Global and Local Gauge Symmetries: Part II (Gravitation, Section A)

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Global and Local Gauge Symmetries: Gravitation, Section A

Abstract

"Local gauge symmetry currents" are forces that maintain the local invariance of universal constants, charges, and other conserved parameters (such as causality, "velocity c", and the "Interval") despite the hostile environment of a variable gravitational (or inertial) metric, relative rather than absolute motion, entropy, partial (fractional) charges, etc. These compensatory forces are due to the activity of the field vectors of the four forces, which not only act (in the long term) to return asymmetric material systems to their original symmetric energy state (light), but also act (in the short term) to protect and maintain the invariant values of charge and other conserved symmetry debts. Conserved charges are conserved symmetry debts awaiting a final repayment via antimatter annihilation, proton decay, the "quantum radiance" of black holes, or a universal "Big Crunch". Gravity pays the entropy-"interest" on the symmetry debt of matter by creating matter's time dimension via the annihilation of space, providing a historical domain within which charge conservation can have durable significance, and in which the repayment of symmetry debts can be indefinitely deferred. Gravity eventually also pays the energy-"principle" on matter's symmetry debt, converting bound energy to free energy in stars, supernovas, quasars, and finally via Hawking's "quantum radiance" of black holes, in the latter case completely vanishing mass and its associated gravitational field.

Preface

Because gravity is a metric, dimensional force, in order to apply the usual global-local analysis to this most universal of local forces, we begin by considering the fact that if the spacetime metric were the same everywhere there would be no gravitational force. According to Einstein, gravity is a distortion of the global electromagnetic (spacetime) metric, as gauged by "velocity c". Suppose we were able to create a local change in the spacetime metric centered on matter (for example, slowing local clocks and shortening local meter sticks), what would the effect be upon the surrounding global metric? The effect would be a gravitational force field, with spacetime accelerating symmetrically and concentrically toward the center of the disturbance.

We establish the warped metric by means of a universal constant "G" ("big G" - Newton's gravitational constant), which applies uniformly to mass everywhere at all times: "Gm") "Big G" determines the strength of the gravitational field associated with a given unit of mass (gram, kilogram, pound, ounce, etc.). "Big G" is the same on Jupiter, Mars, our Moon,

the Sun, as it is on Earth. "Little g", however, denotes the local strength of a gravitational field, and it differs depending on the quantity and density of an object's mass and where the measurements are taken. "Little g" is different on the surface of every planet and varies continuously with distance from the center of any given mass. "Big G" is the global value of the gravitational constant and "little g" is the local value, the later producing a "local gauge symmetry current": the accelerated inrush of spacetime, symmetric and concentric upon the center of mass of any object. The effect of this local "current" is to maintain the measured value of all global constants, "c" as well as "G", on all the planets despite their variable metric fields, such that causality, the "Interval", and the value of electric charge and any other conserved symmetry debts remain invariant on whichever planet or in whatever gravitational environment (on the space station, inside the planet, or wherever) we choose to measure them.

The gravitational flow constitutes a "local gauge symmetry current" caused by the one-way intrinsic motion of bound energy's (matter's) time dimension. Time, the entropy drive of bound energy, exits space at right angles into the historic domain, pulling space along behind it. Space self-annihilates at the center of mass, leaving in its place a metrically equivalent temporal residue, whose intrinsic motion continues the entropic cycle. Hence time and gravity endlessly induce each other, as gravity converts the spatial entropy drive of free electromagnetic energy (the intrinsic motion of light) into the historic entropy drive of bound electromagnetic energy (the intrinsic motion of time). (See: "The Conversion of Space to Time".)

The covariance of space and time conspire to maintain the invariance of velocity c, the "Interval", causality ("Lorentz Invariance"), and other conserved charges, conforming to our expectation for the action of a local gauge symmetry force field: a global invariance is maintained despite a variable environment. In the gravitational case, the variable environment is the metric field of spacetime itself, with time as the local gauge symmetry field vector (time is thus the field vector of gravitation). The ultimate motivation (rationale) for gravitation is the conservation (restoration) of light's non-local distributional symmetry in space, as required by Noether's Theorem. (See: "A Rationale for Gravity".) The time dimension of matter is an entropic "charge" (a charge with intrinsic dimensional motion), addressing light's non-local distributional symmetry debt, incurred when free electromagnetic energy is converted into bound electromagnetic energy in any form or process. *The charges of matter are the symmetry debts of light*. The gravitational symmetry debt is ultimately repaid by the conversion of mass/matter to light in stars, supernovas, quasars, going to completion via Hawking's "quantum radiance" of black holes. (See: "A Description of Gravitation".)

(Because I interpret the topic of "global vs local gauge symmetry" entirely from the perspective of charge and symmetry conservation - which is consistent with the overview of this website but may confuse some readers - several more orthodox explanations of this subject (in non-math terms) are suggested below):
"Most Wanted Particle", Jon Butterworth 2014, The Experiment, LLC: pages 96 - 99.
"Higgs", Jim Baggott 2012, Oxford Univ. Press, pages 23 - 37.
"The Moment of Creation", James S. Trefil 1983, Collier, Macmillan.

As Einstein taught us, gravity is a metric force and phenomenon - that is, gravity is a force affecting the dimensions and their relations to each other. From this we have learned that "clocks run slow" and "meter sticks shrink" in a gravitational field, and that the one-way flow of gravity is toward the slowest (local) clock and shortest (local) meter stick - this apparently being the direction of "cheapest" energy.

The "global" or absolute metric, however, is not a gravitational metric, but an electromagnetic metric, established, regulated, maintained, and "gauged" or scaled by the universal electromagnetic constant "c" (one second of temporal duration is metrically equivalent to 300,000 kilometers of linear distance). The "velocity" of light ("c") is in fact both a gauge of the "non-local" symmetric energy state of light and metric symmetry (the intrinsic motion of light vanishes time and distance), and the gauge of the entropy drive of light and space (the intrinsic motion of light both creates space and causes the expansion and cooling of space). The metric of spacetime regulates space as an energy-conserving domain for light (free electromagnetic energy), and is apparently part and parcel of light - light (photons) being the energy form, the metric being the conservation structure created by and embedded within the energy form. The intrinsic (entropic) motion of light creates, expands, and cools the spatial domain, and so serves not only to create the spatial domain, but provides the primordial entropy drive of free electromagnetic energy and space as well. Finally, the symmetric structure of space is maintained by inertial forces associated with energy conservation laws ("Noether's Theorem"), while the asymmetric time dimension, always present as a potential threat, is suppressed at velocity c (light's "clock" is stopped).

In fact, time can be seen as the *implicit* driver of the intrinsic motion of the photon (time is implicitly present as "frequency"); the photon may be conceived as "fleeing" the asymmetric threat of time, and just managing to keep ahead of and suppress time by always moving at "velocity c". "Velocity c" is the gauge of light's "non-local" symmetric energy state, in which both time and distance (in the direction of motion) are reduced to nothing. The photon consequently, having no distance to travel and forever to get there, has an effectively "infinite" velocity. The "non-local" spatial distributional symmetry of the photon derives from this "infinite" velocity, and from its lack of two dimensions, which means in either a 3 or 4 dimensional space or spacetime, the photon's coordinates or "location" cannot be specified. Light is the most symmetric form of energy, having neither mass, charge, location, time, nor an associated gravitational field. Einstein expressed light's symmetric energy state mathematically by putting light's "Interval" equal to zero.

This is the electromagnetic metric which gravity will modify or "warp" by adding explicit time to it - the same time that is already implicitly present as the driver of light's intrinsic motion. Given the presence of free electromagnetic energy, we can say that energy conservation, symmetry conservation, and entropy are the root cause of light's intrinsic motion, creating also space and the spatial metric. Light is not only the most symmetric energy form, but also the only one which is self-sufficient (or "primary"), in that it produces its own entropy drive (intrinsic motion), and its own conservation domain and metric structure (space). Virtual particles (Dirac/Heisenberg "quantum fluctuations") are also associated with light and light's metric structure. Hence, while light is symmetric and primary, it is not especially simple. All other forms of energy are secondary, derived from light's energy and conservation metric - including gravity - see below).

When free electromagnetic energy (light) is converted to bound electromagnetic energy (mass-matter) during the "Big Bang", there is a conservation requirement for the explicit form of the time dimension, both to service the energy accounts of matter in relative (rather than absolute) motion, and also to serve as bound energy's entropy drive. (See: "The Time Train".) Recall this is the same time dimension that is implicitly present in space and light as the driver of the photon's intrinsic motion (seen most directly in

the "frequency" component of the electromagnetic wave). Einstein (and Minkowski) taught us that space is really spacetime, and when light is converted to matter, the *implicit* temporal component of space becomes *explicit*, producing time and spacetime. This conversion from implicit time to explicit time is accomplished by the gravitational annihilation of space and the extraction of a metrically equivalent temporal residue. (See: "The Conversion of Space to Time".)

Big G and Little g

The universal gravitational constant ("big G") is the global gauge constant defining a local, temporal metric. The magnitude of "big G" determines how much space must be converted to time (per given mass) to provide an historical entropy drive for bound energy. The sign of "G" is determined by the energy difference between the implicit vs explicit form of time. The energy of "G" is negative because it takes energy to convert the symmetric "all-way" spatial entropy drive of free energy to the asymmetric "one-way" historical entropy drive of bound energy - it takes energy to create an asymmetric entropy drive from a symmetric one.

Because time is created directly from space (by gravity), these two entropy drives are automatically equilibrated - they are metric equivalents of one another. The expansion of history and the "velocity of time" is metrically equivalent to the expansion of space and the "velocity of light": "time flies". Historical spacetime is a single, entropic unit, aging and expanding, decaying and cooling, created and held together by gravitation. Finally, spacetime is a completely natural and integrated compound metric because time and space are both implicitly present in the basic electromagnetic energy form which creates spacetime: frequency (time) multiplied by wavelength (space) = velocity "c". (See: "A Spacetime Map of the Universe".)

The universal gravitational constant "Big G" is a global gauge imposed upon another global gauge, the universal electromagnetic constant "c", together producing the compound metric of spacetime. Because velocity c and the electromagnetic metric are responsible for regulating or gauging all the essential conservation parameters of the Cosmos, including energy conservation, symmetry conservation, entropy, and causality, tampering with or modifying the electromagnetic metric is no trivial matter. Gravitation is accordingly heavily constrained in how it may modify the symmetric spatial metric.

First of all, gravitation must produce time directly from space, and time must be inherent in the basic conservation structure and energetic makeup of space - as we have seen (no foreign elements are introduced to the metric). Secondly, gravity can not change the value of the gauge constant c, since that would affect all aspects of energy conservation, including causality, entropy, and charge conservation. Thirdly, gravity must itself be an energy-conserving operation locally - as we see in the spherically symmetric self-annihilating spatial flow of a gravitational field (for example, the Earth's gravitational field does not impart any net spatial motion to the Earth). Finally, the gravitational field energy must come from somewhere and return to somewhere - must be a conserved form of energy in the cyclic global economy of the Cosmos. This we find in the gravitational deceleration of the spatial expansion of the Cosmos, which in fact funds the historical expansion of the Cosmos (via the actual gravitational conversion of space to time). Eventually, because the gravitational "location" charge is conserved, the conversion of bound energy to free energy in stars, supernovas, and quasars goes to completion via Hawking's "quantum radiance" of black holes. Matter is returned to light, the gravitational metric and field energy is returned to the electromagnetic metric and field energy - conserving light's original "non-local" symmetric energy state - in full and final obedience to "Noether's Theorem" of symmetry conservation.

The "local gauge symmetry current" associated with gravitation is the flow of spacetime which we experience as the activity of a gravitational field. We can think of "little g" as characterizing local, variable gravitational metrics, demonstrated by the several planets of our solar system, each with different "surface gravity" and hence with different surface clock rates and overall spacetime metrics. Nevertheless, on all these different planets, causality, energy conservation, symmetry and charge conservation, and entropy are all strictly observed, "velocity c" and Einstein's "Interval" remain invariant, despite differences in their local gravitational metrics, thanks to the covariance of space and time ("Lorentz Invariance" of General Relativity) - the "local gauge symmetry current" which we (following Einstein) recognize as the spacetime flow of a gravitational field. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (Nothing about gravity is hidden except its twofold conservation purpose in the latter-day Cosmos: to provide the metric and entropic conservation requirements of bound energy (historic and aging spacetime), and to return the asymmetric system of matter to its symmetric origins - light.) (See: "Entropy, Gravitation, and Thermodynamics".)

The Double Conservation Role of Gravitation

The primordial conservation role of gravity is to provide negative energy sufficient to exactly balance the positive energy of the "Creation Event", so the universe can be born from a state of zero net energy as well as zero net charge (the latter due to the equal admixture of matter with antimatter). All subsequent conservation roles of gravity are secondary to and derived from this original creation-role.

Following on from its primary role of providing negative energy during the "Big Bang", gravity plays two further major conservation roles in the evolving universe: 1) the creation of bound energy's time dimension (energy/entropy conservation role); 2) the conservation/restoration of light's "non-local" distributional symmetry (symmetry conservation role). In creating time, gravity also creates matter's primordial entropy drive, and the basis for matter's causal linkage. The time dimension also provides a domain in which charge conservation can have application and historical significance. Gravitation affects all four conservation corners of the "Tetrahedron Model". The symmetry conservation role of gravitation can be seen as temporally deferred charge conservation involving the "location" charge of gravity. Time is the active component of gravity's "location" charge, identifying the 4-D coordinate position of bound energy with respect to the total amount and concentration of mass/matter present. Unlike the other conserved charges of matter, time is a charge with intrinsic dimensional motion - an entropic charge, creating and expanding the historic domain, the conservation dimension containing matter's causal information network, web, or "matrix". (See: "The Double Conservation Role of Gravitation".)

Entropy debts are similar to energy debts in that they must be paid immediately, so gravity immediately converts the intrinsic motion of light to the intrinsic motion of time, converting/conserving the entropy drive of free electromagnetic energy to an alternative form as the entropy drive of bound electromagnetic energy. Symmetry debts in the form of charges, however, can be discharged or paid at any future time (due to charge conservation); the universe of matter and time runs on the credit card or promissory note of charge conservation. Gravity pays the entropy-interest on matter's symmetry debt by creating the time dimension in which charge conservation can have meaning (compare the instantaneous action of charge in virtual particle-antiparticle annihilations). The energy which funds the historical expansion is debited from the spatial expansion, which decelerates accordingly. The first indication of gravity's time-deferred symmetry conservation role is seen in the Sun and stars, where bound energy (mass-matter) is gravitationally converted to free energy (light). This process goes to completion in Hawking's "quantum radiance" of black holes, fulfilling "Noether's Theorem" of symmetry conservation. (See: "A Description of Gravitation".)

We see a progression of local gravitational metrics of greater and greater intensity passing from planets to stars to white dwarfs to neutron stars to black holes, where "little g" (the gauge of the local gravitational metric) approaches and finally equals "c", restoring in an equivalent but backhanded fashion the essential elements of the original electromagnetic metric. At the black hole's "event horizon", where "g" = "c", matter itself moves at "velocity c", time stands still, and meter sticks shrink to nothing, just as in the original electromagnetic metric involving only photons. Inside the black hole, proton decay is probably commonplace as gravity squeezes baryons and quarks into elementary leptonic units of charge, which undergo leptonic decays via leptoquark anti-neutrinos. Outside the black hole, via Hawking's "quantum radiance", the gravitational field energy of the black hole is directly converted to light, a process eventually transforming the entire mass energy of the black hole to free electromagnetic radiation. This is actually accomplished by the direct gravitational creation of matter-antimatter particle pairs from the spacetime metric, something like a reprise of the original creation of matter during the "Big Bang". The gravitational conversion of mass to light also reduces the total gravitational energy of the Universe (since light produces no gravitational field), resulting eventually in a relaxation of gravity's early deceleration of the cosmos - seen as the recently observed "acceleration" of the cosmic spatial expansion.

The Origin of Gravitation as a Conservation Force
The charges of matter are the symmetry debts of light.

Gravity is a conservation force which arises in response to symmetry losses or deficits in two intertwined "gauge" (regulatory) functions of light's "non-local" symmetric energy state - losses consequent upon the conversion of light to matter, or free to bound energy forms, as in the "Big Bang" creation of matter, or simply in the capture of a photon by the electron shell of an atom. According to "Noether's Theorem", reductions in light's symmetric energy state must be compensated by some conservation force, usually seen in the form of a conserved charge or inertial force. Light's symmetry losses when converted to bound energy forms are manifold, but those specifically addressed by gravitation include: 1) the spatial entropy drive of light (light's intrinsic motion, regulating the creation, expansion, and cooling of spacetime); 2) the "non-local" energy state of light (regulating the symmetric distribution of free energy in spacetime: everywhere simultaneously). Both functions are consequences of light's intrinsic motion, as gauged by the electromagnetic constant "c" (light's intrinsic motion serves as the primordial spatial entropy drive, and creates space and the spatial metric, the conservation domain of free energy).

The universal gravitational constant "G" is the entropy conversion gauge, regulating how much space must be annihilated and converted to time (per given mass), providing matter with its requisite historical entropy drive, locally expressed as "velocity T", but globally gauged by "velocity c". Time is produced by the gravitational annihilation of space and the extraction of a metrically equivalent temporal residue. The intrinsic motion of time is the primordial entropy drive of bound energy, creating the historic conservation domain of information and matter's "causal matrix" (historic spacetime). Time is also ultimately gauged by c, since "velocity T" is defined as the duration (measured by a clock) required for light to travel a given distance (measured by a meter stick). "G" is therefore related to "c" through their common factor time. Time is a local and flexible dimensional gauge, produced by the gravitational annihilation of space. Both G and c are globally invariant gauge constants. "c" gauges the spatial metric of free energy (including the entropic expansion of space); "G" gauges the the conversion of space to time, per given mass (Gm). (See: "Gravity Diagram No. 2" and " The Conversion of Space to Time").

The intrinsic motion of light produces space and the expansion and cooling of space; hence the intrinsic motion of light is the primordial entropy drive of free energy. (See: "Spatial vs Temporal Entropy".) It is

the function of entropy (in its primordial mode) to create a dimensional conservation domain in which its energy source, whether free or bound (light or matter), can exist and be transformed, used, and conserved: this is the relationship between the 1st and 2nd laws of thermodynamics. Because both the spatial entropy drive and the spatially symmetric ("non-local") energy state of light are gauged by c (both are consequences of light's intrinsic motion), "Noether's Theorem" will automatically require the conservation of light's entropy drive in any transformation in which light's non-local symmetry state must be conserved - as in the conversion of free to bound energy, and/or the creation of matter. Conserving either role of light's intrinsic motion - as the source of light's entropy drive, or the creator of light's non-local symmetric energy state - conserves the other role by default. (See: "The Double Conservation Role of Gravitation".)

One of gravity's several conservation roles concerns the spatial entropy drive of free energy (the intrinsic motion of light), which gravity conserves by transforming light's intrinsic motion to the historical entropy drive of bound energy (the intrinsic motion of time). Time is created by gravity via the annihilation of space and the extraction of a metrically equivalent temporal residue, resulting in the deceleration of the spatial expansion of the Cosmos. Because the spatial expansion is driven by the intrinsic motion of light, it is light's spatial entropy drive (S), which ultimately funds matter's historical entropy drive (T). We can represent this transformation by a quasi-mathematical "concept equation":

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

This "concept equation" represents an entropic conservation loop between space (created by light), and time (created by gravity). The loop continues through the gravitational conversion of mass to light in stars (which essentially reverses this equation), reducing the stars' mass and associated gravitational energy, and resulting in the "acceleration" of the spatial expansion of the Cosmos (as recently observed). The equation also suggests that time, as Einstein noted, is a local characteristic of gravitating mass: (T)m is different for Earth, Mars, Jupiter, the Sun, etc., as seen in its metric effect on clock rate, for example.

(See: "Currents of Entropy and Symmetry".)

Non-Local Light and "c" vs Local Matter and "G"

"Velocity c" is the gauge of both the primordial, spatial entropy drive of light, and the spatially symmetric "non-local" energy state of light (free electromagnetic energy). "Non-locality" is due to the fact, discovered by Einstein, that light has no time dimension and no spatial dimension in the direction of its motion. In Einstein's mathematical formulation of this symmetry, the "Interval" of light = zero. Within its own reference frame, the energy of any individual photon (quantum of light) is distributed uniformly, everywhere, simultaneously. This symmetry in the spatial distribution of light's energy is a consequence of light's "non-locality", and according to Noether's Theorem, "non-locality" is a symmetry of light which must be conserved.

Einstein's "Interval" is an invariant quantity of spacetime (in any reference frame) whose function is to rescue causality from the shifting dimensional perspectives of Einstein's Special and General Relativity - the relative and variable motions of matter and the metric "warping" of gravity. Massless 2-D light is non-local, a-temporal, and a-causal; massive 4-D matter is local, temporal, and causal.

Light is a 2-dimensional transverse wave whose intrinsic motion sweeps out a third spatial dimension. Light requires one spatial dimension each for its electric and magnetic fields, and a third (in the direction

of motion) is required for entropy. Expanding 3-D space is a (positive) entropic conservation domain for free electromagnetic energy (light). Lacking both a time dimension and one spatial dimension (in its direction of propagation), light's position in 3-dimensional space or 4-dimensional spacetime cannot be specified. Since both time and distance are meaningless to light, light has in effect an infinite amount of time to go nowhere. Hence in its own reference frame (moving freely in spacetime (vacuum) at velocity c), light must be considered to be everywhere simultaneously. From this results the "non-local" character of light, light's zero "Interval", light's effectively "infinite" velocity, and the globally symmetric distribution of light's energy.

The charges of matter are the symmetry debts of light, and light's "non-local" distributional and metric symmetry is conserved through the "location" charge of gravitation, of which time is the active principle. The time "charge" and the gravitational field it induces identify energetically the specifiable (and hence asymmetric) location of immobile, undistributed, "rest mass" energy in 4-D spacetime, including the quantity and density of the distributional symmetry violation - the local concentration of matter. Einstein's "Interval" of mass is always greater than zero, due to the presence of time and a third spatial dimension. The time charge breaks the metric symmetry condition of light's "zero Interval", establishing the gravitational metric symmetry debt of bound energy (the warpage of space due to the intrinsic motion of time). Because time is an "entropic" charge (a charge - unlike any other - with intrinsic dimensional motion), the spatial "location" symmetry debt is combined with an asymmetric (one-way) temporal entropy drive. Both debts are dimensional or metric in character. The one-way character of time is necessary not only for reasons of causality and energy conservation, but also to break the otherwise symmetric metric of space, specifying the actual 4-D location of bound energy amidst the isomorphic and entropic spatial expansion.

Gravity (eventually) restores (conserves) the non-local spatial symmetry of light by the conversion of bound to free energy in stars, quasars, supernovas, and other astrophysical processes, culminating in the complete gravitational conversion of matter to light via Hawking's "quantum radiance" of black holes, in full satisfaction of the symmetry conservation requirements of Noether's Theorem. The conversion of bound to free energy pays the entropy debt simultaneously with the symmetry debt, since light is both a-temporal and non-local. The gravitational field "evaporates" along with the mass of the black hole, signifying the final and full payment of gravity's symmetry and entropy debt.

> If the purpose of a metric is energy conservation - as it clearly must be - why is the gravitational metric necessary to address this issue? The gravitational metric is necessary to provide negative energy to balance the positive energy of bound electromagnetic energy (mass/matter). It is the exact balance between the positive rest mass energy of matter and the negative energy of matter's gravitational field which allows the creation of matter from zero net energy during the "Big Bang". This is another and perhaps the most fundamental conservation role of gravity, addressing the upper vertex of the "Tetrahedron Model" diagram.
> In the black hole, the gravitational/temporal metric completely replaces the electromagnetic/spatial metric, including the binding functions of chemical and nuclear physics. But the black hole also exhibits a form of symmetry all its own, in that within its event horizon, all forms of energy, even including massive objects, move at "velocity c". It is also probable that proton decay occurs inside the event horizon (perhaps at the central "singularity"), so that a black hole may contain nothing but gravitationally trapped light. in other words, gravity's relentless drive can be seen as an "agenda" towards its own brand of symmetric energy state, not just toward "Hawking radiation" and the complete restoration of

the electromagnetic symmetry state. In the black hole, gravity has established the ultimate metric of the temporal domain of bound energy and there set its flag - the opposite pole to the electromagnetic metric of empty space. Both extremes are symmetric energy/entropy states in which all forms of energy move at "velocity c" - "the extremes meet". Nevertheless, because the entropy drive of "one-way" time is less symmetric than the entropy drive of "all-way" space, we see in "Hawking radiation" that even the symmetry of light's entropy drive is conserved in accordance with Noether's theorem - producing the final triumph of light over darkness.

We have seen the conservation role of gravity with respect to the four conservation parameters of the "Tetrahedron Model": entropy (converting light's intrinsic motion to time's intrinsic motion), symmetry (the conversion of bound to free energy), causality (the creation of time and historic spacetime, and including "Lorentz Invariance"), and finally energy itself (providing negative energy to balance matter's positive energy). All these roles are intimately connected and related to the regulatory or "gauge" functions of "velocity c". Negative gravitational energy is provided by an imploding rather than exploding spatial metric, which in turn is caused by the intrinsic motion of time, matter's entropy drive (time and gravity induce each other endlessly). Time provides matter's causal linkage and creates matter's historic conservation domain of information, while simultaneously providing matter with a "location" charge representing light's non-local distributional symmetry debt. "Location" charge (whose active principle is time) identifies the 4-dimensional location of immobile, undistributed "rest mass" energy, and eventually converts matter back to its original and symmetric form, light (in stars, black holes, and other astrophysical/gravitational processes). The active "push" or "drive" of this chain of conservation effects is provided by entropy - the implicit or explicit presence of time causing the expansion of space or history.

In the post-"Big Bang" universe, entropy and matter's eternal search for antimatter are the primary motivational impulses. Life arises as an inevitable consequence of matter's information content and the expansion of entropy's spatial/historical conservation domains.

For a more complete discussion of gravitation the reader is referred to: "A Description of Gravitation"; and "Entropy, Gravitation, and Thermodynamics".

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