The Nuclear Weak Coupling Constant

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Abstract: Here, applying the theory of stars to the Einstein-spacetime condensates which are responsible for the weak interactions, from the experimental masses of the three constituents of atoms, we calculated the nuclear weak coupling constant with high accuracy: 0.68584.

1. Introduction

The nuclear weak coupling constant g_W is measured with very low accuracy.

The α_W defines the intrinsic strength of the weak interaction – here we call it the nuclear weak constant or the weak force coupling constant. Formula which relates α_W to g_W looks as follows

$$g_W^2 = 4 \pi \alpha_W . \quad (1)$$

Here, applying the theory of stars to the Einstein-spacetime condensates which are responsible for the weak interactions [1], from the experimental masses of the three constituents of atoms [2], we calculated the nuclear weak coupling constant with high accuracy: $g_W = 0.68584$.

According to the Scale-Symmetric Theory (SST) [1], the Einstein-spacetime (ES) condensates (i.e. the regions with higher number density of the neutrino-antineutrino pairs) behave similarly to ionized gas in the stars. The theory of such stars says that the radiation pressure p is directly in proportion to the four powers of absolute temperature T

$$p \sim T^4. \quad (2)$$

The analogous relation ties the total energy emitted by a black body with its temperature. Such theory also suggests that the absolute temperature of a star is directly in proportion to its mass. From it follows that total energy emitted by a star is directly proportional to the four powers of its mass. However, because the Heisenberg uncertainty principle results that the lifetime of a particle is inversely proportional to its energy, we obtain that the lifetime of a condensate is inversely in proportion to the mass to the power of four

$$\tau_{Lifetime} \sim 1 / m^4. \quad (3)$$

SST shows that the formula for the coupling constants of the Standard Model (SM) interactions is as follows:

$$\alpha_i = G_i M m / (c \hbar). \quad (4)$$

The energy of the interaction defines the formula

$$\Delta E_i = G_i M m / r, \quad (5)$$

then from (4) and (5) we obtain

$$\Delta E_i = \alpha_i c \hbar / r = m_i c^2. \quad (6)$$

From the uncertainty principle and formula (6) we obtain

$$\tau_{Lifetime} \sim 1 / \alpha, \quad (7)$$

where α is the coupling constant of interaction.

From (3) and (7), for the ES condensates, we have

$$\tau_{Lifetime} \sim 1 / \alpha \sim 1 / m^4, \quad (8)$$

which leads to following formula

$$\alpha_W = \alpha_{EM} (M_W / M_{EM})^4, \quad (9)$$

where $\alpha_{EM} = 1/137.036$ is the fine structure constant, M_W is some weak mass, and M_{EM} is some electromagnetic mass.

From (8) results that for ES condensates (which in SST are responsible for the weak interactions) the lifetime is not proportional to the inverse square of the weak force coupling constant as it is in the orthodox theory of weak interaction.

Notice also that from (4) follows that for a pair of condensates ($m \rightarrow 2m$) the weak force coupling constant is two times higher.

2. Calculations

Due to the very long lifetime of the neutron, it is obvious that the mass distance between the neutron and proton is the weak mass

$$M_W = n - p = 1.2933321(5) \text{ MeV [2]}. \quad (10)$$

On the other hand, the photons (or the electron-positron pairs) are responsible for the electromagnetic interactions so mass of two electrons is the electromagnetic mass

$$M_{EM} = 2\, e = 1.0219978922(62) \text{ MeV [2]}. \quad (11)$$

From (9) – (11) we have

$$\alpha_W = 1 / 53.43114 \,. \tag{12}$$

But to compare the weak force coupling constant with the fine-structure constant we must take into account pair of condensates – it is because there is the electron-positron pair. For a pair of condensates is

$$\alpha_{W,pair} = 2\ \alpha_W = 1 / 26.71557 \,. \tag{13}$$

In the orthodox theory, such value is estimated at ~1/30 [3].
Our results give

$$\alpha_{W,pair} / \alpha_{EM} = 5.1294 \text{ and } g_W = 0.68584 \,. \tag{14}$$

3. Summary

Here most important is the fact that accuracy of the SST results is much higher than in the orthodox theory, that the SST theory is mathematically very simple and consistency with experimental results of more than a thousand results obtained within SST is much higher than in the Standard Model.

In paper [1], we calculated the $\alpha_W{}^* = 1/53.4105$ ab initio from the properties of the inflation field. In paper [1], we do not apply formula (9) to calculate $\alpha_W{}^*$. Applying formula (9) to $\alpha_W{}^*$ we obtain following mass of neutron: $n = 939.5655$ MeV.

References

[1] M. Tanabashi *et al.* (Particle Data Group).
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