An Alternative Hypothesis of the Quark Basis of ‘Ordinary’ Luminous Fermionic Matter

“If I’m trying to talk about how a car works, I have to stop talking about the whole car at a certain point and instead, start talking about its components and how they work together.” – D. Weisberg [1]

The atomic theory challenged the antiquated notion that if one were to continue to divide an amount of homogeneous substance into two or more portions, each portion would be comprised of exactly the same substance. It denies presumptions that this common-sense notion can be true ad infinitum. It avers that such a division process would ultimately be halted at a step in which single molecules would be obtained. Further division would obtain individual atoms of one or more of the 92 naturally occurring elements. Continuing this process would reveal that these atoms are comprised of nuclei and electrons. Further division of nuclei has revealed the existence of protons and neutrons. And these, it turns out, can be broken down further into ‘up quarks’ and ‘down quarks’; these have not been directly observed but are strongly inferred. The electron, on the other hand is assumed to be indivisible, but that will be questioned. There is an implied order of viable transitions between stable states of composites of matter that makes sense as a consistent explanation of all that exists. A hierarchical taxonomy of these units of matter is what is envisioned.

the ‘non-exotic’ portion of the ‘standard model’ of particle physics

What is called the ‘standard model’ is conflated to encompass a theory of fundamental particles of matter as well as cosmological origins and effects. The standard model of particle physics concerns itself with three of the forces of nature: the electromagnetic force, what is called the ‘weak force’, and what is referred to as the ‘strong force’ involved in nuclear interactions. As an integral aspect of the theory concerning these forces, the classification of sub-nuclear particles includes participants and enforcers. In figure 1 we illustrate the participant portion of this classification that we will be dealing with in understanding what we refer to as ‘ordinary’ matter.

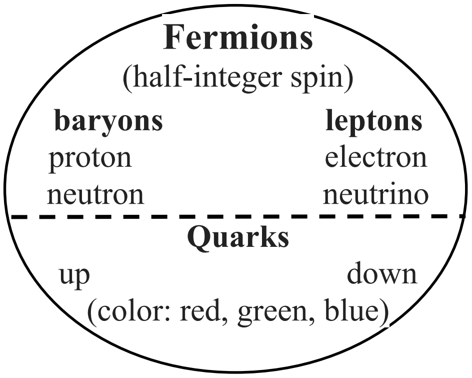

Figure 1: Partial classification of fundamental particle participants

Each nucleon of the elements in the periodic table is comprised of three (whether ‘up’ or ‘down’) quarks, each a different color, beneath their baryon identity as ‘proton’ or ‘neutron’ that together comprise the nuclei of each element in that table. There are other acknowledged particles and quarks to be sure, but these are the ones involved in the makeup of the periodic table. Quarks

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[1] The quotation was cited in the Science Blog, Brain & Behavior, Aug. 13, 2016. https://scienceblog.com/487101/people-prefer-explanations-refer-fundamental-science/

include an additional entries in the quark menagerie denominated 'charm', 'strange', 'bottom', and 'top', but they are constituents of more exotic particles of matter about which we will not concern ourselves here. Although opposite charge and mass might seem to be sufficient in and of themselves, the quarks are traditionally envisioned as being held together in baryons by what are called 'gluons'. The electron is another basic constituent of the mundane variety of matter we will address separately. It is conventionally excluded from having a lower-level breakdown into quarks. We will not subscribe to that exclusion for reasons that will be explained.

Gluons play a role as enforcers, a role envisioned as similar to that played by photons in binding nuclei and electrons. We will exclude gluons from the pantheon for reasons to be explained later. These subatomic particles possess discrete units of charge and spin. We will largely ignore spin other than to restrict ourselves to viable compositions in this regard. All particles also possess a rest mass which, unlike charge, is not meted out in discrete chunks. Elsewhere on this site we have addressed the determination of associated quantities of mass as self-energies for indivisible charged particles. Of course, to the extent that we refer to neutrinos, we need primarily to be aware that their mass has been indeterminate to date and that they are catalysts of the weak force.

The up quark possesses $+ \frac{2}{3}$ of a positive electronic unit of charge e, the down quark possessing $- \frac{1}{3}$ of a negative electronic charge unit. The proton with a positive $+ e$ amount of electric charge is made up of two up quarks and one down quark – the math works. Electrons possess one complete unit, $- e$ of negative electric charge. The neutron has no net electric charge but like the proton, it is made up of a neutral combination of up and down quarks which do have charge. In this case the constituent up and down quarks are in a one-to-two ratio that neutralizes net charge. These decompositions of subatomic particles are shown in figure 2. The gluons are a part of the conventionally conceived structures and are assigned the role of forcing confinement of the quarks.

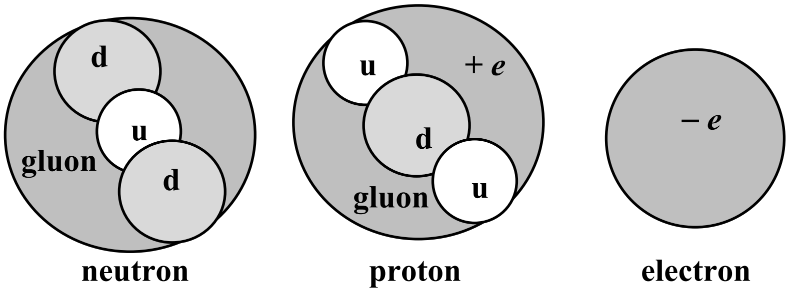

Figure 2: Conventional decomposition of atomic matter

A universe comprised of charged particles of the same sign would quickly be transformed into a situation of lowest possible density as charges remove themselves as far away from others as possible. That situation would correspond to the lowest energy state. The lowest energy state of equal numbers of equally charged positive and negative particles on the other hand would be such that each volume of space would possess an equal amount of positive and negative charge. At high enough temperatures this would constitute a plasma of charges with those of like sign avoiding each other to the extent possible. This would require a sufficiently high temperature to preclude unlike charges collapsing into each other in nucleosynthesis. There will always be a tendency for charges of opposite sign to combine to form neutral (or at least *more* neutral) units which would reduce energy density. This will always be countered in high temperature plasma by the possibilities of collisions or thermonuclear interactions with high energy radiation producing the disassociation of the combinations.

conceptual phases and associated states of matter

In all version of the Standard Cosmological Model there is thought to be an early transitional phase during which the universe consisted of hydrogenous plasma in a temperature range at or above 10^9 K. The nucleosynthesis of the elements envisioned by advocates begins at an advanced stage of synthesis of particles – well beyond a phase of construction neutrons and protons, etc. from up and down quarks. Constituents of envisioned hydrogenous plasma in this early phase are conceived as primarily free electrons, protons, and neutrons with increasing percentages of protons and neutrons secured within the nuclei of helium-4 as temperatures are conceived to have dropped.

In figure 3 we illustrate the nature of such a high-temperature plasma showing the percentages of protons p and free neutrons n as well as deuterium d, tritium t, helium3, and helium4 that appear at lower temperatures in this range. Thermonuclear reactions are the driving forces that determine the composition at each specified temperature. Eventually, of course, with conceived continuous reduction in temperature, it is envisioned that light elements would have been produced by exoergic thermonuclear reactions, with the heavier elements produced by later developments once stars and galaxies had formed.

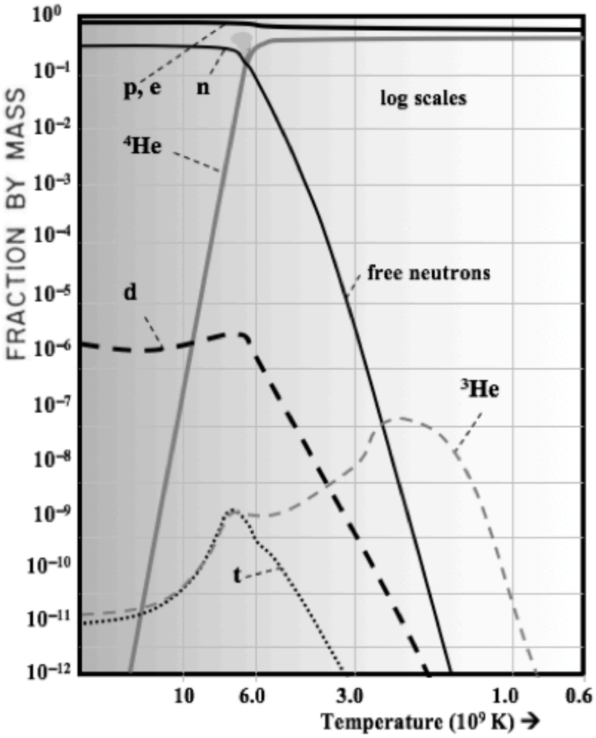

Figure 3Fundamental particle abundances realized as a function of temperature in a large high temperature exploding object whether a big bang, a gamma ray burst, or a black hole

It is noteworthy that such charts are accepted as integral to the general dogma surrounding the notion of an expanding universe. But such charts actually apply to any exploding 'large object' in the specified temperature range, not necessarily the universe per se. Although used in the context of the standard model of cosmology, the chart was generated using assumptions of equilibrium at each temperature value with no presumptions of 'evolutionary' developments. Therefore, it reflects what the situation would be for hydrogenous plasma at any one static temperature at any time and place in the supposed 'history' of the universe. The percentages are explicit functions of temperature, not time, i.e., if the universe were in a stationary state at a temperature of 10^{10} K, the percentage of helium-4 would be between 10^{-6} and 10^{-7} instead of the 23% by mass that it is today.

In thermal equilibrium the percentages of each significant baryon product will be determined in accordance with the temperature-dependent Maxwell-Boltzmann distribution. Therefore, in a thermonuclear reaction equation identified by subscript i, the ratio of numbers of baryon products, on the left-hand side N_{iL} and right-hand side N_{iR}, will be given by the following equation:

$$N_{iL} / N_{iR} = e^{-Q_{iLR} / kT}$$

In this equation Q_{iLR} is defined as:

$$Q_{iLR} \equiv (m_{iL} - m_{iR})\, c^2$$

where m_{iL} and m_{iR} are left and right-hand nucleon masses respectively. Here are some masses that are known with accuracy that we use in our analyses:

	rest mass	**energy**	**plasma temperature**
electron, m_e	$9.10938356 \times 10^{-28}$ g	0.510999 MeV	5.93269839×10^{9} K
proton, m_p	$1.67261637 \times 10^{-24}$ g	938.2723 MeV	$1.08933414 \times 10^{13}$ K
neutron, m_n	$1.67492729 \times 10^{-24}$ g	939.5656 MeV	$1.09083566 \times 10^{13}$ K

Conversions between units of measure in this table are the following: 1 MeV = 10^6 eV; 1 eV = 1.602×10^{-12} erg = 1.161×10^4 K.

inferences of quark masses (conventional view)

If we were to assume that the binding energy that holds the quarks together was negligible, we would obtain the following equation for the mass of the proton according to the conventional view:

$$m_p = 1.67261637 \times 10^{-24} \text{ g} = 2\, m_u + m_d$$

For the neutron we would obtain:

$$m_n = 1.67492729 \times 10^{-24} \text{ g} = 2\, m_d + m_u$$

Solving these two equations that ignore the mass of the gluon for the two unknown quark masses, we would then obtain similar mass values for both the up and the down quark:

$$m_u = 5.568 \times 10^{-25} \text{ g} = 318.59 \text{ MeV}$$

$$m_d = 5.591 \times 10^{-25} \text{ g} = 319.91 \text{ MeV}$$

However, binding energy for both the neutron and proton has been attributed to the ‘gluon’ by the standard model, which possesses a mass that is far from negligible. In fact, it is assigned the bulk of the total mass of these baryons. So, to say that the proton and neutron are comprised of up and down quarks is extremely misleading when expressed by advocates of the conventional view. The gluon is assigned by far the largest majority – 99% – of the total energy of a neutron. Masses of the up and the down quark in that scheme are only m_u = 2.243 MeV and m_d = 4.830 MeV, respectively. Researchers have recently used simulations of the effects of myriad quarks of all types to narrow down the estimates which had previously been thought to have been accurate to within about 30%. They believe that they can, "...finally nail down the masses of the lightest quarks, as researchers reported recently in *Physical Review Letters*. The team finds that an up quark weighs 2.01 ± 0.14 megaelectron-volts, whereas a down quark weighs 4.79 ± 0.16 MeV. That is 0.214% and 0.510% of the mass of the proton, respectively."[2] So the newly accepted values are:

$m_u = 3.583 \text{ x } 10^{-27} \text{ g} = 2.01 \pm 0.14 \text{ MeV}$

$m_d = 8.539 \text{ x } 10^{-27} \text{ g} = 4.79 \pm 0.16 \text{ MeV}$

$m_g = 1.65784929 \text{ x } 10^{-24} \text{ g} = 930.0 \text{ MeV}$

The conjectured nature of the strong force and the associated gluon have been the major consideration behind these assignments. Extreme force is associated with extreme energy and hence it becomes predominant in the determination of nuclear mass. Predominant among the reasons for this conventional view of decomposition and implied mass assignments has been acceptance of point particles.

the anathema of alchemy

First let us consider the variation of inferred percentages of up and down quarks in transitioning through this early hydrogenous plasma phase shown in figure 4. Quantification of this assessment relies exclusively on the assumed decomposition of the items shown in figure 2. Let p_p represent the percentage of protons, p_n the percentage of neutrons, and p_e the percentage of electrons in this plasma; the percentage of up quarks is p_u and p_d is the percentage of down quarks. The decomposition of figure 2 implies the following simultaneous equations:

$p_e = p_p$

$p_u = 2\ p_p + p_n = p_p\ (2 + p_n / p_p)$

$p_d = p_p + 2\ p_n = p_p\ (1 + 2\ p_n / p_p)$

We can solve these (basically two) equations for the ratio of the two unknown quark percentages as a function of the ratio of neutrons to protons, which changes throughout this transition period:

$p_d / p_u = (1 + 2\ p_n / p_p) / (2 + p_n / p_p)$

In the alternative scheme recommended by the analyses to be performed in this paper, the electron cans also be decomposed into three down quarks, $p_p = p_e = 3\ p_d$, so that:

$p_d = 3\ p_e + p_p + 4\ p_n = 4\ p_p + 4\ p_n$

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[2] Adrian Cho, Science Magazine, Apr. 2, 2010
http://www.sciencemag.org/news/2010/04/mass-common-quark-finally-nailed-down

$p_u = 2\ p_p + 2\ p_n$

Therefore, $p_d / p_u = 2$, *always* for the alternative model. Figure 4 is a plot for both models.

The results for the two alternative models illustrate that the model accepted by establishment allows the percentages of up and down quarks to vary over time with variation in the ratio of neutrons to protons. There are many more than just 'free' neutrons to be sure; we include the total in this ratio. It is disconcerting that the standard model accepts the alchemy of transmuting these otherwise 'indivisible' units. That is counter to the warranted atomic view of matter. In the alternative model, there are no such transmutations. The difference derives from the treatment of electrons; in the alternative scheme electrons are not indivisible in the same sense that has been accepted by the standard model. They are, however, irreversibly comprised of three down quarks.

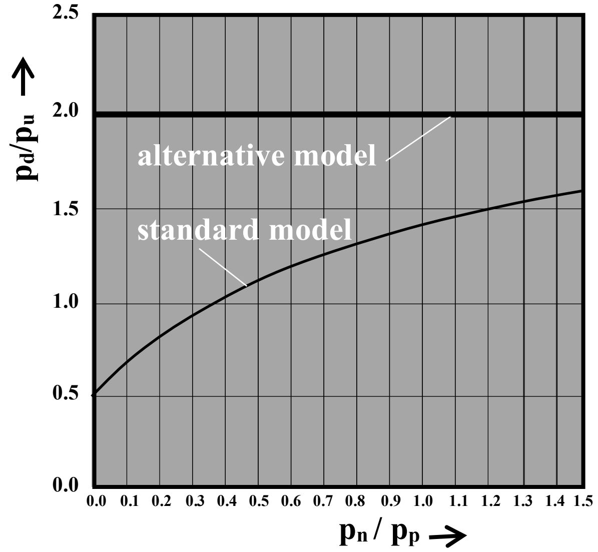

Figure 4: Ratio of up to down quarks

A more consistent subatomic particle decomposition

The quark decomposition shown in figure 2 necessitated acceptance of transmutation of up quarks into down quarks and the creation of electrons for which there had been no precursor. To avoid such inconsistencies with the atomistic view of matter a different decomposition is required. These somewhat different structures are shown in figure 5. The rationale is that at some level of decomposition immutable indivisible particles must be realized. We will investigate the inevitable nucleosynthesis development that supports these assessments.

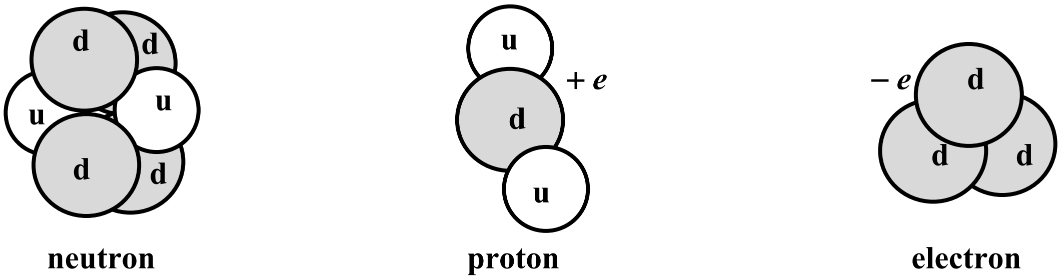

Figure 5: Alternative model decomposition of atomic matter

The ostensible differences in the alternative decompositions involve there being a tandem of the formerly accepted neutron quark structures and an electron that has second level quark structure. In addition to preserving the net positive and negative charge, the respective numbers of up and down quarks are also preserved. The gluon that was necessary if charges were to be restricted to mere mathematical points, but with the Poisson charge distributions this enforcer of the 'strong' force is unnecessary. There are, of course, issues with regard to the exclusion principle and chromodynamics that must be addressed, which we will.

electronic charge distribution issue

Any explanation of the atomic theory of matter must begin by answering the major question: How is electronic charge (and mass) distributed within or about fundamental particles? A cross section, and therefore a dimension is associated with electronic charges of electrons and protons. There are no 'point' charges – scratch that notion. Let's agree that quarks are not point singularities. They have some spatial quality to the charge they possess and however indivisible, one distribution when brought into the proximity of another will overlap to less dramatically increase or reduce overall electrostatic energy density of two such particles. This rational exception to the concept of point particles derives from a proper solution to Poisson boundary value problems once the 'boundary' at the origin (center of a particle) has been specified. This approach and the associated distribution solution is elaborated in papers under the heading 'Neoclassical Field Theory Papers' on this site. The following related papers may be accessed directly at that url:

- Faraday's Most Brilliant Intuition
- Replacing Point Particles with Extended Electrostatic and Gravitational Fields
- There are no inverse square laws, only predominant inverse square factors
- Concerning the Equivalence of Inertial and Gravitational Mass
- Self-energy As the Rest Mass of Fundamental Particles

Features of the Poisson charge distribution advocated in these papers are illustrated in the plots of figure 6 along with a comparison of those implied by advocacy of point particles. Where there is similarity, features are virtually identical at distances large with respect to dimensions of the particle. This distribution of charge is assumed in the alternative model. Electrostatic self-energy is determined as a function of the net charge q_o and variance (or deviance) α of the distribution; this then is associated with the rest mass m_o of an associated particle. Binding energies and interactions between particles are determined by numerical integration of associated expressions.

What logically precedes hydrogenous plasma?

One must question why the combined standard models of particle physics and cosmology begin this coherent association/disassociation account with reified atomic components rather than with the quarks of which they are comprised. How, for example, would two highly charged positive up quarks and a single less charged down quark meet and agree to coalesce in becoming a proton? The repulsion of net charge would seem to veto any such proceeding and there is no temperature at which an associated thermonuclear reaction could be in equilibrium. Therefore, questions concerning the origin of protons, neutrons, and electrons are natural ones to ask. These questions have not been adequately asked or answered. Let us attempt such an explanation.

Suppose that at some temperature (or point in time, as the standard model envisions) a plasma 'soup' of quarks at high temperature (let us say 10^{11} K) in a logically defined precursor state to the left of what is shown in figure 3. What would have happened as cooling took place? How would we get to anything like the inferred hydrogenous plasma at the right of figure 3?

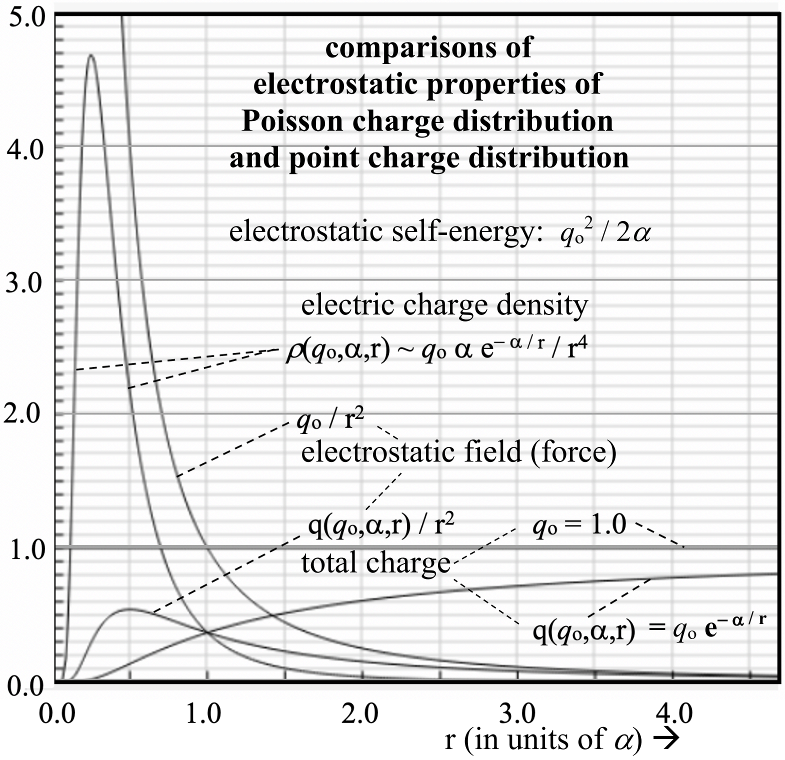

Figure 6: Particle charge distribution comparisons

The obvious answer is that the two thirds positive electronic charge of the up quark would ‘hook up’ with a one third negatively charged down quark releasing energy in the process. No question about it; that is what would happen. Then what would happen? Well, after an up quark combined with a down quark as illustrated in the second frame of figure 7 the product would still possess an excess of one third positive charge that would attract another down quark, further reducing overall energy density in the process. The structure that would result in this case is what is conventionally considered to be the principal constituents of a neutron. The author is convinced however, by arguments whose validity will become apparent further on, that this structure is not yet a finished product. We will call it a ‘con-ton’ because it is in virtually every respect the exact opposite of a proton; it is comprised of two downs and one up quark rather than two ups and a down quark.

To satisfy electrostatic concerns a plasma soup of quarks would be converted in its entirety to neutral contons as illustrated in the third frame of figure 7. What then? Because of the indivisible nature of the charge distributions, the conton would be distorted to reduce the influence of stronger positive charges so that it would possess a dipole moment resulting in two such structures attracting each other with interlocking dublets producing what we will call an octahedral neutron as shown.

the emergence of charged subatomic components

But a major question remains: How would one obtain the particles of unit charge such as the proton and electron which are after all, together with the neutron, the basic building blocks of elemental matter as we know it? They cannot be created directly from free quarks as demonstrated for neutral contons. It might seem, therefore, that there would be no natural inclination whatsoever for particles with net charge to be created out of neutral particles. That is not the case, however.

As contons interact their valence connections inevitably become altered when in the vicinity of other contons such that a conjoining of two would further minimize energy. The down quarks would arrange themselves to accommodate a buffer between the up quarks when two such structures were in close proximity, perhaps forming, or at least nearly forming, a stable octahedron.

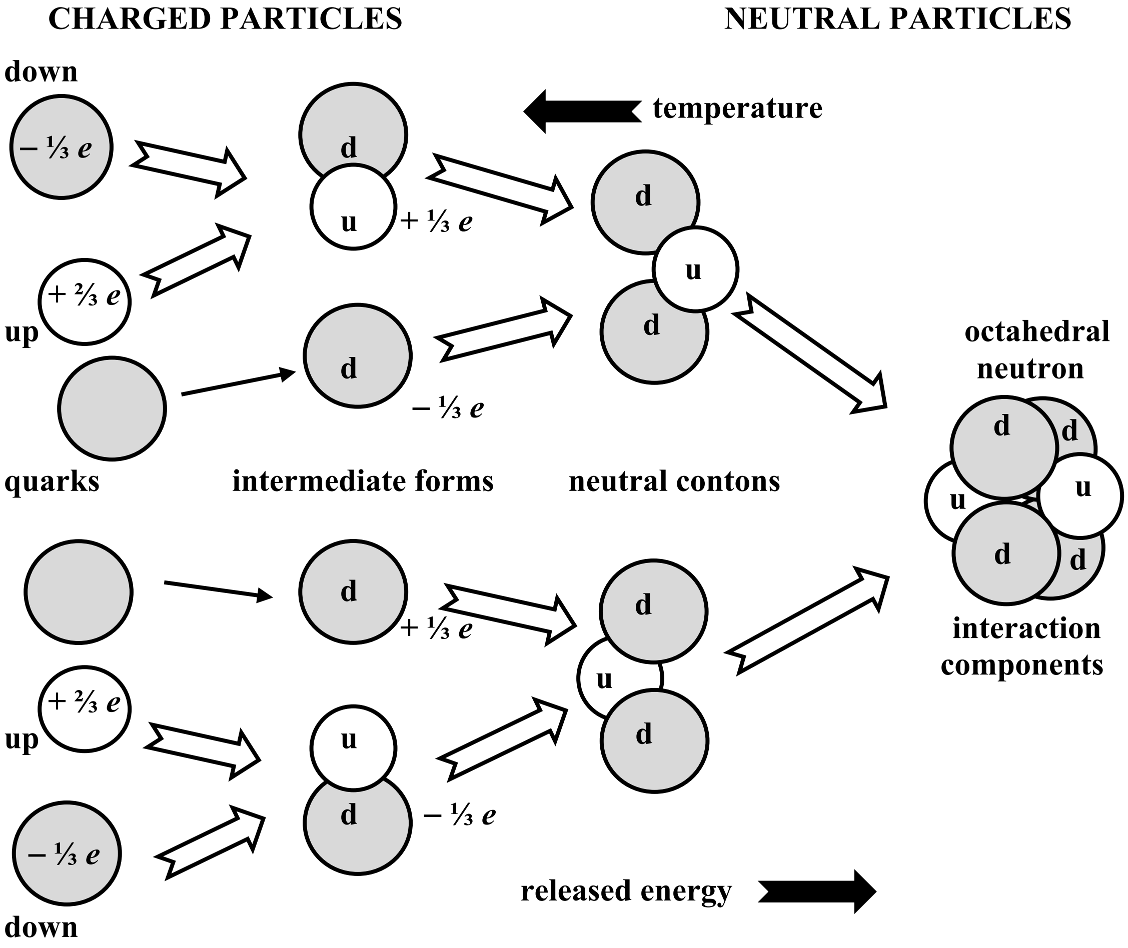

Figure 7: Initial neutralization phase of a quark 'soup'

There is an identical percentage of up and down quarks but with the amount of thermal energy associated with each of the frames in figures 7 and 8, decreasing to the right. There is an energy associated with each of the frames and this energy provides a balance point for a thermonuclear reaction. Furthermore, this balance persists up through the creation of the subatomic particles (including the electron) and all isotopes of the elements included in the periodic table.

the emergence of charged atomic components

Up and down quarks come in colors – not visible colors, of course, but a triad such as RGB in colors, XYZ is space, blood types, or whatever triad of terms make sense by analogy. This is where chromodynamics comes into play. Each quark is either an R, a G, or a B. Viable combinations of quarks cannot have two of the same color quark. That is a fact of nature. Contons are viable if each quark constituent differs in color from every other, octahedral neutrons are not viable combinations of quarks even though they would be electrostatically viable.

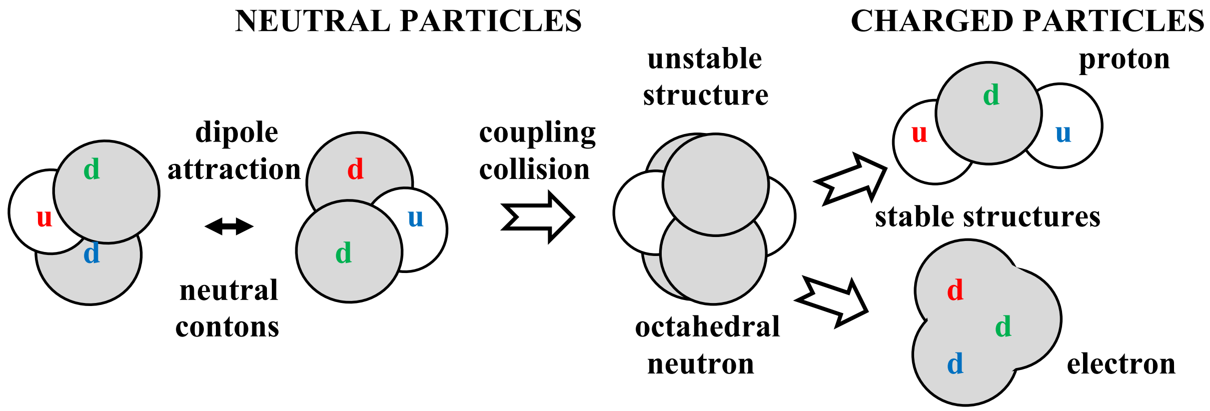

Figure 8: The conjectured alternative further association into subatomic matter

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A ‘completed’ neutron, however it is comprised, possesses more energy than the sum of the energy in a proton and an electron. The composition of an octahedral (or whatever composite structure of contons) neutron would, by color prohibition, temperature, conton collision energy, or neutrino interaction, precipitate disassociation. Free neutrons, however comprised, are known to decay within 15 seconds of being created by whatever means. The accepted beta minus decay weak reaction is the following:

$$n \leftrightarrow p^{+} + e^{-} + \bar{\nu}_e$$

where n is a neutron, p a proton, and $\bar{\nu}_e$ a (nearly) massless antineutrino introduced to guarantee the conservation of energy, momentum, and number of leptons whereas we prefer preserving number of up and down quarks. There are naturally many reasons why our preferred decomposition and particular processes have been overlooked by establishment. We will address these issues in due course, but the efficiency and esthetics of this approach recommend it. There is no transmutation of indivisible particles, and gluons are not required to bind the quarks together like Jesus saving a failed marriage. The simplicity of the alternative suggests Einstein’s sense that, “God would have done it that way.”

The role of what are called ‘electron neutrinos and antineutrinos’ are major in the accepted scheme as being created by, or as precipitating, weak reactions of beta minus decay, beta plus decay, and electron capture. In that scheme they perform the role of balancing the before and after conservation of energy and momentum equations – which can’t be balanced otherwise. That is because in the traditional neutron decomposition there is no contributing kinetic energy when the energy equations are solved in the frame of reference of the accepted neutron. In the alternative scheme the accepted neutron mass is embodied in two contons which must collide to produce the unstable octahedral neutron, contributing their kinetic energy to the products.

quark mass assessment in the alternative model

Now let us discuss the quark mass assignments accommodated by rejecting point particles in favor of the Poisson distribution of charge and mass and the thermonuclear reaction equations that support these conjectures. The accepted values of electron, proton, and neutron masses provided above are used in nucleosynthesis equations to determine the masses of up and down quarks in the alternative more consistent model. We will then address the relative abundance of the various precursor structures in the transitions from a quark soup to the hydrogenous plasma of figure 4, a state that still constitutes the vast majority of baryonic matter in the current universe.

Proceeding to the alternative decomposition we will address the binding energy that holds the quarks together in subatomic particles – first by assuming it to be negligible in comparison to the total of the self-energies of the quarks. This allows us to obtain the lower limit of the masses of the up and down quarks from constituent equations for the electron, proton, and neutron respectively. Before performing the detailed calculations of the alternative constructions however, we address the degree to which approximations without including binding energies of the composites are at least realistic. We will then address the binding energies using the field theoretic equations illustrated in figure 6 with further discussion included on this same site.

The determination of the lower limit of the masses of the up and down quarks is accomplished by solving the following simultaneous equations

$m_n = 2\ m_u + 4\ m_d = 1.67492729 \times 10^{-24}$ g

$m_p = 2\ m_u + m_d = 1.67261637 \times 10^{-24}$ g

This implies:

$m_d = 7.7030666 \times 10^{-28}$ g

$m_u = 8.3592303 \times 10^{-25}$ g

These are very rough estimates because they do not take into account the binding energies.

As demonstrated for Poisson charge distributions in other papers discussing neoclassical field theory on this site, when multiple identical indivisible charge distributions are concentrically superimposed as we assume for the down quarks in the electron decomposition, the result is a single indivisible distribution with n^2 times the self-energy of just one of the n distributions. Thus, in the case of the electron with n=3, instead of what we would otherwise posit as $m_d = \frac{1}{3}\ m_e$, we assign the following mass for the down quark:

$m_e = 3^2\ m_d = 9.10938356 \times 10^{-28}$ g

$m_d = 1.012154 \times 10^{-28}$ g

Then we re-do the mass estimate m_{nu} of the up quark based on the neutron mass equation and then the estimate m_{pu} based on the proton mass equation:

$m_{nu} = 8.372612142 \times 10^{-25}$ g

$m_{pu} = 8.362575773 \times 10^{-25}$ g

The determination of the mass of the down quark is a direct calculation firmly based on the field theoretic binding energy calculation. This overdetermination of the simultaneous equations for the up quark lower limit of mass provides only a ballpark (but quite accurate) estimate. The slight difference in the mass estimates of the up quark from the two sources (proton and neutron) is easily accounted. It is due to the different numbers of quarks with their associated binding energy differences in the corresponding host structures. But the implied differences in the Poisson exponential of the up quark is minimal:

$\alpha_{pu} = 1.3018446 \text{ x } 10^{-17}$ cm

$\alpha_{nu} = 1.300284 \text{ x } 10^{-17}$ cm

We will use $\alpha_u = 1.301 \text{ x } 10^{-17}$ cm as a first estimate in a recursive process to refine the estimate of the variance in the up-quark charge distribution. The calculated value for the down quark is the following: $\alpha_{ed} = 1.405 \text{ x } 10^{-13}$ cm

why a gluon is required in the accepted model but not in the alternative model

Let us consider the electrostatic viability of the proton quark substructure without the gluon in the accepted model of particle physics: The force between charged particles in classical physics is assumed to be proportional to the inverse square of separation of their centers; the central down quark attracts a down quark with a force proportional to $(2e^2/9) \text{ x } (1/1^2) = 2e^2/9$ whereas the other up quark in the proton repels it with a force proportional to $(4e^2/9) \text{ x } (1/2^2) = e^2/9$. Therefore, the proton could not exist without a separate force for which the name and function has been assigned to the 'gluon' to hold the quarks together.

In this regard there is a major difference in the alternative where the forces of interaction between the up and down quarks with their characteristic distribution illustrated in figure 6 and justified elsewhere on this site. For an inverse square law force, separated charged particles would attract or repel each other with increasing force as their separation is reduced – the amount increases to infinity as the separation goes to zero. In the alternative view involving the Poisson distribution, the inverse square law proportionality is ameliorated as the separation is reduced in the vicinity of the deviation factor α, and this reduces the force to zero (rather than infinity) at zero separation. There is no singularity. This fact has significant ramifications with regard to the supposed substructure of the subatomic particles. In figure 9 a proton electric charge substructure is shown.

The implications of a difference in charge distribution of fundamental particles will be immediately obvious when we consider the alternative force fields. Consider the proton with its two up quarks (u1 and u2) and single down quark (d) as shown, ignoring the perceived role of the gluon for now.

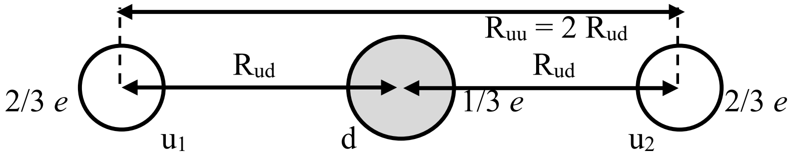

Figure 9: Classical view of electrostatic quark interaction in proton structure

The up quarks possess 2/3 of an electronic charge *e* and a down quark 1/3 electronic charge. Symmetry situates the right-most quark is at a distance 2 R_{ud}. For separations of the quarks of more that 10^{-11} cm there are no field strength differences between the alternative and traditional approach. At shorter distances tremendous differences ensue which enforce stability. In figure 10 the classical and alternative field strength (divided by the common inverse-square factor $1/Rud^2$) realized at the location of the up quark u_1 in figure 9 have been plotted. Of course the experienced force will be the charge times this field strength. There is a 'C' that has been appended to the subscript for the classical field strength and a 'P' for the alternative field strength as follows:

$$E_{Ci}(R_{ij}) = q_i / R_{ij}^2$$

$$E_{Pi}(R_{ij}) = q_i\, e^{-\alpha_1/R_{ij}} / R_{ij}^2$$

All field strengths with 'C' subscript in figure 10 are horizontal.

Employing the Poisson distribution of charge rather than a point charge results in a different situation from the conventional conception. Relative to distances for which the influence of the inverted exponential form is required to adequately represent the field strength of the down quark, the charge density of the up quark can be accurately represented as a point charge. This is because its deviation factor is on the order of 500 times smaller than that of the down quark. Thus, forces between down and up quarks in the proton shown in the left panel of figure 3.7 can be represented as the force at the location of the left-most up quark, u1 as follows:

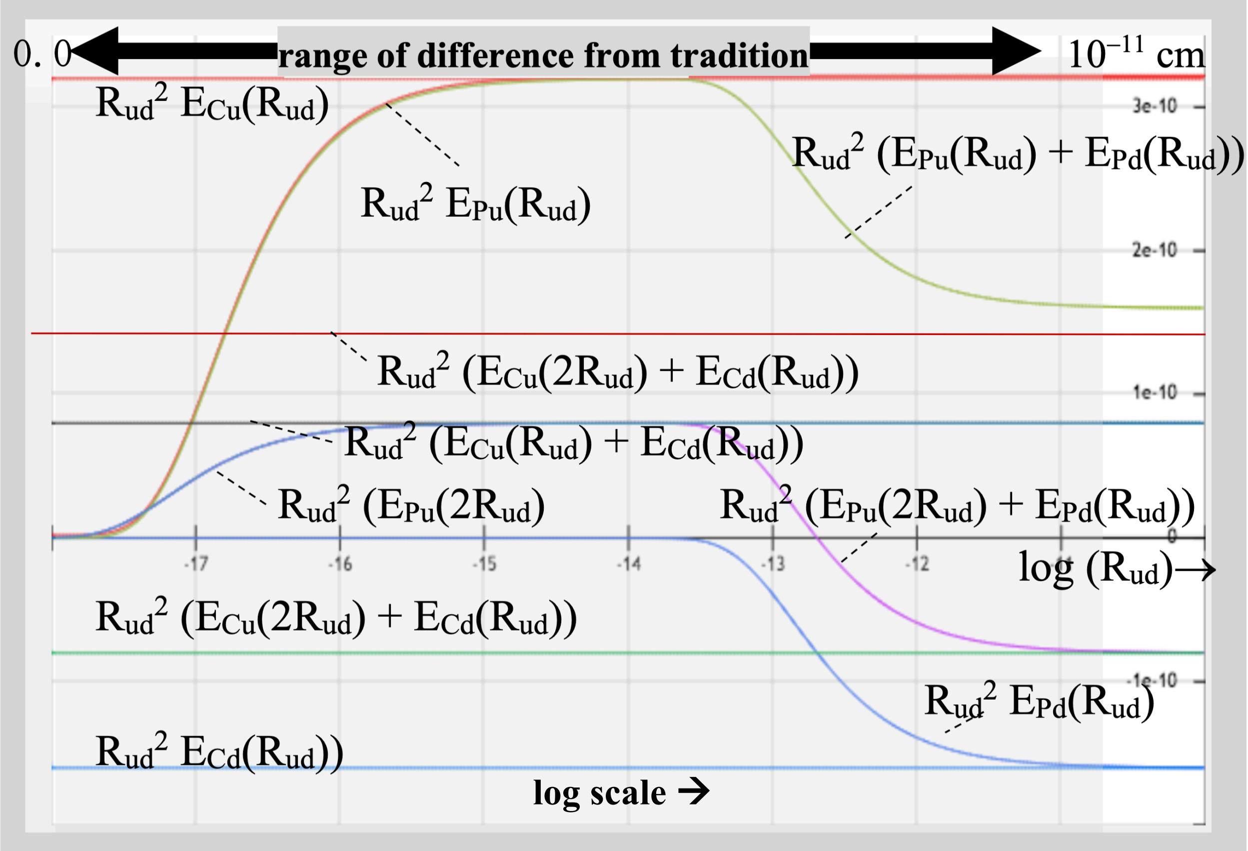

Figure 10: Electrostatic field strength at the left-most up quark in proton of figure 9

$F_{du} = -\, q_u E_d(R_{ud}) = (2/9)\, e^2\, e^{-\alpha_d/R_{ud}} / R_{ud}^2$

$F_{uu} = -\, q_u E_u(2R_{ud}) = (4/9)\, e^2 / 4\, R_{ud}^2$

So that the force on the up quark, u1 can be represented as:

$F_{u1} = F_{uu} + F_{du} = (1/9)\, e^2\, (\, 1 - 2\, e^{-\alpha_d / R_{ud}}\,) / R_{ud}^2$

Again, multiplying by the common inverse square factor R_{ud}^2, the difference in force of classical and alternative approach is illustrated in figure 11.

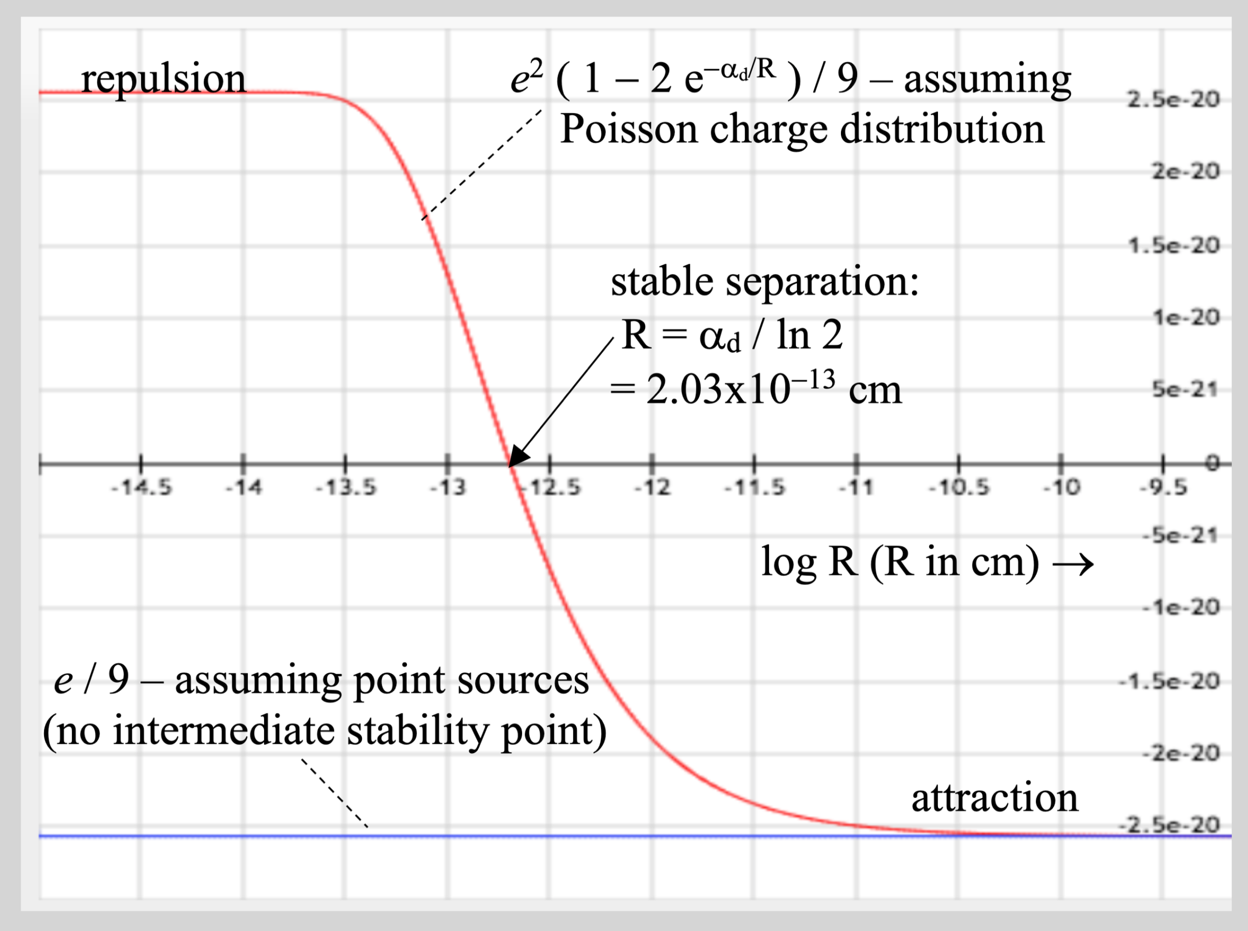

Figure 11: Force stability of alternative formulations of the proton

There are similarities in the profiles of the electric field constructs, of course, but significantly there are major differences between them. Differences include a scale dependence that ensues because, despite similarities, due to extremely small values of the exponential factor α, a Poisson distribution is *not* a Dirac delta function. It is a matter of scale, for although α may be extremely small for fundamental particle charges, it does not 'become zero' by any stretch of the imagination. However, the inverse square law and action-at-a-distance can be used to represent the force in situations where $\rho(\mathbf{r}) \rightarrow 0$ if $\mathbf{r} - \mathbf{r}_1 \gg \alpha$.

The electric binding/repelling force of these quark combinations according to the traditional view would be as shown in the bottom blue line in figure 11. Stable non-juxtaposed combinations would require an extraneous force (the ‘strong force’ attributed to ‘gluons’) to enforce subatomic spatial separations. However, the alternative charge distribution accommodates stability of the subatomic particles without introducing gluons.

Similar analyses apply to the precursor structures up to and including the neutral conton. The situation with these structures differ from that of the proton structure in part because the proximity of the down quarks relative to the up quark is within the range of their density minima, increasing as well as altering the force between them. Thus, interactions of down quark d1 in figure 12 must be handled by numerical integration of the forces implied by the charge distributions throughout space. When the down quark d1 in the neutron moves into position in the stable region of an assembled up and down quark, the other down quark (which had conceivably already been combined with the up quark) will move away from the center of the up quark by an equivalent amount to that of the separation of d_1. So the neutral conton as well as the proton will be configured with stable symmetric separations of the quarks of which they are comprised. However, the stability separation of up and down quarks is ten times closer in the conton structure than for the proton with its stronger up quark repulsive forces.

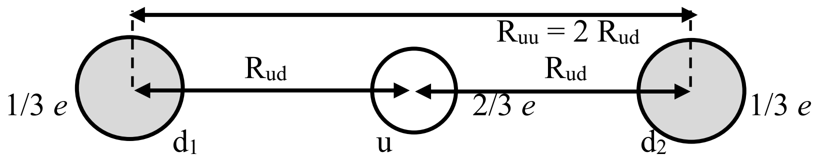

Figure 12: Classical view of electrostatic quark interaction in accepted neutron structure but of the conton in the alternative model

In the alternative model, the conton is not the unstable neutral particle that decays in the creation of a proton and electron. There is an additional endoergic reaction between to contons that gives rise to an unstable neutral structure that disassociates to form the proton and electron.

The emergence of hydrogenous plasma from a ‘quark soup’

The hydrogenous plasma shown in figure 3 is used to justify the creation of the light elements up through lithium as resulting from an intense primordial origin of the universe itself. The plots themselves derive from a stationary model of reactions occurring at each temperature in the figure. It is not a timeline of events but rather a description of nuclear reaction events that occur at the given temperatures. But that is an incomplete picture of the standard model narrative. As my daughter would have asked as a child, “What happened before that?” This question is particularly apropos when a precursor ‘quark soup’ is an integral part of the narrative. The required gluons, W particles, etc. so complicate the story that it is never pictured but described as particles going in and out of existence probabilistically, etc...

There is a much simpler explanation in the alternative model. The precursor particles and the necessary reactions that create them have all been illustrated and pictured. The methodology for determining the charge density variances of the quarks have been described with additional explanation available on this site. The self-energies and rest masses of each precursor particle can be determined by numerical integration of the composite energy as has been discussed. With that data the thermonuclear equation presented above can be used to determine abundances of each particle participating in each reaction at each temperature. The precise values of the rest masses involve the incorporation of distributions of gravitational mass, which perturbs the results slightly. However, from the reactions illustrated in figures 7 and 8, the diagram of figure 3 can be extended to the left to illustrate a continuous trend from a quark soup becomes to the hydrogenous plasma at the lower temperatures of figure 13.

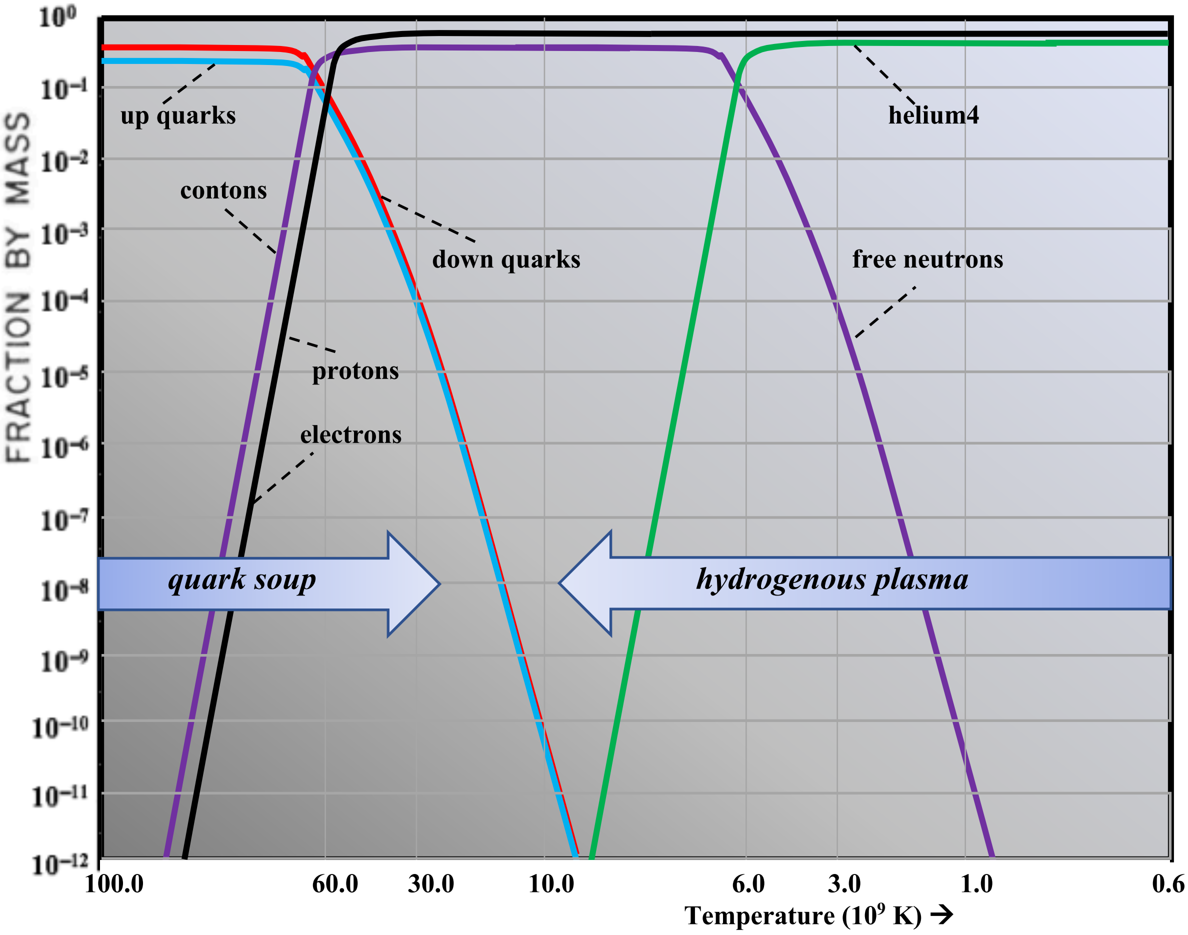

Figure 13: Fundamental particle abundance estimates that would be realized – as a function of temperature in a 'quark soup' up through current hydrogenous plasma

concluding remarks

The advantages of an alternative decomposition of subatomic particles are obvious in terms of requiring fewer additional constructs to produce their observed stability and infrequent instabilities. In the model of particle physics described here, there is an implied order of viable transitions between stable states of composites of indivisible, non-transmutable up and down quarks that makes sense as a consistent explanation of all that exists. A hierarchical taxonomy of these units of matter is what has been described with nothing but up and down quarks accounting for all the subatomic particles that constitute the elements of the periodic table.

The approach relies on having discarded the notion of point particles and action-at-a-distance as described neoclassical field theory elsewhere on this site. That theoretical model employs the same theorems applied to classical field theory but with the additional of a boundary condition at the center of each particle which avoids the nonphysical behavior of singularities.