

The Higgs Boson vs the Spacetime Metric

(Revised Dec., 2011)

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(See also: "The Mysteries of Mass" by Gordon Kane, *Scientific American*, July 2005, pp. 41-48; and: "When Fields Collide" by David Kaiser, *Scientific American*, June 2007, pages 63 - 69.)

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Abstract

Currently, there seems to be (at least) two interpretations of the activity of the Higgs boson: 1) the older, original interpretation of the Higgs as the scalar or gauge boson which determines the *rest masses* of the IVBs and elementary particles (which I can understand and endorse); 2) a newer (additional? alternative?) interpretation consisting of a "Higgs ether" which acts as the source of particle mass in the sense of *inertial resistance* to acceleration. In this latter interpretation, all massive particles interact with a universal Higgs field in proportion to their bound energy content, and it is this interaction or "Higgs ether drag" which causes the inertial resistance to acceleration we characterize as mass. It is this latter interpretation which I cannot understand or endorse, as it seems to force a distinction between rest mass and inertial mass, and has no power at all to explain Einstein's relativistic mass. However, replacing the "Higgs ether drag" hypothesis (but retaining the Higgs scalar hypothesis) with a "gravitational field drag" hypothesis does allow us to understand the mechanism of relativistic variability in the metric and energetic parameters of mass, and crucially preserves the necessary equivalence between inertial and rest mass.

Introduction

In terms of Newtonian or low-velocity mechanics, the inertial resistance to acceleration by mass is simply explained by the conservation of energy. Energy is obviously required to accomplish an acceleration, in direct proportion to an object's mass ($F = ma$). Intuitively, there is nothing particularly mysterious about mass or inertial resistance at low velocity. Classically, the concept of mass was no stranger than the concepts of energy, space, or time; [the equivalence between gravitational "weight" and inertial mass](#) was its greatest mystery. Einstein explained that puzzle but introduced new ones: according to the high-velocity mechanics of Special Relativity, inertial mass increases with increasing velocity, and likewise clocks slow and meter sticks shrink, destroying the classical simplicity of metric symmetry and energy conservation. Energy conservation and causality nevertheless prevail, of course, but it requires a changed (or "warped") metric to do so, and a new understanding of the relation between free and bound electromagnetic energy ($E = mcc$), and between gravitation, space, and time.

More recently still, a new question regarding the scalar origin of the mass of the elementary particles has been raised, a question answered by positing the "Higgs" mechanism (as originally suggested by Peter

Higgs). The Higgs boson acts as a mass scalar which determines the masses of the weak force IVBs (Intermediate Vector Bosons), and subsequently, acting through the IVBs, "gauges" the specific masses of the elementary particles (formalized in the mathematics of the electroweak unification of the "standard model").

The Higgs Field vs the Spacetime Metric

In his book "[Nothingness: The Science of Empty Space](#)" by Henning Genz (English Translation 1999, Perseus Books Pub. L.L.C.), on pages 228-237, Genz provides an illuminating explanation of the "Higgs" field and particle, currently the "Holy Grail" of particle physics. As I read and reread this section, I was struck with the similarity between Genz's description of the interaction of the Higgs field with a particle, and my own notion of the interaction of the spacetime metric with a particle's gravitational field. In Genz's description of the Higgs mechanism, the interaction of a particle with the Higgs field provides the particle's attribute of inertial mass (resistance to acceleration); in my conception, a particle's inertial mass or resistance to acceleration is the consequence of the interaction of the particle's gravitational field with the metric field of spacetime.

I am here considering the distinction between the "rest mass" energy content ($E = mc^2$) of an elementary particle (quarks, leptons), which is evidently [scaled by the Higgs boson](#), and the inertial mass due to acceleration (or the gravitational mass or "weight" of the same particle). M is the same quantity in all three cases, and must be, for energy conservation reasons, which is the rationale for this discussion. However, to attribute the inertial mass of acceleration to an interaction between the Higgs scalar and elementary particles (as a sort of modern-day "ether drag") is to lose the identity between rest mass and inertial mass in non-elementary particles, since in the latter case the binding energy component of rest mass (which is considerable in composite particles such as baryons) cannot be attributed to the Higgs interaction. We preserve this identity (necessary for energy conservation) by attributing a particle's inertial mass of acceleration to the interaction between the spacetime metric and a particle's gravitational field, as we know the gravitational field is an exact measure of the total bound energy content of a particle (Gm), whatever the source of that bound energy may be (elementary particle "rest" mass, composite particle binding energy, etc.). (See also: "[A Description of Gravitation](#)"). Crucially, this formulation also preserves the identity between gravitational "weight" and inertial mass, as well as Einstein's "Equivalence Principle".

The gravitational field of a massive particle is produced by the intrinsic (entropic) motion of the particle's time dimension, exiting space at right angles to all three spatial dimensions, and dragging space along behind it (see: "[The Conversion of Space to Time](#)"). The spatial dimensions self-annihilate at the gravitational center of mass, leaving behind an uncanceled, metrically equivalent temporal residue, which in turn moves on down the time line into history, pulling more space behind it, repeating the self-feeding entropic cycle forever. *A gravitational field is the spatial consequence of the intrinsic motion of time.* Time is the primordial entropy drive of bound energy, produced by the gravitational annihilation of a metrically equivalent quantity of space. (see: "[Entropy, Gravitation, and Thermodynamics](#)").

Gravity

The interaction of a massive particle's gravitational field with the spacetime metric is an interaction with the same spacetime metric that originally established the weak force IVBs and the particle "zoo" through its interaction with high-energy light during the "Big Bang". Even though the Higgs may be an attribute of the spacetime metric (acting as the weak force mass scalar), setting the energy scale for the IVBs and by extension for the rest masses of the elementary particles the IVBs produce, this is a one-time high-energy interaction regulating the production of elementary particles; the Higgs field does not continue to interact with particles (as a sort of "ether drag") to produce their inertial resistance to acceleration. Instead, this role is played by the spacetime metric, interacting with a particle's gravitational field, an interaction which produces a particle's inertial resistance to acceleration, and precisely in proportion to its mass. It also seems highly

unsatisfactory to attribute part of a composite particle's *inertial* mass of acceleration to the interaction of its elementary components with the Higgs boson, and another part (binding energy, for example) to some other, non-Higgs type of inertial interaction: "inertial mass" should arise from a single source to retain its identity with "rest mass" and "gravitational weight". The "Higgs field" may be necessary to gauge the energy scale and regulate the specific *rest mass* or quantized bound energy content of the weak force IVBs and the various elementary particle species (quarks and leptons) the IVBs create, but has nothing further to do with their mass as observed in inertial resistance to acceleration (or gravitational "weight"). The quantization of the Higgs and IVBs is necessary to ensure the invariance of the single elementary particles they produce. (See: ["The Higgs Boson and the Weak Force IVBs"](#).) Even though the Higgs may be viewed as a scaling property arising from the metric itself (a "metric" particle), and as establishing through the IVBs the rest masses of particles, this is not the specific attribute of the metric which creates inertial mass as defined by resistance to acceleration. Energy conservation, as well as Einstein's "Equivalence Principle", requires that the "m" in "rest mass" ($E = mcc$), inertial mass (resistance to acceleration: $F = ma$), and gravitational "weight" ("gm" in an equivalent local field), are all identical.

Mass, Energy, Time

Let us take note at this juncture of the relationship between mass, energy, and time, which we find not only in the non-obvious notion that gravitation, which is exactly proportional to and produced by mass (Gm), [creates time and the entropy drive of bound energy](#) (through the annihilation of space and the extraction of a metrically equivalent temporal residue); but also in the famous set of equations relating "frequency" and energy: $E = hv$ (Einstein-Planck); $E = mcc$ (Einstein); $hv = mcc$ (de Broglie) (the time component is implicit in *frequency*). This subtle relationship emerges again in the notion of the increase of a particle's mass with relativistic motion in Einstein's Special Relativity, a puzzling result which is explained through the concept that a particle's inertial mass (resistance to acceleration) is entirely due to the interaction of its gravitational field with the metric field of spacetime.

The "mass" or inertial resistance to acceleration offered by a particle is due to the interaction and interference of the particle's gravitational field with the metric field of spacetime. The forced interaction between these two metric fields, one asymmetric and the other symmetric, also produces the anomalous results of relativistic motion in the spatial, temporal, and mass parameters of the moving or accelerated system, as discovered by Einstein (slowing of clocks, shrinking of meter sticks, increasing particle mass). Because (in this view) the inertial mass of the system is from the outset attributed to the interaction of its gravitational field with the metric field of spacetime, the relativistic increase of mass with accelerated motion is seen as a natural outcome of the interaction, interference, and especially the feedback between the temporal (or "frequency") components of these two metric fields, and the connection (mentioned above) between frequency, time, energy, and mass (including the covariance of space with time). Recall that although the gravitational field of a particle may seem to be weak, it extends throughout the Universe.

Lorentz Invariance

A particle's inertial resistance to acceleration might also be explained as the energy required to distort a particle's metric parameters in the service of "Lorentz Invariance" - maintaining the invariance of velocity c , Einstein's "Interval", causality, charge, etc. (the slowing of clocks and the shrinking of meter sticks in Einstein's Special Relativity theory, due to the relative motion of massive objects). However, this perfectly plausible explanation (in terms of ultimate principles) cannot be distinguished from the gravitational argument (above), and lacks the latter's proximate mechanism - in which the graviton or the temporal component of spacetime acts as a ["local gauge symmetry current"](#) protecting "velocity c ".

The equivalence of gravitational and inertial mass ("weight" vs resistance to acceleration - leading to Einstein's "Equivalence Principle") is due not only to the reciprocal character of the spacetime accelerations

of gravity vs (for example) rocket engines (spacetime accelerating through us vs we accelerating through spacetime), but to the interaction in both cases of a particle's gravitational field with the metric component of (identically but reciprocally) accelerating spacetime (the spacetime metric accelerating through our gravitational field vs our gravitational field accelerating through the spacetime metric). Likewise, the vanishing of "g" forces in orbit or free-fall is the vanishing of the forced interaction between these two metric fields. Time is the common feature of gravity, acceleration, and even mass (as we saw above, through "frequency": $h\nu = mc^2$). In contrast to immobile, massive matter, note in this connection that light, whose "inertial" state is "intrinsic" motion in space with "velocity c", has neither mass, a time dimension, nor a gravitational field, and consequently and significantly, *has no inertial resistance to acceleration*. (See: "[Does Light Produce a Gravitational Field?](#)")

Postscript

The Higgs Boson and the Higgs Particle Metric

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We must use analogy to gain some level of understanding concerning the unfamiliar concepts of the Higgs field and the Higgs boson (the latter is the quantum unit of the field). We are familiar with the spacetime metric and the photon. The spacetime metric is the low-energy analog of the Higgs field and the photon is the analog of the Higgs boson. The spacetime (or electromagnetic) metric regulates the common features of our dimensionality - the symmetric relations between the dimensions as well as the various particles it contains, as manifest through the very limited varieties of virtual and real particles spacetime will produce and maintain (the leptonic and hadronic families of elementary particles). The electromagnetic metric is "gauged" or regulated by "velocity c", the electromagnetic constant, which determines the "velocity" of light (actually "c" is the gauge of the entropy drive of free electromagnetic energy, as well as the gauge of light's non-local metric and distributional symmetry: in its own reference frame, light is everywhere simultaneously). The gauge constant c also determines the magnitude of electric charge, the inertial properties of spacetime, the invariance of causality and Einstein's "Interval", and the energetic equivalence between free and bound forms of electromagnetic energy: $E = mc^2$. We are composed of electromagnetic energy and live within its conservation domain. We must obey the conservation rules laid down by the gauge constant c and the spacetime metric which it establishes, regulates, and maintains. The invariance of velocity c, the implacable march of time, inescapable inertial and gravitational forces; this is how we usually experience the dimensional limitations of this metric, but it is also limited in terms of the paucity of both its dimensionality and its conserved elementary particle spectrum.

A special feature of our spacetime or electromagnetic metric is that it will produce a (limited) spectrum of elementary particles (in particle-antiparticle pairs) when it is supplied with sufficient energy. This phenomenon tells us that electromagnetic energy exists in two forms - free (light) and bound (particles). There is no explanation for this fact anymore than there is an explanation for the existence of light or free energy itself. But the universe of our experience obviously depends upon it - we live in a compound conservation domain of free and bound electromagnetic energy. (The only explanation on offer is that the negative energy of the gravitational field of bound energy is required to balance the positive energy of the "Big Bang", and so allow the creation of the universe from no net energy. Similarly, the primordial presence of antimatter was required to balance the charges of matter, allowing the creation of the cosmos from a condition of no net charge.) When our familiar spacetime metric is sufficiently compressed or otherwise energized, its particle nature, rather than its wave nature, is expressed. This is the principle which links all the Higgs energy levels with our own. The Higgs metric is a particle metric rather than a dimensional metric, and its symmetries are between particles and forces rather than between dimensions. At the high energy of the force-unification eras, the dimensional conservation constraints of our electromagnetic metric are suppressed

(but they don't completely vanish), and its particle conservation constraints and characteristics come to the fore.

Now imagine our entire electromagnetic metric raised to a (much) higher energy level in which the spacetime metric is replaced by the Higgs (or "particle") metric, the photon is replaced by the Higgs boson, and the gauge (regulatory) role of the electromagnetic constant ("velocity c ") is replaced by the Higgs gauge constant which we will designate as Higgs1 (since there are several higher energy Higgs conservation domains). Such a high energy conservation domain existed in the very early universe, and actually exists today in the extremely ephemeral and limited form of the weak force "Intermediate Vector Bosons" (IVBs), the W_+ , W_- and Z (neutral). A defining feature of this energy level is that it is the energy level at which the electromagnetic and weak forces are unified - the domain of the so-called electroweak force. The union of these forces comprises an energy state of higher symmetry than that of our familiar ground state, the electromagnetic state; we can designate the latter (for convenience) as H_0 . We envision a [cascading series of force-unity symmetric energy states](#) beginning with H_3 at the moment of the "Creation Event", in which all 4 forces were united, including gravity: the TOE or "Theory of Everything" state in which leptoquarks are created and destroyed (the era of leptoquarks and Gamow's "Ylem").

The particles of the initial state (H_3 Leptoquark Era) were designated as "Ylem" by George Gamow, and apparently consisted of a "quark soup" and heavy primordial leptons which the "Y" IVBs of the weak force split into electrically charged leptoquarks, and transformed into electrically neutral leptoquarks. These latter persist as the main constituents of H_2 , the "Hyperon Era", where they decay asymmetrically to produce matter and baryons of the H_1 energy level (Nuclear Era). Mass is created in H_3 by the interaction of gravity with the other forces, including light and the spacetime metric, or (equivalently) gravity and the H_3 Higgs field. An "inflationary" era may have occurred between H_3 and H_2 , causing a huge expansion of the early universe, but this theory remains controversial. (See: "[Inflation](#)".)

As the universe expanded and cooled from the H_3 Leptoquark Era, it stepped down to H_2 , the force-unity symmetry state in which the strong and electroweak forces are unified (the GUT or "Grand Unified Theory" symmetric energy state in which baryons are created and destroyed - the Hyperon Era resulting in the creation of matter). With further expansion and cooling the universe steps down to the H_1 or electroweak force-unity symmetry state (the Nuclear Era under consideration here), in which individual leptons and quarks are created, transformed, and/or destroyed. The final stable ground state of the universe is that of our daily experience, H_0 or the electromagnetic ground state (Chemical Era) in which only information states (electron shell chemical combinations including living systems) are created and destroyed. (All nuclear reactions/transformations belong to the H_1 energy level or above.)

The symmetries of these force-unity or Higgs states are manifest in the union of particle identities as well as of forces. In the H_0 ground state, all particle identities are separately conserved; in the H_1 state all leptonic particle identities are joined and all quark identities are joined; in the H_2 state the leptonic identities are merged with the quark identities; and at the H_3 state, boson and fermion identities are unified - all forms of energy, bound or free (including gravity), are united in H_3 . The biological taxonomic scheme in which species identities are progressively subsumed at the genus, family, and order levels of relationship presents a familiar analogy for these hierarchical energy states of increasingly comprehensive symmetry.

Each of these force-unity states must be distinguished by its own Higgs boson or scalar particle, not only to unambiguously distinguish one Higgs state from another, but crucially to maintain the conservation parameters of mass, charge, identity, energy, etc., of the various particles as they fall through the cascade of manifestation to the ground state. Hence the need for quantized scalar particles or distinct Higgs bosons at each level, to ensure conservation and exact replication of the conserved parameters of elementary particles. Elementary particles created today must be the same in every respect as those created eons ago in the "Big Bang" - for obvious reasons of energy, symmetry, and charge conservation. The Higgs, IVBs, and the whole

quantum-mechanical mechanism of the weak force is dedicated to this complex but necessary task.

The Earth is the domain of chemical transformations, information, biological life forms, and the H0 ground state, but the Sun is (at least partially) a domain of nuclear transformations where the H1 or electroweak state is commonplace (in the interior), as leptons and quarks are created and destroyed and baryons are transformed during the conversion of protons to neutrons and hydrogen to helium. These transformations are accomplished by the weak force IVBs, representatives of the H1 symmetry state, in which all leptonic identities are equivalent and all quark identities are equivalent (H1 is the "generic" state for both leptonic and quark "species"), and hence transformations (or "swapping") of specific identities within the leptonic "genus" or within the quark "genus" are simply the normal course of events.

At the high temperatures of H1, all particles are moving so fast they are essentially the same as photons moving at velocity c . At the H1 energy level, there are no large, empty dimensions: instead, the metric is densely occupied with particles (quarks and leptons); photons cannot move freely under these conditions in any case. Symmetry is expressed through a "particle metric" rather than a dimensional metric. Symmetry-breaking occurs as these particles are released into the large spacetime dimensions of H0, where their differential "rest mass" shows up as inertial and gravitational mass differences. The Higgs boson does indeed replace the photon in H1.

The necessity for the Higgs mechanism is due entirely to the necessity for mass as carried by *single* particles of matter (not particle-antiparticle pairs). Mass is necessary because of its gravitational field, which provides negative energy to balance the positive energy of the Creation Event, allowing the universe to be born as a quantum fluctuation of no net energy. Hence mass is required for the universe to exist - it is not an accidental, incidental, or trivial component of the cosmos. (Nor are sentient beings like ourselves: we are required so that the universe may know itself and explore its creative potential.)

Summary

The spacetime metric is the common thread that links the 4 levels of the "Higgs Cascade". The metric is compressed more and more severely at each higher level of the cascade (at each earlier era of expansion) and the Higgs bosons (H1, H2, H3) gauge or identify each stage of compression. Each stage represents a merging of forces and particle identities, and at each stage a specific type of particle can be produced: at H1 leptons, mesons, and neutrinos (alternative charge carriers) can be created, transformed, and destroyed (and baryons can be transformed but not created); at H2 baryons can be created and destroyed (and matter is asymmetrically created without antimatter); at H3 leptoquarks are created and destroyed (and mass - bound electromagnetic energy - is created). The quantization of these various stages by the several Higgs bosons ensures that the elementary particles created in them will be the same whenever and wherever they are produced and reproduced - an obvious requirement for energy, symmetry, and charge conservation.

The Higgs bosons regulate, gauge, or identify the higher symmetric energy states of the particles and forces in the same sense as the electromagnetic constant c regulates the symmetric aspects of our more familiar (and much expanded) spacetime metric. The spacetime metric can and will produce (and annihilate) elementary particles in symmetric particle-antiparticle pairs, either as virtual particles or as real particles whenever sufficient energy is available. It is a conservation function of the metric and the electromagnetic constant c to ensure the invariance of such particle pairs as well as their immediate or eventual annihilation. However, if single elementary particles are to be produced, without a corresponding annihilation partner, then the elaborate weak force mechanism must be engaged to recreate the original environmental conditions (heat, energy, density, etc.) in which these particles were first created to ensure their absolute invariance throughout space and time.

Mass or bound electromagnetic energy is created in H3 by the complete merger of gravity with the spacetime

metric, free energy, and the other forces. The result is Gamow's "Ylem", the primordial substance, consisting of heavy leptons and a "quark soup" in which the quarks are the mass carriers. Heavy primordial leptons are split into electrically charged triplets by the "Y" IVBs and transformed into electrically neutral leptoquarks; neutral leptoquarks may live long enough to persist into the H2 era of expansion where their asymmetric decay (via the "X" IVBs) produces the Hyperon Era and the matter content of our universe. Hyperons (heavy baryons) decay via the "W" IVBs of the H1 level (Nuclear Era) to produce the protons and neutrons of the H0 ground state (Chemical Era), along with their alternative charge carriers, the leptons, neutrinos, and mesons, which serve to balance charges in the absence of antimatter. The electric charge of the IVBs is determined by the electromagnetic constant "c" and the spacetime metric, however compressed. In turn, the IVBs determine the commensurate charges of the hadrons and leptons. This is an electromagnetic universe, at any energy level.

We can think of the IVBs as the particles of the Higgs metric. The IVBs are simply compressed, quantized examples of the early dense spacetime metric as it existed (in the case of the "W" IVB family) during the electroweak era of the "Big Bang", the time in the early universe when the electromagnetic and weak forces were unified. The compressed metric of the IVBs contains all the usual suspects of our ordinary spacetime metric - that is, the complete spectrum of elementary particles, both lepton and quark, that can be produced as virtual particles in our own universe, the H0 ground state. The big difference between a metric gauged by c (the ground state) and a metric gauged by the H1 Higgs boson (the electroweak state) seems to be that the IVB's virtual particles are so close together in the compressed metric that they can freely exchange identities without threatening or violating any conservation laws - which they cannot do in the expanded metric of the ground state.

Given the presence of a pre-existing "parent particle" ripe for a transformation (note that this is a pre-existing condition of asymmetry, due to the universal absence of antimatter) the IVBs will use their store of (access to) virtual particles to effect any transformation which is energetically possible and obeys the conservation laws regarding charge, spin, mass, momentum, etc. (See: [The "W" IVB and the Weak Force Mechanism](#).) We can think of the "W" IVBs as the form of a "genus" or Higgs metric lepton or quark composite particle. Similarly, the "Z" neutral IVB would represent the generic or Higgs metric form of a composite neutrino particle. In any case, we see that the weak force asymmetry may often (not always) be imposed from the pre-existing environmental conditions (such as a single pre-existing matter particle), while the weak force IVB acts from a symmetric reservoir (the Heisenberg-Dirac "zoo" of virtual particle-antiparticle pairs abundantly available from the spacetime "vacuum"). The original asymmetric production of matter baryons is, of course, traceable to the [asymmetric weak force decay of electrically neutral leptoquarks](#) in the H2 or GUT Leptoquark Era.

The Higgs Cascade (including "rebound" stages)

(See also: [The Higgs Boson and the Evolutionary Eras of the Cosmos](#))

H3: TOE - Theory of Everything - all forces unified. *Leptoquark Era*. Gamow's "Ylem", "quark soup", electrically charged and neutral leptoquarks (electromagnetic primordial substance). Neutral leptoquarks may live long enough to decay in H2 era (below). Particle or Higgs metric gauged by H3 Higgs scalar boson. "Y" IVBs create and destroy leptoquarks, splitting primordial heavy leptons into three subunits (quarks). "Y" IVBs transform charged leptoquarks into neutral leptoquarks. Creation of mass by the union of gravity with the spacetime metric and the other forces. The electromagnetic constant "c" gauges electric charge and the mass equivalency between bound and free electromagnetic energy forms ($E = mc^2$). Union of all particles (fermions and bosons) into the "order" of electromagnetic energy. "Big Bang", "Creation Event", "Big Crunch". Separation from Multiverse with "life-friendly" physical constants. (?Inflation?)

H2: GUT - Grand Unified Theory - strong and electroweak forces unified. *Hyperon Era*. Electrically neutral

leptoquarks, leptoquark neutrinos, hyperons (heavy baryons). Particle or Higgs metric gauged by H2 Higgs scalar boson. Electrically neutral leptoquarks decay asymmetrically (via the "X" IVBs) to produce hyperons and leptoquark neutrinos. Creation and destruction of baryons. Union of leptons and hadrons into "family" level particles (= leptoquarks). Separation of matter from antimatter, creation of matter-only universe. Black Holes, "proton decay".

H1: EW - Electroweak Theory - electromagnetic and weak forces unified. *Nuclear Era*. Alternative charge carriers (leptons, mesons, neutrinos). Particle or Higgs metric gauged by H1 Higgs scalar boson. Hyperons and baryons decay (via the "W" IVBs), producing leptons, mesons, and neutrinos; baryons are transformed but not created. Creation and destruction of leptons, mesons, and neutrinos. Union of lepton and quark species into separate "genera". Stars: element building.

H0: EM - Electromagnetic Force - electric and magnetic forces unified (ground state atomic matter). *Chemical Era*. Chemical and biological information. History; negentropic information states. H0 = spacetime metric gauged by "c", the electromagnetic constant. Expansion and cooling of large dimensions and the spacetime metric. Massless photons travel freely. Creation of cold atomic matter from baryons and leptons; creation and destruction of chemical information. Beginning of gravitational "rebound" and return to original symmetric energy state of electromagnetic energy (light) - via stars, black holes, "Big Crunch". All particles and forces are individually distinct. No nuclear transformations in H0 ground state. Planets, life.

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