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The Formation of Matter and the Origin of Information

John A. Gowan October 1999
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During the first moments of the Creation Event (the "Big Bang"), all the matter of our Universe was produced by an asymmetric reaction between the quarks and color charges of the strong force, and the Intermediate Vector Bosons (IVBs) and leptons of the weak force. The reaction involves the asymmetric decay of a matter-antimatter pair of leptoquarks, which are neutral with respect to both electric and color charge. This asymmetric decay is "mediated" or catalyzed by the weak force IVBs "X" and "W", and can be represented compactly by the reaction equation below:

X(Lq x *Lq*)**W** ----- baryon + *vLq* + (energy)

where Lq indicates the leptoquark and *vLq* the leptoquark antineutrino.

We can also write this reaction in a more complete form as:

X(aB x *aB*) (B x *B*)**W** ----- AB + *B* + (energy)

1) where the left-side reactants are:

-) "a" represents the quarks of a leptoquark, compressed so tightly (by the "X" IVB) that their color charge has vanished;
-) "B" represents the "identity" or "number" charge of the leptoquark (baryon "number" charge);
-) "(aB x *aB*)" represents an electrically neutral leptoquark-antileptoquark pair (italics designate the antiparticles; particle-antiparticle pairs are shown in brackets with an x between them to indicate their linkage);
-) "(B x *B*)" represents a leptoquark neutrino-antineutrino pair (neutrinos are the pure, "bare", or explicit form of identity or number charge).

2) the reaction is mediated by:

-) an Intermediate Vector Boson of the weak force, "W", which catalyzes the reaction by forming the complex (aB x *aB*)(B x *B*), in which the members of the complex are brought into such close spatial proximity by the W that they can exchange, neutralize, or otherwise cancel each other's charges. In this case the B identity charge of the neutrino-antineutrino particle pair annihilates the *B* anti-identity charge of *aB*.
-) another IVB, or heavy metric particle, the "X", whose role is to compress a triplet of quarks so forcefully that their color charges self-annihilate, producing the colorless leptoquark configuration which alone is susceptible to decay via the W.

3) the right-side products of this reaction are:

-) "AB", the unreacted leptoquark carried over from the left side (originally "aB"), whose quarks have expanded under their mutually repulsive forces to reveal their color charge. The uppercase "A" is intended to indicate that the compressed quarks of the lowercase "a" have expanded to reveal their full and conserved color charge. This particle is now a normal, electrically neutral, heavy baryon (essentially a neutron, but containing heavy quark species ("flavors")); it will eventually decay to the ground state proton.
-) "*B*", an antileptoquark neutrino, liberated from the W complex when its particle-pair partner (B) annihilated with the *B* identity charge of the antileptoquark *aB*. Its presence balances the number charge of the newly formed matter baryon;
-) free "(energy)", which will be in the form of some matter-antimatter particle pair which will annihilate each other. This is all that remains of the *a* portion of the antileptoquark *aB*, which being electrically neutral, and with its color charge vanished due to the compression of its quarks by the X, will simply convert its neutralized mass-energy to a particle-antiparticle pair and self-annihilate, when its number charge is cancelled by the leptoquark neutrino "B".

Discussion

The reaction begins with a symmetric matter-antimatter pair of leptoquarks and a symmetric matter-antimatter pair of leptoquark neutrinos. The source of both is the virtual particle "sea", the unlimited reservoir of symmetric, virtual, particle-antiparticle pairs of all kinds created by the interaction of light with the metric of spacetime. From this symmetric mixture we nevertheless produce, via the mediation of the X and W, an asymmetric product - an unpaired matter baryon (which will decay to a proton), and an unpaired antileptoquark neutrino, which remains unchanged to balance the identity or number charge of the matter baryon and its eventual decay product, the proton. The asymmetric character of the weak force is expressed in the decay of just one member of the leptoquark-antileptoquark pair, rather than both. What we actually expect is that this reaction occurs slightly more often than its antimatter counterpart, producing a surplus of matter bayons.

The electrical neutrality of the leptoquark pair is crucial to the success of the reaction, as an electrically charged pair (aB+ x *aB* -) would simply annihilate each other. This electrical neutrality is the reason why this reaction requires a composite particle whose constituent quarks can sum to zero electric charge.

Color Charge

Just as crucial to the success of this reaction as its electrical neutrality is the symmetry of the conserved color charge. Because the gluons which carry the color charge are composed of color-anticolor charge pairs in all possible combinations, the gluon field as a whole sums to zero color. The color field will sum to zero physically if the quarks are sufficiently compresed, yet return to full color charge when the compressive forces are relaxed and the quarks expand under the influence of their mutually repulsive forces (both electric and quantum mechanical). This flexibility allows the antileptoquark to vanish completely, via the weak force W (essentially, the process of proton decay), when its quarks are compressed and the color charge is only implicit, but prevents such total decays when the quarks separate and the color charge becomes explicit. It is the role of the X to effect the compression of the quarks, vanishing the color charge (the effect is recognized as the principle of "asymptotic freedom" (Gross and Wilczek 1973)).

Hence the antileptoquark can vanish in the energy-dense environment of the Big Bang, but the quarks of

the leptoquark, its particle-pair partner which does not decay, simply expand under their mutually repulsive forces to reveal their conserved color charge. By simply expanding its quarks, the unreacted leptoquark is transformed into a heavy, neutral baryon which can only decay partially (to the ground state proton), but cannot vanish completely, as its color charge can neither be neutralized nor transferred to any alternative carrier. To achieve this, the leptoquark must only survive long enough that the ambient compressive forces of the Big Bang become insufficient to prevent the expansion of its quarks, a very short time indeed in the rapidly expanding and cooling early Universe.

The asymmetry in the weak force is very small. In most cases, the leptoquarks will be electrically charged and simply annihilate each other; of those which are neutral, most will annihilate each other despite their electrical neutrality, or both will decay simultaneously via the W+ and W-. A few will decay asymmetrically via the W-, but a few more will decay asymmetrically via the W+. It is this latter imbalance (for which there is no explanation) that produces all the matter of the present Universe. Matter and antimatter (or the W+ and W-) are evidently not perfectly symmetrical opposites. There is some unknown, subtile difference between them which creates the material Cosmos (Cronin 1981).

Neutrinos

The crucial role of the neutrino in this process must also be emphasized. The neutrino is the alternative charge carrier for the "identity" charge, a symmetry debt of light which accrues from the "anonymity" of light. All photons (quanta of light) are alike - they have no individual identity, one cannot be distinguished from another - hence their symmetry of anonymity. The elementary particle spectrum, however - the leptonic series of electron, muon, tau, and leptoquark - are distinguishable one from another: they are not alike, they occupy different "rungs" on the quantum "ladder" of massive elementary particles, and their antiparticles are distinguishable from them by their opposite spin. Hence the symmetry (or information) debt of "identity" is in contrast to the photon "sea" of anonymity and is carried by elementary particles, where it is usually referred to as the conserved "number" charge of the leptons and baryons (all baryons carry one and the same number or identity charge, that of their leptonic ancestor, the leptoquark).

In the massive leptons, including the leptoquark, this identity charge is said to be "hidden", or in its "implicit" form. The neutrino is the "explicit" or "bare" form of identity charge. As such, the neutrino functions as an alternative carrier of identity charge, which otherwise could only be carried by the particle itself, or neutralized by its antiparticle. It is because this charge is specifically "identity" that it alone, among all other charges, must have its own unique carrier. In contrast, the universal electric charge can be carried by, or transferred to, any other lepton, baryon, or meson, and color charge can be carried by any baryon. But identity, being specific to each rung of the elementary particle quantum ladder, requires a carrier specific to that rung, either the particle itself or its specific neutrino. (Note that the identity charge carried by the electron, muon, tau, and baryon, while different from each other, are exactly the same within each particle type; hence it is quite possible for one electron to swap identities with another electron, as in reactions mediated by the Z, but identities cannot be exchanged between different types of elementary particles - an electron cannot swap identities with a muon, for example. When a muon decays to an electron, the identities of both particles are conserved or neutralized by their separate neutrinos, a reaction requiring the mediation of the W).

Without the neutrino, there would be no material Universe, as there would be no alternative carrier for identity charge - only particles and antiparticles could carry this charge and the system would be "stuck" with particle-antiparticle pairs which could only annihilate each other. Manifestation requires

information which is in its essential character asymmetric - otherwise it is not information. In the particle realm, the fundamental bit of information is "identity". Particles can manifest only because their identity can be carried by neutrinos, which provide a conserved alternative to antiparticle carriers. These alternative carriers maintain the essential features of the original symmetry by balancing or neutralizing the identity charge of the manifest particle such that overall identity still sums to zero, as it did in the particle-antiparticle pair; identity is simply carried in two different forms, one hidden or implicit in the particle, one bare or explicit in the neutrino.

The IVBs

Because all particles are derived from the interaction of light with space, the virtual particle "sea" will contain any asymmetry embedded in light, space, or their interaction. The only asymmetry we know of in either light or space is the potential time asymmetry; in light the element of time is expressed as "frequency". In virtual particles this potential asymmetry is expressed as information in the form of various charges, which we characterize as the conserved symmetry debts of light. It is likely that the W particle is metric in origin, a "string-like" particle (as in the theory of "strings"), which is composed of a compressed, convoluted, and intertwined dimensional matrix requiring a huge binding energy to maintain its form - the source of the W's enormous mass-energy. This compressed and convoluted metric, derived from the dense metric of the early Universe, is the mechanism which enables the W to bring particles into such close spatial proximity that they can exchange charges, swap identities, or create new ones. Being derived from the metric, the asymmetric principle (if any) embedded in the W must again be time.

The X is likewise a heavy metric particle, an IVB like the W, but much more massive. Both particles have the similar role of bringing ordinary particles very close together within their spatially reduced metrics. The X compresses quark triplets, the W incorporates baryons, mesons, or leptons which need alternative charge carriers into complexes with leptonic particle-antiparticle pairs that can provide carrier leptons. Similarly, the Z brings particles so close together that if they are compatible, they can swap identities. In the special case of proton or leptoquark decay, both the X and the W must act together.

General Principles

The general principle at work in this reaction, which is significant for the origin of matter, information, and the systems they produce, is the interaction of two fields, one symmetric (the color charge of the strong force and quarks) and one asymmetric (the weak force IVBs and the leptonic field of alternative charge carriers). The action of the asymmetric field reveals the information content of the symmetric field. We see the same principle at work in the dimensional conservation domains of light and matter, the intersection of symmetric space by asymmetric time, an intersection which produces gravitation, revealing a specific "location" in the symmetric field of space. "Location" is the fundamental information "bit" in the dimensional realm (as identified by the character of gravity), just as "identity" is the fundamental information bit in the particle realm (as identified by the character of neutrinos). The information bit "location" is the anchor point of Einstein's "Interval". The asymmetric potential is embedded in the symmetric field from the beginning, as is time in space, the information content of the virtual particle "sea" in spacetime, and the identity charge in particles. (See also: "The Weak Force: Identity or Number Charge").

Appendix

The Particle Spectrum and Weak Force Intermediate Vector Bosons

Quarks	Designations:	**Leptons**	Designations:
X	IVB	W-, W+, Z	IVBs
Lq	Leptoquark	Lq, vLq	Leptoquark, Lq Neutrino
t, b	Top, Bottom	t-, vt	Tau, Tau Neutrino
c, s	Charm, Strange	u-, vu	Muon, Muon Neutrino
u, d	Up, Down	e-, ve	Electron, Electron Neutrino
Composite Particles	Baryons, Mesons	Elementary Particles	Electrons, Neutrinos
Primary Charge Carriers	Hadrons	Alternative Charge Carriers	Leptons
Primary Field, Symmetric	Color	**Secondary Field, Asymmetric**	Identity

The W+, W-, and Z are the "Intermediate Vector Bosons" (IVB's) of the weak force; they mediate the creation and destruction of unpaired leptons and neutrinos, and transformations of identity between them. The X is a 4th and hypothetical IVB, or heavy metric particle, which compresses the quarks of baryons so tightly that their color charge vanishes, creating the leptoquark configuration which is susceptible to decay via the W.

The leptonic series consists of the electron (e), muon (u), tau (t), leptoquark (Lq), and their corresponding neutrinos (v). The electron, muon and tau are identical except for their masses (tau is the heaviest) and their identity charges (the neutrinos). The Leptoquark (which is hypothetical) is the even heavier ancestor of the quarks and leptons; it is indicated at the head of both the leptonic and quark series, for although a lepton when compressed, when expanded it produces the quarks; when it decays, the leptoquark "cascades" to the ground state proton, electron, and electron neutrino, producing all the particles of matter along the way.

The quarks are named up, down (u, d), charm, strange (c, s), and top, bottom (t, b). The u, c, t series carries a fractional electric charge of +2/3; the d, s, b series carries a fractional electric charge of -1/3. Quarks also carry the strong force "color" charge (red, green, blue). Baryons consist of three quarks, mesons of a quark-antiquark pair. Hadrons are the class of particles containing quarks, that is, the baryons and mesons. Baryons as a class all carry one and the same identity charge, whose explicit form is the leptoquark neutrino.

The leptons and leptoquark are the only known massive elementary particles. The neutrinos are the massless, "bare" or explicit form of the identity charges of their corresponding leptons. The quarks occur only as triplets confined to baryons or as quark-antiquark pairs in mesons. Quarks and leptons are produced by the decay of the leptoquark.

Ordinary matter consists of the electron, electron neutrino, and u, d quark energy level only. The quark complement of a proton is (uud)+; that of a neutron is (udd). A corresponding set of antiparticles also exists, but is not shown.

Examples of Weak Force Decays: Leptons

t-(*u*+ x u-)W- _____ vt + *vu* + u-
A tau decays (via a muon-antimuon particle pair complex formed by the W-) to a tau neutrino , a muon antineutrino, and a muon (antiparticles shown in italics).

u-(*e*+ x e-)W- _____ vu + *ve* + e-
A muon decays (via an electron-positron particle pair complex formed by the W-) to a muon neutrino, a positron neutrino, and an electron.

(e- + v e)Z _____ v e + e-
An electron and electron neutrino interact (via a complex formed by the Z) and swap identities.

Examples of Weak Force Decays: Baryons and Mesons

(neutron)(*e*+ x e-)W- _____ (proton)+ + *ve* + e-
A neutron (udd) decays (via an electron-positron particle pair complex formed by the W-) to a proton (uud)+, a positron neutrino, and an electron.

(proton)+(e- x *e*+)*W*+ _____ (neutron) + ve + *e*+
A proton (uud)+ decays (via a W+ complex involving an electron-antielectron particle pair) to a neutron (udd), an electron neutrino, and a positron. This reaction requires an energy input.

(u*d*)-(*e*+ x e-)W- _____ (energy) + *ve* + e-
A negative pion (ud)- decays (via an electron-positron particle pair complex formed by the W-) to a particle-antiparticle pair (energy), a positron neutrino, and an electron.

Hypothetical Weak Force Proton and Leptoquark Decays

1) proton decay uud+ (hypothetical) mediated by both X and W
principal decay products (similar to tau+ decay products):

a) hadron+, neutrals including leptoquark neutrino:

X[uud+(Ud- x uD+)]W --- vlq + uD+

b) 3 hadrons+-, neutrals including leptoquark neutrino:

X[uud+(Ud- x uD+)(Ud- x uD+)]W --- vlq + uD+ + (Ud- + uD+)

2) leptoquark decay lq (+, -, neutral) (hypothetical - during Big Bang or Creation Event only; asymmetries in this decay are the source of the material Universe)
Principle decay products (from the asymmetric decay of an electrically neutral leptoquark-antileptoquark pair):

a) heavy neutral baryon, leptoquark neutrino, heavy neutral mesons similar to:

X[LQ x lq(Tt x Tt)]W --- vLQ + bbt + (Tt + Tt)

b) same, more mesons, charged and neutral

(In a leptoquark, the quarks are compressed by the X to leptonic size, vanishing the color charge. An electrically neutral leptoquark should decay like a very heavy neutral lepton, via the W). The quarks in the unreacted leptoquark expand to form the baryon.

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