The Half-Life of Proton Decay and its Relation to the "Heat Death" of the Universe

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home page

Note to Readers Concerning "Entropy":
See: Spatial vs Temporal Entropy
See also: The "Tetrahedron Model" vs the "Standard Model" of Physics: A Comparison

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Abstract

The significance of proton decay is that it is the end-point of time and temporal entropy for matter, in much the same way we might say the black hole is the end-point of space and spatial entropy for light. Again we find that "the extremes meet": proton decay is surely commonplace inside black holes, while Hawking's "quantum radiance" returns bound energy to free energy and temporal entropy to spatial entropy.

The notion that the ratio of force strengths relates the "heat death" and the "information death" of the Cosmos via proton decay suggests that if we knew one we would know the other; unfortunately, we know neither, and our force ratio is a pure number, without units. Nevertheless, I will use it to make a naive guess at the proton's lifetime. The lower experimental bound on proton decay is currently 10(35) years. According to the hypothesis advanced here, that the proton lifetime reflects the force ratio, in 2.5 x 10(41) seconds all protons will have decayed, which, curiously enough, yields an observational expectation (8 x 10(33) years) not far off the current lower experimental bound.

Introduction

The electromagnetic constant "c" is the "gauge" (regulator) of the velocity of light, and of the metric, symmetric, and entropic relations between space, time, and light (free electromagnetic energy). "c" regulates the metric equivalence between space and time, such that one second of temporal duration is metrically equivalent to 300,000 km of spatial distance. "c" gauges the symmetric relation between space, time, and light by suppressing both the asymmetric time dimension and one dimension of space (in the direction of

propagation), such that light's energy state is two-dimensional, "non-local", and its velocity is effectively infinite (since light has forever to go nowhere). The intrinsic motion of light "sweeps out" a third spatial dimension and drives the expansion and cooling of space; hence "c" gauges the entropy drive of light or free energy. "c" also gauges the energetic equivalence between light and matter: hv = mcc.

In the case of matter or mass, in which free electromagnetic energy has been converted to bound electromagnetic energy: we find an expanding and aging historical entropic conservation domain rather than an expanding and cooling spatial entropic conservation domain. It is the gravitational field of matter that connects the spatial with the historic conservation domains of free and bound electromagnetic energy. Gravity annihilates space, converting space into its metric equivalent (time), liberating the historical entropy drive of matter from its spatial prison, and creating spacetime, the compound entropic conservation domain of both free and bound electromagnetic energy. The universal gravitational constant "G" determines how much space must be annihilated to provide a given mass with its energetically necessary historical entropy drive (time). Because gravity is so weak we know that only a small amount of space must be converted to its metric equivalent, time, and because the gravitational energy is negative we know that it requires energy to convert the symmetric entropic drive of space (the intrinsic motion of light) to the asymmetric entropic drive of history (the intrinsic motion of time) - as we should expect. Hence "G" is the gauge of the entropic and asymmetric relation between space, time, and mass (bound electromagnetic energy), while "c" is the gauge of the entropic and symmetric relation between space, time, and light (free electromagnetic energy).

Space and the spatial entropy drive (S) is related to time and the historical entropy drive (T) by the conversion force or factor -G (the gravitational constant).

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

In this "concept equation", (S) represents the spatial volume annihilated by -Gm to reveal its metrically equivalent (as gauged by "c"), but previously suppressed content of time, which is now free to serve as the entropy drive of mass (T)m. In this interpretation, -G has converted the entropy drive of expanding space (S) into the entropy drive of expanding history (T), simply via the annihilation of space. (S) represents both the annihilated space and the entropy drive contained within it (space itself contains an entropy drive as revealed by the Hubble expansion of the Cosmos). The explicit form of the spatial entropy drive is the intrinsic motion of light, but this is actually caused by a hidden or implicit entropy drive which is time. Einstein and Minkowski have shown us that space is not just space, but is actually the dimensional composite spacetime. The intrinsic motion of light is actually caused by the symmetric entropic component of spacetime "fleeing" its asymmetric entropic component, and by so doing suppressing time. Light protects its own symmetry via its invariant "intrinsic" (entropic) motion "c", driven by asymmetric time "snapping at its heels". The annihilation of space by gravity simply reveals this hidden temporal entropy drive, which then serves directly as the explicit historical entropy drive of bound energy. Here we are just putting together the facts as revealed to us by Einstein - space is actually spacetime and gravity is a dimensionally active force, acting directly upon the dimensions of space and time. In accordance with Einstein's "Equivalence Principle", we simply are recognizing the spatial flow of gravity for what it is, the actual conversion of the entropy drive of space (light's intrinsic motion) into the entropy drive of history (time's intrinsic motion) via the gravitational annihilation of space.

This entropic conversion is the functional role of gravity in service to energy conservation; in turn, this functional role is entrained by the symmetry conservation role of gravity (as required by Noether's Theorem), which acts through the "location" charge of bound energy to protect and conserve the non-local distributional and metric symmetry of free energy. Both the entropy and the symmetry debts of light's non-local energy state as represented by the gravitational "location" charge are ultimately paid off by the conversion of bound to free energy in stars (partially) and by Hawking's "quantum radiance" of black holes (completely). (See: "The Conversion of Space to Time"; and "The Double Conservation Role of Gravity".)

Gravity and Entropy

The intrinsic (entropic) motion of light creates, expands, and cools space; space is the conservation domain of free energy, created by the primordial entropy drive of light. The intrinsic (entropic) motion of time creates, expands, dilutes, and ages historic spacetime; history is the conservation domain of bound energy's causal information web or "matrix", created by the primordial entropy drive of matter. (see: "Gravity Diagram No. 2" and: "Spatial vs Temporal Entropy".

Time is created from space, both quantum mechanically and gravitationally (see: "Entropy, Gravitation, and Thermodynamics"). As gravity creates time by the annihilation of space and the extraction of a metrically equivalent temporal residue, it causes the deceleration of cosmic spatial expansion. Since the expansion of space is driven by the intrinsic motion of light, we see that on the cosmic scale, light's spatial entropy drive (S) is supplying the energy (via gravity) to fund the creation of matter's historical entropy drive (T).

It takes energy to create the one-way drive of historical entropy from the "all-way" drive of spatial entropy, because an asymmetric, one-way temporal expansion must be derived from a 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".

> Because entropy is by definition the energy in a system which cannot be transformed to work, we must be thoughtful when we speak of gravitational energy as "entropy-energy", since obviously gravitational energy is transformed to work on a daily basis in our hydroelectric stations. However, gravity is a form of negative spatial energy and entropy, causing the contraction and heating of space, which is why we are able to use it in its raw form without violating thermodynamic principles. On the other hand, gravity's purely entropic product, time, cannot be so used. The intrinsic motions of time and light, causing the expansion of space and history, are the primordial entropy drives of free and bound forms of electromagnetic energy respectively, protecting energy conservation by virtue of their "infinite" and one-way velocity. Gravity creates time by the annihilation of space and the extraction of a metrically equivalent temporal residue. It is in gravity's spatial collapse mode that we can use its negative energy and entropy, not in its temporal mode of positive entropic historical expansion.
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> Our hydroelectric plants work only because we live in an unresolved gravitational potential at Earth's surface - they obviously would not work at sea level or at Earth's center. Other external factors are also involved in this gravitational "work" - the lifting of water due to the Sun's energy, and the lifting of mountains due to continental drift, plate tectonics, and the radioactive energy of Earth's interior. Because gravitational potential energy is "negative energy", and a form of "negative entropy-energy", we are able to use it (once) due to special circumstances which require constant inputs of energy from other sources such as the fusion and fission of atomic nuclei. The gravitational energy of our hydroelectric facilities is really nuclear energy in origin.
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> Finally, we have to remember that gravity is only partly an "entropy-energy" form, because gravity is only partly an "entropy-energy" debt. Gravity is also a symmetry debt of light, and in its role of symmetry conservation and restoration, for example in the gravitational conversion of bound to free energy during element-building in the Sun and stars, we find gravitational energy triggering nuclear fission/fusion energy. As noted above, it is really this gravitational "symmetry-energy" rather than gravitational "entropy-energy" that we harvest from our hydroelectric installations. Pure entropy-energy in its primordial forms as the expansion of space or the expansion of history, the intrinsic motion of light or the intrinsic motion of time, is not

available for our use and may not, even in principle, be converted to "work". (Note that the energy of light, which we can use, is independent of light's intrinsic motion, which we cannot use.)

As outlined in the Introduction, 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 "concept equation":

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

It is my assumption that such an interpretation is consistent with Einstein's gravitational field equations - or at least does not violate them.

Explicit vs Implicit Time

On the microscopic or quantum mechanical scale, "velocity" c and T are both associated with the implicit and explicit forms of time (see: " Gravity Fig. No. 2"). In the standard formulation of an electromagnetic wave moving freely in vacuum, wavelength multiplied by frequency = c, the velocity of light. Hence both time and space are implicitly present in this expression, space as "wavelength" and time as "frequency". However, as Einstein discovered, light's "clock is stopped", light has no time dimension and no "x" spatial dimension in the direction of motion: therefore, the temporal component of the free wave exists in an implicit condition. The electromagnetic constant or gauge "velocity c" maintains the metric symmetry of its spatial domain by specifically suppressing time and distance. However, when an electromagnetic wave collapses, stops moving freely, and is converted to any form of bound energy, the temporal component of the wave "flips" or switches from an implicit to an explicit state, reversing the dominance relationship between the two wave components, like the "heads vs tails" of a single, primordial "entropy coin".

It is the presence of the embedded, asymmetric, temporal component of the electromagnetic wave which actually causes the intrinsic motion of light: the symmetric "wavelength" or spatial component "flees" the asymmetric "frequency" or temporal component which it manages to "escape" or suppress only at velocity c, by this flight maintaining metric symmetry. Thus it is time and symmetry conservation which are the actual drivers of light's intrinsic motion and spatial entropy expression (spatial expansion and cooling). However, time is in a hidden, implicit condition, and it is the conservation of energy and metric symmetry (in addition to entropy) which is the principle or law being served. Time is the universal entropic driver of the Universe, whether implicit in free energy or explicit in bound energy. (See also: "The Double Conservation Role of Gravitation".)

Gravitation and Time

The primordial drives of spatial and historical entropy cause the expansion and contraction of the Cosmos - as Einstein discovered when his Universe refused to stand still unless he added his infamous "cosmological constant". The intrinsic motion of time moves at right angles to all three spatial dimensions, exiting space, creating and expanding the historic conservation domain of information and matter's "causal matrix" (historic spacetime). The function of the historic domain of spacetime is to order and sustain matter's causal relations, establishing the causal or "karmic" connectivity of the material realm and maintaining the effect of the Universal Present Moment; this in itself constitutes a rationale for gravitation.

The intrinsic motion of time pulls space along after it, until at the gravitational center of mass space self-annihilates as it squeezes down to the point-like entrance of the time line: +X annihilates -X, etc., leaving behind a new time residue of +T which cannot self-annihilate because time being one-way, there is no -T. (See: "The Conversion of Space to Time".) The quantized time unit (a "graviton") thus extracted from space

hurries on down the time line into history, dragging more space behind it, which in turn self-annihilates at the entrance of the time line, and so on, forever. The intrinsic motion of time thus renews itself continuously by causing the continuous annihilation of space. The collapsing space of a gravitational field is caused by the intrinsic motion of time, as it creates the historic conservation domain of information and matter's "causal matrix". *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "A Description of Gravity".) This interpretation of the mechanism of gravitation accords (in the main) with Einstein's mathematical formulation of the subject and his "Equivalence Principle". (Departures from Einstein's Theory are addressed in the paper: "'Dark Energy': Does Light Produce a Gravitational Field"?) (See also: "Extending Einstein's "Equivalence Principle".)

Spatial vs Historic Entropy Domains

We have now established the magnitude of -G and the direction of flow - from space into history - of matter's temporal entropy drive. But there is another remarkable feature to consider in this "simple switch" from spatial to temporal entropy, which is the fact that free energy, light, whose entropy drive is the intrinsic motion of light, completely fills its conservation domain, space, and in fact creates and expands space as its own entropy/conservation domain, such that the energy of light is very rapidly vitiated by its entropy drive. There is little or no separation or distinction between the entropy drive (the intrinsic motion of light) and the free energy form (photons) which the entropy drive serves, nor the conservation/entropy domain they create and inhabit (space). But this is definitely not the case for bound energy (matter) and its entropy drive (the intrinsic motion of time), and the conservation/entropy domain which time creates (history). Matter itself cannot pass through the one-dimensional time line nor go into its zero-dimensional point-like beginning at the gravitational center of mass. Matter occupies only the eternally moving "present moment", not history, and not historical spacetime.

Matter is only tangentially connected to its historic conservation domain (which contains matter's causal information network or "matrix") via the "universal present moment". This tiny tangential connection between matter and "bulk" historic spacetime is the reason why gravity is so weak. The tangential connection between time and space reflects the fact that time and history exist at right angles to all three spatial dimensions simultaneously.

Only matter's causal information component can travel into historic spacetime; it is not matter itself which moves into history, but time, light, gravity, and information. Whereas in the case of free energy both the energy form (photons), and its entropy drive (the intrinsic motion of light), are indistinguishable or at least inseparable, together creating and expanding space, in the case of bound energy only the entropy form (time) actually moves, leaving the energy form itself (matter) behind, as time creates and expands history (see: "The Time Train"). Matter exists only in the universal and eternal "now" or "present moment". (See: "A Spacetime Map of the Universe"). The consequence of this difference in the dimensionality, inertial status, and entropy drive of matter vs light is of course enormous. This amounts to a comparison between the (temporal) entropy drive of a rock to the (spatial) entropy drive of light. Whereas the capacity for work of the expanding spatial universe of free energy is vitiated "in a flash" at velocity c, the energy contained in immobile rocks ($E = mcc$) is virtually eternal. This is a central "rationale" (from the "anthropic" point of view) for the transformation of free to bound energy and the creation of matter in the "Big Bang", and the reason why gravity, which creates matter's temporal entropy drive, is so weak.

Charge Invariance

The invariance of charge in the service of symmetry conservation is another (and perhaps more consequential) rationale for the tangential connection between matter and matter's entropic conservation domain, historic spacetime. Matter's bound energy content, and matter's associated charges, exist only in the "present moment" of time, and do not participate in the entropic expansion of historic spacetime. The charges

of matter, as well as the energy content of matter, are therefore protected from entropic enervation or dilution. Atoms simply do not age, and charge magnitudes are invariant through time. The tangential contact between matter and historic spacetime is also the reason for the weakness of gravity: gravity need supply matter with only enough temporal entropy drive to maintain or "service" this tiny tangential point of contact - the "present moment". At this point of contact, gravity is actually the same strength as the electromagnetic force - as the black hole demonstrates. This notion accords well with the observation of P. A. M. Dirac that the ratio of the strength of the electromagnetic force to the gravitational force is the same as the ratio of the radius of the Cosmos to the radius of an electron - the electron representing the physical size of the "tangential" point of contact between matter and historic spacetime. In the case of the Earth's entire mass, this contact point is only about the size of a ping-pong ball - the size of a black hole's "event horizon" containing the mass equivalent of planet Earth. (The fact that this contact point is greater than zero means that the temporal entropy drive of matter will actually have a very small vitiating effect upon atoms, as realized through "proton decay" and Hawking's "quantum radiance" of black holes.)

Of course, Special Relativity also tells us that matter cannot move with the metric equivalent of "velocity c", and that therefore the time dimension must move instead, while matter remains stationary and rides the "time train". There are multiple reasons for matter's isolation in the "universal present moment", illustrating the seamless interweaving of all natural law, and raising again Einstein's question: is there any latitude in the construction of the Universe? At least from the perspective of the "Anthropic Principle" (natural law and the physical constants must allow human life), the answer is apparently "no".

The 4th Dimension

The entropic drive of bound energy (the intrinsic motion of time) must be the metric equivalent of the entropic drive of free energy (the intrinsic motion of light), otherwise energy conservation would not be satisfied and the two forms of electromagnetic energy could not coexist and interact within their joint dimensional conservation domain (spacetime). But since matter cannot move at velocity c, evidently the only alternative is to have the dimension (the entropy form) rather than matter (the energy form) move with an intrinsic velocity which is the metric equivalent of c, providing thereby a combined entropic domain (spacetime) in which interaction between and conservation of both the free and bound forms of electromagnetic energy is possible. When we move from 2 to 3 spatial dimensions, we do so by simply adding another symmetric (2-way) spatial dimension at right angles to the existing 2; but when we move from 3 spatial dimensions to the 4th dimension of time, it is a wholly different proposition, as we are adding an asymmetric, one-way dimension at right angles to all three spatial dimensions simultaneously, a dimension which furthermore has an intrinsic motion metrically (and entropically) equivalent to velocity c. Indeed, when we move from 3 to 4 dimensions, we add an alternative form of energy ("bound" energy, mass) and its associated entropy drive (time), an alternative conservation domain (history), and a new conservation/conversion force (gravity) to create time from space and mediate between their entropy drives.

Energy stored in the atoms of matter is not degraded by aging and the expansion of space or history, decaying from the ground state baryon only by proton decay and by very strong gravitational fields, remaining available for a practical eternity to do the evolutionary work of the Universe. The difference in efficacy between the entropy drive of light and the entropy drive of matter in terms of vitiating their respective energy forms is absolutely astronomical, equivalent to the strength differential between the electromagnetic and gravitational forces. But there is a penalty for separating bound energy from its historical conservation domain, paid in abiotic systems by gravitation, mass, charge, time and the other asymmetric properties of matter, and in biologically advanced systems such as ourselves, by the physical and psychological burden of our "mortal coil", "existential angst", and the fear of death, the universal basis of religion. (See: "Is There Life After Death"?)

The Entropic Efficacy Ratio Between Spatial vs Temporal Entropy Drives

Because of the differences in dimensionality, inertial status (intrinsic motion), and the type and extent of connection with their respective energy forms, as noted above, the "ratio of entropic efficacy" between the primordial forms or drives of spatial and historical entropy is astronomically large. This ratio is on the order of the strength of the electromagnetic force compared to the strength of the gravitational force - about 1/4 x 10(42) (42 powers of ten) (Feynman's estimate of the force strength ratio). From one point of view we can say this huge ratio is why gravity is so weak - very little of space or of the "strong" spatial entropy drive which space contains need be gravitationally converted to time (per given mass) to satisfy the small temporal entropy requirement or drive of matter. What the intrinsic motion of light will accomplish in terms of the entropic vitiation of a photon's energy content in one second, the intrinsic motion of time will accomplish for an atom's energy content in 1/4 x 10(42) seconds - approximately. (see also: "The Conversion of Space to Time"). Gravity does not have to annihilate much space (per given mass) to extract the temporal entropy drive necessary to satisfy such a small entropic requirement.

This enormous disparity in terms of efficacy between the two forms of entropy drive is a major part of the "rationale" (from the "anthropic" point of view) for the conversion of free energy into bound energy during the "Big Bang" - thereby allowing at least some of the energy content of the Universe to escape the vitiating entropic action of "velocity c", the entropy drive and symmetry gauge of free energy. This great force ratio has been known for a long time, but its relationship to other physical quantities or parameters has never been understood. The hypothesis advanced here is that it represents the efficacy ratio of temporal to spatial entropy drives, that is, it compares the destructive effects of the two kinds of entropy drive - temporal, as gauged by "velocity T" (the intrinsic motion of time), and spatial, as gauged by "velocity c" (the intrinsic motion of light), in terms of the rate at which they degrade the capacity for work of their respective energy forms - free vs bound energy. Furthermore, this ratio bears upon the half-life of proton decay by relating the "heat death" to the "information death" of the Cosmos. The value of G determines the time scale (lifetime) of the Universe both dimensionally (in terms of the expansion/contraction of space) and quantum mechanically (in terms of "proton decay"). In fact, the lower experimental bound on the half-life of proton decay is 10(35) years, which happens to be about 3 x 10(42) seconds.

As noted earlier, the metric connection between space and time is given by the electromagnetic gauge "c" or the "velocity of light": - one second of temporal duration is metrically equivalent to 300,000 km of distance. Hence the "velocity of time" no less than the "velocity of light" is gauged by c - as the duration (measured by a clock) required by light to travel a given distance (measured by a meter stick). Space and time are also connected energetically and dynamically as frequency (time) multiplied by wavelength (space) = c. "c" acts as the symmetry gauge as well as the gauge for the spatial entropy drive of the electromagnetic metric, and is clearly first among gauges, as all others are derived from c and have less symmetry. Nevertheless, "velocity T" is clearly fundamental also, just as "frequency" is fundamentally part of the energetic description of light. T is required to give energetic structure and a finite, definite scale to the spatial metric, for example, to control and regulate its entropic expansion - the expansion of space must take place at a specific rate, maintaining metric symmetry, conserving energy, etc. Beyond, related to, or derived from its role as bound energy's entropy drive, time is also necessary (in material systems) for many other reasons:

> 1) To produce the intrinsic motion of light: time is an internal asymmetry latent in electromagnetic energy, present as "frequency" in the dynamic of the electromagnetic wave. The intrinsic motion of light is caused by the symmetric spatial component of the wave ("wavelength") fleeing this internal, asymmetric temporal component ("frequency") - vanishing time as a result, thereby maintaining light's metric symmetry. Matter or bound energy results when "wavelength" loses this race (perhaps becoming tangled in the metric) and gets caught by "frequency". When this happens and the wave collapses, the frequency component of the wave becomes explicit time, continuously reproducing itself via a gravitational field: *a gravitational field is the spatial consequence of time's intrinsic motion*. Implicit time and symmetry conservation (in the service of entropy, causality, and energy conservation) are the internal

drivers of light's intrinsic motion. (See: "The Conversion of Space to Time".)
2) To establish the temporal sequence of cause and effect for bound energy in relative motion.
3) To regulate the energy accounts of bound energy associated with the variable and relative motion of matter (momentum, kinetic energy).
4) To create bound energy's gravitational field - the gravitational flow of space is due to time's intrinsic motion and the connection between time and space.
5) In conjunction with c and G, to create the joint dimensional conservation domain of spacetime for free and bound forms of electromagnetic energy (light and matter).
6) To serve as a flexible component of the metric, co-varying and interchangeable with space, conserving the invariance of the "Interval", causality, and velocity c, and thereby making energy conservation possible for material systems in relative motion and in variable gravitational fields ("Lorentz Invariance", Special and General Relativity). (See: "Global vs Local Gauge Symmetry in Gravitation".)

See also: "The Time Train"; "The Paradox of the Traveling Twin"; "The Tetrahedron Model ".

"Why" Bound Energy

Speaking teleologically -- the "reason" for the creation of matter from light (in the "Big Bang") is precisely to escape the hugely destructive entropy drive of light, gauged by "velocity c", which quickly exhausts the capacity of the Universe for work, causing its expansion and cooling in orderly but rapid fashion. Nature's solution is to avoid the enormous spatial entropy drive of light completely, by storing energy in a "bound" form that lacks a spatial entropy drive, a form in which energy can "sleep" until called upon, a form which can store energy in great amounts, but which can nevertheless release energy in small quantities over a long period of time, as needed. This conveniently "packaged" form of energy we know as atomic matter.

But even this "sleeping", solid, or bound form of electromagnetic energy (matter) needs some type of entropy drive to conserve and protect its energy content and accounts, to regulate its relative spatial motions (since the energy of bound energy varies with its velocity - momentum, kinetic energy, etc.), and to protect causality and the "Interval" - all concerns addressed by Einstein's Theory of Special Relativity. Furthermore, if bound energy is to interact with free energy, this new entropy drive must be compatible with, which is to say metrically and energetically equilibrated with, the spatial entropy gauge c. This entropy drive for bound energy we know as time, intrinsic "velocity T", the entropic motion of bound energy's time dimension, which is metrically equivalent to the intrinsic motion of light, the entropy drive of free energy. This metric equilibration is accomplished in two steps: 1) the metric relation between time and space is gauged by c; 2) time is extracted by gravity directly from space - temporal entropy is produced from its spatial counterpart via the gravitational annihilation of space, which automatically produces a metric and entropic equivalent temporal residue. (See: "Entropy, Gravitation, and Thermodynamics" and the "Gravity Diagram 1"; see also: "The Conversion of Space to Time".)

When free energy is required from the storehouse of matter to perform work, then once again we have to deal with the highly entropic form of free energy, heat loss, and velocity c. Until then, energy rests, sleeps, or is stored essentially permanently in matter. Rocks just don't decay, unless they are radioactive, but even then they reach a stable "ground state" eventually. "Velocity T", nevertheless, is an entropy gauge and however small, causes the aging and decay of matter and information, just as velocity c causes the expansion and cooling of space. The ultimate form of this temporal decay of matter is "proton decay", whose extremely long half-life (unknown, but at least 35 powers of ten (10(35) years), is related to the extreme weakness of the gravitational force. This is because G relates spatial and temporal entropy, hence relating also the "heat death" of the Cosmos to its "information death" via the ultimate decay of the physical carrier (atomic matter) of the Universe's information content.

Whether or not information survives independently of this physical decay, safeguarded in the historic temporal domain (historic spacetime), is another question, but this is a distinct possibility if the Universe does not collapse in a "Big Crunch". Historic spacetime, the carrier of the information content of matter's "causal matrix", is of course also regulated by gravitation. Both the heat and the information "death" of the Cosmos are asymptotic functions which are best compared as "half-lives". If the value of G were greater, proton decay would be more common - it is almost certainly common now in black holes.

Proton Decay and Gravity

How does the notion that G gauges the rate of proton decay fit with the idea advanced elsewhere (See: "The Particle Table") that proton decay is caused by the supermassive "X" boson, the "big brother" of the "W" IVB? The two ideas are compatible because it is presumed that all the IVBs are "metric" particles of interaction, catalytic particles consisting of a densely compressed and perhaps convoluted metric, a "fossil" relic of the dense metric of a force unification symmetric energy state during the early moments of the "Big Bang". Since G is the gauge of a metric-compressing force, the magnitude of G would affect the relative abundance or ease of formation of any type of "metric" particle. The low value of G makes the formation of the supermassive "X" boson prohibitively difficult in today's cold, expanded spacetime. This would not have been the case in the dense metric of the early Universe; similarly, the dense metric of black holes is why I assume that proton decay is commonplace there (at least in the central "singularity").

Given the absence of antimatter, only two forces threaten the potentially eternal existence of rocks (or atoms): 1) gravitation, which can collect rocks into stars and finally black holes, where the nucleosynthetic pathway and Hawking's "quantum radiance" will eventually and completely return their bound energy content to light; and 2) weak force radioactive, particle, and proton decay, via the "W" and "X" IVBs. Squeezing the quarks together until their color charges sum to zero and self-annihilate ("asymptotic freedom") is the essential mechanism of proton decay. This compression can be accomplished either by the hypothetical "X" IVB, or the interior of a black hole, or the dense metric of the early "Big Bang". Thus we find the connection between gravitational strength and proton decay, which is to say that if G = c, (or g = c), the electrical and quantum mechanical repulsion between the quarks will be overcome (either by internal gravitational attraction between quarks or by external ambient pressure from the gravitationally compressed metric) and proton decay will ensue. Hence the ratio of force strengths between the gravitational and electromagnetic forces is the probable determinant of the half-life of proton decay, and limits as well how common the "X" IVB will be (the larger the value of G, the easier it will be to borrow enough energy to materialize the "X").

The significance of proton decay is that it is the end-point of time and temporal entropy for matter, in much the same way we might say the black hole is the end-point of space and spatial entropy for light. Again we find that "the extremes meet": proton decay is surely commonplace inside black holes, while Hawking's "quantum radiance" returns bound energy to free energy and temporal entropy to spatial entropy.

The notion that the ratio of force strengths relates the "heat death" and the "information death" of the Cosmos via proton decay suggests that if we knew one we would know the other; unfortunately, we know neither, and our force ratio is a pure number, without units. Nevertheless, I will use it to make a naive guess at the proton's lifetime. The lower experimental bound on proton decay is currently 10(35) years. According to the hypothesis advanced here, that the proton lifetime reflects the force ratio, in 2.5 x 10(41) seconds all protons will have decayed, which, curiously enough, yields an observational expectation of 8 x 10(33) years, not far off the current lower experimental bound.

There is a caveat to this calculation, however. The half-life of a free neutron is 15.4 minutes, but when the same neutron is bound in a compound nucleus such as oxygen-16, it is apparently as stable as the proton. Therefore we must wonder if using water as the experimental material will in fact produce a reliable estimate

of proton decay, because the majority of protons (or nucleons) in water are bound in the oxygen nucleus, and therefore may be much less likely to decay than if they were free hydrogen atoms. Supposing only the hydrogen protons of H2O are available for decay, this would increase by 9 times the amount of experimental material needed - or the length of time we must wait to see a positive result. This would explain almost all of the difference between my estimate of the proton lifetime and the Kamiokande lower experimental bound. Can the convergence of these numbers over 41 orders of magnitude be a simple coincidence?

The Super-Kamiokande neutrino and proton decay experiment in Japan is using 50,000 tons of water. *If* I have worked through the math correctly (I am not good at math), dividing the number of molecules in the water by the force ratio and scaling this result from seconds to years, the experiment could expect to see (approximately) one decay every 3 years from the hydrogen atoms, or 3 decays per year from all the nucleons, if the bound (oxygen) nucleons decay at the same rate as the free (hydrogen) ones. Once again, the convergence of these numbers seems beyond mere coincidence.

Proton Decay and Black holes

The magnitude of -G represents the energetic difference between the symmetric spatial and the asymmetric temporal entropy drives: -Gm measures the energy required to produce m's time dimension via the annihilation of space. The magnitude of -G can also provide a clue to the half-life of proton decay via the mechanism of gravitational squeezing of the quarks (to "leptonic size" and complete "asymptotic freedom", vanishing the color charge), which of course can only be effective if the gravitational attraction between the quark's masses is strong enough to overcome their electromagnetic (and quantum-mechanical) repulsion. This condition could also be imposed by the pressure of the environment inside a black hole, where again we find g = c. Hence the ratio of force strengths is directly related to gravitationally induced proton decay and therefore also to the energetic relationship between the drives of spatial and temporal entropy, since c and G are the fundamental gauges of these entropic drives and force domains.

It seems, on the basis of these arguments, very likely that proton decay is commonplace in black holes. If so, then a black hole may be nothing more than a gravitationally bound state of light, light "transformed to rest", a "dark crystal" of light. This would solve the problem of the infinite compressibility of matter at the central singularity, since there is no limit to the quantum mechanical superposition of photons. For a further discussion of gravitationally induced proton decay, see: "Symmetry Principles of the Unified Field Theory".

It should be noted that the gravitational flow of space toward a massive object can, by Einstein's Equivalence Principle, be considered as tantamount to an accelerated motion in spacetime by the massive object itself. In other words, gravity confers upon massive objects the equivalent of an intrinsic, spatial entropic motion ("intrinsic motion G"), although with a negative rather than a positive sign (negative spatial entropy - contractile rather than expansive). "In the limit", massive objects become black holes, in which gravity or temporal entropy returns massive objects to spatial velocity c, albeit with a negative sign, and without any "net" spatial displacement. (Very much as time itself moves with a velocity which is the metric equivalent of c, but without any net spatial displacement.)

Thus "the extremes meet": spatial and temporal entropy drives both converge "in the limit" to intrinsic spatial velocity c. Black holes also cause proton decay in their interiors, crushing the color charge of baryons out of existence, and in any case destroying information. (This last point is controversial. See Leonard Susskind's book: *The Cosmic Landscape* Back Bay Books 2006.) Hence the gravitational situation is symmetric whether looked at from the viewpoint of the (negative) spatial entropy of black holes returning matter to velocity c, or the (positive) temporal entropy of black holes returning matter to light by causing proton decay. Hawking's quantum radiance of black holes returns all bound energy to its positive, spatial, entropic state of light, also conserving the symmetry of entropy, the final expression of "Noether's Theorem". With the final evaporation of a black hole, the gravitational field also disappears, the sign that its symmetry conservation role has been

completed.

Summary

When we think about the possible values that G might take, we do not encounter a barrier in quantum mechanics until G = c, at which point everything, including atoms, either becomes a black hole or reverts to light through proton decay. Hence there is a huge range of possible values in quantum mechanics which G might have taken, but which we find realized in Nature only in the sense of "local g" ("surface" gravity, or inertial forces of acceleration). However, from the cosmological point of view, the value of "big" G (the universal gauge constant) is almost immediately constrained to its presently observed value, since if G were any stronger than it is, the Universe would have collapsed long ago, and if it were any weaker, galaxies would not have formed. Hence the observed value of G is cosmologically rather than quantum mechanically constrained, at least from the point of view of the "Anthropic Principle".

From a microscopic or quantum mechanical point of view, the negative magnitude of G is determined by the small energy difference between the symmetric (all-way) spatial "face" of the entropy "coin", and the inverse, asymmetric (one-way) temporal face (see: "The Conversion of Space to Time" and: "Gravity Diagram No. 2"). From a more general or macroscopic perspective, we find that G is weak because it gauges the conversion of the "strong" spatial entropy drive of light to metrically equivalent units of the "weak" temporal entropy drive of matter. This is a comparison between the entropic drive of light vs rocks - "velocity c" vs "velocity T", the classic comparison between the hare and tortoise. We find furthermore that this difference is due to the differing dimensionality and inertial status of light vs matter, and the differing manner of operation and connection with their respective entropy drives and conservation domains. Light and its entropy drive are coextensive with their spatial conservation domain, but matter and time do not coexist in the historic domain - a huge and crucial difference, and one also reflected in P. A. M. Dirac's observation that the huge force ratio between the strength of the electromagnetic and gravitational forces is the same as the ratio of the radius of the Cosmos to the radius of an electron (see: "Sect. II: Introduction to Gravitation").

The tangential point of contact between matter's "present moment" and historic spacetime is essentially equivalent to Dirac's comparison of an electron's radius to the radius of the cosmos. Hence gravity is weak because it takes very little temporal entropy to establish and maintain this tiny point of (tangential) contact between matter and its historical conservation/entropy domain. On this view, we would expect gravity to be stronger if the unit of time (the "tangential touch") were greater - which is exactly what General Relativity predicts. Time slows down (seconds become of longer duration) in a gravitational field, and time actually stops at the event horizon of a black hole, where the "present moment" becomes the "eternal now", the tangential point of contact between matter and the temporal dimension becomes infinitely enlarged, and g = c. (See: "A Spacetime Map of the Universe".) Time imposes a "bottleneck" (the "present moment") between G and c, which otherwise would be equivalent in strength - as indeed they are in the black hole, where the "bottleneck" is absent (time stands still). This concept is vaguely similar to notions of gravity being "lost" or "leaking away" to extra dimensions, as recently suggested by "string theory" (see: Brian Greene's book *The Fabric of the Cosmos*. A. A. Knoph, 2004).

The World would not work and/or we would not be here if the values of these natural constants and their ratios were not as we find them. To explain our apparently unusual circumstances, we can invoke the theory of the "Multiverse" in service of the "Anthropic Principle": of the infinitely many possible Universes which may exist, we quite naturally find ourselves in one where the possibility of our life-form is favored by the arbitrary values and ratios of its unique natural laws and physical constants. (See: "The Higgs Boson and the Weak Force IVBs".) On the other hand, the tangential connection between matter's time dimension (the "present moment" of experience), and matter's conservation domain of historic spacetime is hardly "anthropic" in origin, but derives from the dimensional structure of the Cosmos and its conservation laws of energy, entropy, causality, and symmetry. There is much about this arrangement, apparently, that could not

be otherwise.

Time and the historic domain exist at right angles to all three spatial dimensions simultaneously, reflecting the tangential point of connection (the fleeting "Present Moment") between matter and the historic domain created by matter's temporal entropy drive. The historic domain contains matter's causal information field, but matter cannot enter this historical domain, and cannot travel at the metric equivalent of velocity c. Therefore time must move rather than matter, creating the gravitational connection between space, time, and matter that sustains our "Present Moment", and matter's causal and entropic connection to historical spacetime and the larger Universe. (See: "The Time Train".)

Links:

Unified Field Theory

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"
Global-Local Gauge Symmetries: Material Effects of Local Gauge Symmetries
The "Tetrahedron Model" vs the "Standard Model" of Physics: A Comparison

Gravitation

A Description of Gravitation
Global-Local Gauge Symmetries in Gravitation
The Double Conservation Role of Gravitation: Entropy vs Symmetry
12 Summary Points Concerning Gravitation
About Gravity
Extending Einstein's "Equivalence Principle"
The Conversion of Space to Time
"Dark Energy": Does Light Produce a Gravitational field?

Entropy

Entropy, Gravitation, and Thermodynamics
Spatial vs Temporal Entropy
Currents of Symmetry and Entropy
The Time Train
The Halflife of Proton Decay and the 'Heat Death' of the Cosmos

Weak Force, Intermediate Vector Bosons ("IVBs")

Section IV: Introduction to the Weak Force
Section XVI: Introduction to the Higgs Boson
The "W" Intermediate Vector Boson and the Weak Force Mechanism (pdf file)
The "W" IVB and the Weak Force Mechanism (html file)
Global-Local Gauge Symmetries of the Weak Force
The Weak Force: Identity or Number Charge

The Weak Force "W" Particle as the Bridge Between Symmetric (2-D) and Asymmetric (4-D) Reality
The Strong and Weak Short-Range Particle Forces
The "Higgs" Boson and the Spacetime Metric
The "Higgs" Boson and the Weak Force IVBs: Part I
The "Higgs" Boson and the Weak Force IVBs: Parts II, III, IV
"Dark Matter" and the Weak Force

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Greene, B. *The Fabric of the Cosmos*. A. A. Knoph, **2004**, 569 + xii pp.
Susskind, L. *The Cosmic Landscape* Back Bay Books, **2006**, 403 + xii pp.