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Summary

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

- 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) 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. Dimensional asymmetry; 2-D or 3-D symmetric space vs 4-D asymmetric spacetime (time asymmetry). Opposite electrical charges attract, motivating antimatter annihilation reactions.

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 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. 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).

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".

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"

and spin. 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".

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 to locally conserved symmetry parameters of matter, time, and relative motion (and vice versa). The photon in its role as the field vector of electric charge, magnetic forces, and antimatter annihilator is prototypical of this function.

7) Gravity transforms the global spatial metric of absolute motion and light, as gauged by the electromagnetic constant c , into a local spacetime metric for relative motion and 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 and Hawking's "quantum radiance" of black holes), discharges all symmetry and entropy debts, accelerating the cosmic expansion. 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 the extreme example of the gravitational conversion and replacement of space and the electromagnetic metric by time and the gravitational metric.

9) The radiance of our sun and the stars announce a completed "circuit" of symmetry conservation.

We have asserted that light and metric space create matter in symmetric particle-antiparticle pairs, and that these, through the mechanism of mutually interlocking charges, annihilate each other to recreate the light which formed them. During the "Big Bang", the (unknown) asymmetric mechanism of the weak force breaks the symmetry of the particle-antiparticle pairs, producing an excess of matter (of perhaps one part in ten billion). We understand that the raw energy of light is stored (conserved) in the mass and momentum of the particles, and that the charges of matter, which appear to be gratuitous from the point of view of raw energy conservation, are in fact necessary from the viewpoint of symmetry conservation: not only the raw energy of light, but its non-local distributional symmetry (and symmetric entropy drive) must be conserved (Noether's Theorem). This interaction occurs within the metric arena of spacetime, the entropic dimensional setting created by the intrinsic motion of light, which houses and conserves the energy "play". What is this drama of light and particles? What is this "play" about?

There is another apex of the "[Tetrahedron Model](#)" which involves the second law of thermodynamics, entropy. It is through entropy that we are able to complete the conservation linkage between the dimensional structure of space, light, and matter. The primordial entropy drive of light is expressed through its intrinsic motion, which not only creates space and its metric (the conservation domain of light), but causes the expansion and cooling of space as well. The primordial entropy drive of bound energy is expressed through the intrinsic motion of time (and gravity), creating historic spacetime, the conservation domain of matter's causal information matrix. The intrinsic motion of time causes the aging and decay of matter and information and the expansion and dilution of history. Time and gravity are therefore a conserved form of light's entropy in matter (second thermodynamic law); mass and momentum are the conserved form of light's raw energy in matter (first law, energy conservation); the charges (and spin) of matter are the conserved form of light's various symmetries, and constitute the essential information which particles require, in the absence of antimatter, to return to their original symmetric state (Noether's Theorem). Causality and the "Interval" are the metric analogs of conserved, invariant material charges. Charge invariance (including the invariance of "velocity c ") is the key to the local activity of the four forces. (See: "[Effects of Global and Local Gauge Symmetries](#)").

Before "Big Bang" symmetry-breaking, in the absence of matter, Noether's Theorem is expressed through inertial metric symmetry conservation (including the suppression of local time), and the suppression of virtual particles by matter-antimatter annihilations, all gauged by "velocity c". After symmetry breaking, in the presence of matter, Noether's Theorem is expressed through charge and spin conservation, the inertial forces of the spacetime metric, and ultimately, by gravitation and time (through the conversion of bound to free energy in stars and black holes). Entropy conservation allows the conversion of free energy to work; symmetry conservation allows the conversion of free energy to charge and information; raw energy conservation allows the conversion of free energy to mass and momentum. These three conservation laws, acting in concert, allow (but do not cause) weak force symmetry-breaking and the conversion of light to our familiar material Universe. Time, causality, gravitation, and historic spacetime provide the connective linkages of matter's "causal matrix" and information field. History is the functional analog of space. The continued reality of historic spacetime and matter's "causal matrix" are necessary to uphold the continuing reality of the "Universal Present Moment" of material existence. (See: "[A Spacetime Map of the Universe](#)".)

Light's primordial entropy drive (light's intrinsic spatial motion), creates, expands, and cools light's dimensional conservation domain, space; matter's primordial entropy drive (the intrinsic motion of time) creates, expands, and dilutes information's dimensional conservation domain, history. Gravity, the entropy conversion force, welds space and the drive of spatial entropy (light's intrinsic motion) into time and the drive of historical entropy (time's intrinsic motion), creating historic spacetime, the joint entropy/conservation domain of free and bound energy. The first and second laws of thermodynamics are connected through the entropic creation of the dimensional conservation domains of light and matter. The function of entropy is to create a dimensional domain (space, history, historic spacetime) appropriate to its energy type (free or bound), in which energy can be transformed and used, but nevertheless conserved. Gravity converts and equilibrates the two entropy drives (by extracting time from space) so that interaction between them is possible, creating their joint dimensional conservation domain, historic spacetime. (See: "[The Conversion of Space to Time](#)".)

The metric relation between space, time, and light is gauged (regulated) by the universal energy constant c; the entropic relation between space, time, and mass is gauged by G, the universal gravitational constant. "G" is related to c through time and entropy. The magnitude of G is determined by the small energy difference between the symmetric spatial entropy drive (S) of light (the intrinsic motion of light, as gauged by "velocity c"), and the asymmetric historical entropy drive (T) of matter (the intrinsic motion of time, as gauged by "velocity T"):

$$S - T = -G$$

This is equivalent to the small energy difference between implicit (S) and explicit (T) time. (For a further discussion of the weakness of gravity, see: "[The Half-Life of Proton Decay and the 'Heat Death' of the Cosmos](#)".)

The gravitational conversion of space and the drive of spatial entropy (S), to time and the drive of historic entropy (T), can be symbolically represented in a "concept equation" as :

$$\begin{aligned} -Gm(S) &= (T)m \\ -Gm(S) - (T)m &= 0 \end{aligned}$$

The spatial entropy drive of free energy therefore funds the historical entropy drive of bound energy, and the expansion of the Cosmos must decelerate accordingly (because time is produced by the gravitational annihilation of space).

The cosmic drama begins innocently enough with the entrance of pure light and light's creation, the spatial

metric (which exists to regulate and conserve light's energy). The primordial interaction of high-energy light with the spatial metric creates a cast of virtual particles in symmetric particle-antiparticle pairs: some heavy (hadrons), some light (leptons), some composite and complex, some elementary and simple, but all related and all derived from the interaction between light's energy and the metric structure of space. They are costumed in various charges which allow them to alternate with blinding speed between their particle and wave forms, a counterpoint between manifest and unmanifest reality, a true magic show. But then a symmetry disaster strikes, and the plot literally thickens. Some of the heavy, composite particles of antimatter have reverted to their wave form via their neutrinos and the weak force "X" IVB, without annihilating their matter counterparts. Caught by surprise in an expanding Universe, the color charges of the remaining leptoquarks also expand from an implicit to an explicit (and conserved) state, preventing any further leptonic decay via neutrinos (since neutrinos do not carry color charge). The matter particles now have no way of reverting to their wave form in the absence of their antimatter partners; they are trapped by their expanding color charges in the 4th dimension of explicit time, whereas before they existed in the virtual realm of two or three symmetric spatial dimensions. We recognize them now as baryons. In the rapidly expanding and cooling Universe, they are left in their asymmetric and massive forms, one half of light's particle form, with all their charges intact and exposed, charges which had previously functioned to unite them with their antimatter partners and return both to light. *The charges of matter are the symmetry debts of light.* Like Hamlet's father, the baryons have been treacherously thrust into a new realm without the chance to absolve their "sins".

Gravitation arises in response to light's (broken) "non-local" distributional symmetry in space, a symmetry broken by the immobile and hence undistributed energy content of mass, matter, or bound energy generally. The active principle of gravity's "location" charge is time. Time identifies 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. 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, the metric equivalent of the annihilated space. The new temporal residue marches off into history, dragging more space which creates more gravity, etc. 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.*

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 the play now unfolds, a negentropic 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 argument of the play 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. In the meantime, as a sort of subplot, or "play within a 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, aesthetic, psychological, intuitive and rational terms, including even the [fractal algorithm](#) of the information pathway. (See: ["The Information Ladder"](#)).

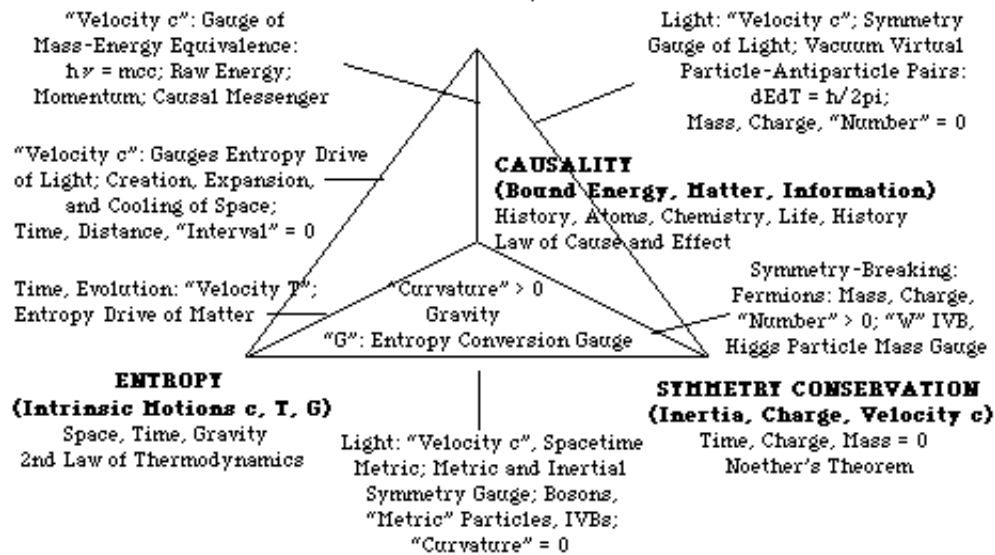
Postscript

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. But it could hardly be otherwise. We might as well be amazed at how perfectly our skin fits our body. 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](#)".)

Life 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 negentropic 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.

Tetrahedron Model Diagram

ENERGY CONSERVATION
(Free Energy, Light, $E = h\nu$)
 Raw Energy, Symmetry, Entropy
 1st Law of Thermodynamics



The Tetrahedron Model of Light and Conservation Law

Conceptual Geometry: a 4x3 General Systems Model of the Conservation Laws Underlying the Unified Field Theory

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Global vs Local Gauge Symmetries = "External" vs "Internal Lines"

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

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

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

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

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

4 Forces of Physics --->	Electromagnetism	Gravitation	Strong	Weak
Below: Comments on the Energy State Rows:	FORCES			
Free Energy, Light:				Elementary Particles

<p>electromagnetic radiation; space; symmetric forms; virtual particles; symmetry-breaking; (reprising the "Big Bang"); (incurring the debt); Spatial Energy Forms; (row 1)</p>	E N E R G Y S T A T E S	<p>Light: $E = hv$ (Planck); Intrinsic Motion c; All Charges = 0; Symmetric Energy ("velocity c" is free energy's entropy drive and symmetry gauge)</p>	<p>Space; Conservation/Entropy Domain of Light; Light's "Interval" = 0; The Spatial Metric; Metric Symmetry, Inertial Symmetry; Metric Curvature = 0 ("non-local" energy)</p>	<p>Sub-Elementary Particles (fractured leptons); Quarks; Particle-Antiparticle pairs; Leptoquarks; Particle Symmetry</p>	<p>Elementary Particles, Leptons; Neutrinos; Particle-Antiparticle Pairs; Higgs (Mass Gauge); Intermediate Vector Bosons (IVBs); Symmetry-Breaking</p>
<p>Bound Energy: matter; history; asymmetric forms; real particles (consequences of row 1 symmetry breaking); raw energy conservation; (down payment), "pay now"; Temporal Energy Forms; (row 2)</p>		<p>Mass: $E = mcc$; $h\nu = mcc$; (Einstein-deBroglie); Matter, Momentum; Asymmetric Bound Energy; Charges > 0;</p>	<p>Causality; Time, History; Conservation/Entropy Domain of Information; Mass Interval > 0; Metric Asymmetry; Time, Gravity; ("local" energy) ("intrinsic motion T" is bound energy's entropy drive)</p>	<p>Mass Carriers; Baryons, Mesons, Nucleons; Atomic Nucleus; (elements)</p>	<p>Alternative Charge Carriers; Leptons, Neutrinos; Electron Shell; (atoms)</p>
<p>Charges: quantized symmetry debts (carried by particles of row 2); symmetry (charge) conservation; (mortgage, credit), "pay later"; Temporal Symmetry Forms; (row 3)</p>		<p>Electric Charge: (4 - dimensional asymmetry - time)</p>	<p>Gravitational Charge: "Location" Charge; "Location" Asymmetry, Temporal Entropy; Spacetime Metric; Conservation/Entropy Domain of Free and Bound Energy; ("G" is the entropy conversion gauge)</p>	<p>Partial Charges: Color Charge (quantum - mechanical partial charge asymmetry); Flavor Charge (least bound energy, "isospin")</p>	<p>"Number" or "Identity" Charge: Neutrinos; ("anonymity" asymmetry - distinguishable elementary particles)</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, Quasars, Black Holes; "Quantum Radianc" 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>
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