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Principles of a Unified Field Theory: a Tetrahedral Model

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Six Relationships: An Analysis of the Lines Connecting the 4 Vertices of the "Tetrahedron Model"

All great discoveries in experimental physics have been made due to the intuition of men who made free use of models which for them were not products of the imagination but representations of real things. - Max Born

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Abstract

The simple story of the Cosmos is the devolution of light to matter followed by the evolution of matter back to light - as required by Noether's Theorem (the conservation of light's symmetry), and as regulated by the four conservation laws of the "Tetrahedron Model". But the information content of energy considerably complicates this simple ontogeny - the Universe apparently seeks self-awareness, self-knowledge, and self-experience (perhaps as the goal of, or justification for, all the effort involved in manifestation). The negative entropy of gravity and Natural Selection drives the evolutionary mechanism of biological matter, with DNA providing replication and the genetic system providing information conservation through heritable genes. Because of its genetic system, life has become a biological conservation domain of molecular information, with humanity advancing this principle evolutionary axis of the Cosmos (Chardin's view) through abstract thought, symbolic writing, science

and technology. Our planet is in her reproductive phase, with humanity as her dispersal agents, seeking new territory in the Galaxy. The natural tendency to evolve complex information systems of planetary size (and beyond) can be seen as the simple outgrowth of matter's search for antimatter (locally employing human intelligence in the quest), and a reprise of the original unity, symmetry, and connectivity of the primordial light Universe.

Introduction

The tetrahedron diagram is a model of the conversion of free electromagnetic energy (light) into bound electromagnetic energy (matter), and their consequent relationship. So far as we know, the creation of baryonic matter (single baryons without antimatter partners) has occurred naturally only once, during the very early moments of the "Big Bang", the birth of our Universe. Other examples of the conversion of free to bound energy, not involving the creation of new baryonic matter, include the conversion of free energy to "work" and the momentum and kinetic energy of massive particles and organized macroscopic systems, and the simple absorption of photons by the electron shells of atoms (including photosynthesis). (Baryons created during radioactive decays do not count because they do not change the total number of baryons in the universe - one baryon simply replaces another by changing or reshuffling its internal quark complement.) The model is reversible in that bound energy is either immediately or ultimately reconverted to free energy by a variety of physical processes, all acting in obedience to Noether's theorem of symmetry conservation.

The tetrahedron diagram is a model of the interrelationship of 4 conservation laws, principles, and their corollaries which underlie or regulate the operation of the 4 forces of physics. This is the ground of natural law which is antecedent to the unified field theory, the realm of principle from which the 4 forces are derived. These 4 principles are: 1) Energy Conservation (1st law of thermodynamics); 2) Entropy (2nd law of thermodynamics); 3) Symmetry Conservation (Noether's Theorem); 4) Causality-Information (law of cause and effect - "karma"). It is a postulate of the "Tetrahedron Model" that these four principles constitute a "minimum linked set", providing a necessary foundation for understanding the Unified Field Theory in the sense of elucidating the relationship between, and the common derivation of, the four forces of physics.

In the primordial transformation of free to bound energy (creating our "matter-only" universe), we find that, in the process, several attributes of light must be conserved. First there is the raw energy and momentum of light, transformed and conserved (by the nuclear and electromagnetic forces) as the mass and momentum of matter (1st Law of Thermodynamics, Energy Conservation). Next there is the spatial entropy drive or intrinsic motion of light, gauged by "velocity c", creating, expanding, and cooling the dimensional conservation domain of light (space). Light's entropy drive is transformed and conserved (by gravity) to the historical entropy drive of matter, the intrinsic motion of time ("velocity T", also gauged by velocity c), creating the dimensional conservation domain of information (historic spacetime - matter's "causal matrix") (2nd Law of Thermodynamics, Entropy, protecting causality and energy conservation). The conversion of space and the drive of spatial entropy (the intrinsic motion of light), to history and the drive of historical entropy (the intrinsic motion of time), is accomplished by both the quantum mechanical and gravitational annihilation of space, exposing a metrically equivalent temporal residue.

Finally, there is the symmetry content of light and its metric, which is transformed and/or conserved

in obedience to Noether's Theorem as: 1) the charges (and spin) of matter (the particle-antiparticle form of light - an energetic aspect of light's symmetry); 2) the forces of gravitation and inertia (the spatial, metric, or wave form of light - an entropic aspect of light's symmetry). *The charges of matter are the symmetry debts of light*. Symmetry-breaking is necessary to reveal the information content of particle-antiparticle pairs and their charges, which manifests as fermions (electrons, neutrinos, and quarks), the atomic constituents of matter. Charge conservation is a necessary guarantee to energy conservation, allowing symmetry-breaking and the conversion of free energy (light) to massive particles and information: charge conservation therefore plays a role analogous to that of entropy, the latter being a necessary guarantee to energy conservation allowing the conversion of free energy to "work". Gravitational conversion of the spatial entropy drive of free electromagnetic energy (light's intrinsic motion) to the historical entropy drive of bound electromagnetic energy (time's intrinsic motion) creates a local, temporal, gravitational metric which allows energy, charge, and entropy conservation in the causal domain of historical spacetime. Through the creation of time directly from space, gravity produces a combined spacetime metric in which both free and bound forms of electromagnetic energy can find all their conservation requirements satisfied. (See: "Spatial vs Temporal Entropy".)

Gravity works continuously at "paying down" the cosmic-scale symmetry/entropy debt of the "matter-only" cosmos (the debt of missing antimatter), by the creation of time from space, decelerating the cosmic expansion (addressing the entropy portion of the debt). This deceleration is opposed by the conversion of mass to light in multiple astrophysical processes (addressing the symmetry portion of the debt), converting negative gravitational entropy into positive electromagnetic entropy, eventually resulting in a net *acceleration* of cosmic expansion (as recently observed). (See: "Dark Energy: Does Light Produce a Gravitational Field?")

The Trinity Triangle

Speaking in terms of physical models, the "Trinity" triangle is the precursor of the "Energy Tetrahedron", which it creates in its own "image and likeness". In the 2-dimensional drawing of the tetrahedron model, a "doubling" of the three triangle lines occurs - almost reminiscent of chromosome doubling in biological cell division. This second set of lines becomes the 3 "interior" lines of the (2-D) tetrahedron drawing, all connecting to the 4th pole of causality, matter, and information. In each case, the interior line is formed from an interaction between the two external "Trinity" or triangle lines which enclose them. Thus from a mixture of the C-E free energy and space line with the C-S virtual particle line, we derive the internal raw energy conservation line C-CI, in which the raw energy component of free energy is converted to the mass and momentum of particles. From a mixture of the C-S virtual particle line with the S-E spacetime metric line, we derive the internal S-CI line of the fermions, atoms extracted by symmetry breaking via the Intermediate Vector Bosons (IVBs) of the weak force from the Heisenberg-Dirac vacuum "sea" of virtual particle-antiparticle pairs. Finally, from a mixture of the E-S line of the spacetime metric and the C-E line of light's intrinsic motion and space, we derive the internal line of time's intrinsic motion and history (including evolution) (E-CI). Note that the three outer triangle or "Trinity" lines are all forms of light, variously expressed as waves, virtual particles, or the metric of spacetime (including "metric particles", the bosons or field vectors of the forces). The model is self-consistent in that the outer "given" light lines naturally produce, through their interaction, the interior "derived" lines of matter which they enclose.

This internal "matter set" of 3 lines is a transformed and conserved duplicate of the outer "Trinity set": 1) conserving the raw energy of light as the mass and momentum of matter (via the quantum mechanical "collapse of light's wave function"); 2) conserving the symmetry of light as the charges (and spin) of matter (via weak force symmetry-breaking and the IVBs), and via the gravitational and inertial forces of the spacetime metric; 3) conserving the spatial entropy drive of light as the historical entropy drive of matter (via the gravitational conversion of space to time). The information produced in matter by atomic structure, and in life forms by the neg-entropic march of gravity, natural selection, evolution, and heritable genes, is conserved in the causal domain of historic spacetime - the conservation domain of information and matter's "causal matrix", created by the entropic march and drive of time.

Matter is created as an asymmetric, conserved form of light whose internal charges, forces, and information content will sooner or later act to return matter to its original symmetric state of light. The extensive information and causal webs created by matter (especially through its biological forms), suggests that bound energy is attempting to recreate in material form the original unity and connectivity of the light Universe, as driven by the electromagnetic force and matter's eternal search for antimatter. In this effort, we discern the operation of another conservation law, perhaps a corollary of Symmetry Conservation, the Conservation of Unity and/or Connectivity, which may be the source of humanity's spiritual awareness. The emergence of "beauty" in biological organisms may likewise be seen as a transformed expression of symmetry conservation in material systems and the source of our aesthetic awareness.

We turn next to an examination of the relationship between each of the 6 lines connecting the 4 vertices of the Tetrahedron Model. The lines are identified in the usual geometric fashion; for example, C-E refers to the line connecting the Conservation (C) and Entropy (E) poles or vertices of the 2-D diagram.

1) C-E The Relationship Between Energy Conservation and Entropy

The intrinsic (entropic) motion of light creates space, the conservation domain of free electromagnetic energy. Entropy is an embedded primordial property of light (light's intrinsic motion is the spatial entropy drive of free electromagnetic energy). Created by the intrinsic motions of light, time, and gravity, the dimensions are conservation domains for free and bound forms of electromagnetic energy, where energy can be used and transformed, but nevertheless conserved (2nd law of thermodynamics).

This is the relationship between the 1st and 2nd laws of thermodynamics, which is modeled here in its most basic form as the creation of dimensional conservation domains by the primordial entropy drives of free and bound energy - that is, by the three intrinsic *dimensional* motions of physics: light ("velocity c"), creating space; time ("velocity T"), creating history); and gravity ("velocity G") creating time and spacetime. (See also: "Spatial vs Temporal Entropy".)

a) The primordial forms of entropy are embedded in their energy types as intrinsic dimensional motions - gauged by c, G, T.

b) The dimensions of spacetime are conservation domains created by entropy. The intrinsic motion of light ("velocity c") - and its metric equivalent the intrinsic motion of time ("velocity T") - are effectively infinite velocities which protect causality, entropy, and energy conservation against

tampering by fast spaceship or "time machine", sealing the borders of their respective conservation domains (space and history). Any possible gravitational or inertial loopholes ("wormholes") are closed by the "event horizon" and central "singularity" of black holes. There is no (physical) escape from, or entrance into, the electromagnetic conservation domain of spacetime, other than via the "Big Bang" (or perhaps the "Big Crunch"). Even the energy of a black hole does not escape spacetime, but is recycled via Hawking's "quantum radiation" (demonstrating that even gravitational entropy obeys Noether's Theorem).

c) The intrinsic motion of light creates space, including the metric of space (the symmetric, inertial, scaled and regulated relationship between the dimensions). "Velocity c" is both the entropy drive and symmetry "gauge" or regulator of free energy and its spatial metric, not only creating space, but also expanding and cooling space. Space does not preexist the Big Bang; space is a dimensional conservation/entropy domain created by light for its own conservation. Light is the only energy form which can create its own conservation domain from nothing - or rather, from its own nature (intrinsic motion). Light is a 2-D transverse wave, requiring one dimension each for its electric and magnetic fields. The third dimension - the direction of propagation - is required by entropy. (See : "The Higgs Boson and the Weak Force IVBs".)

d) The role of entropy, whether positive or negative, is to create a dimensional conservation domain (space or history) for its energy type (free or bound electromagnetic energy), in which energy can be both used and conserved. The negative spatial entropy of gravitation creates matter's time dimension and the joint dimensional conservation domain of free and bound energy, spacetime. The intrinsic motion of time (the positive entropy drive of bound energy) creates history, the temporal analog of space, and the conservation domain of Information and matter's "causal matrix".

e) Thermal, thermodynamic, or "work" entropy allows the transformation of energy to work - thermal entropy permits energy to be simultaneously used and conserved by forbidding energy's abuse (non-conservation). Because of entropy, the same energy cannot be used twice to produce the same net work (prohibiting perpetual motion machines, or any cyclic device which creates net energy). Thermal and information entropy are related through the concept of ordered vs randomized energy ("useful" energy vs "heat" or "noise"). (See: "Gravity, Entropy, and Thermodynamics".)

f) Entropy is conserved in the sense that total entropy never decreases, although it may be transformed from one form to another. The intrinsic, entropic, spatial motion ("velocity c") of free energy (light) is gravitationally conserved as (converted to) the intrinsic, entropic, historical motion ("velocity T") of bound energy's time dimension. Without entropy, the first law would prevent any use of energy at all, and there would be no dimensional conservation domains, nor intrinsic motions to create them. As we should expect, the primordial forms of entropy (intrinsic dimensional motion) are embedded properties of energy: entropy and energy are an inseparably linked conservation pair.

g) Gravitational entropy conservation is demonstrated in a cosmic gravitational collapse or "Big Crunch", where the total thermal, spatial, electromagnetic and positive entropy of the Universe is converted to the negative, temporal, and gravitational entropy of a cosmic scale "black hole". In such a case, the total entropy of the Universe sums to zero. Gravity replaces the drive of positive spatial entropy (S) with the drive of a metrically equivalent historical entropy (T); spatial expansion is consequently reduced as gravitation funds the historical component of the total entropy equation (by

the annihilation of space and the extraction of a metrically equivalent temporal residue). We can represent the gravitational conversion of the drive of spatial entropy (S) to the drive of historical entropy (T) by the quasi-mathematical "concept equation":

$$-Gm(S) = (T)m$$
$$-Gm(S) - (T)m = 0$$

See: "Entropy, Gravitation, and Thermodynamics" and "A Description of Gravitation".

2) S-C The Relationship Between Symmetry Conservation and Energy Conservation

"Velocity c" is the gauge of light's "non-local" distributional and metric symmetry, vanishing the x, t dimensions (distance, time) and suppressing the spontaneous manifestation of virtual particles. Light is a perfectly symmetric energy form; light's symmetry must be conserved no less than light's energy (Noether's Theorem). This line also represents the suppressed Heisenberg-Dirac "vacuum sea" of virtual particle-antiparticle pairs.

The relationship between Symmetry Conservation and Energy Conservation is characterized by Noether's Theorem which states: in a multicomponent field (such as the electromagnetic field or the metric field of spacetime), wherever we find a symmetry we also find an associated conservation law, and vice versa. I think of this great theorem (the key to force unification) as the "Truth and Beauty" theorem (referring to Keat's *Ode on a Grecian Urn*: "Beauty is truth, truth beauty, - that is all / ye know on Earth, and all ye need to know"). In Noether's Theorem, the role of truth is played by Energy Conservation and that of beauty by Symmetry Conservation. Charge conservation is a common example of Noether's theorem enforced in nature; the symmetry of the spacetime metric as regulated by inertial forces is another example.

In essence, Noether's theorem states that the symmetry of light (in all its forms) is conserved: the "quality" of light must be conserved no less than its quantity. (Note, however, that the "potency" or "intensity" of light is not conserved, as this parameter of light (capacity for "work") is attenuated by entropy - the expansion of space caused by light's embedded entropy drive or intrinsic motion "c" (the total energy, of course, is conserved). Because matter is created from light, consisting in effect of one member of a particle-antiparticle pair, we see that *the charges of matter are the symmetry debts of light*. Because light itself is perfectly symmetric and carries no charges of any kind, light can only endow the particle pairs it creates with charges which sum to zero. The function of all charges in particle-antiparticle pairs is to cause and facilitate the annihilation of the pair, returning its bound energy content to the symmetric state of light. If, however, one member of a pair disappears (as happened during the "Big Bang"), the other member is left with its charges intact, charges whose annihilation functions are suspended indefinitely in the absence of their intended mates. Hence these charges are nothing if not *the symmetry debts of light,* for the complementary half of their original "whole" or symmetric charge is missing. Electric charge is the primary charge recording this symmetry disaster - the creation of our "matter-only" universe (others include gravity, time, and the parity or "handedness" asymmetry of the neutrinos.

The Heisenberg-Dirac "vacuum" is full of virtual particle-antiparticle pairs, whose opposite electric charges mutually attract their partners through space, effecting their annihilation within the "Heisenberg Interval", the time limit for the existence of virtual particles (dEdT = h/2pi). Because the

photon is the field vector of electric charge, we see that light is directly protecting its own symmetry in particle-antiparticle annihilations. The role of electric charge in nature is precisely to protect the symmetry of light, suppressing the spontaneous manifestation of virtual particles, preventing light from devolving into the linked asymmetries of mass, time, charge, and gravitation - the asymmetric "gang of four".

Virtual particles illustrate the tendency of light to manifest; particles may be envisioned as a consequence of the entanglement of a 2-dimensional high-energy electromagnetic wave with the structure of the spacetime metric, producing immobile 4-dimensional "knots": the structural attributes of particles derive from the dimensional metric. The production of real rather than virtual particles is thought to also involve the "Higgs" boson as well as the IVBs of the weak force. Both the Higgs and the IVBs appear to be "metric" particles, particles composed of a compressed, convoluted, and bound element of the metric structure itself, rather like one of the particles of "string theory". (See: "The Higgs Boson and the Weak Force IVBs".)

A program of force unification involves the identification of the broken symmetries of light which are represented by each of the four forces and their charges. We have already seen that gravitation is associated with the symmetry and entropy debt of light's "non-local" and "a-causal" energy state, light's loss of intrinsic motion c when its energy is converted to immobile "rest" mass. Hence the active principle of the gravitational charge (time) confers "locality", temporal causality, and an historical entropy drive upon any form of bound energy. Other examples (of light's broken symmetries) include our "matter-only" universe, a cosmic-scale symmetry debt which is recorded by bi-polar electric charge; light's "anonymity" symmetry (light's indistinguishable individual photons), a symmetry of "identity" protected by the weak force IVBs, neutrinos, and "identity" charges; and finally, a quantum-mechanical symmetry involving whole quantum unit elementary charges, which confines the fractional charges of quarks within baryons, a symmetry protected by the color charges and gluons of the strong force. For more on this topic of charges, forces, and their unification, see: "Symmetry Principles of the Unified Field Theory".

Charge conservation makes possible the conversion of free energy to particles and elementary forms of information, much as entropy makes possible the conversion of free energy to work, while raw energy conservation makes possible the conversion of free energy to bound energy, mass and momentum. Similarly, inertial forces and time make possible the relative motion of massive particles, while gravity creates the conservation parameter of time, converting the entropy drive of free energy (light's intrinsic spatial motion) to the entropy drive of bound energy (time's intrinsic historical motion). It is the time dimension that makes the conservation of energy possible for any massive particle, including the historical redemption of conserved charges, and relative rather than absolute motion. The conservation function of time is why mass requires a gravitational field - because gravity produces time from space, providing a combined spatio-temporal metric to satisfy the conservation requirements of both free and bound forms of electromagnetic energy. (See also: "A Rationale for Gravitation".)

3) E-S The Relationship Between Entropy and Symmetry Conservation

The symmetric electromagnetic metric of space and light vs the asymmetric gravitational metric of spacetime and matter. Gravity creates time by the annihilation of space, extracting a metrically

equivalent temporal residue, creating spacetime, the compound conservation domain of free and bound forms of electromagnetic energy. The Metric exists to regulate and conserve energy. Gravity, Inertia, Metric Particles, Bosons, General Relativity. The gravitational metric also conserves light's symmetry, as seen in the conversion of bound to free energy in stars, supernovas, quasars, and Hawking's "quantum radiance" of black holes.

Gravity

Gravity is matter's memory it once was light

a) The E-S line between the Entropy and Symmetry poles represents the (expanding and cooling) electromagnetic metric of space and light (before the creation of matter), and the gravitational metric of spacetime and particles (after the creation of matter). The metric exists for one reason only - to conserve and regulate energy. The spatial metric is created by the intrinsic, entropic motion of light, a conservation domain for light's energy created by light's own intrinsic motion, that is, light's own embedded entropy drive. Such is the primordial and intimate relation between the first and second laws of thermodynamics.

"Velocity c" is the gauge of the electromagnetic metric of space and light, and is simultaneously: 1) the gauge of light's entropy drive (light's intrinsic motion); 2) the gauge of the symmetric "non-local" distributional and metric symmetry of light's energy; 3) the gauge or regulator of the symmetric inertial relations among the three spatial dimensions. Among other functions, "velocity c" vanishes the time and distance dimensions (light has no "x" or "t" dimensions), and suppresses the spontaneous manifestation of "virtual" particle-antiparticle pairs. Among many other regulatory functions, the electromagnetic constant "velocity c" is first and foremost the symmetry gauge (regulator) of electromagnetic energy, but its connection to entropy is through light's intrinsic motion and the creation, expansion, and cooling of space - light's dimensional conservation domain.

When light is converted to matter, a new dimension (time) must be created to accommodate the variable energy accounts of massive particles, since their energy depends upon their relative motion, whereas light's energy depends only upon its frequency (light's intrinsic motion is "absolute" and invariant). The new temporal dimension is created by the quantum mechanical and gravitational conversion of space to time (see: "The Conversion of Space to Time"), creating gravitational spacetime, a compound conservation domain in which both free and bound forms of electromagnetic energy can interact and find all their conservation needs satisfied. Gravity has a double conservation role involving both light's entropy drive and the non-local distributional symmetry of light's energy. Gravity conserves by default both the entropic and symmetric gauge functions of "velocity c" when it conserves (transforms) either one - converting the intrinsic motion of light to the intrinsic motion of time.

The intrinsic motion of time becomes matter's entropy drive, creating history, the analog of space and the dimensional conservation domain of matter's causal information field. The gravitational metric "warps" or "curves" the electromagnetic metric (by the addition of time's intrinsic, one-way motion), and if matter is present in sufficient quantity and density, the gravitational metric will completely overwhelm the electromagnetic metric, creating a "black hole" in which gravity replaces all the metric functions formerly provided by light. (See: "A Description of Gravitation".)

b) One of gravity's several conservation roles is the creation of matter's time dimension; another role - the conservation of the "non-local" distributional symmetry of light's energy - seemingly reverses the first by converting bound to free energy (as in stars). Gravity creates time by the annihilation of space, extracting a metrically equivalent temporal residue. Because time is created from space, this same gravitational action creates spacetime, the joint dimensional conservation domain of free and bound electromagnetic energy. Time and space are entropicly equilibrated by "G" and metrically equilibrated by "c", integrating the interaction of light and matter in spacetime (the entropic conservation domain of free and bound forms of electromagnetic energy). (See: "Gravity, Entropy, and Thermodynamics".)

c) Time is the active, entropic principle of gravity's "location" charge, identifying the 4-dimensional position of massive, immobile energy. "Location" is the symmetry debt of light's "non-local" energy state, a symmetric energy state with respect to the distribution of light's energy, which is broken when light (free electromagnetic energy) is converted to massive stationary forms of matter (bound electromagnetic energy).

d) The gravitational "location" charge carries both an entropy and a symmetry debt of light; "velocity c" gauges both the non-local distributional and metric symmetry of light, as well as light's entropy drive (see: "The Double Conservation Role of Gravitation"). Time is the active principle of both gravitational debts. The quantum mechanical collapse of an electromagnetic wave initiates a gravitational field: the wave switches from a "wavelength" or explicit spatial character to a "frequency" or explicit temporal character (see: "Gravity Diagram No. 2"). The implicit temporal component of light or the traveling wave becomes the explicit temporal component of the particle or stationary wave, "setting" or initiating the time charge, determining the magnitude of G, and identifying the four-dimensional position of massive, immobilized electromagnetic energy. (See: "The Conversion of Space to Time".)

Light is non-local, due to its lack of an "X" and "T" dimension. The consequent "infinite" velocity of light results in the symmetric distribution of its energy, everywhere, simultaneously, throughout its spatial conservation domain (the Cosmos). This distributional symmetry of light's energy is broken when light loses its intrinsic motion and is converted to bound energy. This broken symmetry is conserved in accordance with Noether's Theorem by gravity's "location" charge, of which time is the active principle. We therefore surmise that the magnitude of G is determined by the small energy difference between the primordial drive of symmetric spatial entropy ("S" - the intrinsic motion of light), and the primordial drive of asymmetric historical entropy ("T" - the intrinsic motion of time), or equivalently, between implicit vs explicit time:

$$S - T = -G$$

e) Gravity pays its symmetry and entropy debts simultaneously by converting bound to free energy, as in stellar processes, and ultimately and completely in Hawking's "quantum radiance" of black holes. The latter process demonstrates that even the symmetry of entropy is conserved - the "all-way" spatial entropy drive of light having greater symmetry than the one-way historical entropy drive of bound energy. Black holes provide the physical demonstration of the notion that gravity converts space and the drive of spatial entropy (intrinsic motion "c") to time and the drive of historical entropy (intrinsic motion "T"). The surface of a black hole (the "event horizon") is a time surface, and its area is proportional to the black hole's entropy (theorem of Bekenstein and Hawking). In a black hole, the

temporal metric of gravity and negative entropy completely replaces the spatial metric of electromagnetism and positive entropy. But this ultimate gravitational metric can also claim to be a symmetric metric in that everything, including matter, moves at "velocity c" inside a black hole (g = c).

f) From the point of view of energy conservation, it is the "causal" nature of matter that requires the one-way time dimension, and hence the quantum mechanical mechanism to produce it; from the point of view of Noether's Theorem (symmetry conservation), it is the "local" nature of matter that requires the gravitational conversion of bound to free energy (as in stars). From the point of view of entropy, it is the fact that matter has no net intrinsic spatial motion that requires instead the intrinsic motion of matter's time dimension. These entropy and symmetry debts originate with "velocity c", which gauges both the entropy drive and symmetric energy state of "non-local" and hence "a-causal" light or free energy. To conserve either gauge function of "velocity c" is to conserve the other by default. Massless light is "non-local", a-temporal, and a-causal; massive matter is local, temporal, and causal. (See: "The Double Conservation Role of Gravity" and "A Rationale for Gravitation".)

G) Charge conservation = symmetry conservation. *The charges of matter are the symmetry debts of light*. The cosmos is a "charge now - pay later" symmetry conservation domain which runs on the "credit card" of gravity. Gravity pays the entropy-"interest" on matter's symmetry debt by creating time from space, providing an historical conservation domain in which charge conservation can have meaning. The cosmos' spatial expansion, which funds the historical expansion, is reduced in consequence. Gravity pays the energy-"principle" on matter's symmetry debt by converting bound to free energy in stars, supernovas, quasars, etc. (partially), and via Hawking's "quantum radiance" of black holes (completely). The cosmos' spatial expansion increases accordingly (as recently observed) - as the total mass and hence the total gravitational energy of the cosmos is reduced. (See: "Dark Energy": Does Light Produce a Gravitational Field?)

4) C-CI The Relationship between Energy Conservation and Causality-Information

The conversion of free electromagnetic energy (light) to bound electromagnetic energy (matter); the creation of mass. hv = mcc; Conservation of energy; 1st law of thermodynamics. Light as the causal messenger; Einstein's "Interval"; Lorentz Invariance.

Because it is a conservation relation, the equivalence between mass and free energy discovered by Einstein - E = mcc - makes possible the conversion of light to particle mass and momentum. Particle-antiparticle pairs are created by the entanglement of light's electromagnetic wave in the structural web of the spacetime metric. Matter is separated from antimatter by the Higgs boson (mass scalar) and the weak force IVBs (Intermediate Vector Bosons), which mediate the asymmetric creation of matter during the "Big Bang". (See: "The Origin of Matter and Information"; see also: "The Higgs Boson and the Weak Force IVBs".)

a) When light is converted to matter, as in the "Big Bang", there are three principle conservation modes protecting the energy of light: 1) Raw Energy (as conserved by mass and momentum in matter); 2) Entropy (dimensionality, intrinsic motion), the intrinsic motion of light (the entropy drive of free energy, creating space), conserved as the intrinsic motion of time (the entropy drive of bound

energy, creating history); 3) Symmetry (as conserved during symmetry-breaking by the charges and spin of matter, and the gravitational and inertial forces of spacetime). Free and bound energy are only equivalent energetically: free energy (light) is 2-dimensional, massless, non-local, a-temporal, a-causal, and symmetric, carrying no charges of any kind (neither gravitation nor information); bound energy (matter) is 4-dimensional, massive, local, temporal, causal, and asymmetric, carrying various charges (including gravitation and information). The formal relations of time and causality as they apply to matter, including matter's interaction with light, are the subject of Einstein's Special Theory of Relativity. The ability of Earth and its life forms to capture, store, and process energy from the Sun (for example, in photosynthesis) depends upon the capacity of light and matter to engage in energy-conserving interactions. (See: "The Tetrahedron Model".)

b) Biological information is conserved (in molecular form) in the heritable genome of organisms (individually) and species (collectively). The genetic conservation domain of biological information (the genome) is subject to positive entropic forces, however, including mutation (at the molecular level), death (at the individual level), and extinction (at the species level). The genome is also subject to negative entropic forces through evolution as driven by Darwinian Natural Selection. Higher animals process information through their nervous systems and brains. Humans have added a new fractal iteration to the information domain in terms of language and other abstract symbolic representations or codings of information, including mathematics, machine and electronic languages, as well as cultural/social information storage and processing modes, centers, and adaptations (books, libraries, schools, computers, the internet, etc.).

Information is strictly conserved only at the level of elementary particles and charges, and in the historic (causal) dimension of spacetime. This has the advantage of freeing higher levels of system information (for example, electron shell interactions, combinations and permutations) from oppressive conservation restrictions. If information were strictly conserved at every level, evolution would be either impossible or ineffective: evolutionary advance depends upon a moderately rapid cycle of death, birth, extinction, and the creation of new species - in a word, change. However, the conservation of information in the historic time dimension is another matter altogether. In this case one "observer's" history or past is another observer's present moment. Causality would fail if the historical dimension did not conserve information. Yesterday is inaccessible, but real nonetheless. If it were not, the linkage between the present moment and our birth would disappear, and we would cease to exist. In the occult tradition of the "Akashic record", access to the information stored in the historical dimension of spacetime is possible to the adept. We are all immortal in history. (See: "A Spacetime Map of the Universe".)

c) Light is the causal messenger. Einstein's "Interval" is an invariant unit of spacetime necessary to rescue causality from Einstein's relativistically variable spacetime. Observers in relative motion (or variable gravitational fields) find that time and space co-vary in such a way that causal relations are always respected and "velocity c" (and electric charge) remain invariant ("Lorentz Invariance"): the integrity and conservation function of the metric remains intact.

5) S-CI The Relationship Between Symmetry Conservation and Causality-Information

The conversion of light's symmetries into the charges of matter. The creation of atomic matter. Charge conservation = symmetry conservation. The charges of matter are the symmetry debts of light. *Charge*

conservation; charge invariance; Noether's Theorem. Information. Symmetry-breaking, fermions, atoms, elements, IVBs, the weak force, quantum mechanics. Nuclear and electron shell chemistry. Life. The fractal "Information Pathway".

a) ***The charges of matter are the symmetry debts of light.***

b) Information requires asymmetry. Light carries zero information because it is perfectly symmetrical. Information is conserved in the historic spacetime domain (matter's "causal matrix", network, web).

c) The production of particles and information from energy during the "Big Bang" requires both charge conservation and symmetry-breaking; symmetry-breaking is permitted only because charge conservation provides for the preservation (in an alternative form) of light's various symmetries. Charges are an alternative, "manifest" form of light's symmetries - a form capable of repayment (restoration of light's symmetry) at any time, and complete conservation into the indefinite future - for "as long as it takes" to repay light's symmetry debt (as by antimatter annihilation, for one example).

d) Charges and elementary particles are the primordial physical forms of information.

e) Charges create forces whose purpose is to return matter to its symmetric origin, light (symmetry conservation - Noether's theorem). The search for antimatter and a pathway back to symmetry is eternal, due to charge conservation.

f) The conservation role of information (in the form of charge) is to provide a return pathway from the asymmetric state of bound energy (matter) to the symmetric state of free energy (light). (The human analog is "knowledge" providing the pathway to "enlightenment".)

g) Matter is created from light; light is primary, matter secondary; matter is an asymmetric form of light, consisting of one-half of a particle-antiparticle pair. (Analogously, time seems to be one-half of a symmetric spatial dimension.) Hence matter is one-half of light's symmetric particle form. The charges carried by particles were intended to cause and facilitate annihilation reactions with antimatter partners, restoring such pairs to light's original symmetry. Hence these particle charges, "hung" in time because of the absence of an annihilation partner, are indeed the "symmetry debts of light".

h) A charge can be considered a "bit" of elementary information, and charge conservation is the mechanism which allows one component of the symmetry of free energy to be transformed into material particles and information. In this regard, the role of charge conservation enabling the creation of particles is analogus to the role of entropy enabling the production of "work". When light is transformed to matter, charge conservation provides the guarantee that symmetry debts representing those charges will be repaid. Likewise, entropy provides the guarantee that energy will be conserved when it is transformed to work. Charges generate forces that act to return the material system to symmetry. Without charge conservation, the symmetry of the particle-antiparticle pairs could not be broken, as there would be no guaranteed pathway back to symmetry, and hence no symmetry conservation. The information held by the charges of matter is the information necessary for matter's return to symmetry; this is one reason why information is a significant physical parameter (another is that information allows the universe to become self-aware, through living, biological systems).

The value or magnitude of any charge is not affected by relative motion (or entropy) because charges

are symmetry debts, not energy debts, and have no relation to the quantity of energy they are associated with. This is even true for gravity, as seen in the invariance of "Big G", the universal gravitational constant, despite the fact that gravity represents both an entropy and a symmetry debt of light. The symmetry debt is quantized, which means that time is also quantized - time being the active principle of gravity's "location" charge.

i) Fermions are the basic information carriers produced in the symmetry-breaking reactions of the "Big Bang". Fermions include the familiar atomic constituents, nucleons (protons, neutrons), electrons, and neutrinos. Matter is composed of fermions. Bosons are typically the force carriers of fermion charges - photons, gravitons, gluons, IVBs. (See: "The Particle Table".) The IVBs (Intermediate Vector Bosons) of the weak force are instrumental in the process of symmetry breaking. IVBs (as scaled by the Higgs boson) form a bridge between the real world of fermions and the virtual realm of particle-antiparticle pairs, mediating the birth, death, and transformation of quarks and leptons through interactions between the "real" world and the virtual particle "sea" of the Dirac/Heisenberg spacetime "vacuum". As the name indicates, the IVBs are intermediate forms between typical bosons and fermions, and hence appear in both the S-E and S-CI lines. IVBs have mass like the fermions, but act as force carriers like the bosons. The weak force charge mediated by the IVBs is known as "number", "flavor", or "identity" charge (these charges are actually provided by the virtual particle "sea" rather than the IVB itself). (See: "The Weak Force: Identity or Number Charge"; see also: "The 'W' IVB and the Weak Force Mechanism".)

j) The mechanism of symmetry breaking in the "Big Bang" remains a mystery, but evidently involves a tiny asymmetry in the weak force reaction rate with matter vs antimatter, on the order of about one part per ten billion. Hence the time dimension ("rate"), already asymmetric, is thought to play the major symmetry-breaking role. (See: "The Origin of Matter and Information").

k) Matter holds information in the nuclei and electron shells of the atomic elements of the periodic table, and especially in their chemical combinations, permutations, and geometric configurations. The "organic" bonding patterns of carbon and the replicating molecules RNA and DNA form the chemical basis for life. Through the complex chemistry of these molecules, genetic heritability and evolution, life has become a molecular conservation domain of information. There is simply no upper limit to the amount of information that can be produced from energy, and no way of knowing what the extent and complexity of its domain might become. The rise of consciousness, cognition, and information systems is an evolutionary vector/parameter recognized by Chardin and carried forward in many abstract, symbolic, and artificial forms by the Human species (memory, language, writing, technology, computers, social systems, schools, libraries, science, art, mythology, religion, etc.). (See: "Newton, Darwin, and the Origin and Abundance of Life in the Cosmos".)

See also: "Chardin: Prophet of the Information Age", "The Information Ladder" and "The Information Pathway" and "Nature's Fractal Pathway".See also: "The Human Connection".

6) E-CI The Relationship Between Entropy and Causality-Information

Time, history, causality. The creation of the temporal and historical domain by gravity. History is the temporal analog of space and the conservation domain of matter's causal information field. Evolution, "Karma"; positive and negative entropy of genetics (mutation, Natural Selection), life.

This line represents the time dimension, history, and in living systems includes evolution and the negative entropy of Natural Selection. In the phenomenon of evolution, we see clearly the mixture of time with information, the convergence of the lines E-CI and S-CI in the central apex (matter) of the material world.

a) The origin of time is via space, light, and gravity; the intrinsic motion of time is a conserved residue or derivative of the intrinsic motion of light. Both time and space are implicit in the formula describing the intrinsic motion of light: "frequency" (time) multiplied by "wavelength" (space) = "c". Time is extracted from space by the action of gravitation (gravity annihilates space, extracting a metrically equivalent temporal residue), or the quantum mechanical collapse of an electromagnetic wave. In turn, the intrinsic motion of time causes the intrinsic motion of gravitation (as time pulls space into history): gravity and time induce each other in an endless entropic loop. In the end, the entropy drive of time and gravitation (the intrinsic motion of time) are both derived from the entropy drive of light and space (the intrinsic motion of light); this linkage is why the Universe decelerates when free energy is converted to bound energy - an amount -Gm(S) of the spatial entropy drive (S) of light has been gravitationally transferred to the historical entropy drive (T) of matter:

$$-Gm(S) = (T)m$$

b) The intrinsic motion of time is the metric equivalent of the intrinsic motion of light ("time flies").

c) The aging of the temporal dimension (the expansion of history) and the decay of matter and information is a complex analog of the expansion and cooling of the spatial dimension; history is the temporal and entropic analog of space.

d) History is the conservation domain of information and matter's "causal matrix"; bound energy forms are connected by the causal time line and matrix of history. Time and history are the connective tissue of massive energy forms, just as space is the connective medium of massless energy forms. Gravity connects everything: light, space, time, history, and matter into a single causally connected whole: historic spacetime.

e) Time is an asymmetric, one-way, moving, linear dimension (actually 1/2 of a linear dimension). Massive objects age, but they do not participate in the expansion and dilution of causal history in the way light participates in the expansion and cooling of physical space; hence they retain their energy content practically indefinitely (depending only on their gravitational environment and the half-life of particle and proton decay). (See: "The Time Train" and "The Half-Life of Proton Decay and the Heat Death of the Cosmos".)

The intrinsic motion of time is the entropy drive of bound energy. Matter requires a one-way linear moving time dimension to maintain causality and to keep its energy accounts, because unlike light, which moves with an absolute, constant, and non-relative velocity, the energy content of matter is relative and varies with matter's variable and relative velocity. Without the time dimension, matter could not move because its kinetic and momentum energy accounts could not be continuously registered, updated, and conserved, nor could the causal relations associated with these motions and its spacetime position be established, regulated, and conserved.

There is a radical difference between the drives of temporal and spatial entropy. Because space is

3-dimensional and symmetric (each spatial dimension is two-way), the spatial entropy drive (the intrinsic motion of light) causes the rapid expansion and cooling of the spatial conservation domain of light. Light fully participates in the entropic expansion of its conservation domain - in fact, the intrinsic motion of light is the entropy drive which creates space and causes its expansion. However, this is not true for matter and matter's entropy drive, time. History is not an expansive domain available for our exploration as is space, again because time is one-way only, and it is the time dimension which moves, not us. We are in physical contact only tangentially with time's moving front (via the ephemeral "present moment"); the increasing time line and matrix of history, which is certainly real enough, nevertheless recedes from us at the equivalent of light speed (and at "right angles" to all three spatial dimensions simultaneously), and therefore cannot be accessed by we who have created it. (See: "A Spacetime Map of the Universe".)

Whereas light completely occupies its expanding (and cooling) spatial conservation domain, matter does not similarly occupy its historic domain - only information follows time into history. Matter exists always in the "Eternal Now", forever on the tangential cusp of an ever-receding and expanding historical dimension. These dimensional differences profoundly change the effects of entropy on bound vs free energy forms. Biological organisms like ourselves "age" because of our complexity, genetic programming, and fragility; but our constituent atoms hardly age at all. (See: "Proton Decay and the 'Heat Death' of the Universe".)

In biology, the neg-entropic mechanism of Natural Selection uses the positive entropy of genetic variation to produce organisms with greater "fitness", reversing the entropic erosion ("mutation") of genetic information. The negative entropy mechanism of Natural Selection is necessary to produce the incredible complexity of biological organisms. It is because of the negative entropy associated with evolution, and the conservation of information via heritable genes, that the biological systems of life have truly become a molecular conservation domain of information. Our evolutionary history resides in our genes, where it is conserved in coded molecular form. History is the analogous dimensional conservation domain of matter's information web, network, or "causal matrix". (See: "Newton, Darwin, and the Origin and Abundance of Life in the Cosmos".)

Like chemistry, *evolution is simply a physical fact and process*, the natural neg-entropic pathway for the spontaneous conscious awakening of matter, energy, and the Cosmos. Evolution and the facts of Biology are no more an affront to human "dignity" than the facts of Chemistry, Physics, or Celestial Mechanics. Humans have furthered the natural evolution of information systems through abstract thought and symbolic writing, science, technology, and social systems. Human information systems actually represent a new iteration of the universal 4x3 fractal algorithm (the "Metaphysical Realm"), as demonstrated in our understanding and control of the evolutionary process, chemistry, and even nuclear reactions (see: "The Information Pathway"). According to Teilhard de Chardin, information building is in fact the central evolutionary axis, vector, or "purpose" of the Universe. See: "Chardin: Prophet of the Information Age".

See Also: "Postscript, Commentary, and Additions to this Paper"

See also the two papers: "Information vs Causality" and "Section 14: Causality".

Links:

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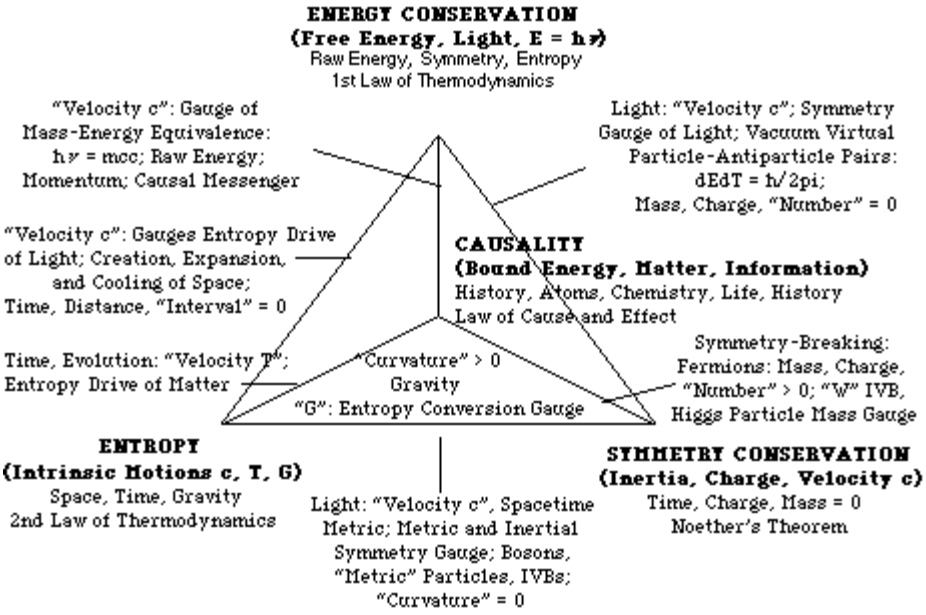
Fig. 1: The Tetrahedron Model



The Tetrahedron Model of Light and Conservation Law
Conceptual Geometry: a 4x3 General Systems Model of the
Conservation Laws Underlying the Unified Field Theory
John A. Gowan and August T. Jaccaci Jan., 2009
http://www.johnagowan.org/index.html
Global vs Local Gauge Symmetries = "External" vs "Internal Lines"

1) Energy conservation: 1st law of thermodynamics. Free energy, light. E = h ν (Planck's energy quantum); h ν= mcc (Einstein-deBroglie mass-energy equivalence); dEdT = h/2pi (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.