Section II: Introduction to Gravitation

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home page

Papers: "A Description of Gravitation";
"Gravity, Entropy, and Thermodynamics"

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Abstract

Gravity is matter's memory it once was light.

The rationale for gravity begins with the creation of the Cosmos - the negative energy of gravity is necessary to balance the positive energy of the "Big Bang", so that the "Creation Event" requires zero net energy. For similar reasons, antimatter is also required to balance the charges of matter so that creation occurs from a state of zero net charge. Beginning in a condition of complete neutrality (perhaps as a giant quantum fluctuation of the vacuum, an "inflationary bubble", or by Divine Fiat), the Universe can only subsequently evolve into a state of complete conservation. Regarding the beginning of the Universe, we can only speculate.

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) energy conservation (at all gravitational field strengths) for bound forms of energy, via the creation of time, history, and matter's temporal entropy drive; 2) symmetry conservation (at stellar and higher gravitational field strengths) via the conversion of bound to free energy (mass to light) in stars, supernovas, quasars, and related astrophysical processes, and ultimately and completely, via Hawking's "quantum radiance" of black holes. These secondary conservation roles,

manifesting as the gravitational conversion of space to time and bound to free energy, are natural consequences of the mode of action of gravity's primary role, which is the creation of negative energy and entropy via the contraction, heating, and destruction of space (creating time), in contradistinction to the creation, expansion, and cooling of space by the positive energy and entropy of light.

The relationship of gravity to the other forces is through "Noether's Theorem" of symmetry conservation: *all charges and their forces originate as symmetry debts of light*. In its broadest "global" sense, then, the negative energy of gravity is the symmetry debt of the net positive energy of electromagnetic energy. In a narrower, "local"sense, however, the gravitational charge of mass (Gm), whose active principle is time, represents the symmetry debt arising from the (lost) "non-local" distributional symmetry of light's free energy, a debt incurred whenever free electromagnetic energy is converted to bound electromagnetic energy: hν = mcc. I refer to the gravitational charge as "location".

Gravity pays the entropy-"interest" on the symmetry debt of matter by creating a time dimension for bound energy in which charge conservation can have an historical expression and causal significance. This conversion of space to time, as on planet Earth, does not vanish either mass or the gravitational field (hence the analogy with "interest"). Gravity pays the energy-"principle" on the symmetry debt of matter by converting mass to light (in stars and related astrophysical processes) - which vanishes both mass and its associated gravitational field (hence the analogy with "principle"). The first reaction causes a deceleration of the spatial expansion of the Cosmos, while the second causes an apparent acceleration (as recently observed).

Introduction

The subject of gravitation is of course central to any attempt at force unification; the well-known standoff between quantum mechanics and relativity theory centers on the inability of "establishment" physics (or the "standard model") to produce a satisfactory theory of quantum gravity, or any theory that integrates gravity with the other forces of physics (electromagnetic, strong, and weak).

There has always been an element of mystery surrounding gravitation - what is gravity and why does such a dimension-warping force exist? What is the role of gravity in the economy of natural law - what is the conservation reason for the existence of this force? Why is gravity so weak? These are among the questions concerning gravity which neither Newton nor Einstein (nor anyone since) has answered satisfactorily.

The unification theory presented in these papers is nevertheless built around the central question: why does gravitation exist as a force in Nature; why must it exist; what is the conservation role of gravity? Newton and Einstein have figured out the "how" and the quantitative mathematical representation of gravitation; I set out, many years ago now, to figure out the "why". (I assume in these papers that Einstein's mathematical representation of

gravitation, minus his "cosmological constant", is essentially correct. However, I do not agree with Einstein's apparent assumption that light, moving freely in the vacuum of spacetime, produces a gravitational field.)

Einstein had tried to unify the long-range "spacetime forces", gravity and electromagnetism, but without success. In his day the short-range "particle forces", the strong and weak forces, were essentially unknown. A fully unified theory had no chance of being developed until the two "particle forces" were better known, long after Einstein's death. In the light of present knowledge, however, we can have a more reasonable hope of achieving unification.

Chronologically, I climbed the first (and most important) rung on the ladder of my personal understanding of gravitational unification with my introduction to "Noether's Theorem", which essentially states that the symmetries of light (and the symmetries of the spatial metric which light creates) must be conserved. I realized that *the charges of matter are the symmetry debts of light,* that is, the conserved charges (and spin) of particles - charge conservation - is just a basic form of symmetry conservation. This is the simple, overarching principle which unifies gravity with the other forces of physics. Charge conservation is one example of Noether's Theorem enforced in the "real" (rather than the theoretical) world. The "inertial" forces of spacetime, including gravitation, are the corresponding "metric" or dimensional examples of Noether's Theorem enforced. Einstein had tackled the gravitation problem (with resounding success) from the inertial, geometric, dimensional, and metric point of view. Perhaps something in addition could be gained by looking at the gravitational question from the perspective of particles and charges - completing, as it were, the particle-wave analysis of the force.

If gravity represented the conservation force associated with a symmetry debt of light (if gravity, like the other forces, was produced by a "charge"), then it would fall under the conservation umbrella of Noether's theorem and could be treated like any other charge of matter. Also, by treating gravity as one of the quantized charges of matter, one automatically had a leg up on the problem of joining quantum mechanics and relativity. The immediate question, therefore, was: what symmetry of light was gravity conserving, and what was the consequent gravitational charge?

The Symmetric "Non-Local" Energy State of Light

I soon realized that indeed light did have a symmetry which was broken during the conversion of free to bound energy that looked as if it might be the cause of the gravitational "charge" or symmetry debt. This symmetry is the "non-local" equitable distribution of light's energy, everywhere in spacetime, simultaneously. This distributional symmetry of light's energy comes about because of light's intrinsic motion and "non-local" character (gauged by "velocity c") - as discovered by Einstein. Light's position in spacetime cannot be localized or specified because light has no time dimension and no "x" spatial dimension in the direction of propagation. Lacking two dimensions, it is impossible to specify light's position in either 3 or 4 dimensional space or spacetime. Since neither time nor distance exists for light, yet light has intrinsic motion, light has essentially forever to go nowhere (whatever the actual magnitude of "velocity c" might be); hence we can say that in free flight in its own reference frame (moving freely in the vacuum of space at velocity c), light is everywhere within its conservation domain of

spacetime simultaneously (light is "non-local" or has an "infinite" velocity).

Einstein characterized this spatially symmetric condition of light's "non-local" energy state through his mathematical formula for the "Interval": light's "Interval" equals zero. (The "Interval" is an invariant measure of the quantity of spacetime separating two events.) When I realized that "velocity c" was not usefully conceived as an ordinary (nor even as a "non-ordinary") velocity, but was instead a "gauge" or regulator of energetic and metric symmetry which vanished (suppressed) time and distance - and that Noether's theorem required such symmetries to be conserved - I knew that the combination of Einstein's "Interval" and Noether's Theorem provided the formal basis for understanding gravitation as a conserved charge or symmetry debt of light. In the gravitational case, the lost or broken symmetry is light's "non-local" energy state and the lost symmetric distribution of light's energy throughout space everywhere, simultaneously (in its own reference frame). The distributional symmetry of light's energy is lost when free energy (light) is converted to immobile bound energy (mass-matter), whose concentrated "rest mass" ($h\nu = mcc$) has no (net) intrinsic spatial motion.

The fact that the metric "warpage" or "curvature" of a gravitational field (-Gm) identifies (in aggregate) the spacetime position of the immobile lump of bound energy (m), and also reflects the quantity and density of mass, in other words, the concentration of bound energy at a particular spacetime locus, was proof to me that this force behaved exactly as a symmetry debt or charge should if it was recording, as hypothesized, the (broken) symmetry of the spatio-temporal distribution of the energy of light. Gravity was telling the conservation domain of spacetime in the universal, energetic language of metric asymmetry (inertial-dimensional force) exactly where, how large, and how intense was matter's distributional symmetry debt (violation of energy's distributional symmetry) as represented by the spacetime location, quantity, and density of the offending immobile concentration of bound energy. Finally, the light of the Sun bore witness to the fact that gravity was acting, exactly according to the expectations of Noether's theorem, to "pay off" this symmetry debt by converting mass back to symmetrically distributed free energy. Hawking's "quantum radiance" of black holes carries the gravitational conversion of bound to free energy to completion - which is one reason why Hawking's result is so important, as it confirms the ultimate symmetry conservation role of gravitation.

The "Location" Charge of Gravity

In 1980, I named this gravitational charge "location", and wrote my first paper on this subject. My father, the late Prof. John C. Gowan, actually published a version of this early paper in his book "Enveloped in Glory" in 1982.

While the "location" charge of gravitation remains to this day as the essential "first rung" in my understanding of gravitation (gravity represents the symmetry debt of the (lost) "non-local" distribution of light's energy), it was only many years later that I climbed the next rung toward understanding this complex force. According to my records (which are in most other respects lamentably incomplete), it was not until November of 1997 (17 years later - remember this is a hobby I pursued while I worked a full-time job at Cornell, built a house for my mother, and with my wife Esther raised a family of 3 boys) that I took the next step, realizing that gravity was creating the time dimension of matter by the annihilation of space. Gravity, I finally

understood, was quite literally converting space into time, and time itself was the active principle of the gravitational "location" charge. Hence the time quantum or charge is the connection between Quantum Mechanics and General Relativity - *a graviton is a quantum unit of time, metrically equivalent to a quantum unit of negative spatial entropy, spatial contraction, or gravitational force*.

In November of the following year, 1998, I climbed another rung and realized that time and gravitation actually induce each other in an endless cycle - much as do the electric and magnetic fields of light, but via quite a different mechanism. The intrinsic motion of time pulls space after it into the point-like beginning of the one-dimensional time line situated at the center of any given mass; there space self-annihilates, + x canceling - x and so on, but leaving a +T temporal residue, the metric equivalent of the annihilated space, which cannot cancel since time being one-way, there is no -T. The intrinsic (entropic) motion of the new time charge immediately marches down the time line into the historic conservation domain of information and matter's "causal matrix" (historic spacetime), pulling more space after it in an endless cycle, and causing the collapsing accelerated flow of spacetime we recognize as a gravitational field.

The historic domain of bound electromagnetic energy is at right angles to all three spatial dimensions; time is one-way because time protects causality and thereby energy conservation; the gravitational field is spherically symmetric because time couples equally to all three spatial dimensions; the field accelerates due to the constant application of a force (the constant intrinsic motion of time), and vanishes at the center of mass where the spatial metric self-annihilates. *A gravitational field is the spatial consequence of the intrinsic motion of time*. This mechanism is perfectly in agreement with Einstein's "Equivalence Principle", the collapsing, accelerated flow of spacetime being the indistinguishable equivalent of a static "warped" or "curved" metric field: spacetime accelerating through us is the "reciprocal equivalent" of our accelerating through spacetime. This is the macroscopic qualitative mechanism, but not yet the whole "why" of gravitation.

In terms of the present theory, we can now formulate the analogy between gravitation and electromagnetism which so intrigued Einstein: As magnetism is the invisible, spatially projective, electrically active ("electro-motive") force of the loadstone, so gravity is the invisible, spatially projective, dimensionally active ("inertio-motive") force of the ordinary rock. In the case of magnetism, we trace the force back to the moving (and aligned) electric charges of atomic electrons in the loadstone; in the case of gravity, we trace the force back to the moving (and one-way) temporal charges of bound energy in the rock. A moving electric charge creates a magnetic field; a moving temporal charge creates a gravitational field. In both cases the field is produced at right angles to the current. The relation is reciprocal as well: moving magnetic and spatial (gravitational) fields create electric and temporal currents. Finally, gravity and time induce each other endlessly, as do the electric and magnetic field components of light. Both time and magnetism represent "local gauge symmetry currents" of their respective forces, protecting energy conservation and the invariance of causality (time), and symmetry conservation and the invariance of electric charge (magnetism).

Time (added Feb. 2014)

It should be noted that I treat the gravitational "location" charge like other charges, in the sense that antimatter carries the same charge but with an opposite sign. Hence particle-antiparticle pairs will cancel each others "location" charges, just as they do all other charges. My expectation is that the antimatter gravitational "location" charge nevertheless is universally attractive with respect to bound energy of any type, in the same manner as our familiar matter gravitational charge (since space is perfectly symmetric with respect to "anti-space"), but differs in the one-way (asymmetric) "direction" of antimatter time. We are familiar with our own one-way time asymmetry - in the anti-universe, I expect this same one-way causal temporal flow to occur, but in a "direction" opposite to our own. By this I do not mean causality is violated in the anti-world (which would also violate energy conservation), I simply mean the one-way direction of time is opposite our own, much like "east vs west", but expressed within the temporal rather than spatial parameter. We have a related example of such an effect in the "handedness" or "parity" of our neutrinos - all matter neutrinos are left-handed, all antimatter neutrinos are right handed, distinguishing the information content of matter vs antimatter.

Wheeler and Feynman raised similar speculations regarding the time travel of antimatter, but later abandoned them, evidently due to causality concerns. However, I think the causality violations can be avoided if a purely "directional" reversal of time flow is postulated, that is, a reversal (like parity) that does not have causal consequences violating energy conservation.

Nevertheless, two oppositely directed time flows cannot coexist within the same reference frame, hence accounting for the immediate and violent annihilation of matter vs antimatter (the head-on collision of two universes time-traveling in opposite directions). This may be the actual mechanism producing the attraction between opposite electric charges - whereas the principle involved is the conservation of light's non-local symmetric energy state (returning bound energy to light via particle-antiparticle annihilation reactions).

Accordingly, in the "Spacetime Map of the Universe", we would diagram the anti-universe with the spatial axis increasing upwards, as before, but with time increasing toward the right, rather than the left, as in the original diagram. That is, the universe and anti-universe would occupy opposite (left-right) quadrants in the upper half of the figure.

More to the Story: Entropy and Gravitation
(See: "Spatial vs Temporal Entropy")

It was while driving to work one fine spring day in 1999 that I climbed another rung in my personal understanding of the "why" of gravitation, as the connection between gravity and entropy finally dawned on me. In addition to its symmetry conservation role, gravity must also be conserving the entropy of the "Universe of light", the entropy drive of free energy, the expansive principle of space, the intrinsic motion of light as gauged (regulated) by "velocity c". By July 1999 I had written the first version of the "Entropy, Gravitation, and Thermodynamics" paper. In November of 1999, I submitted the paper to the Archives of Physics (an electronic archive of physics papers, originally at Los Alamos, but now at Olin Library, Cornell University). (The archive paper has been updated several times since, but the most recent version will always be found on my public website - and on the public viXra.org alternative open E-print archive.)

"Velocity c" is the gauge (regulator) of light's non-local, spatial, symmetric energy state, light's symmetric spatial/inertial metric, and the gauge of light's symmetric "all-way" spatial entropy drive (the intrinsic motion of light). On the one hand, "c" regulates the metric symmetry of space, suppressing the asymmetric time dimension, and maintaining light's "non-local" energy state, while on the other hand "c" regulates the creation, expansion, and entropic cooling of light's spatial conservation domain. By the summer of 2002 I was writing papers on "velocity c" and "velocity T" as the entropy gauges of free and bound electromagnetic energy, and on the entropic significance of their metrically equivalent and effectively infinite velocities. To fulfill their entropy functions, both c and T must represent effectively "infinite" velocities as a guarantee against any violations of causality or energy conservation (by fast spaceship or "time machine"). (See: "Spatial vs Temporal Entropy".)

By the summer of 2003 I understood the relation between entropy and symmetry in the double role of the free energy gauge "velocity c" regulating light's intrinsic motion, and the consequent double conservation role of gravity as the carrier of the symmetry/entropy debt of light's lost "non-local" symmetric energy state. (See: "The Double Conservation Role of Gravity"). The relation between light's non-locality, metric symmetry, and lack of a time dimension meant that light is non-local, a-temporal, and a-causal. The temporal sequence of cause and effect is meaningless to an energy form which has no time dimension. Light has no gravitational field, nor the time charge which could produce one. But matter is local, temporal, and causal, with a gravitational field produced by the intrinsic and self-renewing motion of matter's time charge. The active principle of the gravitational "location" charge is time itself, both identifying the 4-dimensional position of bound energy (recognizing light's non-local distributional symmetry debt), and due to time's intrinsic motion, serving as matter's entropy drive (recognizing light's lost intrinsic motion or entropy debt). (See also: "Does Light Produce a Gravitational Field?")

Hence the ultimate reason for the existence of gravitation (beyond the primordial energy balance of the "Big Bang") is a twofold conservation linkage (the consequence of conserving the double gauge role of "velocity c"): 1) the conservation of light's non-local distributional symmetry or symmetric energy state; 2) the establishment and maintenance of matter's entropy drive (time) and historic "causal matrix" (historic spacetime). The gravitational creation of time from space can also be seen as the conservation of light's entropy drive - the conversion of light's intrinsic motion into time's intrinsic motion. This double conservation role is accomplished through the double role of gravity's entropic time charge. Time is the active principle of gravity's "location" charge, both identifying the 4-D spatial coordinate position of asymmetrically distributed immobile, concentrated mass-energy, and simultaneously establishing the historical entropy drive of matter, the intrinsic motion of bound energy's time dimension (see: " The Time Train"). The conservation of energy and causality are of course also served by the gravitational creation of matter's time dimension (since matter has relative rather than absolute motion).

By Dec. 2008 I understood that the intrinsic motion of time and gravitation produces the historic conservation domain of information (historic spacetime), which links today with yesterday and space with time, a linkage which is essential to upholding the reality of the "Universal Present Moment". The latter is the real effect of and necessity for matter's historic "causal matrix" - the continuum of spacetime. This last bit of understanding - that gravity

produces and maintains the necessary historic/energetic connection between past and present and space and time - creating the historic continuum of spacetime - is simply another step up the ladder of understanding the conservation role of this most complex and paradoxical of the four forces of physics. Light is connected by space, matter is connected by time, gravity connects everything. Gravity both creates and is created by the intrinsic motion of time. Time and gravity induce each other in a self-feeding endless cycle. (See also: "A Spacetime Map of the Universe".) (Still other conservation roles for gravity are surmised in the "Higgs Boson" papers, involving the recreation of the primordial force unification eras of the "Big Bang".) (See also: "A Description of Gravity".)

Local Gauge Symmetry

The notion of gravity as the spacetime flow of a "local gauge symmetry current" creating time, gave me yet another perspective upon this primal conservation force (Nov. 2006). We can now formulate a (somewhat technical) statement of gravity's role which accommodates the "Standard Model" of "establishment" physics:

> The 1st law of thermodynamics, energy conservation, can be regarded as the primary role of gravitation, with the conservation of entropy, causality, and symmetry as corollaries, since the role of the spacetime metric is first and foremost to conserve energy. The action of gravitation converts a global electromagnetic metric of space, light, and absolute motion gauged by "c", to a local gravitational metric of time, matter, and relative motion gauged by "G". Time or temporal entropy can be regarded as a "local" form of entropy drive, distilled from the "global" entropy drive of light (by the gravitational annihilation of space and the extraction of a temporal residue). Time is the local compensating component of the gravitational field vector (spacetime) - equivalently, the local gauge symmetry "current" - protecting the invariance of the "Interval", causality, and "velocity c" within the gravitational metric, accomplishing energy conservation despite the variable and relative motions of matter, or a variable gravitational/metric field. To this end, time itself must be flexible and interchangeable with space (covariance of time and space in Special and General Relativity - "Lorentz Invariance"). In this local gauge symmetry role, time is the functional analog of the magnetic component of the electromagnetic field: time protects energy conservation and the invariance of "velocity c", magnetism protects symmetry conservation and the invariance of electric charge. (See: "Global vs Local Gauge Symmetry and Gravitation".)

Quantum Relations

(See: "The Conversion of Space to Time")

Time and gravity are the microscopic (quantum mechanical - particle/charge/temporal/entropic) and macroscopic (general relativistic - mass/location/spatial/symmetric) aspects of the same force. The unification of gravity with quantum mechanics subsists in the unification of gravity with time. *Gravity is the spatial consequence of the intrinsic motion of time*. Time is the active principle of the gravitational "location" charge. It is the entropic nature of the gravitational

"location" charge that distinguishes gravitation from the other forces and their charges: the latter represent symmetry debts only. Gravitation carries both a symmetry and an entropy debt of light, the consequence of the fact that gravity conserves both aspects of the double regulatory role of "velocity c", which gauges both the "non-local" symmetric energy state of light and the entropy drive of light (light's spatially expansive intrinsic motion). In conserving light's (broken) non-local distributional symmetry, gravitation automatically conserves both the symmetric and entropic metric gauge functions of c. Hence in the Sun, gravitation is both creating the Sun's time dimension by converting space into time, and simultaneously reversing this reaction by converting bound energy (mass) into light. (See: " Spatial vs Temporal Entropy".)

One of several rationales for gravitation (in addition to registering immobile matter's asymmetric spatio-temporal distribution), is the causal nature of bound energy, which requires a one-way temporal sequence to regulate its energy accounts. This temporal flow also serves as bound energy's entropy drive, which is the metric equivalent of velocity c, the latter gauging the entropy drive of free energy. "Velocity c" also gauges "velocity T" (determining that one second of temporal duration is metrically equivalent to ~300,000 kilometers of distance), and hence "c" is the ultimate gauge of both entropy drives (see: "Gravity Diagram No. 2"). "G" (the universal gravitational constant) is the metric conversion/conservation gauge and force acting between the primordial entropy drives of space and time, converting either into the other. "c" is the regulator of the metric equivalence between space, time, and light (free electromagnetic energy); "G" is the regulator of the entropic equivalence between space, time, and mass (bound electromagnetic energy).

Both forms of entropy drive (the intrinsic motions of light and time) create dimensional conservation domains for their energy types (space and history), in which energy can exist, be used and transformed, but nevertheless be conserved. It is the effectively "infinite" velocity of both c and T which prevents the abuse of energy while it is being used, and also seals the borders of space and history against causality violations via fast space ship or "time machine". In the case of the black hole, where the gravitational metric of matter completely overwhelms and replaces the electromagnetic metric of light, including its protective entropic functions, gravity seals the borders of spacetime via the "event horizon" and central "singularity". T, c, and G are all entropy gauges which both create and protect dimensional conservation domains: history, space, and spacetime. The creation of dimensional conservation domains via "infinitely" fast intrinsic/entropic motions is the connection between the first and second laws of thermodynamics. (See: "The Tetrahedron Model".)

The Intrinsic Motion of Light

The intrinsic motion of light is caused by the symmetric spatial component ("wavelength") of an electromagnetic wave "fleeing" the asymmetric temporal component ("frequency") - the latter is an internal property of light's own nature (frequency multiplied by wavelength = c). Only by moving constantly at velocity c can the symmetric wavelength component of light suppress the asymmetric temporal component to an "implicit" state - light has no time dimension, yet it has a "frequency". Light requires one dimension each for its electric and magnetic components, and a third for its entropic motion. Hence space is the entropic

dimension, providing the base of light's energy conservation domain. When light is brought to rest and becomes bound energy, the implicit time component becomes explicit, serving as matter's temporal entropy drive. The explicit time dimension of matter marches off into the historic domain (at right angles to all three spatial dimensions), dragging space after it, and so causes the macroscopic gravitational field. The entropic time charge of gravitation is thus the connection between gravity and quantum mechanics, realized through the switch of the temporal component of the electromagnetic wave from implicit to explicit, 2-dimensional to 4-dimensional. This simple switch is the whole difference between the expansion of space as driven by the intrinsic motion of light, and the collapse of space as driven by the intrinsic motion of time and gravity - the difference between positive and negative spatial entropy, or implicit vs explicit time (see: "The Conversion of Space to Time").

The Sign of "G"

The sign of G is determined by the small energy difference between the symmetric spatial entropy drive (S) of light (the intrinsic motion of light, as gauged by "velocity c"), and the asymmetric temporal entropy drive (T) of matter (the intrinsic motion of matter's time dimension, as gauged by "velocity T"):

$$S - T = -G$$

This is equivalent to the small energy difference between implicit (S) and explicit (T) time. (See: "Gravity Diagram No. 2".)

It takes energy to create the drive of one-way temporal entropy from the drive of "all-way" spatial entropy, because an asymmetric, one-way temporal order must be imposed upon the symmetric, "all-way" spatial expansion. This entropy-energy cost of time is the origin of the "negative energy" characteristic of gravity and the negative sign of "-G".

The notion of the gravitational conversion of space and the drive of spatial entropy (S) to time and the drive of historical entropy (T), can be symbolically represented by a (quasi-mathematical) "concept equation" as:

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

> Because I assume the general validity of Einstein's gravitational equations (excepting his "cosmological constant" and the case of light in free space), it follows that I assume Einstein's formulation of the gravitational "warpage" of spacetime must be a mathematical description of the conversion of space to time (his "covariance" of space and time). For example, when Einstein tells us that meter sticks shrink and clocks run slow in a gravitational field, I assume that the missing space reappears as the extra time, such that the metric total remains constant - as is indeed the case in Einstein's formulation of the spacetime "Interval". Hence the actual mathematics behind my grossly simplified "concept equation" has already been done. (See also the paper "The "Higgs" Boson and the Spacetime Metric".)

The time element which is implicit in the photon (as "frequency") and causes the intrinsic motion of light (the entropy drive of free energy), is the very same time element which becomes explicit in mass or matter, causing the intrinsic motion of time (the historical entropy drive of bound energy). The small energetic difference between the symmetric spatial form (S) and the asymmetric temporal form (T) of the entropy drive determines the sign of G: S - T = -G. (Energy must be borrowed (from space) to produce an asymmetric entropy drive from a symmetric one, hence G is negative.) Finally, this entropy-energy, like any energy, must be conserved, and how else could this conservation be accomplished except by completing the gravitational loop between the spatial and temporal entropy drives - decelerating the expansion of the entire Cosmos in consequence? The historical expansion of the cosmos is funded by the gravitational deceleration of the spatial expansion of the cosmos. This is physically accomplished by the gravitational annihilation and conversion of space into metrically equivalent temporal units. When mass is converted to light (as in stars), the total gravitational energy of the Cosmos is reduced, and the expansion increases again in consequence - recently observed as the mysterious "acceleration" of the universe. "Dark energy" is the reduction of cosmic gravitational entropy-energy and its replacement by the expansive spatial entropy drive of light.

Black Holes

Black holes are the physical evidence and demonstration that gravity creates time from space. The "event horizon" of a black hole is the "frozen" entropy of light, light's intrinsic motion and spatial metric completely converted to time and matter's historical metric, both light and time brought to rest in a gravitationally bound form (the Bekenstein-Hawking theorem) - just as the mass of a stone is the "frozen" energy of light converted to matter/atoms and brought to rest in a chemically bound form. Hawking's "quantum radiance" of black holes is the ultimate expression of Noether's Theorem fulfilled (in the case of the gravitational symmetry/entropy debt), confirming that only in the black hole is gravity's symmetry-conservation quest totally realized. With the complete evaporation of the black hole via "quantum radiance", the mass and temporal entropy of asymmetric matter are all converted to its original symmetric form (light), and the gravitational field that was associated with the bound energy of the hole vanishes, its conservation work finally accomplished. (See: "Entropy, Gravitation, and Thermodynamics".) (See: Science vol. 337 3 Aug., 2012 pp. 536 - 547: special section on black holes.)

Black holes actually convert a relatively large percentage of the rest mass of in-falling matter into light - as the brilliance of quasars demonstrates. This conversion of mass to light is considerably more efficient than nucleosynthetic conversion in ordinary stars (up to 28% of the in-falling rest-mass energy), and so forms a distinct, major conversion category at both the stellar and galactic structural levels. (See: Caleb Scharf *Gravity's Engines* Scientific American/Farrar, Straus and Giroux 2012 p 76.) This is yet another stepping stone in the inexorable gravitational pathway leading toward total mass conversion and complete symmetry conservation, culminating, as we have seen, in Hawking's "quantum radiance". (See: "Nodes of the Gravitational Metric".)

Why Gravity is so Weak

Gravity is weak because mass is connected to its entropic conservation domain of historic spacetime only by the tangential point of the "present moment" (time is at right angles to all three spatial dimensions). Gravity creates only enough time to provide the temporal entropy drive for this point-like tangential connection between matter and its historic conservation domain. This notion accords with P. A. M. Dirac's observation that the ratio between the strength of the electromagnetic and gravitational forces is the same as the ratio between the size of the cosmos and an electron. Black holes demonstrate that the intrinsic strength of gravity is at least as great as the other forces, when measured at the tangential point of contact between space and time. For more on this topic, see: "The Half-Life of Proton Decay and the 'Heat Death' of the Cosmos".

Philosophical Connections of the "Tetrahedron Model"

(See: Maudlin, Tim. *Philosophy of Physics: Space and Time* 2012 Princeton Univ. Press.)

In a beautiful convergence between philosophical tradition (both ancient and modern) and the gravitational physics of the "Tetrahedron Model", Tim Maudlin (see citation above) points out that since empty 3-D space is perfectly symmetric, there is no point/place in it that can be preferred over any other point/place. Hence God could not decide "where" to place the Creation. In the "Tetrahedron Model", massless light can (therefore) only be symmetrically distributed throughout the spatial domain, and simultaneously at that, since light and 3-D space both lack a time dimension. Hence light and space are equivalently symmetric, and indeed, we think of light as creating space for its own conservation needs. The intrinsic motion of light is the fundamental expression of entropy in free electromagnetic energy, creating, expanding, and cooling the primary dimensional conservation domain (space) of free electromagnetic energy (light). Light and space both lack a time dimension, and hence both also lack a space-warping gravitational field. (See: "Does Light Produce a Gravitational Field?") The electromagnetic constant "velocity c" also "gauges" (regulates) the metric symmetry of light's spatial conservation arena. (See: "Symmetry Principles of the Unified Field Theory".)

Contrast this situation with that of massive forms of bound (rather than free) electromagnetic energy, from atoms to galaxies, which all produce space-warping gravitational fields whose precise effect is to identify in the undeniable energetic terms of metric-warping inertial force the exact spatial location of the massive system's "center of mass". Since massive particles, completely lacking the intrinsic spatial motion of massless light, cannot distribute themselves symmetrically within the volume of 3-D space, some way of selecting/identifying a particular place within that spatial plenum must be found. This is accomplished by time and the gravitational field of the particle(s), which induce each other. (See: "The Conversion of Space to Time".) The extra time dimension is added to 3-D space to break the spatial symmetry and identify a specific location within the spatial domain, which becomes a 4-D spacetime continuum with an infinity of identifiable points due to the addition of the extra time dimension. Time has "intrinsic" (entropic) motion, the analog of light's intrinsic (entropic) motion, except in time's case it is one-way motion to provide completely distinguishable points ("events") within an infinite and expanding historical spacetime. These 4-D spacetime positions are unique not only because time runs one-way, but also because the Cosmos as a whole unit begins simultaneously in the "Big Bang". History is the temporal analog of space, the conservation domain of matter's causal information field. Light is connected through space, matter is

connected through history, gravity connects everything, converting space to time and vice versa. (See: "A Description of Gravity".)

There is a similarity in function between the color charges and gluon field of the strong force, and time and the gravitons of gravity: both provide an extra dimension ("degree of freedom") in which to separate and distinguish particles in what would otherwise be an overcrowded field of fermions. This is another view of the connection between the spacetime and particle "metrics" of free and bound forms of electromagnetic energy, and the activity of their field vectors as "currents of local gauge symmetry".

Links:

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
- A Short Course in the Unified Field Theory
- Principles of the Unified Field Theory: A Tetrahedral Model
- (Postscript and Commentary on paper above)
- The Tetrahedron Model in the Context of a Complete Conservation Cycle
- Synopsis of the Unification Theory: The System of Spacetime
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- Global-Local Gauge Symmetries and the "Tetrahedron Model"
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Gravitation

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The Half-life of Proton Decay and the 'Heat Death' of the Cosmos

Gravity Diagrams

A New Gravity Diagram
The Gravity Diagram
The Three Entropies: Intrinsic Motions of Gravity, Time, and Light
The Tetrahedron Model (complete version)
Nodes of the Gravitational Metric

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See: *Science* vol. 337 3 Aug., 2012 pp. 536 - 547: special section on black holes.