QUANTUM COSMOLOGY, NEW SCALING, MASS OF OSCILLATING NEUTRINO AND LIFE

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"Suppose, for simplicity, that there is the God. Yes. The question is why He will do explosions? Why show bad example for future terrorists on Earth?..." (E. A. Novikov, Essay "God and explosions", 2012).

Abstract

From the quantum modification of general relativity (Qmoger), supported by cosmic data (without fitting), a new quantum scaling is derived. This scaling indicates a mechanism of formation new particles from the background matter. Based on this scaling, mass of neutrino is estimated in agreement with experimental bounds. The neutrino oscillations are explained in terms of interaction with the background quantum condensate of gravitons. Subjective experiences (qualia) and functioning of living cell are also connected with the background condensate.

Key words: quantum cosmology, scaling, neutrino, qualia.

In the quantum modification of general relativity (Qmoger), in contrast with the conventional Big Bang theory, the matter (energy) is produced continuously by the vacuum. Qmoger equations [1-3] differ from the Einstein equations of general relativity by two additional terms, responsible for the production of matter. In Qmoger, production of new particles from the background matter takes place in local bangs in a manner, which is described by exact general analytical solution of the (1+1)-dimensional Newtonian gravitation [4].

The simplest situation with production of matter is when averaged density of matter is constant: $\rho = \rho_0$. In Ref. 5 a more general situation is considered with $w = \rho c^2 + p = w_0$ (w - density of enthalpy, p - pressure, c - speed of light). Taking into account, that averaged pressure is small, for many purposes the dust approximation ($p = 0$) is useful. In this case, the large-scale dynamics of the universe in Qmoger theory is determined by three physical parameters: gravitational constant G, c and ρ_0. From these parameters we have unique scale:

$$L_* = \frac{c}{(G\rho_0)^{1/2}}, \tag{1}$$

We use value $\rho_0 \approx 2.6 \cdot 10^{-30} gcm^{-3}$, which, according to WMAP, includes ordinary and dark matter. We do not include the dark energy, which does not exist in Qmoger (see below). (1) gives $L_* \approx 76$ billion light years (bly) [2, 3], which is comparable with the current size of the visible universe $a_0 \approx 46.5$ bly.

Qmoger equations have corresponding exact analytical solution [6, 2, 3, 5] for the scale factor a in homogeneous and isotropic universe:

$$a(\tau) = a_0 \exp[H_0\tau - 2\pi(\tau/L_*)^2],\ \tau = ct, \tag{2}$$

where H_0 is the Hubble constant, divided by c, which is the current value of function $H(\tau) = d(\ln a)/d\tau$. Remarkably, $L_*H_0 \approx 2.6$. Solution (2) do not have any fitting parameters and quantitatively agrees with cosmic data [6, 2, 3, 5]. This solution also eliminates major controversies, such as critical density of the universe, dark energy (cosmological constant) and inflation.

In nonrelativistic regime, Qmoger reproduces Newtonian dynamics, but the speed of the gravitational waves can be different from c. This give us a hint, that gravitons have mass. With scale (1) we associate gravitons with mass $m_0 = \hbar/(cL_*) \sim 0.5 \cdot 10^{-66} gram$ and electric dipole moment (EDM) $d \sim m_0^{1/2} l_P^{3/2} c \sim 2 \cdot 10^{-72} gram^{1/2} cm^{1/2} s^{-1}$[2, 3], where $l_P = \left(\hbar G/c^3\right)^{1/2}$ is the Planck scale. EDM of background particles can explain the baryon asymmetry in terms of breaking the reflection symmetry. It is shown [2, 3], that such particles form quantum condensate even for high temperature [2, 3].

In the isenthalpic case ($w = w_0$), which takes into account radiation [5], Qmoger equations have the same solution (2) with $L_w = c^2 \left(Gw_0\right)^{-1/2}$instead of L_*. These two scales are very close because averaged pressure in small.

During formation of galaxies, in stars and in hot planets (Jupiter, Saturn), the local density of matter becomes large and new particles are synthesized. In these processes, instead of gravitational constant, the Planck constant $\hbar$ becomes important. From c, $\hbar$ and ρ_0, we now have unique scale:

$$l_* = \left(\frac{\hbar}{c\rho_0}\right)^{1/4} \approx 10^{-2} cm \tag{3}$$

We can rewrite (3) in the form:

$$l_* = \frac{\hbar}{cm_*},\ m_* = \rho_0 l_*^3 \approx 2.6 \cdot 10^{-36} gram \approx 1.46 \cdot 10^{-3} eV/c^2. \tag{4}$$

So, scale l_* corresponds to Compton wavelength of a particle with mass of background matter occupying volume of size l_*. This can indicate a mechanism of formation new particles from background matter. Neutrino can be the first generation of particles, produced by the background condensate. Mass m_* corresponds to experimental bound for the mass of neutrino [7]. The time scale:

$$t_* = \left(\frac{\hbar}{\rho_0}\right)^{1/4} c^{-5/4} \approx 3.3 \cdot 10^{-13} s \tag{5}$$

could be associated with the neutrino oscillations. The physics of these oscillations can be related to interaction of neutrino with the background condensate of ultralight gravitons with indicated above tiny EDM [2, 3]. The averaged number of background particles interacting with such neutrino can be estimated by $N_* = m_*/m_0 \sim 10^{30}$.

The new scaling predict bigger EDM for neutrino or similar particles:

$$d = \hbar^{3/2} c^{1/2} \rho_0^{-1/2} \approx 5.8 \cdot 10^{-11} g^{1/2} cm^{5/2} s^{-1}. \quad (6)$$

Note, that Qmoger theory with its seeping gravitons [2, 3] could also lead to correction of some deficiencies of the quantum field theory, particularly, the inequivalent representations [8]. Indeed, the active background can eliminate unstable representations of reality.

The big bonus of Qmoger is the explanation of subjective experiences (qualia) in terms of interaction between background dipolar condensate and the neuron system [9]. The action potentials of living cells, particularly, neurons [10], create traps and coherent patterns in the condensate, which we actually see and feel. By manipulating with action potentials and quantifying qualia response, we can open a new window into the dark sector of matter.

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