

Go to: ["Symmetry Principles of the Unified Field Theory: Part 1"](#)

Go to: ["Symmetry Principles of the Unified Field Theory: Part 2"](#)

Go to: ["Simple Table of the Unified Field Theory, Rational Mode"](#)

## Summary

(revised May, 2014)

### Symmetry Conservation and Charge Invariance in the Unified Field Theory ("[Tetrahedron Model](#)")

#### Abstract

The Cosmos begins with a free form of electromagnetic energy, light, the purest, simplest, and most symmetric form of energy known. Through weak-force symmetry-breaking, the primordial light energy is converted into bound forms of electromagnetic energy: atomic matter. Atomic matter is a temporally conserved form of light's spatial energy expression. In matter, light's raw energy is conserved as mass and momentum; light's symmetry is conserved as charge and spin; light's entropy is conserved as time and gravity; light's spatial continuity is conserved as historical causality. Energy Conservation, Symmetry Conservation, Entropy, and Causality/Information are the four principle conservation parameters of the "Tetrahedron Model", and constitute the foundation of natural or physical law which underlies and supports the Unified Field Theory of the four physical forces. (See: ["The 'Tetrahedron Model' of the Unified Field Theory"](#)). In this paper we explore the connections between of the four physical forces, with special emphasis upon their symmetry relations under the unifying mantle of Noether's symmetry conservation theorem: "The charges of matter are the symmetry debts of light". The particles of matter bear light's symmetry debts as charges; these charges produce forces which act to return the asymmetric massive system of matter to its symmetric massless origin in light.

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- 1) Noether's Theorem requires the conservation of light's symmetry no less than light's energy.
  - 2) The charges (and spin) of matter are the symmetry debts of light.
  - 3) Charge/spin conservation is a temporal, material form of symmetry conservation. Charges are a material translation (representation) of specific symmetry parameters which can be conserved through time as active, invariant debts awaiting repayment (as by annihilation with antimatter).
  - 4) Maintaining the invariance of, and paying (discharging) light's symmetry debts as held by the charges of matter, is the role of the field vectors of the four forces of physics.
  - 5) The maintenance of charge invariance (in the service of symmetry conservation) is the key to understanding the local action of the forces ("local gauge symmetry currents").

Symmetry debts of the four forces, as conserved by their charges, are identified as:

**a)** Electromagnetic force: electric charge. Matter-only asymmetry - the antimatter matching half of the cosmos is completely missing. This giant asymmetry, which characterizes our entire universe, includes a vast dimensional asymmetry: 2-D or 3-D symmetric space (in the symmetric light universe) vs 4-D asymmetric spacetime (time and gravity asymmetry of the matter universe). The left-handed neutrino asymmetry is another universal asymmetry due to the absence of antimatter.

Opposite electrical charges attract, motivating matter-antimatter annihilation reactions, hence restoring the material system to its original light symmetry.

**b)** Gravity: "location" charge. "Non-local" distributional symmetry of light's energy ("free electromagnetic energy") vs local, immobile, undistributed concentrations of mass energy ("bound electromagnetic energy") (the "Interval" of light is zero, the "Interval" of mass is positive). The active principle of "location" charge is time, so the gravitational location charge ( $G_m$ ) carries both an entropic drive for bound energy (the intrinsic dimensional motion of time), as well as a symmetry debt (the 4-D spacetime coordinate position of mass, including the quantity and density of any form of bound energy).

**c1)** Strong force: baryon level, color charge, gluon field. Gluons attract each other. Whole quantum charge units vs the fractional charges of the quarks (symmetry conservation via charge conservation, resulting in permanent confinement of the sub-elementary quarks). Fractional charges threaten the quantum mechanical mechanism of charge conservation (resulting in "asymptotic freedom" and the vanishing of color charge in the leptoquark - since the gluon field, which is composed of color-anticolor charges in all combinations, naturally sums to zero when sufficiently compressed.)

**c2)** Strong force: nuclear level, flavor charge, meson field. Least bound energy solutions to compound nuclear arrangements of protons and neutrons ("nucleons", "isospin symmetry", Yukawa nuclear binding field - exchange of virtual mesons between neutrons and protons). Symmetry conservation through principle of "least bound energy" = "nuclear chemistry" and the nucleosynthesis of heavy elements in stars and supernovas.

**d)** Weak force: "identity" ("number") charge (sometimes known as "flavor"). Distinguishable (as to type) elementary leptonic particles vs "anonymous" photons. Leptonic elementary particles break the "anonymity" symmetry of the photons (all photons are alike and indistinguishable from one another, a symmetry of "anonymity"). Neutrinos carry "bare" identity charges, which identify elementary leptonic particles and their appropriate antimatter annihilation partners, by "flavor" distinctions and spin - the beginning of the "information" parameter of our cosmos. Alternative charge carriers (leptons, neutrinos, mesons) are necessary (but not sufficient) to allow the mass field

of the quarks to break the primordial symmetry of matter-antimatter particle-pairs during the "Big Bang".

Primordial symmetry-breaking probably occurs via the asymmetric weak force decay of electrically neutral leptoquarks, as mediated by the "X" IVB. Higgs bosons gauge the mass of weak force IVBs (probably 3 families), which in turn control the weak force creation, destruction, and transformation of *single* elementary particles. IVBs reconstitute the energy density of the primordial force-unity era of the Big Bang in which these particles were originally created - such as the electroweak era of the "W", "Z" IVB family. Single elementary particles created today must be exactly the same as those created in the "Big Bang" - explaining the complex, massive mechanism of the weak force.

**6)** The field vectors of the forces act as local gauge symmetry "currents" which transform globally conserved symmetry parameters of light, space, and absolute motion in flat metrics ("velocity  $c$ "), to locally conserved symmetry parameters in relative motion in warped metrics of mass/matter, history, causality, charge/spin, and information. The photon in its role as the field vector of electric charge, magnetic forces, and antimatter annihilator is prototypical of this function. The electromagnetic constant " $c$ " gauges the spacetime metric, causality and the "Interval", the value of electric charge, and the energetic equivalence between mass and free energy ( $h\nu = mc^2$ ).

**7)** Gravity transforms the global spatial metric of absolute motion and massless light, as gauged by the electromagnetic constant  $c$ , into a local spacetime metric for relative motion and massive matter, as gauged by the gravitational constant  $G$ .

**8)** Gravity pays the entropy "interest" on matter's symmetry debt, creating time by the annihilation of space and the extraction of a metrically equivalent temporal residue, decelerating the cosmic spatial expansion in consequence. Conversely, the gravitational conversion of bound to free energy (as in the stars, supernovas, quasars, and Hawking's "quantum radiance" of black holes), pays the "principle" on matter's symmetry debt, discharging all symmetry and entropy debts, and accelerating the cosmic expansion - as recently observed - by reducing the total mass and associated gravitational energy of the universe. The expansion of matter's historic domain (historic spacetime - the conservation domain of matter's causal information "matrix"), is funded by and replaces the purely spatial expansion of the Cosmos. Black holes are an example of the total gravitational conversion and complete replacement of space and its pos-entropic electromagnetic metric by time and the neg-entropic gravitational metric.

**9)** Time and gravity induce each other endlessly, creating historic spacetime, the conservation domain of matter's causal information matrix: *a gravitational field is the spatial consequence of the intrinsic motion of time.*

**10)** The radiance of our sun and the stars announces a completed "circuit" of symmetry conservation. The solar gravitational field is reduced as the sun's mass is converted to

light. When a black hole's mass is completely converted to light via Hawking's "quantum radiance", the hole's gravitational field likewise vanishes, indicating that its symmetry-conservation role has finally been fulfilled.

**11)** Gravitation arises in response to light's (broken) "non-local" distributional symmetry in space, a symmetry destroyed by the immobile, concentrated, and hence undistributed energy content of mass, matter, or bound energy generally (matter has no (net) intrinsic spatial motion). The active principle of gravity's "location" charge is time. Time and gravity identify the 4-D location, quantity, and density of matter's immobile energy content. The gravitational "location" charge is unique in that it is an entropic charge, a charge with intrinsic, dimensional motion. Gravitation creates the time dimension through its ceaseless annihilation of space, extracting a metrically equivalent temporal residue. In turn, time creates gravity as time's intrinsic motion drags space into the historic domain. Space self-annihilates at the point-like entrance to the one-dimensional and one-way time line, creating another temporal residue, again the metric equivalent of the annihilated space. The new temporal residue marches off into history, dragging along more space, which creates more gravity, etc.

**12)** Gravity creates a local, spacetime metric (gauged by "G"), imposed upon the global, spatial metric (gauged by "c"), in which the conservation requirements of both free and bound electromagnetic energy can be satisfied simultaneously. Spacetime becomes the dimensional entropy/conservation stage upon which a cosmic drama now unfolds, a neg-entropic arena provided by the energy of gravitation (energy borrowed, in turn, from the entropic expansion of space). Gravity pays the entropy-interest on the symmetry debt of matter by the creation of time, funded through the deceleration of cosmic spatial expansion. The question posed to the Cosmos is this: can the particles, using their conserved symmetry charges, either individually or collectively, revert to their symmetric wave form (light) in the absence of their antimatter partners? Is one-half of the information contained in the original particle-antiparticle pair enough to accomplish this magical transformation? The answer is yes, but only in the additional dimension of explicit time, and in two modes: a collective process (the gravitational conversion of bound to free energy in stars and black holes), and an individual process (proton decay). Both will arrive at the same result, the complete transformation of the particle and bound energy to light. Meanwhile, as a sort of subplot or "play within the play", an electromagnetic information pathway develops (life, biology), which attempts to express or reconstitute in material systems its charge-memory of the symmetry and connective unity of its primordial state. The development of personal "identity" and the abstract information systems of humans reprise and recollect our primordial, abiotic, physical origins, in religious, artistic, psychological, intuitive and rational terms, including even the [fractal algorithm](#) of the information pathway. (See: "[The Information Ladder](#)").

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### Postscript

As for the issue of "intelligent design", the recent concept of the global "Multiverse" in service of the "Anthropic Principle" offers a completely satisfactory resolution of the problem of the "special

balancing" or "exquisite adjustment" of our Universe's physical constants. According to this view, we naturally find ourselves inhabiting that special local Universe, of perhaps infinitely many realized possibilities, in which the physical constants of Nature are so adjusted, by chance alone, as to favor the evolutionary development of our life form. While this is a completely rational explanation for the peculiar characteristics of our Universe, it actually says nothing at all regarding the existence of a "First Cause" or "Creator" - neither for nor against; that issue is simply pushed back to the level of the all-symmetric "Multiverse". Concerning the issue of evolution, it is simply a biological form of negative entropy driven by Natural Selection, as factual, mechanical, and impersonal as gravity or chemistry. (See: "[Newton and Darwin: the Evolution and Abundance of Life in the Universe](#)".)

### Information

The miracle of Life, the raising of atoms to conscious biological information systems of incredible complexity and sophistication, appears to be the means by which the Universe becomes self-aware and experiences itself, including exploring new modes of creativity and new forms of beauty. The meaning of the biological information pathway that develops through time in the neg-entropic domain of gravitation, the significance of our human experience and our Universe, are separate topics which I address in other papers (see: "[The Information Pathway](#)"; and: "[Chardin: Prophet of the Information Age](#)"; "[The Human Condition](#)"; "[Is There Life After Death?](#)"). See also my late father's book: "[Trance, Art, Creativity](#)" in regard to the significance and meaning of the human experience.

The physical reason for the existence of "Information" (which exists primordially in the form of charge), is to provide a lawful pathway for matter back to its original symmetric energy state - a sort of road map to salvation. This same information becomes, over cosmological time, elaborated into the life forms we know on planet earth: remarkably, we too have begun to convert matter back to light following the sun's example, making common cause with the universal drive of the natural forces. So if we blow ourselves to bits, we can always say we were driven to it by the cosmos itself! Life provides the universe with self-awareness and experience, multiple new evolutionary pathways, and a fully satisfactory rationale for its existence. Why is there something rather than nothing? So there may be life! Only a universe capable of supporting some form of life could justify the enormous expenditure of energy required for its creation.

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[home page](#)

Tetrahedron Model Diagram

[The Tetrahedron Model](#)

Table of Forces and Energy States (Simple Table #1)

4 Forces of Physics --->	Electromagnetism	Gravitation	Strong	Weak	
Below: Comments on the Energy State Rows:	<b>FORCES</b>				
Free Energy, Light: electromagnetic radiation; space; symmetric forms; virtual particles; symmetry-breaking; (reprising the "Big Bang"); (incurring the debt); Spatial Energy Forms; (row 1)	<b>E</b> <b>N</b> <b>E</b> <b>R</b> <b>G</b> <b>Y</b> <b>S</b> <b>T</b>	Light: $E = hv$ (Planck); Intrinsic Motion $c$ ; All Charges = 0; Symmetric Energy ("velocity $c$ " is free energy's entropy drive and symmetry gauge); Invariance of "velocity $c$ "	Space; Conservation/Entropy Domain of Light; Light's "Interval" = 0; The Spatial Metric; Metric Symmetry, Inertial Symmetry; Metric Curvature = 0 ("non-local" energy)	Sub-Elementary Particles (fractured leptons); Quarks; Particle-Antiparticle pairs; Leptoquarks; Particle Symmetry	Elementary Particles; Leptons; Neutrinos; Particle-Antiparticle Pairs; Higgs (Mass Gauge); Intermediate Vector Bosons (IVBs); Symmetry-Breaking
Bound Energy: matter; history; asymmetric forms; real particles (consequences of row 1 symmetry breaking);	<b>A</b> <b>T</b> <b>E</b> <b>S</b>	Mass: $E = mc^2$ ; $h\nu = mc^2$ ; (Einstein-deBroglie); Matter, Momentum; Asymmetric Bound Energy;	Causality; Time, History; Conservation/Entropy Domain of Information; Mass Interval > 0;	Mass Carriers; Baryons, Mesons, Nucleons; Atomic Nucleus; (elements)	Alternative Charge Carriers; Leptons, Neutrinos; Electron Shell; (atoms)

<p>raw energy conservation; (down payment), "pay now"; Temporal Energy Forms; (row 2)</p>	<p>Charges &gt; 0;</p>	<p>Metric Asymmetry; Time, Gravity; ("local" energy) ("intrinsic motion T" is bound energy's entropy drive)</p>		
<p>Charges: quantized symmetry debts (carried by particles of row 2); symmetry (charge) conservation; (mortgage, credit), "pay later"; Temporal Symmetry Forms; Symmetry Carriers; (row 3)</p>	<p>Electric Charge: Asymmetry: Lost Antimatter (the "Great Asymmetry"): Magnetism, Quantum Mechanics, Charge Invariance</p>	<p>Gravitational Charge: "Location" Charge; "Location" Asymmetry, Temporal Entropy; Spacetime Metric; Time; Conservation/Entropy Domain of Free and Bound Energy; ("G" is the entropy conversion gauge)</p>	<p>Partial Charges: Color Charge; (fractional charge asymmetry); "Asymptotic Freedom"; Flavor Charge (least bound energy, Nucleon "isospin"); "Yukawa binding" (mesons)</p>	<p>"Identity" Charge: Neutrinos are "Bare" Identity Charges; ("anonymity" asymmetry - distinguishable elementary particles); Neutrino Parity; Asymmetric Weak Force Decay</p>
<p>Force Carriers, Field Vectors, Bosons: (produced by charges of row 3) (symmetry restoration via the conversion of bound to free energy); (retiring the debt); Temporal Conservation Cycles; (row 4)</p>	<p>Photons; Exothermic Chemical Reactions; Matter-Antimatter Annihilation Reactions</p>	<p>Gravitons: Stars, Supernovas, Quasars, Black Holes; "Quantum Radiance" Gravitational Conversion of Mass to Light</p>	<p>Mesons, Gluons: Fusion, Nucleosynthesis; Proton Decay</p>	<p>Intermediate Vector Bosons (IVBs: W, Z, X); Leptonic Decays, Fission, Radioactivity; Particle and Proton Decay</p>
<p>John A. Gowan and August T. Jaccaci May, 2014</p>				

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