Global and Local Gauge Symmetries: Part II (Gravitation)

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home page

(See also: Global-Local Gauge Symmetries in the Tetrahedron Model
Global-Local Gauge Symmetries of the Weak Force)
Global-Local Gauge Symmetries: Material Effects of Local Gauge Symmetries)

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Abstract

"Local gauge symmetry currents" are forces that maintain the local invariance of universal constants, charges, and other conserved parameters (such as causality and the "Interval") despite the hostile environment of a variable gravitational (or inertial) metric, relative rather than absolute motion, entropy, partial 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 these asymmetric material systems to their original symmetric state (light), but also act (in the short term) to protect and maintain the invariant values of their symmetry debts (charges), while 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 significance. Gravitation eventually also pays the energy-principle on matter's symmetry debt, converting bound energy to free energy in stars and via Hawking's "quantum radiance" of black holes.

Preface: The Electromagnetic Constant "c"

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 the metric (the intrinsic motion of light vanishes time), and the gauge of the entropy drive of light and space (the intrinsic motion of light causes the expansion and cooling of space). The metric 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 embedded with the energy form. The intrinsic 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"), which 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.

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 the photon'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.

However, once 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 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".)

Introduction: The Universal Gravitational Constant "Big G"

The universal gravitational constant ("big G") is the global gauge constant of a local, temporal metric. The magnitude of "big G" determines how much space must be converted to time (per unit mass) to provide the primordial historical entropy drive of bound energy. The magnitude 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 "all-way" spatial entropy drive of free energy to the "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 and via proton decay and Hawking's "quantum radiance" of black holes returns matter to light and the gravitational metric and field energy 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.

"Little g"

The "local gauge symmetry current" associated with gravitation is the flow of spacetime which we identify as the activity of a gravitational field - not only the flow of space but also the flow of time. 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 conservation, and entropy are all strictly observed, velocity c and Einstein's "Interval" remain invariant, despite differences in their local metrics, thanks to the covariance of space and time, and the "local gauge symmetry current" which we 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: to provide the metric conservation requirements of bound energy (spacetime), and to return the asymmetric system of matter to its symmetric origins - light.) (See: "Entropy, Gravitation, and Thermodynamics".)

The Double Conservation Role of Gravity

The principle conservation roles of gravity are two: 1) the creation of bound energy's time dimension (energy/entropy conservation role); 2) the conservation of light's "non-local" symmetric energy state (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 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 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 equivalent to energy debts and must be paid immediately, so gravity immediately converts the intrinsic motion of light to the intrinsic motion of time, conserving the entropy drive of free electromagnetic energy 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 (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. The energy which funds the historical expansion is debited from the spatial expansion, which decelerates accordingly. The first indication of gravity's deferred symmetry conservation role - in which gravity begins to pay off the "energy-principle" of matter's symmetry debt - 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, but which involved only photons. Inside the black hole, proton decay is commonplace as gravity squeezes baryons and quarks into elementary leptonic units of charge, which undergo leptonic decays via leptoquark antineutrinos. Outside the black hole, via Hawking's "quantum radiance", gravity directly converts the gravitational field energy of the black hole to light, and eventually converts 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, 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 in the recently observed "acceleration" of the cosmic spatial expansion.

Evidently it is a general rule that symmetry conservation is not fully consummated until the local "metric" or symmetry gauge assumes the form or magnitude of the global metric or symmetry gauge from which it is derived.

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 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", 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). Both functions are consequences of light's intrinsic motion, as gauged by the electromagnetic constant "c" (light's intrinsic motion creates space

and the spatial metric, including the spatial entropy drive, 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 unit mass) to provide 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, and as entropy is related to energy.) 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 spacetime metric, the spatial metric as it is modified by the conservation requirements of bound energy.

The magnitude of G measures the small energetic difference between the symmetric spatial entropy drive (S) of free energy (the intrinsic motion of light as gauged by "velocity c"), and the asymmetric historical entropy drive (T) of bound energy (the intrinsic motion of matter's time dimension, also gauged by "c"):

$$S - T = -G$$

Equivalently, -G is the energetic difference between *implicit* and *explicit* time. It takes energy to create asymmetric one-way temporal entropy from "all-way" symmetric spatial entropy. This entropy-energy cost of creating time is the origin of the "negative energy" characteristic of gravity and the negative sign of "-G". (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 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 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 "concept equation" as:

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

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' 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., not only in quantity and intensity, but also in its metric effect (on clock rate, for example). The only global constant in the equation is G.

(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, atemporal, and acausal; 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. 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 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, 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 atemporal 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.

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

Global and Local Gauge Symmetries: Gravitation

"c" is a global constant gauging a global metric; "G" is a global constant gauging a local metric. Massless light is non-local, atemporal, and acausal, producing no gravitational field; massive matter is local, temporal, and causal, producing a gravitational field (which is the source of matter's time dimension).

While I am more interested in gravity's "global vs local" metric and conservation roles, for completeness I will list here certain "global" symmetries of gravity, as the term is usually defined. These "global" symmetries of gravitation originate with the universal gravitational constant "G", including (at least) 4 major physical phenomena: 1) the equivalence of mass, in whatever form, with respect to the production of a gravitational field; 2) all massive objects of whatever composition fall with an equivalent acceleration in a given gravitational field; 3) the universal equivalence of gravitational vs inertial forces of acceleration (Einstein's "Equivalence Principle"); 4) Variation in the value of G, if universally applied and not too extreme, would be undetectable in either free fall or orbit (in the absence of external observations). ("Mass" is any form of 4-D bound energy which does not have intrinsic motion c, has a time dimension, produces a gravitational field, and whose spacetime "Interval" is greater than zero.)

All these "global" phenomena are related to the action and character of the gravitational field vector, the "graviton", which produces a one-way local gauge symmetry "current" we recognize as "time" and the spatial flow of a gravitational field. A graviton is a quantum unit of time or temporal entropy. The universal gravitational constant G determines, regulates, or "gauges" how much time or temporal entropy must be created per unit mass; time is created by the gravitational annihilation of space and the extraction of a metrically equivalent temporal residue. Hence G controls how much space must be collapsed to provide a given mass with its requisite time dimension or temporal entropy drive: -Gm(S) = (T)m. Time is the active principle of gravity's "location" charge. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "The Conversion of Space to Time".)

All massive objects fall with an equivalent acceleration in a given gravitation field because they are all co-movers with the accelerated flow of spacetime. The acceleration of a gravitational field is due to the constant application of a force - the constant intrinsic, entropic motion of time. Einstein's equivalence principle of gravitational and inertial forces of acceleration is due to the fact that we cannot distinguish between the reciprocal effects of spacetime accelerating through us (as in our gravitational "weight" on Earth's surface) or we accelerating through spacetime (as in a rocket ship). (See: "Extending Einstein's Equivalence Principle".)

A third gravitational symmetry, the spherical spatial collapse of a gravitational field, is due to the equivalent coupling between time and each of the 3 spatial dimensions. As time marches off into history, it pulls the spatial dimensions along with it, until they self-annihilate at the point-like entrance to the time line at the gravitational center of mass. Time and space are connected through a tangent point at right angles to all three spatial dimensions. (This tiny connection between space and time, experienced as the fleeting "present moment", is the reason for both the smallness and the invariance of G.) (See: "Proton Decay and the 'Heat Death' of the Cosmos".)

Another global symmetry, electromagnetic in origin and gauged by the electromagnetic constant c, involves energy conservation within the whole spatial metric. Absent matter and its gravitational fields, we could exchange places with anyone (at rest) in the Cosmos and not notice any difference in the parameters of the spatial metric. This global, inertial symmetry of the spatial metric is obviously necessary for energy conservation.

Of course, Einstein discovered that gravitational fields slow clocks and shrink meter sticks, as does relative motion of any kind, breaking the global metric symmetry of spacetime. These local effects are caused by relative motions - either our motion through spacetime, or spacetime's motion through us (gravitation). These relative motions of matter require (or cause) compensatory adjustments in the local spacetime metric ("local gauge symmetry currents"), which are necessary to protect and conserve the invariant values of various conserved material charges, including "velocity c", the "Interval", and causality. Hence we find the "Lorentz invariance" of Special Relatively, in which "moving clocks run slow" and meter sticks shrink in the direction of motion, and similar effects due to gravitation in General Relativity. Time and space can vary, as Einstein realized, *but only* if both vary together in such a way as to maintain the value of the electromagnetic energy gauge "c", and the ability of the metric as as a whole to conserve energy.

Thus in spite of the fact that the metrics of gravitational spacetime vary continuously with distance from the center of the field's source, or from one planet or star to another, "velocity c" remains constant wherever it is measured. The same is true for relative motions of any kind: clocks may slow and meter sticks may shrink, but causality and the measured value of velocity c remains invariant - independent of the relative motion (whether linear or accelerated) of source or observer.

Since we are making the assumption that the field vectors of the forces are in effect "local gauge symmetry currents", converting global symmetries into local symmetries (and vice versa), we must allow the field vectors to inform us regarding the activity and conservation role of the force in question. In the case of gravitation, the field vector or "graviton" is time or spacetime, the activity is the conversion of space into time, and the conservation role is extremely broad, encompassing the conservation of energy, entropy, symmetry, and causality. In the context of the "global vs local gauge symmetry" paradigm, the conservation role of gravitation is most generally characterized as the conversion of the symmetric global, spatial metric, whose only energy form is light, to an asymmetric, local spacetime metric which accommodates the conservation requirements of both light and matter (free and bound electromagnetic energy).

The purpose of a dimensional metric is energy conservation, and gravitation acts to convert the energy-conserving symmetric global metric of space and light to the energy-conserving asymmetric local metric of spacetime, light, and matter. This is essentially the conversion of a global Newtonian metric consisting of an invariant space and time, to an Einsteinian local metric consisting of an invariant electromagnetic constant "c", with co-varying space and time (Minkowski spacetime). The key local interaction is the Lorentz transformation or "Lorentz invariance", in which space and time co-vary in such a way ("moving clocks run slow and meter sticks shrink in the direction of motion") that regardless of relative motions or variable gravitational fields, velocity c remains an invariant universal constant, conserving causality, the "Interval", and the value of the various charges and symmetry debts of matter. This is the basic energy conservation role of gravity, which must include the creation of bound energy's historical entropy drive. The gravitational force will, in addition, eventually fulfill and complete its symmetry conservation role via the conversion of bound to free energy in stars and through Hawking's "quantum radiance" of black holes.

In the gravitational force, co-varying time and space are the analogs of light's co-varying electric and magnetic fields, the local gauge symmetry "current" or force. Time is implicitly resident in the spacetime

metric, just as magnetism is implicitly resident in light's electromagnetic field.

Gravitons

The graviton is the presumed field vector of gravitation, the local symmetry current exchanged between all massive particles (via its effect upon the spacetime metric). The graviton is actually a form of time or spacetime. A graviton is a quantum unit of time or temporal entropy. All massive objects have a "location" charge, whose active principle is time, and as the time charge exits space (at right angles to all three spatial dimensions, marching off into history), time pulls the spatial dimensions along behind it, causing them to annihilate each other at the point-like entrance to the one-way time line, leaving a temporal residue which is the metric equivalent of the collapsed space. This new temporal residue likewise moves off down the time line into history, pulling more space behind it, repeating the endless, self-feeding entropic cycle. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "A Description of Gravity"; and see: "The Conversion of Space to Time".)

Conservation Roles (again)

I have previously observed that gravitation has two principle conservation roles: 1) an entropy conservation role, creating matter's time dimension by the annihilation of space (in the process, transferring the spatial entropy drive of light (the intrinsic motion of light), to the historical entropy drive of matter (the intrinsic motion of time)); 2) a symmetry conservation role, converting bound to free energy in stars and via Hawking's "quantum radiance" of black holes - conserving light's non-local symmetric energy state, in complete fulfillment of the symmetry conservation requirements of Noether's Theorem. This connects the symmetry/entropy conservation function of gravity back to its origin in the (broken) symmetric energy state of light, completing the conservation loop from global metric to local metric, and back again to global metric (light - matter - light); (light - gravity - light); (space - time - space). (See: "The Double Conservation Role of Gravitation".)

The geometric symmetry of spherical gravitational contraction is exactly the inverse of the geometric symmetry of light's spherical expansion. This is just the difference between explicit vs implicit time, or the negative gravitational entropy drive of matter vs the positive spatial entropy drive of light. *In a metaphoric sense,* we can think of this (in one case) as symmetric "wavelength" fleeing embedded, asymmetric "frequency", creating space; in the opposite case, "wavelength" is pulled by "frequency" into history, creating time (wavelength x frequency = c). (See: "Gravity Diagram No. 2".) (See: "The Conversion of Space to Time".)

The eventual effect of the gravitational local gauge symmetry current with respect to mass (the spacetime "current" or "graviton" flow produced by the gravitational "location" charge of mass), is to gather all massive objects in one place and return them to light (as in the stars). The effect of the spherical geometric symmetry of gravitation is therefore to reconnect the global and local metric gauge symmetries in a loop of conservation that circles from free energy, space, and the intrinsic motion of light, to mass, history, and the intrinsic motion of time, then finally back to light and space again - as in our Sun. These transformations are mediated in both directions by gravitation. The Sun's radiance represents a completed circuit of symmetry conservation. The loop also circles from the global metric of light, to the local metric of gravity, back to the global metric of light; and similarly, from the symmetric entropy drive of light (the intrinsic motion of light), to the asymmetric entropy drive of matter (the intrinsic motion of time), back to the symmetric entropy drive of light. (See: "Currents of Symmetry and Entropy".)

Energy Conservation within a Gravitational Metric

In the case of the electric, number, and color charges we recognize a quiescent state of local symmetry

brought about by the field vectors of the forces as they transform globally invariant charges to locally invariant charges, evidenced as a condition of charge neutrality and balance (the ground state of cold atomic matter). This neutral state is achieved despite the relative (rather than absolute) motions, differing histories and species, and partial charges of the massive charge carriers (electrons vs protons, for example). In the case of gravitation, because gravity is an entropic charge, creating matter's time dimension, its activity is always apparent to us. Of course, the electrons are always active in their orbits as well (as the ordinary bar magnetic demonstrates), but we are usually not aware of their ceaseless activity.

The gravitational analog of the cold, crystalline, locally charge-neutral ground state of atomic matter is realized at the center of a massive object such as our planet Earth, where the gravitational forces neutralize, balance, and annihilate one another, summing to zero, and in orbital motion, which is equivalent to an endless free fall. On planet Earth, gravity only creates the time dimension, fulfilling its entropy, causality, and energy conservation role, but gravity does not yet have sufficient strength to begin fulfilling its symmetry conservation role, the conversion of matter to light, as in our Sun. On a more abstract level of analysis, the quiescent, local symmetry state of gravitation is seen as energy conservation achieved within the local, gravitationally defined temporal metric (spacetime). The spacetime metric exists to ensure, facilitate, and accomplish energy conservation; this goal and purpose must be achieved within the gravitationally defined local metric gauged by G (spacetime), no less than within the globally defined electromagnetic metric gauged by c (space). Because the gravitational forces (metric) of any object all sum to zero at the center of mass, no *net* motion is imparted to either local spacetime or the gravitating mass, as energy conservation requires. On the other hand, on the global scale, gravity decelerates the spatial expansion of the Cosmos, funding the historical expansion of matter's time dimension - an action we are aware of because we experience the local flow of time as well as the local acceleration of space (gravitational "weight").

Energy conservation within the locally defined gravitational metric is accomplished in a relative (rather than absolute) environment ruled by the entropic march of time. Time is necessary to balance and conserve the energy accounts of matter because unlike light, the energy content of matter varies with matter's relative motion. Light's energy varies with its frequency, not with its motion, which is absolute and invariant. Time protects causality, produces history, and accomplishes energy conservation in bound energy, while providing the entropic drive of matter, all the consequence of the gravitational conversion of space to time. The "Interval" of matter is always greater than zero, and the motion of matter is always relative (less than c), never absolute. Nevertheless, because of time and the gravitational metric, energy conservation is accomplished in a local, relative, and imperfect (variable) world. The (conceptual) expression of the conversion of global into local metric "symmetry":

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

also represents the gravitational deceleration of cosmic spatial expansion, which transfers entropy-energy from space and the global entropy drive of light (S), to history and the local entropy drive of matter (T). The intrinsic (entropic) motion of light and space funds the intrinsic (entropic) motion of matter and history via the gravitational annihilation of space and the consequent deceleration of the cosmic expansion. This is the natural energetic linkage between our three intrinsic dimensional motions or entropy drives: light, gravity, time (the spatial entropy drive of free energy, the entropic conversion force of gravity, the historical entropy drive of bound energy). (See: "The Tetrahedron Model".)

Energy conservation is readily achieved in the global, symmetric, spatial metric defined by c, the invariant electromagnetic constant. Energy conservation must also be achieved in the local, asymmetric, spacetime or temporal metric defined by G. The new invariant global parameters in this gravitational metric are G, the "Interval", and causality. The new variable parameter that achieves energy conservation in the gravitational metric is time, protecting the invariance of causality, the Interval, and "velocity c", accommodating the

relative motion and variable energy content of matter, providing the entropy drive for bound energy, and creating historic spacetime, the conservation domain for matter's causal information field. Time is the active principle of gravity's "location" charge. Time in the gravitational metric is the functional analog of magnetism in the electromagnetic metric. Just as the magnetic field is part and parcel of the electromagnetic field vector (the photon), so too, time is part and parcel of the gravitational field vector (the "graviton").

The field vectors of all forces, which act as local gauge symmetry "currents", function (in the present moment) to conserve energy in the material, relative system, and (when possible) to return the asymmetric system of matter to its original symmetric energy state, light. They always contain a variable component which "copes" with local, relative conditions - time, magnetism, or the virtual particle-antiparticle components of the strong and weak forces (gluons, mesons, and leptonic alternative charge carriers). Time is created by the gravitational annihilation of space and the extraction of a metrically equivalent temporal residue. (The conversion of globally symmetric space and the spatial entropy drive of light, to locally asymmetric time and the historical entropy drive of matter, is necessary to conserve the invariance of matter's Interval, causality, and "velocity c", and also to achieve energy conservation within a metric characterized by relative motion.) (See: "The Conversion of Space to Time".)

Because time is extracted directly from space, the dimensional parameters of spacetime are from the beginning metrically and entropically equilibrated, and can function together seamlessly in their compound conservation domain for free and bound forms of electromagnetic energy.

Massless, 2-D light is non-local, atemporal, and acausal. Massive, 4-D matter is local, temporal, and causal. Energy conservation is observed in both the globally symmetric state (of light) and the locally asymmetric state (of matter). The spherical symmetry of a gravitational field (which vanishes or self-annihilates at the center) is an essential feature of its energy conserving role, by this means not only producing time, but also avoiding producing any net spatial motion in the gravitating mass. Gravitation accomplishes the transformation of the global metric into a local metric; the field vector is time (or spacetime), the active principle of the gravitational "location" charge. The entropy- energy to create matter's time dimension is taken from the intrinsic motion of light via the gravitational annihilation of space and the deceleration of the cosmic expansion. This entropy-energy debt is repaid by the (eventual) gravitational conversion of matter to light, as in the stars and via Hawking's "quantum radiance" of black holes, satisfying the symmetry conservation mandate of Noether's Theorem. The cosmic expansion "accelerates" (rebounds) in consequence of these symmetry payments, which reduce the Universe's total gravitational energy - as recently observed.

When Gauges Coincide

It is apparently a general rule that when the local gauge returns to the magnitude or form of the global gauge from which it is derived, then symmetry conservation is consummated. For example: when "little g" = "c" in the black hole, we find Hawking radiation outside the "event horizon", and proton decay inside the event horizon, with matter moving at velocity c, clocks stopped, and meter sticks shrunk to nothing - just as is the case for photons in the electromagnetic metric gauged by "c". In the case of the weak force: the local gauge symmetry "current" is the mass of the IVBs (as scaled by the Higgs boson) which recreates the three force unification symmetric energy states of the "Big Bang". The mass series increases from the "W" IVB family to the "X" IVB family to the "Y" IVB family (see: "Table of the Higgs Cascade".)

At the "W" (electroweak) unified force level, the quark and lepton species are subsumed into their generic identities (hadrons vs leptons). All quark species are equivalent and all lepton species are equivalent, and can be transformed one to another, within their respective identity "genera" (but not between genera- rather like the usual hybridization rules between plants). At the next higher mass IVB level, the "X" IVB of the GUT unity level incorporating the strong and electroweak forces, we find leptons and hadrons unified (at the "family" level of "fermions") and transforming between "genera", with the consequence that proton

decay is possible, the complete return of matter to light via the short-range particle forces. This actually corresponds to the "black hole" energy level in the astrophysical hierarchy, where proton decay also occurs (at least hypothetically: quarks are squeezed until the gluon field and color charge vanish ("asymptotic freedom") - by gravity in the one case and the "X" IVB in the other).

"Asymptotic freedom" (the vanishing of the gluon field) is the strong force example of the gauge coincidence phenomenon. As the quarks are compressed, the gluon field sums to zero color (since the gluon field is composed of color-anticolor charges in all combinations); the gluon field consequently becomes more and more like the photon field from which it was originally derived. When the gluon field and color charges completely self-annihilate (under compression), the baryon becomes essentially a heavy lepton (leptoquark) and proton decay (via a leptoquark antineutrino, or equivalently, with the emission of a leptoquark neutrino), can ensue. Gluons return to photons, baryons return to leptons, partial charges return to whole unit charges, leptoquarks decay, and mass returns to light.

The next higher force unity level is at the TOE level, incorporating all forces, particles, charges, and metrics including gravity (at the final level (within our universe) of positive electromagnetic vs negative gravitational energy), and represents a cosmic-level reprise of the complete force unity of the electromagnetic "Big Bang" realized through a gravitational "Big Crunch".

Gravitation and Charge Conservation

The weakness of gravity is due to the tangential connection (which we experience as the ephemeral "present moment") between matter and its causal conservation domain of information (historic spacetime). (See: "The Half-Life of 'Proton Decay' and the 'Heat Death' of the Cosmos".) This tangential connection reflects the fact that it is matter's time dimension that has intrinsic, entropic motion, and not matter itself. Matter has no (net) intrinsic motion in either space or time, although matter's associated gravitational field (Gm) consumes space to produce matter's moving temporal dimension. Matter's gravitational field represents bound energy's primordial, intrinsic, historical entropy drive, producing time via the annihilation of a metrically equivalent quantity of space. (See: "The Time Train".)

The separation (or tenuous, tangential connection) between matter and its historical, causal conservation domain of information is the root cause of human anxiety regarding our fleeting experience of life, but is necessary to protect both the energy and charge of atoms from the vitiating action of temporal entropy (aging). In consequence of this protection, atoms retain the full value of their energy content and charge magnitudes until their energy and symmetry debts are paid in full - either gravitationally by Hawking's "quantum radiance" of black holes, or via the electromagnetic annihilation of matter-antimatter particle pairs, or by the strong and weak nuclear forces through fission, fusion, radioactivity, particle and finally "proton decay".

Summary

The invariant, global magnitude of gravity's time or "location" charge ("G") - like all other charges - must be maintained, because of the intimate connection between time and energy conservation (entropy, causality, the Interval, relative motion, etc.). Hence both c and G must be universal and invariant metric constants. Nevertheless, time can vary locally if space co-varies, a combination which maintains the constant value of c, the "Interval", and causality. T can vary locally only within the framework of a global metric structure which as a whole remains capable of conserving energy ("Lorentz Invariance"). Charge invariance - including the "Lorentz Invariance" of special relativity - is the key to understanding the local forces and the local action of the field vectors (local "gauge symmetry currents"). The local, relative motions of matter require local compensatory forces to maintain and protect the invariant, global

parameters of charge, including the "Interval", causality, and the electromagnetic constant, "c".

We see a hierarchy of global-local gauge symmetries, with the global "multiverse" at the top, existing purely in terms of creative potential, with all the various possible universes as the local gauge expressions of the next lower (derivative) level. Our universe is one such local choice among these (infinite?) possibilities, whose physical laws and constants (by chance alone) favor the evolution of our life form (the "Anthropic Principle"). (Within our own universe, however, the evolution of life is not due to simple chance, but to the operation of a 4x3 General Systems or fractal algorithm. See: "Nature's Fractal Pathway".) At the multiverse level, the energy type, dimensional parameters, and physical constants of our universe are but the local gauge parameters of a specific (electromagnetic) choice or realization, perhaps among an infinitude of possible universes. I would guess that the only restriction upon the physical parameters of any universe is that: 1) it requires no net energy (or charge) to create; 2) it must be capable of conserving such energy as it does contain; 3) it must be able to break its initial symmety condition; 4) it must be able to return to its symmetric origins.

Within our electromagnetic, 4-D universe, the electromagnetic constant c is the dominant global energy gauge, regulating spacetime and its perfectly symmetric metric, with massless, non-local light as the perfectly symmetric energy form. Next below light, c, and the symmetric (inertial) spacetime metric, is matter and gravity, both derived from light and light's spatial metric. "G" is a global gauge but defines a local metric, which is characterized and "warped" by asymmetric time. The gravitational charge recognizes all particles only in terms of their mass equivalency, the broadest category among material particles, matter or antimatter. Next below the gravitational "location" charge (in terms of generality) is the electric charge, recognizing the equivalency of all electrically charged particles. The weak "identity" charge follows, recognizing four subcategories of number or "identity" charge (lepton and baryon "number" charges); finally at the bottom, we find the narrowest category, the strong force charge recognizing only the global category of color charge (all quarks are equivalent with respect to color charge, regardless of other charges they may bear).

This same hierarchy is like a set of nested Russian dolls with respect to the physical volumes of space (or general dimensionality) within their domains. At the top, we have the multiverse of infinite creative potentiality and n-dimensional conservation domains; next, our 4-D unbounded universe of light, followed by our gravitationally bounded universe, and the gravitational boundaries of galaxies, stellar systems, stars, and planets; below planets is the electrical domain of crystals and organic molecular systems and forms, and atomic electron shells; below the atomic level is the realm of the two nuclear forces, the weak force at the level of elementary particles (creation, destruction, decay, and transformation), followed by a final (?) layer of the sub-elementary quarks, permanently confined by the color charges of the strong force. Biological (living) systems, depending upon how one defines them, fit somewhere below stellar systems (space-faring species) and above crystals (bacteria, virus).

At every level, from the "Big Crunch" to the Sun, stars, and Hawking's "quantum radiance" of black holes, to the matter-antimatter annihilations of particle-antiparticle pairs, or particle and proton decay, the system of interwoven and nested global and local symmetries drives toward a single goal: the return of bound to free energy, the transformation of matter to light, as required by the symmetry conservation mandate of "Noether's Theorem".

A diagrammatic representation of the global-local gauge symmetry structure of natural law and the physical forces can be seen in: "The Tetrahedron Model". A comparison of the "Tetrahedron Model" vs the "Standard Model" of physics is also available.

Postscript
A Hierarchy of Gravitational Conservation Roles and Domains

1) Gravitational Realms: Single Systems (planets and stars)

A) Entropy-only Conservation Domains: (the gravitational creation of time via the gravitational conversion of space to time) (atoms -> planets):

Atoms - time ("half-life") - radioactivity, particle, and proton decay (gravity provides the time dimension within which all forms of charge conservation can have an historical significance - another example of the connection between gravity and symmetry conservation)

Spherical shapes created by symmetric gravitational forces (large composite objects); large asteroids, satellites, moons, planetismals

Planetary life zone - biological information domain (atmosphere, liquid water, magnetic field, all necessary?); (time is necessary for biological evolution)

Planets (various sizes, approximately Earth to (?) Jupiter-sized planets)

Brown dwarfs ("failed" stars: ~13 - 80 Jupiter masses; limited fusion of deuterium and lithium)

B) Entropy-plus-Symmetry Conservation Domains: (the gravitational creation of space and light via the conversion of bound to free energy - simultaneously with the gravitational conversion of space to time: nuclear fusion reactions (the nucleosynthetic pathway) repaying the entropy and symmetry debts of matter) (stars)

Sun and Stars - various types and sizes (above 80 Jupiter masses up to ~ 100 (?) solar masses); stellar "generations" (first generation stars may be (much?) more massive)

Nucleosynthetic pathway (creation of heavy elements)

Novas and supernovas (creation and dispersal of heavy elements)

White Dwarfs - electron shell collapse; electron "gas" (condensed matter series begins)

Neutron stars - pulsars and magnetars

Black Holes: small (primordial); large (stellar); giant (galactic)

"Quantum Radiance" - Hawking (total conversion of mass to light and final gravitational repayment of matter's entropy and symmetry debts)

Proton Decay - probably common at central "singularity" of black holes (black holes therefore probably consist only of gravitationally bound light)

2) Gravitational Realms: Complex Orbital Systems (Stellar Systems and Galaxies)

C) mixed entropy, symmetry, and neutral domains (stable orbits are gravitationally neutral domains) (orbital pairs - Universe)

Orbital motions (moons, satellites, asteroids, comets, etc.)

Stellar Systems (planetary systems with a central star or stars)

Binary stars, and simple multiple orbital systems

Globular Clusters

Galaxies and galactic structures (disc, central bulge, halo, globular clusters, giant molecular clouds, stellar nurseries, spiral arms, central giant black hole, etc.)

Galaxy types: spirals, barred spirals, ellipticals, irregulars, dwarf, etc. (small - large; primitive - evolved)

Quasars (and "active" galaxies)

Galaxy clusters, giant central galaxies, satellite galaxies, interactive galaxy pairs, colliding galaxies, etc.

Giant galactic "walls" and "voids"; galactic superclusters; "foam-like" mega-structure of Cosmos

3) Cosmic Scale: Creation, Destruction, Fate of Universe

D) Creation of Light, spacetime, and Matter (from multiverse?); Creation of Entropy/Conservation Domains of Space and Historic Spacetime

Deceleration of cosmic expansion (due to gravitational annihilation of space)

Acceleration (rebound) of cosmic expansion (due to gravitational annihilation of mass

and vanishing of associated gravitational fields)
Creation of Universe: "Big Bang" (via compensating negative gravitational energy: net energy = 0)
Destruction of Universe: "Big Crunch" (and rebound) (net entropy = 0) (return to multiverse?)

Links:

Cosmology
- A Spacetime Map of the Universe

Unified Field Theory
- Section I: Introduction to Unification
- Section X: Introduction to Conservation
- Section IX: Symmetry: Noether`s Theorem and Einstein's "Interval"
- Section XIV: Causality
- Symmetry Principles of the Unified Field Theory (a "Theory of Everything") - Part I
- Symmetry Principles of the Unified Field Theory (a "Theory of Everything") - Part 2
- Principles of the Unified Field Theory: A Tetrahedral Model
- (Postscript and Commentary on paper above)
- Synopsis of the Unification Theory: The System of Spacetime
- Synopsis of the Unification Theory: The System of Matter
- Light and Matter: A Synopsis
- Global-Local Gauge Symmetries and the "Tetrahedron Model"
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Gravitation
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Gravity Diagrams
- A New Gravity Diagram
- The Gravity Diagram
- The Three Entropies: Intrinsic Motions of Gravity, Time, and Light
- The Tetrahedron Model (complete version)

home page

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