Experimental Premises for Existence of Baryon Core

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Abstract: Of course, the most important premise for the existence of baryon core is the impossibility of compressing the nuclear plasma to a mathematical point, which is permissible due to asymptotic freedom. Here we show that baryon-core dynamics and Stefan-Boltzmann law assign characteristic masses inside the core to the masses of known particles. Core of baryons leads indirectly to properties of dark matter.

1. Introduction

According to the Scale-Symmetric-Theory (SST) [1], the core of baryons consists of the spin-1/2 torus/electric-charge with a mass of $X^{+,-} = 318.2955$ MeV and the spin-zero scalar condensate with a mass of $Y = 424.1245$ MeV. Inside the torus are created the large loops with a mass of $m_{LL} = 67.54441$ MeV which are responsible for the nuclear strong interactions. The neutral pion, $\pi^o = 134.97674$ MeV is the spin-zero binary system of such large loops – the large loops interact electromagnetically. We can calculate mass of such loop from $X^{+,-}$

$$m_{LL} = 2\, X^{+,-} / (3\pi)\,. \tag{1}$$

The binding energy of the core is $\Delta E = 14.98$ MeV so mass of the charged core is $H^{+,-} = 727.44$ MeV.

On the other hand, from the Stefan-Boltzmann law we have

$$j^* \sim T^4\,, \tag{2}$$

where j^* is the total energy radiated per unit surface area of a black body across all wavelengths per unit time (the radiant emittance), and T is the black body's thermodynamic absolute temperature. The radiant emittance is the radiant flux emitted by a surface per unit area. We have

$$j^* \sim E_{Emitted}\,, \tag{3}$$

where $E_{Emitted}$ is the emitted total energy which here can be the rest mass, M_o, of emitted particle by the core of baryons.

We know that emitted energy is directly proportional to four powers of temperature while from the Wien's displacement law (it is for the black-body radiation) we have that absolute temperature is inversely proportional to wavelength which, on assumption that spin and rest mass are invariants, is inversely proportional to speed of wave, v. These remarks and formula (2) lead to following relationship

$$M_o \sim v^4 . \tag{4}$$

For two masses, on assumption that mass M_1 is spinning while M_2 is moving in radial direction, we have

$$M_1 / M_2 = (v_{Spin} / v_{Radial})^4 . \tag{5}$$

The core of baryons consists of the entangled and/or confined Einstein-spacetime components. Their resultant speed must be equal to the speed of light in "vacuum" c. The mean spin speed of the torus/electric charge is $v_{Spin} = 2c/3$. On the other hand, particles created by the core of baryons are emitted along the direction of its spin or in plane defined by its equator so the radial velocities are perpendicular to the spin velocities – it means that the mean radial speed must be $v_{Radial} = 0.74535599c$. So we have

$$M_1 / M_2 = (v_{Spin} / v_{Radial})^4 = 0.64 . \tag{6}$$

2. The three ratios consistent with formula (6)

Consider two large loops (they are spinning) and muon-antimuon ($\mu^+\mu^-$) pair (it is emitted in radial direction)

$$M_1 / M_2 = 2\, m_{LL} / (\mu^+ + \mu^-) = 0.6394 \approx 0.64 , \tag{7}$$

where $\mu^{+,-} = 105.6583745(24)$ MeV [2].

Consider the torus/electric-charge (it is spinning) and neutral kaon (K^o) (it is emitted in radial direction)

$$M_1 / M_2 = X^{+,-} / K^o = 0.6396 \approx 0.64 , \tag{8}$$

where $K^o = 497.611(13)$ MeV [2].

Consider a neutral pion-pion pair (they are spinning) and the central condensate (it can be emitted in radial direction)

$$M_1 / M_2 = 2\, \pi^o / Y = 0.6365 \approx 0.64 , \tag{9}$$

where $\pi^o = 134.9770(5)$ MeV [2].

3. Magnetic monopoles as progenitors of dark matter (DM)

Here we show that properties of dark matter follow indirectly from structure of the core of baryons.

The four phase transitions of the SST inflation field [1] lead to three similar theories of core of lightest neutrinos [3], core of baryons [1], and core of the Protoworld that transformed into dark matter [4].

The theory of the core of the Protoworld is consistent with the two other theories when there exists a DM-particle/torus/magnetic-charge with a mass equal to mass of the core of baryons about $M_{DM} = 727.44\ MeV$. In [5], we showed that such particle should behave as magnetic monopole because in them spins of the Einstein-spacetime components are rotated by $\pi/2$ radians in relation to the orientation in the electric charge of the core of baryons. Electric charge can create photons in which the spins of the Einstein-spacetime components are perpendicular to directions of their motions so they can rotate i.e. they can accumulate energy. On the other hand, magnetic monopoles (or magnetic loops in which electric lines are closed or magnetic tubes) can create magnetic condensates, magnetic loops or tubes in which the spins of the Einstein-spacetime components are tangent to directions of their motions so they cannot rotate i.e. they cannot accumulate rotational energy. Such structures we call the DM structures i.e. they are composed of the DM-tubes which can be entangled. We can see that the DM structures cannot interact electromagnetically so it is very difficult to detect them. Contrary to the electric charge, the magnetic charge cannot produce some analogs to the virtual electron-positron pairs so it can interact only due to the short-distance quantum entanglement, gravitationally and weakly. Moreover, the phase transition of the Protoworld forced the decays of the dark-matter particles into loops with increasing radii [5]. This leads to conclusion that detection of the progenitors of dark matter (i.e. of magnetic monopoles) is also very difficult.

According to SST, the very early universe was an analog to the neutral pion and it was composed of the most massive neutron stars [4]. It suggests that the ratio of abundances of dark matter and baryonic matter should be

$$\text{Ratio} = M_{DM} / \pi^o = H^{+,-} / \pi^o = 5.4\ . \tag{10}$$

Obtained here ratio is consistent with observational data [6].

Notice that there already were created some analogs to the DM magnetic tubes – they were created in some condensed matter systems and in the synthetic magnetic field as non-isolated magnetic-monopole quasi-particles [7], [8].

4. Summary

Here we showed that masses of muon, neutral kaon and neutral pion, and the ratio of abundances of dark matter and baryonic matter are directly related to the internal structure of the core of baryons described within the Scale-Symmetric Theory.

References

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