoquark neutrino has not been seen because we have never seen the creation or destruction of "singlet" baryons (the creation of matter and "proton decay"). The leptoquark neutrino is a prime candidate for "dark matter". (I presume there is only one leptoquark neutrino species for baryons of all types.) The recently observed "oscillation" of the leptonic neutrinos suggests that our "ground state" electromagnetic spacetime is not a zero-energy ground state, but remains sufficiently energetically elevated to provide a "symmetric energy state" for neutrinos in which they can swap identities with each other, just as the much more massive leptons and quarks can exchange identities within their respective families at the electroweak unification energy level created by the "W" IVBs. (See: *Science* Vol. 316, 27 April, 2007, page 539.)

Perhaps the greatest success of the "Standard Model" to date has been the prediction and discovery of the massive weak force IVBs, and the unification of the electric and weak forces. (Glashow, Weinberg, Salam, Nobel prize 1979; Rubbia and van der Meer, Nobel prize 1984.) This has not, however, included an elucidation of the IVB transformation mechanism nor an explanation of the nature of the massive IVB particles (they appear to be "metric particles", bound quanta of energy-dense primordial spacetime, specific to a particular force unification energy level). The integration of the electroweak IVB system with the higher energy levels of the weak force (the "X" and "Y" IVBs of the GUT and TOE force unifications) also remains "a work in progress". (See: "The Higgs Cascade" table.)

While the electroweak unification remains an impressive achievement of the "Standard Model" (and is the basis of the widespread faith in the material reality of the Higgs boson), the electroweak theory remains a theory of symmetry-breaking and largely ignores the symmetry-keeping role of the weak force (as suggested above). The symmetry-keeping role of the weak force could suggest a pathway to a broader unification of the electroweak force with the remaining forces of physics. *The charges of matter are the symmetry debts of light,* and no charge is more important than the weak force "identity" charge, as it alone allows manifestation, the creation of "singlet" material particles. Conversely, the weak force identity charge assures that every elementary particle must some day redeem this debt in an annihilation event conserving symmetry, thereby fulfilling the mandate of "Noether's Theorem".

Links

Unified Field Theory

Gravitation

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