Global and Local Gauge Symmetries: Part II (Gravitation)

Section B

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Global and Local Gauge Symmetries: Gravitation, Section B

Massless light is non-local, atemporal, and acausal; massive matter is local, temporal, and causal. "c" is a global constant gauging a global metric; "G" is a global constant gauging a local metric.

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

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

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

The purpose of a dimensional metric is energy conservation, and gravitation acts to convert the energy-conserving symmetric global metric of space and light to the energy-conserving asymmetric local metric of

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

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

Gravitons

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

Summary

> The invariant, global magnitude of "big G", the gauge of gravity's "location" charge, must be maintained because of the intimate connection between time and energy conservation (entropy, causality, the Interval, relative motion, etc.). Hence both c and G must be universal and invariant metric gauge constants. Nevertheless, time can vary locally if space co-varies, a combination which maintains the constant value of c, the "Interval", and causality. Time can vary locally only within the framework of a global metric structure which as a whole remains capable of conserving energy. Charge invariance - including the "Lorentz Invariance" of Special and General Relativity - is the key to understanding the local forces and the local action of the field vectors (local "gauge symmetry currents"). The local, relative motions of matter require local compensatory forces to maintain and protect the invariant, global parameters of charge, including the "Interval", causality, and the electromagnetic constant, "c".

We see a hierarchy of global-local gauge symmetries, with the global "multiverse" at the top, existing purely in terms of creative potential, with all the various possible universes as the local gauge expressions of the next lower (derivative) level. Our universe is one such local choice among these (infinite?) possibilities, whose physical laws and constants (by chance alone) favor the evolution of our life form (the "Anthropic Principle"). (Within our own universe, however, the evolution of life is not due to simple chance, but to the operation of a 4x3 General Systems or fractal algorithm. See: "Nature's Fractal Pathway".) At the multiverse level, the energy type, dimensional parameters, and physical constants of our universe are but the local gauge parameters of a specific (electromagnetic) choice or realization, perhaps among an infinitude of possible universes. I would guess that the only restriction upon the physical parameters of any universe is

that: 1) it requires no net energy (or charge) to create; 2) it must be capable of conserving such energy as it does contain; 3) it must be able to break its initial symmety condition; 4) it must be able to return to its symmetric origins.

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

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

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

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

Postscript
A Hierarchy of Gravitational Conservation Roles and Domains

1) Gravitational Realms: Single Systems (planets and stars)
   A) Entropy-only Conservation Domains: (the gravitational creation of time via the gravitational conversion of space to time) (atoms --> planets):
      Atoms - time ("half-life") - radioactivity, particle, and proton decay (gravity provides the time dimension within which all forms of charge conservation can have an historical significance - another example of the connection between gravity and symmetry conservation);
      Spherical shapes created by symmetric gravitational forces (large composite objects); large asteroids, satellites, moons, planetismals;
      Planetary life zone - biological information domain (atmosphere, liquid water, magnetic field, all necessary?); (time is necessary for biological evolution);

Planets (various sizes, approximately Earth to (?) Jupiter-sized planets);
Brown dwarfs ("failed" stars: ~13 - 80 Jupiter masses; limited fusion of deuterium and lithium).

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

Sun and Stars - various types and sizes (above 80 Jupiter masses up to ~ 100 (?) solar masses); stellar "generations" (first generation stars may be (much?) more massive);
Nucleosynthetic pathway (creation of heavy elements);
Novas and supernovas (creation and dispersal of heavy elements);
White Dwarfs - electron shell collapse; electron "gas" (condensed matter series begins);
Neutron stars - pulsars and magnetars;
Black Holes: small (primordial); large (stellar); giant (galactic):

"Quantum Radiance" - Hawking (total conversion of mass to light and final gravitational repayment of matter's entropy and symmetry debts);
Proton Decay - probably common at central "singularity" of black holes (black holes therefore probably consist only of gravitationally bound light).

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

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

Orbital motions (moons, satellites, asteroids, comets, etc.);
Stellar Systems (planetary systems with a central star or stars);
Binary stars, and simple multiple orbital systems;
Globular Clusters;
Galaxies and galactic structures (disc, central bulge, halo, globular clusters, giant molecular clouds, stellar nurseries, spiral arms, central giant black hole, etc.);
Galaxy types: spirals, barred spirals, ellipticals, irregulars, dwarf, etc. (small - large; primitive - evolved);
Quasars (and "active" galaxies);
Galaxy clusters, giant central galaxies, satellite galaxies, interactive galaxy pairs, colliding galaxies, etc.;
Giant galactic "walls" and "voids"; galactic superclusters; "foam-like" mega-structure of Cosmos.

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

D) Creation of light, spacetime, and matter (from multiverse?); creation of energy/entropy conservation domains of space and historic spacetime:

Deceleration of cosmic expansion (due to gravitational annihilation of space);
Acceleration (rebound) of cosmic expansion (due to gravitational annihilation of mass and vanishing of associated gravitational fields);
Creation of Universe: "Big Bang" (via compensating negative gravitational energy: net energy = 0);
Destruction of Universe: "Big Crunch" (net entropy = 0) (return to multiverse?).

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Gravity Diagrams

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The Three Entropies: Intrinsic Motions of Gravity, Time, and Light
The Tetrahedron Model (complete version)

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Brewer, J. W. and M. K. Smith, eds. *Emmy Noether: A Tribute to her Life and Work*. 1981. M. Dekker, New York.
Frank Close: *Lucifer's Legacy*. 2000. Oxford Univ Press.
Leon Lederman with Dick Teresi: *The God Particle*. 2006. Mariner Books.
Leon Lederman and Christopher Hill: *Symmetry*. 2008. Promethus Books.
Robert Oerter: *The Theory of Almost Everything*. 2006. Penguin (Plume).
Pais, Abraham *Inward Bound: of Matter and Forces in the Physical World*. 1986. Oxford University Press, NY
Robert Resnick: *Introduction to Special Relativity*. 1968. John Wiley and Sons, Inc.
James S. Trefil: *The Moment of Creation* 1983. Collier, Macmillan.
Frank Wilczek: *The Lightness of Being*. 2008. Basic Books.