

John A. Gowan
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Synopsis of The Tetrahedron Model
(revised May, 2011)

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Abstract

The "Tetrahedron Model" is a model of the devolution (asymmetric transformation) of light (free electromagnetic energy) into matter (bound electromagnetic energy), that is, of the relationship between the two forms of electromagnetic energy which constitute our Universe. The "Tetrahedron Model" revolves around the conversion of light into matter and vice versa, as regulated by four conservation laws: the Conservation of Energy, Entropy, Symmetry, and Causality. These four conservation laws underlie the formulation of any Unified Field Theory.

Preface

In the "[Tetrahedron Model](#)", the four "points" or apices of the diagram are associated with fundamental conservation principles: 1) the Conservation of Energy; 2) Causality-Information; 3) the Conservation of Symmetry; 4) Entropy. These cardinal points are furthermore associated with (respectively) 1) light, or free electromagnetic energy (including space); 2) matter, or bound electromagnetic energy (including history); 3) Noether's Theorem (including virtual particles and the spacetime metric); 4) Intrinsic Dimensional Motions (of light, gravity, and time). Six lines connect the points of the diagram; they are divided into two sets, "external" (light lines), and "internal" (matter lines). The "light lines" are associated with "velocity c", virtual particles, and the spacetime metric. The "matter lines" are associated with mass, charge, time. The [faces of the "Tetrahedron Model"](#) have also been interpreted to represent the four realms of the manifest Cosmos: Microphysical, Biophysical, Astrophysical, Metaphysical. It is presumed that a complete theory of the Cosmos can be built upon the conservation base provided by this model. This paper addresses the relationships between the four major conservation principles as suggested by their six conjoining lines. (See also: "[Nature's Fractal Pathway](#)".)

(Because I have relatively recently reformulated the material or "central" apex of the [Tetrahedron Model](#) as

"Causality-Information" or "Causality" (formerly designated as simply "Information"), this preface is added to help clarify the reasons for this change, the connection between Causality and Information, and the role of both in the model. Additionally, the discussion is intended to serve as a general introduction to the model and paper.)

Introduction: "Causality" vs "Information"

(see also: "[Causality](#)" and "[Section 14](#)")

While "Information" is a useful general characterization of the fundamental significance of matter, both for the model and the Universe, it is not quite "active" enough in its meaning to complement the other three conservation principles of the [Tetrahedron Model](#). "Information" is a state or configuration of energy and/or charge, whereas the other three model parameters (Energy Conservation, Entropy, and Symmetry Conservation) are conservation principles or their corollaries. Causality (the law of cause and effect - causes must precede effects and all effects must have causes) is also a conservation principle, connecting with the other three laws in a very natural and illuminating way, as we shall hopefully see below. Meanwhile, although "Information" is to be demoted to a secondary position in terms of the "Tetragrammaton" of conservation laws, it obviously remains of first importance for a description of the significance of the material system in either its parts or its entirety. It is in fact the potent combination of Causality and Information that makes up matter's "causal matrix" within the conservation domain of historic spacetime, the "Karma" and "Akashic Record" of metaphysical systems of thought. Ultimately, neither Causality nor Information has any meaning without the other, but the connection to the other conservation laws is clearer and simpler through the causal member of this linked pair.

As stated in the abstract, the ["Tetrahedron Model"](#) is a model of the devolution (asymmetric transformation) of light (free energy) into matter (bound energy), that is, of the relationship between the two forms of electromagnetic energy which constitute our Universe. As diagrammed, the "top" of the tetrahedron is the free energy apex (light), identified with the principle of Energy Conservation; the "interior" point of the diagram is the bound energy apex (matter), identified with the two linked principles, Causality-Information. The left-right position of the remaining two conservation principles (which facilitate the transformation of light to matter and vice versa) is arbitrary, but I habitually put Entropy on the (reader's) left and Symmetry on the right. The transformation of light, space, and the electromagnetic constant c into matter, history, and the gravitational constant G is also represented as the transformation of absolute, "global" gauge symmetries into relative, "local" gauge symmetries. (See: "[Global and Local Gauge Symmetries in the Tetrahedron Model](#)".) (See Also: "[The 'Tetrahedron Model' vs the 'Standard Model' of Physics: A Comparison](#)".)

(While this configuration applies only to my particular 2-dimensional drawing of the tetrahedron, I have found it heuristically invaluable, and habitually think of and refer to the "interior" and "exterior" lines of the diagram, which of course cannot be so distinguished in the 3-dimensional figure; but in any case the only value of a model is its heuristic potency.) This intuitive placement is validated by the realization that the three "outer" lines represent "global" or absolute symmetries (whose spatial metric is timeless, established or "gauged" by the electromagnetic constant " c "), while the three "interior" lines represent corresponding or derived "local" or relative gauge symmetries (whose metric includes time, established and gauged by the gravitational constant " G ").

This model revolves around the conversion of light to matter and vice versa, as regulated by four conservation laws - the Conservation of Energy (1st law of thermodynamics), Entropy (2nd law of thermodynamics), Symmetry Conservation (Noether's Theorem), and Causality (Law of Cause and Effect). It is this simplicity which makes the model elegantly beautiful,

scientifically rigorous, and explainable. It is of utmost significance for our model that: 1) the tetrahedron is the simplest regular polygon in which all apices are directly and equivalently connected; 2) the molecular bonding pattern of both carbon and water is tetrahedral (see below). (See also the table: "[The Tetrahedron Model in a 4x4 Matrix Format](#)"; and: "[The Interaction of 4 Conservation Laws with 4 Forces](#).)

The evolution of Information, especially biological information and its conservation in the historic domain of spacetime (as seen in the "[Spacetime Map](#)"), identifies the 4th (Causal) material apex as the locus of most of the complexity in the Universe (illustrated by the "[Fractal Organization of Nature](#)" table, and the [papers which accompany](#) that table). The *abiotic* purpose of Information is to provide a "map" for matter back to its original symmetric energy state (light), despite the absence of antimatter (for example, through the conversion of bound to free energy in stars, quasars, Hawking's "quantum radiance" of black holes, particle and proton decay, fusion and fission). This pathway is illustrated in the 4x4 matrix of the "[Metaphysical Table, Rational Component](#)" and discussed in the papers on "[Symmetry Principles of the Unified Field Theory](#)", etc.

The *biotic* purpose of information is related but distinct (see the "[Information Ladder](#)" table and its [accompanying papers](#)). I have explained the expanding information networks of biology as the attempt by matter to resurrect the original unity and connectivity of the light Universe. Like "beauty" in nature and human aesthetics, this drive towards "holism" represents the probable operation of an emergent corollary to the principle of Symmetry Conservation. Remarkably, humans have even converged with the abiotic drive to restore matter to its symmetric state of free energy, most notably in our mimicry of solar fusion in the hydrogen bomb. This notion is perfectly commensurate with the driving force of the biological Information domain: matter's eternal search for antimatter via the long-range electromagnetic and gravitational forces, expanding through humanity into the short-range strong and weak forces. (A strictly local interpretation of biotic purpose (in the case of humanity) is the dissemination of Gaia's (Mother Earth's) life forms throughout our galaxy.)

In biology we also find the evolution of consciousness, self-awareness, and personal identity, as the self-referent and fractal Universe awakens, explores, and expands its information and creative potential through living matter, becoming aware of and experiencing itself. The evolution of consciousness in biology can even be seen as the attempt to reconstitute the wave form of light (as thought) in macroscopic material forms. (See: "[DeBroglie's Matter Waves and the Rise of Consciousness in Biology](#)".)

The Tetrahedron Model is an attempt to reduce conservation law to an essential minimum set. Analysis of the Tetrahedron Model's rational component suggests an abundance of metaphysical analogies. For example, in the conservation of Unity, we find an analog of the metaphysical principle of universal "Love"; in the connectivity of the Cosmos we find the analog of "spirit"; in the 4 conservation laws and the 4 forces of physics we find analogs of Divine Law and Omnipotence; in Causality we find the classic principle of "Karma"; while in Information itself we find the principle of universal self-knowledge ("Omniscience"), essentially [Chardin's "Omega Point"](#). This latter idea is also advanced by Prof. J. C. Gowan (Sr.) in his book "[Trance Art, Creativity](#)": - the "All" evolving toward a state of universal self-knowledge, in which the All shall know and be known by the All.

Synopsis of the Principle Connections and Interactions of [The Tetrahedron Model](#)

(Explaining the meaning associated with the lines connecting the 4 vertices or conservation laws of the

model. Interactions between the 4 conservation principles are symbolized by the six lines connecting the vertices of the tetrahedron.) (See also: "[The 'Tetrahedron Model' vs the 'Standard Model' of Physics: A Comparison](#)".)

(Upper-case abbreviations below refer to the 4 principles: C = Energy Conservation, CI = Causality-Information (or simply Causality), E = Entropy, S = Symmetry. The index "C-CI" therefore refers to the interaction between Energy Conservation and Causality, the line (in the model diagram) connecting the Conservation - Causality vertices, etc.)

Part I: The "Trinity of Light": (The "External" Lines: **Velocity c, Virtual Particles, Spatial Metric**)

Entropy, Symmetry, Conservation of Energy (Intrinsic Motion c, Virtual Particles and Virtual Time, the Spatial Metric.)

1) Line C-S: Virtual particle-antiparticle pairs and "non-local" energetic symmetry; 2) Line S-E: the symmetric, atemporal, inertial spatial metric; 3) Line C-E: the intrinsic, entropic, and "absolute" motion of light (creating, expanding, and cooling space).

(See also: "[Tetrahedron Model: External Lines](#)"; and "[The Ethereal/Material Tetrahedron](#)".)

C-E) The connection between Energy Conservation and Entropy as found in free electromagnetic energy (light) and "intrinsic motion c". The creation, expansion, and cooling of space by the intrinsic motion of light, as gauged by the electromagnetic constant c ("velocity c").

Space is the dimensional conservation/entropy domain of free energy, created by the entropy drive of light (light's intrinsic motion) for light's own conservation. Space does not preexist the "Big Bang"; spatial dimensionality is created by the intrinsic motion (entropic drive) of free electromagnetic energy. Light is the only energy form which can create its own conservation domain (space) from nothing - or rather, from its own nature (entropy drive, "intrinsic motion"). The "intrinsic" (self-motivated) motion of light is caused by the "wavelength" or symmetric spatial component of an electromagnetic wave fleeing the "frequency" or asymmetric temporal component which is embedded in light's own nature (the classic "bur under the saddle") ("frequency multiplied by wavelength = c"). Intrinsic motion at "velocity c" suppresses the temporal component of spacetime to an implicit state, maintaining the symmetric energetic state of atemporal metric space and "non-local" free energy, while also causing the expansion and cooling of the Cosmos. The entropy drive and symmetric energy state of free energy (light) and the spacetime metric are all gauged and linked by "velocity c". Time, whether implicit in light or explicit in matter, is the entropy drive and the motivating agent for change in the Cosmos. (See: "[The Conversion of Space to Time](#)".)

Entropy creates dimensional conservation domains in which energy can be used and transformed, but nevertheless conserved; this is the connection between the 1st and 2nd laws of thermodynamics. This is one reason why "velocity c" must be an effectively infinite ("absolute") velocity. The conservation of Causality is another. The intrinsic motion of light is caused by the entropy drive of free energy in the service of energy and symmetry conservation. (See: "[Gravity, Entropy, and Thermodynamics](#)".)

Concerning the Primordial Forms, Drives, and Gauges of Entropy (c, G, T):

(the intrinsic motions of light, gravity, and time)

See: "[Spatial vs Temporal Entropy](#)"

C-S) The connection between Energy Conservation and Symmetry Conservation as found in free electromagnetic energy (light): (the suppression of time, distance, and massive particles at "velocity c"; virtual particles and virtual time; metric and matter-antimatter symmetry; Noether's Theorem).

Particle-antiparticle pairs are created in the virtual Heisenberg/Dirac vacuum "sea" by the interaction of light with the metric structure of spacetime. The mixture of wavelike light and the metric structure of spacetime (itself created by light's intrinsic motion) exhibits a secondary particle-like expression of electromagnetic energy in terms of a variety of particle-antiparticle pairs - according to the rules of quantum mechanics, including Heisenberg's "Uncertainty Relation" and Dirac's virtual antiparticle "sea". These are potentially bound forms of energy but they remain as unmanifest (symmetric) virtual particle-antiparticle pairs so long as they are created (and instantly annihilated) in equal numbers.

Virtual particle-antiparticle pairs are created with opposite sets of various charges (color, flavor, electric, spin) which function to cause their immediate annihilation - thereby maintaining the non-local, massless, atemporal, energetic and metric symmetry of light. The role of electric charge is to prevent light's symmetric energy state from devolving into asymmetric, immobile, massive particles and their asymmetric companions: time, gravitation, and charge. Noether's theorem requires the conservation of light's symmetry, no less than light's energy, realized (in part) through electrically motivated annihilation reactions, suppressing the creation of "real" (massive, temporal) particles, and the metric-warping gravitational fields which must accompany them. Not only the quantity (total energy) but the quality (symmetry) of light must be conserved. Symmetry conservation in light (as gauged by "velocity c ") suppresses the creation of "real" particles from the virtual "sea": as the force carrier or field vector of electric charge, the photon protects its own symmetry by means of particle-antiparticle annihilation reactions. *The charges of matter are the symmetry debts of light.*

Matter is an asymmetric form of light - one half of a particle-antiparticle pair. The function of charge is symmetry conservation, as we see in the annihilations of particle-antiparticle pairs. When the symmetry of particle-antiparticle pairs (and hence of light) is broken by the weak force creation of matter during the "Big Bang", the charges of the matter half of the particle-antiparticle pairs remain, and their symmetry conservation function continues in the new time/historical dimension as the principle of charge conservation (time and gravity are created simultaneously with massive particles during weak force symmetry-breaking). Charge and charge conservation are necessary to symmetry-breaking and the creation of matter because they allow symmetry conservation to continue in a massive, temporal form during and after the conversion of symmetric light to asymmetric matter. Charge conservation allows the conversion of light to matter and the energy of light to information - information previously expressed (before the creation of particles) as the structural content of the spacetime metric and virtual particle-antiparticle pairs. The information content of the "spacetime metric" is therefore reflected in the "particle metric" - as seen in the 4x3 fractal (resonant) structure of both. The conversion of light's energy to mass, light's entropy to time, and light's symmetry to charge, are the energy conversions and conservation measures necessary for the creation of matter from light. We will visit all these conversions and conservation considerations in the second half of this paper, where we discuss the "interior" lines of connection in the ["Tetrahedron Model"](#).

E-S) The connection between Entropy and Symmetry Conservation as found in the inertial forces of spacetime and the intrinsic motion of light (the creation of the "non-local" spacetime metric by the intrinsic motion of light).

"Velocity c " gauges, regulates, and maintains the symmetry of the spacetime metric, suppressing time and distance (the x , t , dimensions of spacetime). Noether's Theorem states that symmetry is a conserved property of light and light's conservation domain, spacetime. This line also represents gravity and the gravitational metric when energy is in the form of mass, entropy is in the form of time, and symmetry is in the form of charge. This designation is especially appropriate since the gravitational charge ("location") carries both an entropy and a symmetry debt of light (see: ["The Double Conservation Role of Gravitation"](#)).

The symmetric spacetime metric is created by the intrinsic motion of light, and is the site of "inertial" forces which maintain the metric's energy-conserving symmetry. The "metric" of spacetime is the measured

relationship within and between the dimensions - "gauged", regulated, created, and maintained by the intrinsic motion of light ("velocity c"). "Velocity c" is the gauge of light's "non-local", atemporal, and massless symmetric energy state, as well as the gauge of light's entropy drive (light's intrinsic motion). The symmetry (uniformity) of the metric is required by energy conservation. The metric relationship between space and time is "gauged" (established, fixed, regulated) such that one second of temporal duration (measured by a clock) is metrically equivalent to 300,000 kilometers of linear space (measured by a meter stick). It is the function of "velocity c" to maintain the metric symmetry of space by suppressing time to an implicit state, and to maintain light's "non-local" symmetric energy state by suppressing distance in the direction of propagation; "velocity c" also suppresses the conversion of virtual particles into real particles, preventing the devolution of free energy into asymmetric matter, mass, time, gravitation, and charge. The atemporal metric symmetry state and entropy drive of light or free electromagnetic energy, as expressed in the entropic (expanding and cooling) conservation domain of spacetime, are both gauged and linked by "velocity c".

The spacetime metric has both a wavelike aspect (light, gravitation, the dimensions, intrinsic motion, etc.) and a particle-like aspect (the bosons or field vectors, photons and gravitons, as well as the weak force IVBs (Intermediate Vector Bosons), virtual particle-antiparticle pairs, etc.). Unlike the fermions (quarks, leptons) of the atomic elements, bosons (photons, gluons, gravitons, IVBs), which are their own antiparticles, are not created by symmetry-breaking during the "Big Bang", but appear to be vibrations, compressions, or particle-forming convolutions of the metric itself, perhaps relicts (in the case of the IVBs) of the early, dense metric of the "Big Bang". Inertial forces maintain metric symmetry, for which "velocity c" is the gauge. "Velocity c" gauges both the entropy drive and the distributional symmetry of light and the spacetime metric; gravitation is both an entropy and a symmetry debt of light's "non-local" character. Through this dual association, gravitation is brought under the symmetry conservation umbrella of Noether's theorem. In Hawking's "quantum radiance" of black holes, we see the ultimate conservation of light's symmetry, even including the conservation of the symmetry of light's entropy drive. (See: "[The Double Conservation Role of Gravitation](#)".)

Inertial forces, gravitation, and metric symmetry conservation are also linked through [Einstein's "Equivalence Principle"](#). The perfect spherical symmetry of gravitational force, required by energy conservation, is also an example of this association.

Because the gravitational "location" charge represents both an entropy and a symmetry debt of light, I associate gravitation with the E-S line, a natural placement since this is also the line of the spacetime metric and its (energy and symmetry conserving) inertial forces. In Einstein's theory, gravitation is the "warpage", "curvature", or "acceleration" of this line (the spacetime metric). It is the presence of one-way time (matter's entropy drive) which "warps" the symmetry of the spatial metric of light. Whereas c is the gauge of the metric relation between light, space, and time, G is the gauge of the entropic relation between mass, space, and time. (See: "[Symmetry Principles of the Unified Field Theory](#)"; and "[A Description of Gravitation](#)".)

One of gravity's several conservation roles is the creation of matter's historical entropy drive, time, by the gravitational conversion of space to time and history. Conversely, *gravity is the spatial consequence of time's intrinsic motion*. The intrinsic motion of time and gravity induce each other in an endless entropic loop. Time is the active principle of gravity's "location" charge. Gravity provides a local, temporal metric complete with entropy drive to service and conserve the energy accounts of a local, massive, typically immobile energy form, matter. When matter does move, it must be motivated by an external force and moves with relative rather than absolute motion. (See: "[Entropy, Thermodynamics, and Gravitation](#)".)

Another conservation role of gravity, the conservation of light's "non-local" distributional and metric symmetry, is demonstrated by the gravitational conversion of bound to free energy, as in stars and Hawking's "quantum radiance" of black holes. Gravity converts space and the spatial entropy drive of free

energy (the intrinsic motion of light) to time and the historical entropy drive of bound energy (the intrinsic motion of time), and vice-versa. Establishing and maintaining the causal relations of matter (creating time via the annihilation of space - entropy role), and conserving light's symmetric "non-local" energy state (converting bound to free energy in stars - symmetry role), are among the chief conservation roles and [rationales for gravitation](#). The entropy and causality of bound energy are linked through the intrinsic motion of time just as the entropy and symmetry of free energy are linked through the intrinsic motion of light.

Gravity pays the entropy-"interest" on the symmetry debt of matter by the annihilation of space and the extraction of a metrically equivalent temporal residue. The spatial expansion of the Cosmos decelerates as it is gravitationally converted into the historical expansion of spacetime. Thus it is the intrinsic motion of light and the expansive, entropic energy of space which ultimately funds the intrinsic motion of time and the expansive, entropic energy of history. Gravity pays the energy "principle" of matter's symmetry debt by converting bound to free energy in stars (partially), and in Hawking's "quantum radiance" of black holes (completely). The gravitational force vanishes when mass vanishes, demonstrating the completion of gravity's symmetry conservation role, in complete satisfaction of Noether's theorem. (See: ["The Double Conservation Role of Gravitation"](#).)

Part II: The "Trinity of Matter" (The "Internal" Lines: Mass, Time, Charge)

(Matter, Causality, Information) ($h\nu = mcc$, the conversion of free to bound energy; atoms, galaxies, history, information; "Karma": the historical conservation domain of matter's causal information "matrix").

(See also: ["Tetrahedron Model: Interior Lines"](#); and ["The Etheric/Material Tetrahedron"](#).)

C-CI The connection between Energy Conservation and Causality-Information (or free and bound electromagnetic energy) - as seen in light vs mass, space vs time, and "non-local" metric symmetry gauged by "c" vs "local" metric asymmetry gauged by "G".

Mass: Raw energy conservation expressed through the conversion of free energy to the mass and momentum of particles, as in the creation of matter during the "Big Bang" (or more simply and commonly, the capture of photons by the electron shells of atoms).

The heat/light produced by our Sun and captured by abiotic and biotic chemical and physical processes on Earth is a secondary example of the transformation of free to bound energy, not involving the creation of elementary particles. $E = h\nu$, $E = mcc$, $h\nu = mcc$, are all famous equations (by Planck, Einstein, and DeBroglie, respectively) which represent the energetic equivalence between free and bound electromagnetic energy forms. It is the transformation of free to bound energy (and vice versa) which is the central process of the Cosmos (and the ["Tetrahedron Model"](#)). The proclivity of light to interact with electrically charged particles and to conserve its energy in the bound form of particle mass, momentum, and electronic configuration, is the basis for the existence of the material realm of particulate matter, and its highest and most complex expression, life (including photosynthesis). (Neutrinos, by contrast, hardly interact with matter at all; "dark matter" (if it exists), apparently interacts only gravitationally.)

The basic unit of energetic information recorded in the transformation of light to matter is the quantity of energy involved, reflected in the mass, momentum, kinetic energy, and "excitation" of particles, and the ["location" charge of gravitation \(Gm\)](#). Responding (in accordance with "Noether's Theorem") to the breaking of light's "non-local" symmetric energy state (by the conversion of free to bound energy), gravity records the spacetime location of mass by the "warpage", "curvature", or "acceleration" of the spacetime metric. Gravity (immediately) creates matter's time dimension by the conversion of space to time (gravity's entropy conservation role), and (eventually) conserves light's "non-local" distributional and metric symmetry by the conversion of mass to light in stars, quasars, and Hawking's "quantum radiance" of black holes (gravity's symmetry conservation role). (See: ["The Double Conservation Role of Gravitation"](#).) The

roles (gravity's symmetry conservation role). (See: [THE DEEPER CONSERVATION ROLE OF GRAVITATION](#).) The great difference between energy/entropy conservation and symmetry conservation is that the latter can be deferred through time - via the transformation of symmetry to charge, followed by charge conservation - until eventual charge-anticharge annihilation.

Information is conserved as charge, and in historic spacetime (as matter's "causal matrix") - upholding the "Universal Present Moment" of bound energy (with a universal network of causal relations). Because of gravity, the location of all bound energy forms is recorded by the warpage of spacetime; because of the charge of the neutrino, the identity and number of every elementary particle is known; and because of the causal linkages of time, every "event" is immortalized in historic spacetime - the conservation domain of information and matter's "causal matrix". The Universe is indeed a dimensional, entropic conservation domain for information and electromagnetic energy in all its forms. (See: "[A Spacetime Map of the Universe](#)".)

Causality: the temporal sequence of cause and effect (as regulated by the covariance of time and space in Special and General Relativity ("Lorentz Invariance") - gauged by the invariant "velocity c" and Einstein's similarly invariant "Interval"). Time is necessary to regulate matter's raw energy accounts because matter's energy content varies with its relative velocity. Think of the classic example of breaking a rack with the cue ball on a pool table. Time is necessary to regulate the orderly (and energy conserving) transmission of momentum and kinetic energy from one ball to the next. Massive matter is local, temporal, causal; massless light is non-local, atemporal, acausal. Causality (temporal linkage) is a necessary but not sufficient condition allowing the conversion of free to bound energy. Light does not require a time dimension because light's motion is invariant and absolute, not relative. Light's energy varies with its frequency, not its motion. Time is also necessary to provide the entropy drive of bound energy (see below under E-CI). Light is connected by space; matter is connected by time; gravity connects all. (See also: "[The Time Train](#)".) History is the temporal analog of space; both are the creations of the intrinsic dimensional motions of their entropy drives, time and light. Yesterday must remain real to uphold the reality of today ("karma"). The causal relations of matter and bound energy generally are a [rationale for gravity](#). Time is produced by the gravitational annihilation of space and the extraction of a metrically equivalent temporal residue. Time is one-way due to the requirements of causality, entropy, and hence energy conservation. (See: "[Gravity, Entropy, and Thermodynamics](#)".)

S-CI) The connection between Symmetry Conservation (manifesting as charge conservation) and Causality (historic spacetime).

Charge conservation is a means of extending symmetry conservation into the time or historic dimension (in contrast to the inertial forces of the spacetime metric, which also conserve symmetry, but which have no mechanism allowing deferment in time) (just the difference between a credit card and a debit card). *The charges of matter are the symmetry debts of light.*

Because certain types of symmetry can be conserved through time in the form of charge, matter can have an historical (and necessarily causal) dimension, unlike light which bears no charges and is both atemporal and acausal. Unlike raw energy and entropy debts, which must be paid immediately, symmetry debts (when in the form of conserved charges), constitute the "credit card" of the Cosmos - "buy now, pay later". Gravity pays the "interest" on the symmetry debt of matter through the deceleration of the cosmic expansion via the gravitational conversion of space to time. It is therefore the entropy drive of free electromagnetic energy (light) and the expansion of space which (through gravity) funds the entropy drive of bound electromagnetic energy (matter) and the expansion of history. The charges of matter (symmetry debts) are eventually paid by matter-antimatter annihilations, the conversion of bound energy to free energy in stars, quasars, and Hawking's "quantum radiance" of black holes, and by particle and proton decay. Charge conservation, like the historical entropy drive (time's intrinsic motion) and the conversion of free energy to mass ($h\nu = mc^2$), gives the Universe a life in the historical domain, in which energy can be converted to work, information,

and material objects with relative rather than absolute motion, and yet all conservation laws are nevertheless observed. (See: "[Global vs Local Gauge Symmetry and the 'Tetrahedron Model'](#)".) The energy required to create matter's 4th dimension and entropy drive (time), is simply subtracted from the entropy drive of light and space (light's intrinsic motion), by the gravitational conversion of space to time, with the consequent deceleration of the spatial expansion of the universe. The expansion of pure space is gravitationally converted to the historical expansion of spacetime. (See: "[The Conversion of Space to Time](#)".)

Charge: the creation of fermions (quarks, leptons, neutrinos, and their charges) by symmetry-breaking during the "Big Bang". Fermions are the surviving matter half of light's particle-antiparticle form: charge conservation ensures that their symmetry debts, held through time as charges, will eventually be repaid. Charge conservation = symmetry conservation in the time dimension (hence the cardinal importance of charge invariance, with all the local gauge symmetry currents and forces required for its maintenance). *The charges of matter are the symmetry debts of light* - (Noether's Theorem). Charge conservation is a temporal form of symmetry conservation - made possible by the creation of the historical domain through the gravitational conversion of space to time. Fermions comprise the 92 naturally occurring elements, the information base of matter, created in the "Big Bang" and by the nucleosynthetic pathway in stars (and supernovas). Charges are held in the time or historical dimension where they are balanced or neutralized until they can be annihilated or otherwise canceled by their corresponding antimatter charges. Charge conservation is moot in the absence of a time dimension, as the mutual annihilations of virtual particle-antiparticle pairs attests.

This line (in the "Tetrahedron Model") is essentially the linkage between Causality and the source of Information, as Information is primarily supplied from the Symmetry pole, beginning with fermions, atoms, and charge conservation. In the chain of cause and effect, information must always be associated with the purely reactionary or mechanical aspects of the causal linkage - what, exactly, is the cause, and what, exactly, is the appropriate effect? In the classic notion of "Karma", the linkage of cause and effect with information is implicit: both the criminal and the crime are known, and "the punishment must fit the crime". Information is by its very nature asymmetric and begins with charge. The gravitational "location" charge of bound energy, and the "identity" or weak force "number" (or "flavor") charges of elementary particles (carried in their explicit form by neutrinos), are the most fundamental charges of matter; spin, electric charge, and color follow in descending order of importance or universality. Charges produce forces (carried by "field vectors" or "bosons") which act to pay the symmetry debts. Exactly what symmetries of light these charges represent is discussed in the paper "[Symmetry Principles of the Unified Field Theory](#)", among others.

Symmetry-breaking is necessary during the "Big Bang" to extract a residue of matter from the otherwise symmetric virtual particle "sea". Virtual particles (when not bound to an atom or other massive particle) do not exist in real time and hence do not produce a gravitational field (see: "[Does Light Produce a Gravitational Field?](#)"). Free virtual particles become manifest ("real", massive, temporal) only through the mediation of the [weak force Intermediate Vector Bosons \(IVBs\)](#). Acting in concert, the "Tetrahedron" of conservation principles allows the conversion of free energy to the mass, 4th dimension, and information of particles (bound energy, causal and entropic time, charge). But the weak force must still produce an asymmetry between particle vs antiparticle before the symmetry of the primordial pairs can be broken, isolating matter from antimatter. (See: "[The Origin of Matter and Information](#)".)

Charge conservation and atomic matter form the base of the "information pyramid". Most information originates in the atomic nucleus, but is vastly amplified in the chemical interactions, combinations, and permutations of the electron shells of atoms. (See: "[The Information Ladder](#)" and "[The Information Pathway](#)".) Molecular biologic information is carried by DNA and genes; symbolic information is carried by language and human writing, including math, music, and machine language, etc. Information is conserved permanently in the historic domain of spacetime (matter's causal web, net, field, or "matrix"), and

conserved temporarily in the molecular genetic code of life, and symbolically through human agency (as in libraries). Time is a necessary dimensional parameter both to order information (as in abiotic cause and effect and in biotic development and evolution), to preserve information and matter's "causal matrix" through historic spacetime, and to produce the entropy drive of bound energy. Causality orders information just as it orders the spacetime metric and energy, providing evolutionary and developmental routes, abiotic and biotic, for the return of bound to free energy. Finally, time is the necessary dimensional parameter in which charge conservation has meaning.

The gravitational charge is complex in that it represents a double debt, one of entropy (intrinsic motion), and one of symmetry (immobile mass), both consequent upon the loss of light's intrinsic motion and non-local distributional symmetry (whenever free electromagnetic energy is converted to bound electromagnetic energy). (See: ["The Double Conservation Role of Gravitation"](#).) Due to the mixture of the entropy debt with the symmetry debt, the latter cannot be deferred in time; gravity can never be neutralized, unlike electric charge. Hence we see the gravitational debt being paid or satisfied in two modes, which it is convenient to think of as a payment of "interest", occurring at all gravitational energies (entropy debt - intrinsic motion, the gravitational conversion of space to time - as on planet Earth), and a payment of "principle", occurring only at high gravitational energies (symmetry debt - immobile mass, the gravitational conversion of bound to free energy - as in the stars).

Gravity pays the "interest" on the symmetry/entropy debt of matter by the conversion of space to time, creating a historical domain and a temporal entropy drive for matter and its charges. This action, however, only addresses the entropy debt (intrinsic motion), and does not diminish the actual symmetry debt (immobile mass) of matter (as in the familiar case of planet Earth), hence the analogy with "interest". The spatial expansion of the Cosmos is reduced nevertheless, supplying energy for the historical expansion. Therefore it is ultimately the intrinsic motion of light, the primordial entropy drive of free energy, which (through gravity) funds the intrinsic motion of time, the primordial entropy drive of bound energy. Gravity finally pays the "principle" on matter's symmetry/entropy debt by converting bound to free energy in stars, and by various other astrophysical processes, which go to completion in Hawking's "quantum radiance" of black holes. The gravitational force vanishes when mass vanishes - demonstrating the final repayment of the symmetry/entropy debt "principle", in complete satisfaction of Noether's Theorem. (See: ["A Description of Gravitation"](#).)

The "intrinsic" information inherently contained in free electromagnetic energy (light), and in the spacetime light creates, is expressed as the dimensional metric with its derivative, entropic regulatory gauges c , T , and G , its inertial forces conserving energy and symmetry, and finally as the "particle metric", the structural property of spacetime determining the species and masses of particles, charges, and force carriers that the "vacuum" is prepared to host, produce, and conserve (including the scaling property of the "particle mass gauge" or "Higgs" boson).

The realized possibilities we see in our Universe for quantized, bound energy forms are the 3 families of 4 elementary particles: 6 leptons and 6 quarks, and these determine the material parameters and characteristics of the Universe as we experience it (in our daily life, only 2 leptons and 2 quarks are found). The four dimensions of spacetime, the 3 energetic families each of 4 elementary particles, the four forces of physics, and the four major conservation laws, constitute the primary evidence of a 4x3 fractal algorithm inherent and operating in Nature, beginning with the electromagnetic "vacuum" of energized spacetime. This fractal algorithm is the fundamental and resonant "bit" or "Word" of Cosmic Information diagrammatically and symbolically represented by the ["Tetrahedron Model"](#). (See also: ["Nature's Fractal Pathway"](#); ["The Information Pathway"](#); and ["The Fractal Organization of Nature"](#).)

E-CI The connection between Entropy (expressed as the intrinsic motion of matter's time dimension) and Causality-Information (the cause-and-effect relations of mass-matter).

Time, History, Historic Spacetime: The one-way temporal entropy drive of bound energy, information, and matter's "causal matrix"; creating, expanding, and aging historic spacetime (see: "[The Time Train](#)"). "Intrinsic motion T" is the metric and entropic equivalent of "intrinsic motion c". (See: "[Spatial vs Temporal Entropy](#)".) Time is created from space and/or the collapse of an electromagnetic wave by two processes:

1) By the quantum mechanical switch ("collapse of the wave function") from the space-like or "wavelength" character of a freely moving electromagnetic wave to the time-like or "frequency" aspect of a particle or stationary wave. Time is the implicit entropy drive of free energy and the explicit entropy drive of bound energy. (see: "[Gravity Diagram No. 2](#)" and: "[The Conversion of Space to Time](#)").

2) By the gravitational annihilation of space with the consequent conversion of the primordial drive of spatial entropy (the intrinsic motion of light) (S), to time and the primordial drive of historical entropy (the intrinsic motion of time) (T). The entropic expansion of space is gravitationally converted to the entropic expansion of history, as symbolically represented in the "conceptual equation":

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

History is the temporal analog of space, the dimensional conservation/entropy domain of matter's "karmic" information network. Historic spacetime is a 5th dimension, containing Information and matter's "causal matrix", the whole past and evolutionary history of the entire Cosmos. (Time and our own history is a 4th dimension; adding up the historical timelines of the entire universe constitutes a 5th dimension.) (See: "[A Spacetime Map of the Universe](#)"; see also: "[The Spacetime Map as a Model of Juan Maldacena's 5-Dimensional Holographic Cosmos](#)".)

Aging and the expansion (dilution) of history is due to the positive entropy drive of time, affecting all material elements. Proton decay and black holes are the ultimate form of temporal or information entropy. The entropic march of time creates the historic conservation domain of Information at "right angles" to all three spatial dimensions, conserving matter's "causal matrix". It is only matter's causal matrix that sustains the reality of the "present moment" everywhere in the Cosmos. Today (the "effect") is real only because yesterday (the "cause") remains real in historic spacetime. Our past is some other observer's present, and vice versa. We are all immortal in history. (See also: "[Proton Decay and the 'Heat Death' of the Cosmos](#)".)

The "infinite" velocities of both time and light (the entropy drives of bound and free energy) constitute entropy's guarantee to energy conservation that breeches of the spacetime domain by "time machine" or fast space ship are impossible. Velocities T and c are metric equivalents, sealing the borders of their respective conservation domains (history and space). The intrinsic motions of time and light establish and also protect their dimensional conservation/entropy domains. Gravity performs the same protective function through the "event horizon" and central "singularity" of black holes, where $g = c$ and light and time stand still. In a black hole, gravity assumes the protective functions of both c and T as it takes over their entropic roles, just as gravity assumes the binding functions of the atomic and nuclear forces. In the black hole, the gravitational metric performs locally all functions that were formerly performed globally by the electromagnetic metric. (See: "[Entropy, Gravitation, and Thermodynamics](#)".)

In contradistinction to light, which is indistinguishable from its entropy drive (the intrinsic motion of light), and inseparable from its conservation domain (space), matter is distinct from its entropy drive (the intrinsic motion of time), and separate from its conservation domain (history). (See: "[The Time Train](#)".) Matter's time dimension moves but matter itself does not; nor does matter participate in the expansion of its entropic conservation domain, history. The tangential relation between matter, time, and history prevents the inflation, or attrition, of the value of charge by matter's entropy drive and hence the devaluation of the

symmetry debts those charges represent (charge invariance = charge conservation = symmetry conservation). There is no cosmological "red shift" for charge.

The preservation of the value of symmetry debts through time and regardless of the expansion of the Cosmos and the action of entropy, provides a conservation rationale both for the quantization of charge and for the otherwise anomalous separation of matter from its entropy drive, time, and its conservation domain, history. Note in this regard that light, which is united with its entropy drive and expands with its entropy domain, carries no charges of any kind.

The tangential relation between matter and its historic domain (experienced as the ephemeral "present moment"), is due to the fact that the time dimension has intrinsic motion but matter does not. Nevertheless, the separation of matter from its temporal entropy drive and the historic conservation domain of information is not sufficient to completely protect the invariance of charge (and hence charge and symmetry conservation), or the invariance of the "Interval" (and hence causality and energy conservation), from local effects in the present moment such as relative motion, the partial charges of the quarks, or the hidden, implicit "identity" charges of the weak force. To protect charge invariance in these local, variable, and relative conditions, extra help is needed in the form of magnetism, time ("Lorentz Invariance"), the gluon field, and the massive weak force IVBs with their associated "Higgs boson". (See: "[Global and Local Gauge Symmetries in the Tetrahedron Model](#)".)

Another, perhaps equally important reason (at least from an "anthropic" perspective) for the separation of matter from its entropy drive and historic domain, is to preserve the energy content of matter in an undiluted form so that it can perform the evolutionary work of the Cosmos - as in the slow release of matter's energy content by our Sun. Whereas the energy of light is rapidly vitiated by its intrinsic motion, "diamonds are forever"; atoms simply do not age, at least by human standards. Given the absence of antimatter, strong gravitational fields and proton decay are the only threats to the proton's lifetime or the permanence of matter.

The physical, "tangential" separation of matter from its entropy drive and historic conservation domain is the fundamental reason for the weakness of gravitation - and for humanity's "angst" regarding our tenuous connection to the Cosmos. (Gravity is weak because only a small amount of space need be converted to time per given mass ($-Gm(S) = (T)m$) to provide the temporal entropy drive for the tiny tangential connection (consisting of the ephemeral "present moment") between matter and its historic entropy domain. This is actually commensurate with P. A. M. Dirac's observation that the ratio of the strength of the gravitational force to the electromagnetic force is the same as the ratio of the radius of an electron to the radius of the universe- if we take the radius of the electron as equivalent to the tangential point of contact between the "present moment" and the cosmic continuum of historic spacetime. (See: "[The Half-Life of Proton Decay and the 'Heat Death' of the Cosmos](#)".)

Postscript: An Antimatter Model

If we add a fifth apex to the "[Tetrahedron Model](#)", directly opposite the causal vertex and projecting backward rather than forward from the plane of the paper and the free energy "base" of the tetrahedron figure, we create a diagram of two tetrahedra which share a common free energy base, a six-sided hexahedron. I have begun to think this is a suitable representation for the combined realm of matter-antimatter. Note that there is no direct connection between the two Causal or Information (matter-antimatter) vertices - they are insulated from each other by the free energy base (essentially neutral light), so they avoid an immediate annihilation reaction, although their opposite charges (the doubled set of "internal" lines) will soon pull them back together and cause an annihilation, leaving nothing but the original "trinity" base of light, an expanding spacetime metric, and virtual particles. The oscillation, or inflation and collapse, of the 3-D hexahedron crystal with its 2-D free energy "trinity" base, exactly expresses the creation and annihilation cycle of particle-antiparticle pairs with the light which creates them.

It is to be noted that it is only possible to add a single (fourth) point to the "trinity base" of the tetrahedron, and still have all model points directly connected one to another; this to me expresses the essential fact of the cohesion and unitary character of the tetrahedron (diamond) crystal and of the spiritual-material Universe, and why the Antiuniverse cannot coexist with it. The physical assumption is that there is some difference in the time lines of the two tetrahedra that prevents their exact reciprocal alignment, and thus allows a matter residue to remain after otherwise mutual annihilation reactions.

See also the two papers: "[Information vs Causality](#)" and "[Section 14: Causality](#)".

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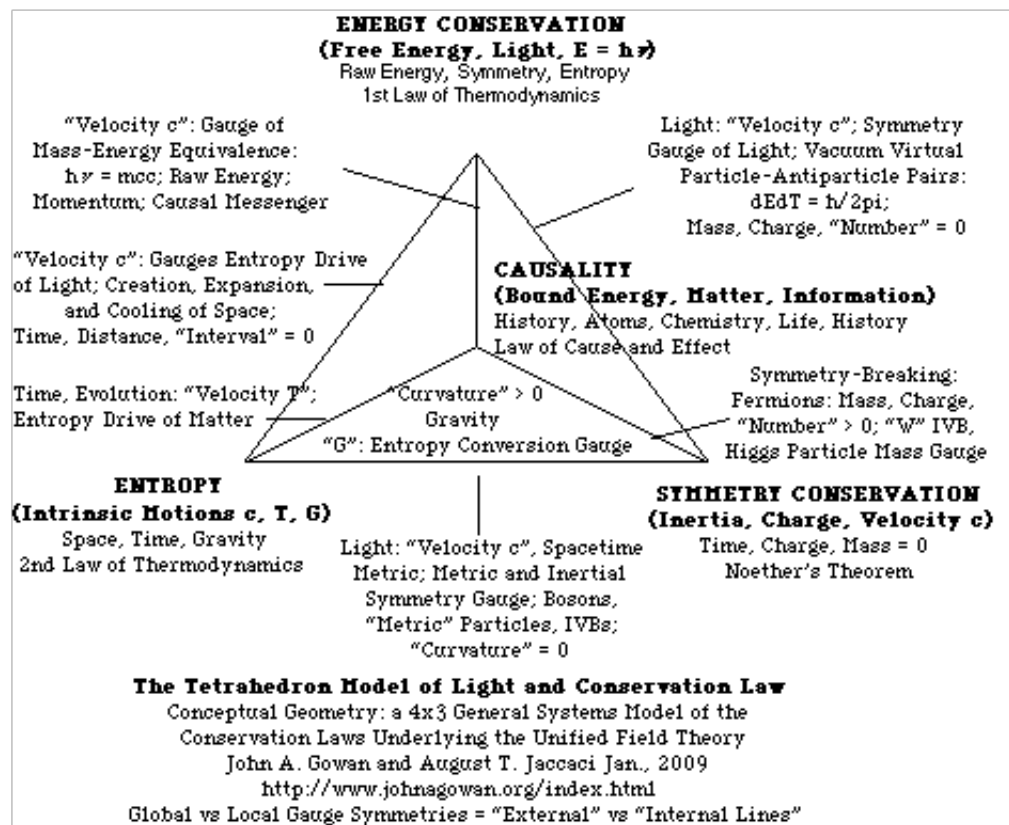
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Fig. 1: The Tetrahedron Model



1) Energy conservation: 1st law of thermodynamics. Free energy, light, $E = h\nu$ (Planck's energy quantum); $h\nu = m_0c^2$ (Einstein-deBroglie mass-energy equivalence); $dE dT = h/2\pi$ (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.