A Periodic Table of the Four Forces and the Unified Field Theory (General Systems Format)

Forces:	**Electromagnetic:** (energy type)	**Gravity/Entropy:** (dimensions)	**Strong:** (mass carriers: particles)	**Weak:** (alternative charge carriers)
Symmetric Energy Input: Quantum Fluctuation From Multiverse (?) ("Big Bang")	Light: Free EM Energy; $E = h\nu$ (symmetric energy form)	Space: Entropic, A-causal Conservation Domain of Light; (intrinsic motion "c" = symmetric energy gauge)	Leptoquarks: Particle-Antiparticle Pairs (symmetric)	Symmetry-Breaking: "Y", "X" IVBs Create Single Matter Particles (from electrically neutral leptoquarks) (?)
Energy Conservation: Particles (mass, momentum); Asymmetric Energy Forms	Mass/Atomic Matter, Momentum; Bound EM Energy (asymmetric energy forms - no antimatter) $E = Mcc$	Time/History; Causality; "Karma"; Spacetime Metric; Entropic/Causal Conservation Domain of Matter; Time is Created From Space by Gravity, Producing "Spacetime"	Hyperons, Nucleons, Baryons, Mesons, Quarks; Atomic Nucleus; Mass Carriers	Leptons/Neutrinos; Alternative Charge Carriers; Electron Shell; "W" IVBs (Intermediate Vector Bosons)
Symmetry Conservation: Charge *(the charges of matter are the symmetry debts of light - Noether's Theorem)*	Electric Charge; Symmetry Debt: Missing Antimatter (lost during the "Big Bang")	"Location" Charge (of gravity); Symmetry Debt: Lost Non-Locality (non-local symmetric distribution of energy is lost whenever free energy (light) is converted to bound energy (matter))	Color Charge; Symmetry Debt: Lost Whole Quantum Charge Unit (quark partial charges)	"Identity" Charge (of the weak force); Symmetry Debt: Lost Anonymity of Photons (elementary particles are distinguished by type) (neutrinos are explicit identity charges: left-handed = matter, right-handed = antimatter)
Maintenance of Charge Invariance and Final Payment of Symmetry Debts: Field Vectors; Local Gauge Symmetry Currents	Photons; Magnetic Forces (conserving invariant electric charge); Exothermic Chemistry; Matter-Antimatter Annihilations (symmetry restored/conserved whenever bound energy is converted to free energy) [Chemistry - Life; Biological Information; Negentropic Processes]	Gravitons; Lorentz Invariance (conserving the "Interval", Causality, and "velocity c"); Stars, Supernovas, Quasars, Black Holes, "Quantum Radiance" (gravitational conversion of bound to free energy) ("accelerating" cosmos, "dark energy") [Source of Negative Energy and Entropy]	Gluons (conserving whole quantum charge units); Strong Force Fusion (mesons), Nucleosynthesis; Proton Decay (asymptotic freedom)	Weak Force IVBs: "W", "X" Families; (conserving elementary particle invariance, including invariance of "identity" charge); Fission, Radioactivity; Particle and Proton Decay; (leptoquark neutrino = "dark matter")
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The 4x4 table above represents interactions of the 4 forces of physics with several conservation laws, most notably energy, entropy, causality, and symmetry. The table may be read in the order of an English paragraph - left to right, top to bottom. The first row represents the "Big Bang", which initiates our cosmic system. The origin is assumed to consist of an input of light (free electromagnetic energy), a perfectly symmetric energy form, perhaps derived as a quantum fluctuation (of zero net energy and charge) from the Multiverse.

In the first row, light expands and cools to establish space, the entropic conservation domain of free electromagnetic energy. Light has an alternative symmetric form consisting of particle-antiparticle pairs, in addition to its (simpler and perhaps more primitive) wave form. During the "Big Bang" the symmetry of these particle-antiparticle pairs (and the light which produced them) is broken by asymmetric decays mediated by weak force IVBs (Intermediate Vector Bosons), producing our matter-only universe. It is thought that this asymmetric transformation occurs in electrically neutral leptoquarks via "Y" and "X" IVBs of great mass and high energy, in the early micro-moments of the "Big Bang" or "Creation Event".

The argument of the table follows: the original input of energy may be transformed temporarily, but eventually (if not immediately) the total amount of energy must be conserved in some form (row 2 - atomic matter, mass and momentum), and the symmetry of the original light must also be conserved as charge (row 3 - Noether's Theorem): *the charges of matter are the symmetry debts of light*. (The nature of these symmetry debts which the charges represent and hold invariant (charge conservation) is also identified in row 3). The inertial forces of spacetime and the "Lorentz Invariance" of Special and General Relativity (shrinking meter sticks and slowing clocks) are analogous dimensional effects regulating the metric parameters of spacetime, necessary to hold invariant "velocity c", causality, and Einstein's "Interval".

Time and history constitute an alternative entropic domain for matter (bound electromagnetic energy), which having no intrinsic spatial motion, cannot directly participate in light's entropic, expanding spatial conservation domain. Time is created by the gravitational annihilation of space for the express purpose of accommodating matter's energy and entropy conservation requirements. The two metric and entropic systems of free and bound electromagnetic energy merge seamlessly into "historic spacetime", since the gravitational annihilation of space leaves a metrically equivalent temporal residue, which is furthermore exactly calibrated (Gm) to the quantity of bound electromagnetic energy involved.

It is the principle role of the field vectors of the four forces to maintain the invariance of charge, velocity "c", the metric parameters of spacetime, etc. (The electromagnetic constant "c" is the gauge of both metric symmetry (inertia, causality) and the symmetric energy state of light (non-local timelessness), as well as gauging the entropic parameter of light's conservation domain (expanding and cooling via "intrinsic" motion "c"). Row 4 involves the maintenance of charge invariance by the field vectors of the forces ("local gauge symmetry currents"), as well as the final repayment (conservation) of the original energy and symmetry debts of light held by the mass and charge of atomic matter and any other forms of bound energy. All four forces spontaneously act to return bound electromagnetic energy to its free form (light), whether through matter-antimatter annihilations, gravitational processes converting mass to light (culminating in Hawking's "quantum radiance" of

black holes), or the nuclear forces of fission, fusion, and proton decay. The 4x4 matrix form of the table has significance for General Systems models of cosmic organization, a thesis elaborated in many papers on my website. (See: "Symmetry Principles of the Unified Field Theory").

Alternative charge carriers (leptons/neutrinos), alternative entropic drives and domains (intrinsic motion "c" and space vs the one-way march of time and history), alternative forms of energy and symmetry (mass and charge); the Heisenberg-Dirac vacuum particle-antiparticle pairs (a secondary form of free electromagnetic energy) - all these dualities waiting to serve the purposes and conservation requirements of manifestation (the primordial symmetry of light and its particle-antiparticle pairs cannot be broken without them) - indicate convincingly that our material 4-dimensional universe is no accident, and that all these accommodations are simply part and parcel of a larger electromagnetic energy plenum which arrives (from the Multiverse?) fully prepared to materialize, moreover bearing native physical constants which regulate its processes and interactions, and guarantee its conservation.

We cannot help but remember (with astonishment) Plato's analogy of the prisoners in the cave whose view of reality is limited to shadows cast upon the wall. So too, we glimpse in the conservation laws and the alternative forms of energy, entropy, and symmetry (mass, time, charge) realities beyond the ken of surface experience.

This table does not adequately address the information parameter of our universe, especially as elaborated in the Periodic Table of the Elements, the macro-universe, or the incredibly complex biological phenomena of life. Rather, this table represents a foundation stone in the hierarchy of these domains, which are treated in other papers on the website. (See for example: "The Information Pathway" and: "The Fractal Organization of Nature".)

The physical sequence described by the matrix, reading from top to bottom, may succinctly be sketched as: "Symmetric primordial light produces asymmetric atomic matter bearing charges; the mass and momentum of matter conserves the raw energy of the original light, while the charges of matter conserve the symmetry of light. Charges produce forces (via field vectors) which act both to hold charges invariant and to return asymmetric matter to its symmetric origin - light."

The principle of unification of the forces is derived from Noether's Theorem: *The charges of matter are the symmetry debts of light*. Each of the four forces bears a charge which represents a symmetry debt of the primordial light which created matter in an asymmetric process during the "Big Bang" - (row 1 and 2).

In row 3 we list and explain these symmetry debts as follows: (See also: "Symmetry Principles of the Unified field Theory".)
Electric Charge: The symmetry debt representing missing antimatter. The universe consists of matter only, the antimatter half of the cosmos having been annihilated during the "Big Bang". All symmetry debts originate from this primordial asymmetric "Creation Event" (the analog in physics of "original sin"). The natural role of electric charge is to motivate annihilation reactions between matter and antimatter - the positive charge of one attracting the negative charge of the other - from across the universe if necessary. The electrical charges of matter remain even though there is no longer an opposite antimatter charge to balance, attract, and annihilate them. These remaining charges may

therefore truly be characterized as symmetry debts representing the missing antimatter of our cosmos (and of the light which created it). If antimatter can be found, this debt is immediately paid via annihilation reactions, returning the asymmetric system of matter (and antimatter) to the symmetric state of the light which first created it (row 4).

Gravitational Charge: I designate "location" charge as the charge of gravity, to better characterize its action. (See: "A Rationale for Gravity".) The gravitational charge arises in response to the loss of the symmetric distribution of light's energy, everywhere, simultaneously, throughout spacetime - a distributional symmetry which derives from the "non-local" character of light discovered by Einstein. Traveling with intrinsic motion "c", light has no time dimension and no spatial dimension in the direction of propagation. Within its own reference frame, therefore, light has forever to go nowhere, resulting in light's "infinite" or "non-local" velocity and distributional symmetry. The non-local distributional symmetry of light's energy is lost whenever light (free electromagnetic energy) is converted to immobile mass-matter (bound electromagnetic energy) which has no intrinsic spatial motion. This distributional symmetry loss is the origin of the gravitational "location" charge, which registers the spacetime coordinates of the offending lump of concentrated mass-energy, including its total amount and density, in the unambiguous terms of an inertial force (Gm) directed toward the center of any mass. *Gravity is matter's memory it once was light*.

The secret of gravitation is that *the active or motivating principle of the "location" charge is time*. Time and gravity both have one-way intrinsic motion - the gravitational annihilation of space (at the center of every mass) leaves behind a metrically equivalent temporal residue (because "space" is really "spacetime"). This temporal residue, formerly implicitly present in "spacetime" but now explicitly present due to the gravitational annihilation of its spatial component, has its own intrinsic motion and marches off into the 4th dimension of history, at right angles to all three spatial dimensions. The march of time into history pulls space along behind it to the center of mass where the annihilation cycle is repeated. *A gravitational field is the spatial consequence of the intrinsic motion of time*. (See: "The Conversion of Space to Time".)

Time and gravity induce each other in an endless self-feeding cycle. The conservation role of matter's time dimension is several fold: 1) to provide matter with an alternative entropic conservation domain (historic spacetime) in which it has its own alternative intrinsic motion - the functional analog and metric equivalent of light's "velocity c"; 2) to provide matter with an energy accounting system (energy conservation domain) which can accommodate the relative (rather than absolute) motion of matter and hence its variable energy content due to the contingent character of matter's velocity (by contrast to light's constant velocity); 3) to provide matter with a causal reference frame such that causes always precede effects; 4) to provide a form of negative energy and entropy which can balance the positive energy and entropy of the "Creation Event", allowing the universe to be created with zero net energy as well as zero net charge (the latter due to the initial presence of antimatter). (See: "A Description of Gravitation".)

In row four we record the gravitational conversion of bound to free energy in astrophysical processes such as stellar nucleosynthesis, supernovas, quasars, and finally and completely, Hawking's "quantum radiance" of black holes. These conversions, of course, return the asymmetric system of matter to the symmetric system of light. The recently observed "acceleration" of the cosmos is due to the reduction

of the total cosmic gravitational field, consequent upon the conversion of bound to free energy by the spontaneous action of all forces. (See: "Does Light Produce a Gravitational Field?")

The Strong Force ("color charge"): unlike the "long-range" forces of electromagnetism and gravity, which operate across the universe (throughout the domain of spacetime), the strong nuclear force of the "color charge" and its "gluon" field vectors operate only within the confines of a baryon, engaging in a "round robin" exchange of "gluon" field vectors between the three quarks of baryons (protons, neutrons, hyperons). Both quarks and gluons carry color charges. The strong force color charge is in response to the fractional electrical charges of the quarks, which threaten to destroy the whole quantum unit electric charge and split it into sub-units or fractional charges of 1/3 the original magnitude. In general, such partial quark charges could not be annihilated and hence symmetry could not be conserved. This is a "whole unit charge" symmetry within quantum mechanical law which is powerfully defended by the gluon color charges, which (unlike photons of the electromagnetic force) are attracted to each other as well as to the quarks. This mutual attraction results in the "short-range" force law of the color charge ("asymptotic freedom"), in which the threat to the symmetry, unit, or invariance of the whole quantum unit electric charge is reduced as the quarks move closer together, reducing the strength of the strong force. On the other hand, as the quarks move apart, the threat to charge symmetry is increased, and the strong force grows stronger. The strong force bond of the color charge is in fact unbreakable - quarks never exist as "singlets". "Asymptotic freedom" however, can lead to the complete vanishing of the strong color charge (self-annihilation), and in the absence of the conserved color charge, proton decay can occur, mediated by a weak force "X" IVB and a leptoquark anti-neutrino. Proton decay may actually be commonplace at the center of black holes. (See: "The Strong Force: Two Examples".)

The Weak Force: The weak force is the second short range nuclear force, responsible for the destruction (fission) of atomic nuclei (radioactivity) and the transformation of elementary particles, in contrast to the strong force, which binds nuclei and quarks together ("fusion"). The weak force in many ways is the most remarkable of the forces since it is responsible for the creation of matter, specifically for the creation/transformation/decay of *single* elementary particles. Other forces may create particle-antiparticle pairs, but only the weak force can create *single* elementary particles.

There are two especially anomalous phenomena associated with the weak force - the (nearly) massless neutrinos and the (very) massive IVBs (Intermediate Vector Bosons). We will look at the neutrinos first.

Neutrinos are "raw" or explicit "identity" charges - "identity" is the charge of the weak force. As a symmetry debt of light, "identity" charge represents the broken symmetry of the photon's "anonymity". All photons are alike, one cannot be distinguished from another, and indeed as bosons they can superimpose upon one another without limit. Single elementary particles (leptons) created from light during the Big Bang are not all alike and can be distinguished from one another both by type (electron, muon, tau) and as matter vs antimatter (unlike photons which are their own antiparticles); as fermions they furthermore cannot superimpose upon one another. (The identity charge is necessary to distinguish elementary particles so that, for reasons of energy and symmetry conservation, they can be reproduced exactly and annihilated completely.)

There are two related classes of elementary leptonic particles, the "heavy" leptons, electron, muon, and tau, and the (nearly) massless neutrinos, which are paired one-to-one with their heavy partners, as electron neutrino, muon neutrino, and tau neutrino. There is a corresponding set of antiparticles, in which matter neutrinos are distinguished by left-handed spin and antimatter neutrinos are distinguished by right-handed spin. This curious pairing between heavy leptons and their very light neutrino counterparts has a huge practical consequence: it is the reason our matter-only universe escaped from the "Big Bang" without being annihilated by matter-antimatter reactions.

The electron and electron neutrino both carry the same weak force "identity" charge - the electron in "hidden" or implicit form, and the neutrino in explicit or "raw" form (this charge is also known as lepton "number" charge). An "explicit" electron anti-neutrino can balance or cancel the electron's "implicit" identity charge, and likewise, an "explicit" electron neutrino can act as an alternative charge carrier for the electron's "implicit" identity charge. Playing a similar role, the electron itself can act as an alternative charge carrier for the electric charge of baryons, or cancel and balance a proton's electric charge, as in the familiar electron-proton atomic pair. In general, leptons seem to function as *alternative charge carriers*, the heavy leptons carrying electric charge for the baryons, their neutrino partners carrying "identity" or "number" charge for the heavy leptons. (In a similar role, mesons function as alternative carriers of quark "flavor" and color charges.) We may not understand why this lepton-neutrino partnership exists, but without it we would not exist. Looked at from the unifying perspective of symmetry debts, identity charge arises as a consequence of breaking the symmetry of the photon's "anonymity" by the creation of single massive elementary particles from light during the "Big Bang". Photons have no individual, distinguishable "identity", but massive elementary particles do.

Thinking in terms of the symmetry accounts of either the "vacuum" or of spacetime, the lepton-lepton anti-neutrino pairing yields a "lepton number" of zero, both before and after the creation of a singe leptonic particle. It's obvious that an electron-positron pair has a total lepton number of zero, but an electron and electron antineutrino pair also has a zero lepton number, but (crucially) without producing a matter-antimatter annihilation reaction. Whenever a single elementary lepton is created by the weak force, it is always accompanied by an antineutrino specific to its kind, such that the lepton number of the spacetime "vacuum" is zero both before and after single particle genesis. Likewise, whenever a single elementary lepton vanishes from 4-D spacetime, lepton number must remain unchanged (zero), such that the massive lepton is replaced by an equivalent neutrino carrying the appropriate number charge (that is, an electron must be replaced by an electron neutrino - which also balances the extant electron antineutrino which previously accompanied its birth). The simple rule is that lepton number does not change (is conserved) in all reactions, whether leptons are created or destroyed. Hence the original symmetry of the vacuum remains undisturbed despite the comings and goings of single elementary leptonic particles. There is probably a similar rule for "baryon number" involving leptoquark neutrinos, but these reactions (such as "proton decay") take place at such high energies that they have yet to be observed. Nevertheless, they would seem to be a logical necessity given nature's penchant for keeping track of her elementary particles - in this latter case leptoquarks (which will subsequently decay into baryons).

Nature is very stingy with her elementary particles: so far as we know, only 3 or 4 species of them exist - the electron, muon, tau, and probably the leptoquark. (Quarks, however, are sub-elementary

particles, apparently derived from primordial heavy leptons, and have no associated neutrinos). Each elementary particle is distinguished by its own neutrino, left-handed if matter, right-handed if antimatter. While photons are massless and 2-dimensional, elementary particles are massive and 4-dimensional. Hence the transformation from light to matter involves a dimensional as well as an energy state transformation, and energy (and symmetry) must be conserved across this dimensional boundary in both directions, that is, during creation or annihilation of an elementary particle. The neutrino is the identity "certificate" that tells the conservation mechanism of spacetime what this particle is in terms of mass and spin and therefore how to deal with its conservation requirements. This careful accounting by particle type is related to the second anomalous phenomenon of the weak force - the very massive IVBs or weak force field vectors. (See: "The Higgs Boson and the Weak Force Mechanism".)

The weak force can create single elementary particles only because the neutrino acts as an alternative charge carrier for the identity charge of the "heavy" leptons - the electron, muon, and tau. This crucial service means that identity charge conservation can be accomplished in the absence of antiparticles, and hence also in the absence of annihilation reactions. The identity charge of an electron (for example) can be balanced by an electron anti-neutrino instead of an actual anti-electron - avoiding an antimatter annihilation reaction. This is why the neutrino is the key to the creation of our matter-only universe: during the Big Bang weak force asymmetric reactions were allowed because neutrinos could be used to carry charges, balance reactions, and satisfy charge conservation laws, rather than actual antimatter counterparts. Electrically neutral leptoquarks were able to decay asymmetrically, producing more matter baryons than antimatter baryons, all because leptoquark neutrinos could serve as alternative charge carriers of "identity" rather than actual leptoquarks or anti-leptoquarks - avoiding the otherwise inevitable annihilation reactions. The electrical neutrality of the leptoquarks is also crucial to the process of "baryon genesis" - which neatly explains why the sub-elementary quarks and their fractional electric charges are necessary to the primordial process of creating our matter-only universe. Baryons composed of sub-elementary quarks can arrange their internal constituents such that their fractional charges cancel, producing electrically neutral baryons (heavy analogs of the familiar neutron). We also discover in the quark partial charges the probable reason for the three "families" of elementary particles - the six quarks of the three families allow for many more electrically neutral baryon combinations - greatly facilitating baryon genesis. It is also plausible (if not likely) that baryons are created by splitting heavy primordial leptons. We have already hinted how such an origin would naturally give rise to the strong force gluons and the permanent confinement of individual quarks with their symmetry-threatening partial charges.

One final digression - the anti-leptoquark neutrinos produced during the creation of matter in the "Big Bang" (one per excess matter baryon) are natural candidates for the mysterious "dark matter" or "missing mass" of the cosmos.

Returning to the IVBs - it is the role of the weak force to produce single elementary particles but with a stringent qualification: every elementary particle ever produced from the beginning of the universe (and onward into its future) must be exactly the same as its fellows within type (all electrons must be identical, and likewise the muon and tau). We have seen that the neutrino has a role to play in this process, allowing the creation of a single electron (for example) in the absence of a positron (anti-electron), and in effect certifying that any newly created electron is the genuine article in all respects.

But the actual mechanism of manufacture involves the hugely massive IVBs (81 proton masses) even for the tiny electron, which weighs about 1/2000 of a proton. Why is this huge "overkill" of energy during the creation process necessary? It is because the only way to circumvent the enervating effects of the entropy of a constantly expanding and cooling universe over eons of time upon the manufacture of identical elementary particles is to return to the original primordial energy density and creative phase of the Big Bang in which these particles were first formed - always going back to the original mold, as it were. Every weak force transformation involving an IVB is therefore a recreation of a particular energy density of the Big Bang, but in miniature. Only by such extreme measures is the exact similarity of every electron (past, present, and future) guaranteed, and only these are given the neutrinos' "certificate of authenticity and true identity".

The energy-density recreated by the "W" IVBs is that of the electroweak unification energy density, and all of the leptons and mesons of the "Standard Model" (the alternative charge carriers) can be faithfully reproduced at this energy level. (Reproducing the baryons themselves requires the next higher energy level of the "Grand Unified Theory" and the supermassive "X" IVB (unifying the electroweak and strong forces and allowing lepton-quark transformations.)

When a (single) massive elementary particle comes into 4-D existence, its identity charge must be balanced by an appropriate neutrino, and likewise, when it passes out of 4-D existence its identity charge must be replaced by an appropriate neutrino. A system of many moving parts but with a single goal - the absolute conservation of energy and symmetry - whether in 2 dimensions or 4, whether in the symmetric realm of light and space, or the asymmetric realm of matter and spacetime. (See: "Introduction to the Weak Force".)