An Extension of the Dynamics of the Core of Baryons

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Abstract: Presented here an extension of the dynamics of the core of baryons reduces the initial 3 iterative numbers in the Scale-Symmetric Theory (SST) to 2. Now SST starts from 7 parameters and 2 iterative numbers which are derived after formulation of the theory.

1. Introduction

The dynamics of the core of baryons is partially described within the Scale-Symmetric Theory (SST) [1]. In [2], applying the dynamics of the core, we showed the origin of the two gamma-ray absorption lines measured by researchers from Osaka University [3] and of the two gamma-ray peaks in best-fit model for the time-integrated photon spectrum (3.3 s – 21.6 s) [4].

Here we present an extension of the dynamics of the core of baryons. We reduced the 7 initial parameters plus 3 initial iterative numbers applied in SST [1] to 7 parameters plus 2 iterative numbers. Notice that the initial iterative numbers are calculated after formulation of the SST so they are not the real parameters. We introduced them to simplify the mathematical description. We can neglect the iterative numbers but it causes that we must solve systems of equations with many variables.

The core of baryons [1] consists of the spin-1/2 torus/electric-charge with a mass of $X^{+,-} = 318.2955$ MeV which we can calculate from initial parameters without any iterative number, and of the spin-zero scalar condensate with a mass of $Y = 424.1245$ MeV which we calculated applying the initial parameters and 3 iterative numbers. 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 interacting electromagnetically large loops) – we can calculate mass of the large loop from $X^{+,-}$

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

To eliminate one of the three initial iterative numbers, we must calculate the mass Y and coupling constant for the nuclear weak interactions, $\alpha_{W,proton} = 0.018723$, using the initial parameters and the iterative numbers $F_1 = 1.0011596522$ (it is the ratio of mass of the electron to its bare mass) and $F_2 = 2.2854235$ (it is the ratio of the mass of the core of baryons to mass of the torus) [1].

2. Dynamics of the core of baryons

Range of the large loop, so of the neutral pion as well (it is responsible for the strong interactions), is $2\pi R$, where R is the radius of the loop. It follows from the rolling-unrolling mechanism characteristic for the virtual (or real) large loops. On the other hand, range is inversely proportional to mass so a transition from the spin motion of the large loop to vibrations along its radius increases mass 2π times

$$Y^* = 2\,\pi\, m_{LL} = 424.39405\text{ MeV}\,. \tag{2}$$

From the Stefan-Boltzmann law we have

$$j^* \sim T^4\,, \tag{3}$$

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

$$j^* \sim E_{Emitted}\,, \tag{4}$$

where $E_{Emitted}$ is the emitted total energy.

We know that emitted energy is directly proportional to four powers of temperature while from the Wien's displacement law we have that absolute temperature is inversely proportional to wavelength (which, here, decreases from $2\pi R$ to R) i.e. emitted energy is directly proportional to $1/(2\pi)^4$

$$E_{Emitted} = -Y^* / (2\pi)^4 = 0.2723014\text{ MeV}\,. \tag{5}$$

On surface of the Y condensate, the Einstein-spacetime components are moving with the speed of light in "vacuum" c. It suggests that to create the Y condensate, the initial radius of it must be smaller than the Schwarzschild radius for the weak interactions i.e. must be smaller than the radius of Y multiplied by 2. The Schwarzschild radius for weak interactions is about 27 times lower than the radius of the large loop [1]. It means that the transition from R to $R/(2\pi)$ does not lead to Y. We need the second transition but emphasize that wavelength is equal to size of the created ball so we have $2[1/(2\pi)]^2 = 1/(2\pi^2)$. The total density inside the ball is higher than density of the Einstein spacetime so the associated energy is the absorption energy. We have

$$E_{Absorbed} = +Y^* / (2\pi^2)^4 = 0.0027954\text{ MeV}\,. \tag{6}$$

The total mass of the condensate Y is

$$Y = 2\,\pi\, m_{LL}\,\{1 - E_{Emitted} + E_{Absorbed}\} = 424.12454\text{ MeV}\,. \tag{7}$$

We can see that we calculated the mass Y taking into account only the dynamics of the core of baryons.

Now we must calculate from the dynamics of the core of baryons the coupling constant for the nuclear weak interactions i.e. the $\alpha_{W,proton} = 0.018723$ [1].

The core of baryons is created due to the nuclear weak interactions. The weak coupling constant is a relative coupling which is the ratio of the initial state and the final state

$$\alpha_{Relative} = \alpha_{W,proton} = \alpha_{Initial} / \alpha_{Final} . \quad (8)$$

In SST, the coupling constant for the weak interactions is defined as follows [1]

$$\alpha_{W,i} = M_i R_i c / \hbar , \quad (9)$$

where M_i is the mass of scalar condensate, and R_i is its radius. R_i is directly proportional to wavelength so from (3) and (9) we have

$$\alpha_{W,i} \sim M_i / E_i^{1/4} , \quad (10)$$

where E_i is mass of the source of interactions while M_i is mass of the carrier of interactions.

From (8) and (10) we have

$$\alpha_{W,proton} = \alpha_{Initial} / \alpha_{Final} = [M_{Initial} / E_{Initial}^{1/4}] / (M_{Final} / E_{Final}^{1/4}] =$$

$$= [E_{Final} / E_{Initial}]^{1/4} / (M_{Final} / M_{Initial}] . \quad (11)$$

Here we have:

$E_{Final} = X^{+,-} + Y^* + (e^+ + e^-)_{bare}$, where $(e^+ + e^-)_{bare} = 1.0208$ MeV is the bare mass of the electron-positron pair produced by the charged torus $X^{+,-}$ outside it [1],

$E_{Initial} = X^{+,-}$,

$M_{Final} = \pi^o$, where $\pi^o = 134.97674$ MeV [1],

$M_{Initial} = 2(e^+ + e^-)$ which is the spin-zero pair of the spin-1 electron-positron pairs produced inside the charged torus. Such quadrupole does not violate the half-integral spin of the charged core. Here $e^{+,-} = 0.5109989$ MeV [1].

It leads to

$$\alpha_{W,proton} = 0.01872253 \approx 0.018723 , \quad (12)$$

as it should be.

3. Summary

Here, using an extension of the dynamics of the core of baryons, we reduced number of the initial iterative numbers applied in SST from 3 to 2.

References

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