THE COSMIC FORGING OF PROTONS BY THE ELECTROMAGNETIC COMPRESSION OF QUARKS

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Considerations of the presently held views regarding the synthesis of nucleons from quarks during the nascent stages of our cosmos, when its gravitational hold was so great that no energy or particles could escape its plasmatic core, have led to three alternative schemes for forging quarks into protons by utilizing their mutual attractive electromagnetic potential energy for the forging process. The three models provide the mass and energy of the primary quarks, the resulting forged quarks, the potential energy assimilated by the proton, and its final attractive hold, as deduced and detailed in the body of this paper. The values deduced for the primary quarks (193.845e or 196.98e) suggest that muons (~207e) could be playing the role of the long-sought quarks.

1. Introduction

According to the presently held theories, the birth and evolution cycle of our Universe began when an infinitely dense point of energy technically named singularity started its relentless expansion. During the early stages of this event, dubbed the Big Bang, no energy could yet escape the attractive hold of the extremely potent and nimbly swelling plasmatic core, despite its extremely high energy density. Any particle-antiparticle pairs are believed to have undergone mutual annihilation, replenishing the energy pool, until the energy density dropped to a propitious threshold, when two unique triplets of hypothetical particles, amusingly named Quarks (Q), not only survived annihilation but also got immortalized by being forged into Protons (p) and Neutrons (n). The said quarks left behind no direct evidence of their existence and identity. However, the existence of the universe and our own presence in the same imply that some fraction of the primordial energy certainly got converted into protons, neutrons and electrons, which are the essential constituents of our universe. Whether it was through the advent of the Big Bang and the intermediacy of quarks or by some other mechanism has been intriguing the imagination of scientists probing the origin and ultimate fate of our cosmos [1].

Thus, while the followers of the Big Bang – the mainstream theoretical and experimental physicists – have been focusing on the search for quarks and other fundamental particles with increasingly energetic particle colliders, such as the presently dismantled Large Electron Positron Collider (LEP), succeeded by the Large Hadron Collider (LHC), several skeptics have been voicing their discontent with the drawbacks of Big Bang and have proposed alternative theories for the origin of our universe. Among these dissidents, two highly qualified physicists, Dr. Harold Aspden and Dr. Paul A. La Violette, have developed elaborate schemes wherein they resuscitate the universal "Ether" in new garbs, endowed with exotic properties. They have published extensively, both in the scientific journals as well as the popular media, and maintain internet sites where their views and publications can be checked and verified [2, 3]. In this context, it is interesting to highlight here that Noble Laureate Frank Wilczek, a pioneer at the forefronts of modern and fundamental physics, is also advocating a dynamic superconducting universal medium, which he calls the "Grid" to avoid any association with the long banished "Ether" [4].

Now focusing on the experimental findings of the high energy and particle physics, one is greatly impressed by the fact that in sharp contrast to the illusive quarks and other short lived or transitory particles, protons and electrons are found to be ubiquitous and practically immortals. This is true both under the ordinary circumstances and the high energy conditions of LEP and LHC, where twin beams of either electrons and positrons or that of protons, respectively, are boosted to extremely high energies and then smashed into each other, followed by analyses of their debris to find new particles.

Regarding the neutrons, it is very instructive to note that the lone and free neutrons are unstable. They last for just about one thousand seconds (~1000s) and disintegrate into proton, electron, and electron's antineutrino. On the other hand, the fusion reactors of our sun and other stars are continuously converting a significant portion of their protons into neutrons, as needed for the synthesis of Helium and higher chemical elements. Consequently, it is believed that only a small portion of the primordial neutrons survived by virtue of their fusion with protons to form the nuclei of light chemical elements: Deuterium, Helium, and Lithium, etc. The neutral atoms of these chemical elements formed much later when the union of their nuclei with electrons could withstand the buffeting and splitting influence of the surrounding tumultuous ocean of energy.

2. A Model for Forging Protons from Quarks

This scenario leads to the conclusion that the genesis of the fundamental constituents of matter - the so called quarks - and their forging into protons and neutrons took place under uniquely favorable conditions during the extremely dense and high energy state of the Primordial Universe, when its gravitational hold was so great that neither electromagnetic radiation (EMR) nor any particles could escape the presumed plasmatic core. Therefore, all the energy vibrations and whirlpools or the quarks, being confined to the plasmatic fireball, were in close contact with each other. Thus, the contiguous interacting quarks (Q^+: Q^-: Q^+) could neither shed off their potential energy as EMR nor balance it with a secondary kinetic energy by orbiting around each other, due to lack of any room (space). Consequently, all of their mutual attractive potential energy should have been converted into the rest mass energy (m_oc^2) of the final components by being squeezed into smaller and denser entities, in accordance with the quantum restraints for the energy and mass of these particles (fermions): $\mathbf{m_o c r_o = h/4\pi\ (=\hbar/2)}$; $\mathbf{m_o c^2 = \hbar c/2r_o}$; $\mathbf{r_o = \hbar c/2m_o c^2}$.

Note that this contrasts sharply with the nuclear fusion reactions, which liberate both EMR and particles.

In other words, the forging of a proton from quarks utilizes their attractive electromagnetic (EM) potential energy (E_1, E_2, E_3, etc.) to squeeze and weld them into smaller and denser entities, thereby increasing the mass and energy of the original components and that of the final compound named proton (p):

a) $(Q^+:Q^-) + E_1 = \mathbf{x^+:x^-}$; b) $(\mathbf{x^+:x^-}) + Q^+ + E_2 = \mathbf{y^+:z^-:y^+}$ (**p**); c) $(\mathbf{x^+:x^-}) + Q^- + E_2 = \mathbf{y^-:z^+:y^-}$ ($\mathbf{p^-}$);

d) $(Q^+:Q^-:Q^+) + E_3 = \mathbf{y^+:z^-:y^+}$ (**p**); e) $(Q^-:Q^+:Q^-) + E_3 = \mathbf{y^-:z^+:y^-}$ ($\mathbf{p^-}$).

The double edged bipolar intermediate ($\mathbf{x^+:x^-}$) is expected to be highly reactive as it can weld itself with either Q^+ or Q^- to provide proton (p) or antiproton (p^-). Moreover, under the high density conditions, the contiguous (Q^+, Q^-, Q^+) or (Q^-, Q^+, Q^-) triplets, obviating the difficulty of three particle encounters, could be forged directly into proton (p) and antiproton (p^-), respectively [5].

3. The Forging Process and its Requirements

Let us reexamine and organize some of the fundamental requirements and restraints involved in these forging processes.

1. In order that this forging process can succeed, both the electric and magnetic forces and the respective potential energies of the quark-antiquark interactions must result in a net sum of the attractive potential energy, instead of canceling each other to a null result.
2. Compressed by the electromagnetic forces and confined by the spatial restraints caused by gravitational hold, quarks squeeze each other instead of orbiting around one another with a secondary velocity. Moreover, as the electric field of each quark is pulsating around its respective center with velocity c, the magnetic force and potential energy for the **paired poles** are equal, respectively, to the electric force and potential energy: **Magnetic $\mathbf{E_{pot}}$ = Electric $\mathbf{E_{pot}}$.**
3. It is very important to bear in mind that the forging of quarks into protons took place in the **primary medium** of their genesis, there being no secondary dielectric medium isolating them. Consequently, their electromagnetic potential energy is also governed by the EM properties of this primordial medium. Thus, for the paired quarks, being spin **ħ/2 (h/4π)** particles, their electromagnetic interaction energy is given by $\mathbf{E_{pot} = \hbar c/d}$, where **d** is the sum of the radii ($\mathbf{r_x, r_y, r_z}$, **etc.**) of the compressing partners.

   For comparison and contrast, one may recall that the interaction energy of an electron orbiting a proton in the hydrogen atom is given by $e^2/r_e = mv^2 = \hbar v/r_e = \hbar c\beta/r_e$*, which is c/v (~137 = 1/β) times smaller than* hc/r_e.

4. The mutual compression, while adding energy to each partner brings them even closer, thereby increasing the magnitude of the EM interactions, which provide the driving force for the forging process. Eventually, the densifying of quarks comes to a halt when the final potential energies due to attraction and repulsive reaction to compression have attained a balance in the final product.
5. The intrinsic radius (**r_o**) of a quark being inversely proportional to its energy, compression decreases the radii of the partners in accordance with their new total energy. To simplify calculations and avoid the repetition of technical terms, let the symbols for the new entities x, y, and z also represent their rest mass energy, that is: m_oc^2 of x, $\mathbf{E_x = x; E_y = y; E_z = z.}$ Moreover, as the fermion $\mathbf{r_o = \hbar c /2m_oc^2}$ (*vide infra*), the intrinsic radii of x, y, and z are given by: $\mathbf{r_x = \hbar c/2x;}$ $\mathbf{r_y = \hbar c/2y;}$ **and** $\mathbf{r_z = \hbar c/2z.}$
   For example, electron's $r_o = \hbar c/2m_oc^2 = 3.1654/16.4 \times 10^{-10}$ cm $= 0.193 \times 10^{-10}$ cm, which corresponds to the r_o of the gamma ray progenitor of electron and positron pair, as also deduced in a recent study by Bo Lehnert [6].

4. The Models and their Analysis

Guided by these arguments, let us analyze the forging of a proton from 3 quarks (Q), each bearing a unit positive or negative electric charge, instead of invoking the hypothetical fractional charges. The central quark is being compressed on both sides and receives energy contribution from both the partners.

Model A:

a) $\mathbf{Q^+ + Q^- + Q^+ \rightarrow y^+:z^-:y^+}$ **(p);** **b)** $\mathbf{y = Q + E;}$ **c)** $\mathbf{z = Q + 2E = y + E}$

d) For each y:z attractive interaction, electromagnetic $\mathbf{E_{pot} = hc/ (r_y + r_z)}$. Substituting the values of $\mathbf{r_y = \hbar c/2y}$ and $\mathbf{r_z = \hbar c/2z}$ (item 5 above), affords $\mathbf{E_{pot} = 2yz/(y + z)}$. Let us put $\mathbf{yz/(y + z) = E.}$ Thus, for two y:z interactions the total is 4E. In the absence of any y–y repulsive interaction, each y quark receives 1E, while the z quark gets 2E.

The value of E is deduced from items (b - d):

$E = yz /(y + z) = (Q + E) (Q + 2E) / (2Q + 3E)$ **or** $2QE + 3E^2 = Q^2 + 3QE + 2E^2$ **or** $E^2 - QE - Q^2 = 0$, which gives $E = [Q \pm (Q^2 + 4Q^2)^{1/2}] / 2 = (Q \pm 2.236Q) / 2$, affording the two values: $\mathbf{E = 1.618Q}$ **or** $\mathbf{-0.618Q}$.

As compression is adding energy to the particles, the positive solution leads to $\mathbf{E = 1.618\ Q.}$ Therefore, $\mathbf{y = Q + E = 2.618\ Q}$ **and** $\mathbf{z = Q + 2E = 4.236\ Q.}$ Finally, $\mathbf{y^+:z^-:y^+}$ (p) $= 3Q + 4E = 9.472Q = 1836.1e$, gives $\mathbf{Q = 193.845e}$ (99.055MeV), which provides $\mathbf{y = 507.486e}$ (259.325MeV)**,** $\mathbf{z = 821.127e}$ (419.596MeV), **and** $\mathbf{E = 313.641e}$ (160.270MeV) [7].

Thus, **the gift of 4E = 1,254.56e** (641.08 MeV), **received as compression energy by the proton,** constitutes the major part (68.33%) of its total energy of 938 MeV (1836e). In the present model, devoid of any y-y repulsion, it is equal to and is balanced by the total attractive potential energy (**4E**) of the final quarks.

5. Alternative Schemes and their Consequences

In the above analysis and calculations, the 1-3 y-y repulsive interaction was ignored, assuming an effective total screening by the intervening z quark. However, as no *pro* or *contra* evidence for this assumption is available at the quark level, the alternative arguments and calculated data in the presence of y-y repulsion are presented below.

Model B:

The y-y distance is twice the separation of y-z centers. Thus, the magnitude of the repulsive Epot is just ½ of the y-z attractive Epot. Moreover, as there is only one repulsive y-y interaction, compared with the two y-z attractive interactions, the total value of the repulsive Epot is just ¼ of the total attractive Epot. Consequently, it is tempting to conclude that the total attractive Epot calculated above (4E) drops to just 3E, which is shared among the y, z, and y quarks as: 0.75E, 1.5E, and 0.75E. This brings about significant changes in the value of diverse parameters calculated above. Let us verify these changes following the procedure developed earlier for such calculations. Here, I would like to caution the reader that the value of the y:z potential energy calculated in Model A (E = 1.618Q), cannot be used in the present case, as it does not reflect the compression energy in the final product. The new picture is composed by:

y = Q + 0.75E; z = Q + 1.5E = y + 0.75E.

E = yz /(y + z) = (Q + 0.75E) (Q + 1.5E) / (2Q + 2.25E) **or**

$2QE + 2.25E^2 = Q^2 + 2.25QE + 1.125E^2$, which on rearrangement to $1.125E^2 – 0.25QE – Q^2 = 0$, provides $E = [0.25Q \pm (0.0625Q^2 + 4.5Q^2)^{1/2}] / 2.25 = (0.25Q \pm 2.136Q) /2.25$, affording the two solutions: E = 1.0604Q or -0.8382Q.

For compression the positive solution leads to:

E = 1.0604Q; **y = Q + 0.75E = 1.7953Q** and **z = Q + 1.5E = 2.5906Q.**

Finally, $\mathbf{y^+:z^-:y^+}$ (p) = 3Q + 3E = 6.1812Q = 1836.1e, gives **Q = 297.04e**, which provides:

E = 314.9939e; **y = 533.2848e;** **z = 769.5303e**.

As expected, the total added compression energy (3E = 945e), amounts to about 51.5% of the total mass of proton (m_p) and is much lower than that calculated before (68.33%), in the absence of repulsion.

Model C:

However, a closer scrutiny reveals that a better choice is available for the use of the repulsive energy. Repulsion does not amount to a mere subtraction from the attraction. Instead, it is being profitably employed for balancing the compression energy. This can be achieved by a judicious sharing of the total attractive potential energy (4E) among the y and z quarks as: 1.25E per each y and 1.5E for z. In fact, while the y quarks squeeze the z quark, they are also pushing against their own repulsion, thus mutually adding energy (0.5E) to each other, which brings their share to 1.25E. Consequently, the total of two y-z compressions (2.5E) will be balanced by the compression energy reaction of z (1.5E) plus the y-y repulsive energy (1E). The resulting consequences are deduced below:

$y = Q + 1.25E$; $z = Q + 1.5E$. $E = yz/(y + z) = (Q + 1.25E)(Q + 1.5E) / (2Q + 2.75E)$.

Or $2QE + 2.75E^2 = Q^2 + 2.75QE + 1.875E^2$. Or $0.875E^2 – 0.75QE – Q^2 = 0$.

Thus, $E = [0.75Q \pm (0.5625Q^2 + 3.5Q^2)^{1/2}] / 1.75$, affords $E = (0.75Q \pm 2.0156Q) /1.75$.

The positive solution leads to **E = 1.5803Q.**

Therefore, **y = Q + 1.25E = 2.9754Q** and **z = Q + 1.5E = 3.3705Q.**

Finally, $\mathbf{y^+:z^-:y^+}$ (p) = 3Q + 4E = 9.3212Q = 1836.1e, provides **Q = 196.98e** (100.66MeV), which gives **y = 586.09e** (299.49eV)**, z = 663.92e** (339.26MeV), and **E = 311.2875e** (159.07MeV).

The total added energy (4E) of 1245.15e amounts to 67.8% of m_p and evidently compares very favorably with 68.33% deduced in the absence of repulsion. But the final y-z attractive energy (4E) is weakened by the y-y repulsive energy (1E), which should render this option less stable than Model A.

In this regard, although protons and neutrons are believed to be built from oppositely charged quarks held together by gluons, examples of oppositely charged particles in touch with each other are unthinkable under the ordinary conditions. On the other hand, the sticking together of bar magnets is a common experience.

6. Conclusions

In conclusion, it is very gratifying to verify that just the plain arguments involving the extremely high energy and spatial restraints, presumed during the genesis of the protons, have led to three possible schemes or models for their forging from quarks. Coupled with **only one fixture, the known mass of the proton (1836.1e)**, these models have provided three sets of the calculated values for the mass and energy of the **primary** or **nascent quark (Q)**, the **forged quarks (y and z)**, the value of attractive and repulsive EM interactions, the **compression energy** (**4E, 3E and 4E**) **assimilated by the forged quarks**, as calculated above in the three schemes.

The y-y repulsion free model (A) and the third model (C), with the y-y repulsion, appear to be superior to the second scheme (B), which is included here both for record as well as for comparison with the other two rivals. Moreover, I would also like to highlight the number **1.618**, associated with the value of E (1.618Q), found in Model A. It is the "Golden Ratio" [$\theta = (1 + 5^{1/2})/2$] and has all the mystique, charm, and virtues associated with it since antiquity [1]. Thus, one may verify that the values of the Primary quark (Q), the compression energy E (θ Q), the y quark (θ^2 Q), and the z quark (θ^3 Q) are all related by the golden ratio θ. This implies that the radii and the fundamental frequencies of the y and z quarks are also harmoniously related by the same ratio. Still another astonishing fact is that the calculated half-length or radius of the forged proton (r_p) is exactly (mathematically) equal to the calculated radius of the Primary quark (r_q = 0.99582fermion): $r_p = (2r_y + r_z) = (2r_q/\ \theta^2 + r_q/\ \theta^3) = r_q\ (2\ \theta + 1)/\ \theta^3 = r_q$, because $(2\ \theta + 1) = \theta^3$. Interestingly, this calculated value (0.99582fm) is comparable to the value (0.8768 – 0.8775fm) reported for the charge radius of proton [1]. *May be this is one of Mother Nature's hints about its workings*.

Now coming to the most important clue of the present study, the value of the Primary quark found in Model A (193.845e) and Model C (196.98e) strongly recommends $\boldsymbol{\mu}^+$ and $\boldsymbol{\mu}^-$ muons (~207e) as the most probable candidates for the synthesis of protons and antiprotons, as further supported by the following arguments and observations:

1. The $\mathbf{p}^+$ and $\mathbf{p}^-$ are expected to be born with some kinetic energy in accord with the environment of their formation. Therefore, the input energy should be higher than their rest mass energy (E_0).
2. In sharp contrast to the hypothetical and unidentified quarks, muons are rather abundant, being the penultimate decay product of almost all the known particles of high energy physics. Furthermore, they are the most long-lived (2.2μs) of the transitory particles, allowing enough time for their reactions and transformations. Thus, it is well documented that μ^- can replace an electron in the ordinary atoms forming exotic hydrogen and other so called "Muonic atoms". Moreover, μ^+ can capture an electron forming a pseudo isotope of hydrogen [1].
3. I am not aware of any studies with muons directed towards the synthesis of protons. But the electron and positron beams have been boosted to extremely high energies and smashed in the LEP collider. It is very encouraging to verify that protons, antiprotons, and lots of pions have been detected in their debris [8]. This raises the logical question whether pions, by virtue of their prompt decay into muons, could thus generate protons under the high density conditions of the LEP collider?

But instead of this indirect and uncertain support for the present hypothesis [9], a direct evidence and proof are very desirable. This becomes even more important due to the wide range of the past estimates for the mass and energy of the **u** and **d** quarks, which have varied from just the one third of the nucleon mass (612e) to the present day calculations by the quantum chromodynamics (QCD): **u** = 1.7 – 3.3MeV (3.33 - 6.46e); **d** = 4.1 – 5.8MeV (8.02 -11.35e) [1]. Therefore, it would be very valuable and instructive if an experimental team can manage to mix or smash variable proportions of π^+ and π^- or μ^+ and μ^- beams, confined under high density conditions, and check for the formation of protons, antiprotons, and even neutrons, because my ongoing studies suggest the possibility of neutron formation from p and p^- by the capture of μ^- or μ^+.

Regretfully, no clue or justification has been found for the peculiar and unique mass and energy of the Primary or nascent quarks (Q). **Why just one combination survived and got forged into protons, in spite of the unlimited possibilities?** Similarly, it is very astonishing to note that though the spectrum of EMR is practically continuous, its materialization into the stable or even the transitory particles is extremely selective! Moreover, the extraordinary stability of electron has also defied any explanation. Nevertheless, these pitfalls are well familiar and common to all the present theories, including the very sophisticated ones [10]. Probably, the extraordinary stability of proton and electron highlight a special property of the Primordial Void, Quantum Vacuum or the Plenum, called by several names in different publications. This Universal Primary Medium has several peculiar properties, some of which are presently known (c, G, h, etc.), while others await their discovery or revelation.

Finally, despite these standing uncertainties and taking into account that nobody has really got hold of a quark and much less weighed it [11], the present unconventional and low tech forging of protons reported in the present study pleads for a serious review, resulting in its improvement, acceptance or justified rejection.

NOTES AND REFERENCES

1. The Big Bang, electrons, protons, neutrons, and quarks are presently a part of both the scientific and the pop culture, having a widespread literature, easily accessible by Google search. A very convenient source is the Wikipedia: http://wikipedia.org., which provides useful information and original references on almost all the topics discussed in the present study.
2. Aspden H. Modern Aether Science and several other related books and papers: www.haroldaspden.com
3. LaViolette P. A. Subquantum Kinetics – A Systems Approach to Physics and Cosmology. Starlane Publications, Niskayuna, NY, 2010. For other Publications visit: www.etheric.com
4. Wilczek F. The Lightness of Being - Mass, Ether, and the Unification of Forces. Basic Books, New York, 2008.

5. The direct conversion of the appropriate photons into protons and antiprotons is beyond the scope of the present study.
6. Lehnert B. A Model of Electron-Positron Pair Formation. *Progress in Physics,* **2008, vol. 1, 16 – 20.**
7. The values reported in this study have been rounded off to 2 - 4 decimal places depending on their presumed importance for the argumentation. For conversion to MeV, e =0.511 MeV. To depict the closeness of interacting particles, a colon (:) is used, instead of a dash, which denotes a chemical bond and a large separation.
8. Wilczek F. **Ref. 4, p. 16**.
9. Incidentally, according to Dr. Harold Aspden the universal ether is populated by "Quons" and the oppositely charged muons, which give rise to protons via the virtual dimuons: **Ref. 2, Tutorial 09 – Proton Creation**.
10. Dr. LaViolette and Dr. Aspden circumvent or explain some of these difficulties by the special and unconventional properties of the Universal Medium "Ether". **Refs. 2** and **3**.
11. I would like to offer my apologies to Noble Laureate Frank Wilczek, who has published a color photograph of the jets of particles attributed to a quark, an antiquark, and a gluon, discussing it at length: **Ref 4, pages 51 -57** and **Color Plate 1**.