# Currents of Entropy and Symmetry

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Our Sun is the archetypical example of a completed circuit of symmetry conservation. (See: "The Sun Archetype".)

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## Abstract: Currents of Magnetism and Gravity

As magnetism is the invisible, projective, electrically active ("electro-motive") force of the loadstone, so gravity is the invisible, 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) electrical charges of electrons in the loadstone; in the case of gravity, we trace the force back to the moving (and one-way) temporal charges of matter 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. Both relations are reciprocal: moving magnetic and spatial (gravitational) fields create electric and temporal currents. Magnetism and time are both "local gauge symmetry currents", the variable magnetic current protecting the invariance of electric charge in relative motion, the variable temporal current protecting the invariance of causality and velocity c ("Lorentz Invariance"). Finally, time and gravity induce each other endlessly, as do the electric and magnetic components of an electromagnetic field. This is the analogy between electromagnetism and gravitation which so intrigued Einstein. (See: "The Conversion of Space to Time".)

## Introduction

Can we extend the analogy (see abstract) between magnetism and gravitation further, to include the north-south magnetic poles that provide a closed conservation loop for the field lines of a typical bar magnet, such that its force remains unquenched through time? The Earth's gravitational force likewise remains unquenched through time, but it has the appearance of a symmetric, unidirectional monopole, rather than a magnetic dipole. But how can the Earth's gravitational field be indefinitely sustained, unless a conservation loop of some sort exists to "recycle" this force? (The short answer is that magnetic forces are indefinitely sustained by charge and symmetry conservation, while gravitational forces are indefinitely sustained by charge, symmetry, entropy, and energy conservation. But in any

case, we wish to pursue the conservation-loop analogy for heuristic purposes.)

## Currents of Entropy and Symmetry

The long answer to the question posed above (How far can we push the analogy between magnetism and gravitation?) involves two primordial entropy forms (for free and bound electromagnetic energy - light and matter respectively) which act as source and sink, while gravitation provides the connection between. It is therefore the principle of entropy that sustains gravitation - entropy as manifest spatially through the intrinsic motion of light and historically as the steady march of time. The conservation loop exists in the gravitational connection between the primary spatial form of entropy, the intrinsic motion of light (the entropy drive of free electromagnetic energy), and the secondary historical form of entropy, the intrinsic motion of time (the entropy drive of bound electromagnetic energy). Gravitation is the force which effects the conversion of one type of entropy to the other, either by the conversion of space to time (as in the case of all bound energy forms, including our planet Earth), or additionally and simultaneously by the conversion of bound to free energy (as in the case of the Sun and stars). The connection is demonstrated in the first instance by the gravitational deceleration of the cosmic spatial expansion - that is, the historical entropy drive (the intrinsic motion of time) is funded by gravitationally siphoning energy from the spatial entropy drive (the intrinsic motion of light). Conversely, in the second case, the reduction of total cosmic gravitational force consequent upon the conversion of bound to free energy (as in the stars), has, as an inevitable result, the apparent "acceleration" of the cosmic expansion (which is instead, and equivalently, a reduction in the deceleration of Cosmic expansion). (See: "The Double Conservation Role of Gravitation".) (See Also: "Dark Energy": Does Light Produce a Gravitational Field?)

The primordial, fundamental role of gravitation is to provide sufficient negative energy to balance the positive energy of the "Big Bang". But while doing so, "velocity c" and causality must still be protected (for obvious reasons of energy conservation) within the gravitationally modified electromagnetic metric - producing a "local gauge symmetry current" of co-varying space and time ("Lorentz Invariance").

The entropic expansion of history (historic spacetime) takes place at the expense of, instead of, and indeed is funded by, the entropic expansion of space. The historical entropy drive (the intrinsic motion of time), is funded by the spatial entropy drive (the intrinsic motion of light). Conversely, the conversion of matter to light (in stars) converts matter's historical entropy drive to light's spatial entropy drive: as Einstein discovered, light has no time dimension. (See: "Entropy, Gravitation, and Thermodynamics".)

*A gravitational field is the spatial consequence of the intrinsic motion of time*. But time is the *implicit* driver of light's intrinsic motion and the entropic expansion of space. Gravity creates time by the annihilation of space, exposing the implicit and metrically equivalent temporal component.

While the spatial and temporal entropy drives appear to be distinct superficially, fundamentally they are the same, two sides of the same electromagnetic entropy "coin", the implicit vs the explicit form of time, the entropy drives of free and bound forms of electromagnetic energy. (see: "The Conversion of Space to Time" and "Gravity Diagram No. 2"). Both types of entropy drive converge upon the same goal - the conservation of energy, causality, and the symmetry of energy (Noether's Theorem).

## Black Holes

Symmetry conservation in the case of gravitation is easy to observe, as seen in the universal drive toward the conversion and return of bound to free energy in our Sun and the stars (through the

nucleosynthetic pathway), and finally (and completely) through Hawking's "quantum radiance" of black holes. Symmetry conservation in the case of light itself involves the maintenance of metric (inertial) symmetry (as gauged by "velocity c", for one example), and the suppression of time, mass, charge, and gravitation (via electrically motivated matter-antimatter annihilations, for another example). But the temporal entropy drive also works toward the conversion of bound to free energy, first through the "half-life" of particle and radioactive decay, and finally though "proton decay". Indeed, these three symmetry conservation pathways meet in black holes, where proton decay is (presumably) commonplace in the interior. (See: "The Half-life of Proton Decay and the 'Heat Death' of the Cosmos".) In a remarkable convergence, Einstein's "Equivalence Principle" is also brought into play, since at the event horizon, where g = c and time stands still, matter is returned to an equivalent "velocity c", at least partially returning mass to the timeless energetic symmetry state of light.

Thus in the black hole, where "the extremes meet", we find an interior containing nothing but gravitationally bound light (due to the annihilation of matter by gravitationally induced proton decay); an event horizon where g = c, time stands still, meter sticks shrink to nothing, and bound energy moves equivalently at velocity c; and an exterior of "Hawking radiation" where Noether's theorem is completely satisfied by the return of asymmetric matter and historical entropy to the symmetric energy state of light and spatial entropy (via gravitationally induced matter-antimatter annihilation reactions). Finally, black holes (especially as seen in "quasars") convert a large proportion of the bound energy of in-falling matter to light, much more than the usual nucleosynthetic pathway of ordinary stars. No wonder nature likes black holes!

Of course the game is up if the conservation loop is broken - a true monopole (without a return loop) cannot exist. In the case of temporal entropy, if gravitation runs out of space to convert to time - the means by which it regenerates and sustains its confining force (as for example in the final moments of the "Big Crunch") - then we get an instant "flash over" or conversion of all residual bound energy to free energy in the "rebound" of a new "Big Bang". (See: "The Connection Between "Inflation" and the "Big Crunch".) The conversion occurs because light is the only energy form which by its own intrinsic motion (entropy drive) can create its own conservation domain (space).

The Universe is ruled by Energy Conservation, but it manifests through Entropy and Symmetry Conservation. Acting together, these three principles allow the transformation of free energy to work, information, and causally regulated matter (including historic spacetime). (See: "The Tetrahedron Model".) (See also: "The 'Tetrahedron Model' vs the 'Standard Model' of Physics: A Comparison".)

**The Energy Debt of Asymmetric Temporal Entropy**

There is an overall seamless circularity in the cause of time's intrinsic motion and the gravitational field, beginning with the flow of time into matter's historic causal domain (historic spacetime), pulling space after it - a self-feeding flow which continuously creates more time by the annihilation of space. The flow of time establishes the causal linkage and entropy drive of matter, and continuously renews bound energy's "location" charge and the gravitational flow of space. This connected, circular flow of space and time has the aspect of an electric circuit, as the temporal flow into expanding history provides an exit ("ground") for the spatial (gravitational) current, which flows to "bulk" historic spacetime, in consequence decelerating the cosmic expansion which is its energy source (via the actual conversion of space to time by gravity). Similarly, the causal linkages of historic spacetime connect back to the "universal present moment" to complete their circuit ("karma" and the infinite range of the gravitational force). We could say that the freely expanding possibilities of the "present moment" are "decelerated" (constrained, limited) by the causal chains of karmic consequence. (See: "The Time Train".)

Thus the intrinsic motion of light (the entropy drive of free energy, causing the expansion and cooling of space) is the ultimate energy source for the intrinsic motion of time (the entropy drive of bound energy, causing the expansion and aging of history), in which gravitation provides the connection between the "bulk ground" of historic spacetime, the "time charge" of the present moment (the "location" charge of mass and gravitation), and the intrinsic motion of light, decelerating the spatial expansion of the Cosmos in consequence. This "braking energy" subtracted from the spatial expansion provides the energy for the growth of matter's historic domain. In the gravitational force, space and history play the roles of the north and south poles of the bar magnet or loadstone. The entropy balance of the universe, gravitationally divided between an expanding spatial domain (S) driven by light's intrinsic motion, and an expanding historical domain (T) driven by time's intrinsic motion, may be symbolically represented by a "concept equation" as:

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

> (Because I assume the general validity of Einstein's gravitational equations (other than the case of light in free space), it follows that I assume Einstein's formulation of the gravitational "warpage" of spacetime can be interpreted as the conversion of space to time. The interconversion ("covariance") of space with time is well known in other contexts involving moving or gravitational reference frames (Einstein's invariant "Interval", "Lorentz Invariance") in both Special and General Relativity. Hence the actual mathematics behind my grossly simplified "concept equation" has evidently already been done.) (See also the paper "The "Higgs" Boson vs the Spacetime Metric".)

(See: "A Description of Gravitation".)

At the microscopic quantum mechanical scale of local action, the conversion of space and the drive of spatial entropy to time and the drive of historical entropy is accomplished by the simple switch or "flip" of the electromagnetic entropy "coin" from implicit time to explicit time. The implicit form of time causes the intrinsic motion of light and the expansion of space, while the explicit form of time causes the gravitational annihilation of space and the expansion of history.

While the perfect symmetry of light is also seen in the "all-way" spatial character of light's entropy drive or intrinsic motion, the "one-way" historical character of matter's entropy drive (time's intrinsic motion) tells us that it is "goal oriented" with a symmetry conservation task to perform - the final return of bound to free energy. The conversion of mass to light in our Sun, stars, and via Hawking's "quantum radiance" of black holes is the final example of the conservation loop or completion of the symmetry circuit from space and light, to history and matter, and back again - exactly as required by Noether's symmetry-conservation theorem. (See: "Symmetry Principles of the Unified Field Theory".)

## Part II:
## Photons vs Gravitons

The similarity between the electromagnetic and gravitational force lies in the fact that both are conducting a search for antimatter, and for the same purpose - to effect a matter-antimatter annihilation and return the asymmetric bound energy form of matter to its symmetric (and original) free energy form of light. Both searches are conducted by means of a conserved charge producing an attractive "long-range" force - the bipolar "electric" charge (positive vs negative force field) in the case of the electromagnetic force, and the mono-polar "location" charge (negative only force field) in the case of gravitation.

The electromagnetic force uses "photons" (quanta of light) as its field vector - the exchange of "virtual" photons between electrically charged particles produces the force field. Because the electromagnetic force is a "long-range" force, oppositely charged particles of matter and antimatter will attract each other across the cosmos and ultimately effect a mutual annihilation - an extremely simple principle and method of symmetry conservation.

The gravitational force uses "gravitons" (quanta of spacetime) as its field vector - we may imagine the exchange of virtual gravitons between the "location" charges of massive particles as producing the gravitational force field (below I will also suggest an alternative to this view). Like electromagnetism, gravity is a long-range force, and one mass will attract another across the entire cosmos to effect an annihilation - if one is matter and the other is antimatter. However, the attraction works in either case and if only matter is present, then huge accumulations (planets, stars, galaxies) of matter will eventually be formed, as unlike electromagnetism, gravity has no repulsive component.

Both gravity and electromagnetism have a similar problem in that both attract matter as well as antimatter - the problem being that the particles they attract may not be annihilation partners. The most familiar components of the typical atom are examples of this dilemma - the electron and proton are attracted by each other's opposite electric charges, but they are not each other's antiparticles. They can't annihilate but neither can they deny their attraction, and so they become "stuck" as perpetually frustrated partners. Electrical pairs of this sort can build up to large chemically bound crystals and even mountain-sized rocks, eventually giving way to spherical, astronomically-sized, gravitationally bound accumulations of matter.

Of course, in the early universe the attractive forces of electromagnetism actually did effect matter-antimatter annihilations on a cosmic scale, producing (or so we imagine) the "Big Bang". However, because of a small asymmetry in the weak force (about one part in ten billion), this primordial annihilation was not complete, leaving a tiny residue of matter which currently comprises our material universe, and which searches in vain for antimatter annihilation partners by the forces generated by both its long-range conserved charges.

## A Tale of Two Forces

We must of course wonder why there are two such long-range charges/forces when one should be sufficient, and how they differ. It appears (to state the case in the most naive terms), that the electric charge is "plan A", the simple and fast solution to the symmetry conservation problem, while gravity is "plan B", the backup or fail-safe solution should electric charge fail to get the job done. Gravity is a more universal charge than electric charge, and it is only attractive: no massive particle, whether matter or antimatter, escapes its grip. And the mechanism of gravitational attraction is also of a more universal nature than the simple exchange of virtual field vectors between charged particles. The field vector of gravity is spacetime itself: time is the active principle of gravity's "location" charge.

As noted elsewhere, the "location" charge of gravity codes for both an entropy and a symmetry debt of matter, responding to (or reflecting) the fact that the electromagnetic constant "c" gauges both the entropy drive of free energy (the intrinsic motion of light) and the symmetric "non-local" distribution of light's energy throughout spacetime - everywhere, simultaneously.

At low gravitational field energies (as on planet Earth), we only see gravity paying matter's entropy debt, as the intrinsic motion of light is converted into the intrinsic motion of time (via the gravitational annihilation of space with the consequent extraction of a metrically equivalent temporal residue). This quiescent situation, where a constant symmetry-seeking force subsists (gravity), but no symmetry debts

are actually repaid, is very similar in character and effect to that of the electrically neutral atom in the loadstone, where electric and magnetic forces subsist, but no charges are actually annihilated. In both cases, charge conservation is simply biding its time, maintaining charge invariance, until conditions become favorable for actual symmetry debt repayment - either through the attraction of an actual particle of antimatter, or the attraction of enough matter to increase the gravitational field energy beyond the threshold level for symmetry conservation to begin via nuclear reactions.

At high gravitational field energy (as in stars), gravity begins converting bound to free energy (via the nucleosynthetic pathway of element building), actually repaying matter's symmetry/entropy debt. At extreme gravitational field energy (as at the "event horizon" of a black hole), gravity completely repays the symmetry/entropy debt of matter via "Hawking radiation", the direct creation of matter-antimatter particle pairs from the "vacuum" of spacetime. Note that this also pays the symmetry debt carried by the typical atom, either through matter-antimatter annihilation at the "event horizon", or by "proton decay" in the interior (See: "Proton Decay and the 'Heat Death' of the Cosmos").

## The Attractive Pinciple of Gravitation

In the end, gravity accomplishes what electromagnetism cannot, because gravity cannot be neutralized and builds in intensity until its field energy is equal to any symmetry-conservation task. Unlike the electrical symmetry debt, it is the "double" nature of gravity's symmetry debt - paired with an entropy debt - that makes it impossible to neutralize the gravitational force until the entropy/symmetry debt is completely repaid (by the conversion of bound to free energy).

It seems the best way, or at least the most heuristic way, to visualize gravitational action is not as the exchange of gravitons between massive "location" charges, but as the action of time upon space: the temporal component of gravity's "location" charge moves with intrinsic (entropic) motion into history, pulling space along with it. The historic domain of matter's causal information field, however, lies at right angles to all three spatial dimensions, and the entrance to the historic time line is a zero-dimensional point. The spatial dimensions annihilate each other as they try to squeeze into the time line, which exposes another metrically equivalent temporal residue, continuing the endless self-feeding entropic cycle of "intrinsic" gravitational motion. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "The Conversion of Space to Time".) Since all forms of bound energy require a time dimension to accommodate their energy accounts in relative (rather than absolute) motion, the creation of time by gravity offers an energy-conservation rationale for the existence of this force which is far beyond beyond the simple symmetry-keeping role of electromagnetism.

## The Credit Card of the Cosmos

Charge conservation acts as the "credit card" of the Cosmos - "buy now, pay later", with gravity paying the entropy-"interest" on matter's symmetry debt by creating matter's time dimension via the annihilation of space. The notion of charge conservation would be moot in the absence of time. On planet Earth, gravity only pays the entropy "interest" on matter's symmetry debt, since the "principle" of this debt (mass or bound energy) is never reduced thereby, nor is the gravitational field itself ever reduced. However, in the Sun, gravity pays down the "principle" of matter's symmetry debt by the conversion of bound to free energy, reducing both the mass of the Sun and its associated gravitational field. In Hawking's "quantum radiance" of black holes, gravity completely pays off matter's symmetry debt by completely converting the hole's mass to light. The gravitational field completely vanishes when bound energy and its associated symmetry debt completely vanishes. It is only the vanishing of the gravitational field that tells us its symmetry-conservation role is completed. (See: "Dark Energy:

Does Light Produce a Gravitational Field?")

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