The Mass of the Universe and Other Relations in the Idea of a Possible Cosmic Quantum Mechanics

Ioannis Iraklis Haranas* and Michael Harney†

*Department of Physics and Astronomy, York University, 314A Petrie Building, North York, Ontario, M3J-1P3, Canada
E-mail: ioannis@yorku.ca

†841 North 700 West, Pleasant Grove, Utah, 84062, USA
E-mail: michael.harney@signaldisplay.com

Recent observations confirm that galactic red-shifts might be quantized and hint a possible new form of quantum mechanics, which could probably explain these observed properties of the galaxies. This brief note investigates some expressions for the mass of the universe M_U, which were obtained with the help of the definition of the new cosmic Planck's constant $\hbar_g$.

Introduction

After it was found that the recession velocities for single and double galaxies appear to be quantized [1] then a new quantum of action was also derived to yield [2, 3]:

$$\hbar_g = \frac{\left(1+\sqrt{3}\right)^2 M}{H} V^2 \cong 7.0\times 10^{74} \text{ erg}\times\text{s}, \tag{1}$$

where $V = 12$ km/s, $M = 10^{44}$ g, and $H = 1.7\times 10^{-18}$ s^{-1}. Using Weinberg's relation for the mass of an elementary particle [4] we can now expect to obtain the mass of the universe if Planck's constant in (2) has been substituted by the new maximum value of the new cosmic quantum of action $\hbar_g$ [5]. Therefore we have

$$M_U = \left[\frac{\hbar_g^2 H}{Gc}\right]^{1/3}. \tag{2}$$

If we now solve for the new defined quantum of action $\hbar_g$ in equations (2), and also use (1) we obtain that the mass of the universe is given by:

$$M_U = \left(1+\sqrt{3}\right)^4 \left[\frac{v^4}{GHc}\right]. \tag{3}$$

Relation (3) was obtained after treating the universe as the "ultimate superparticle" following Weinberg's idea [4], and using his relation for the mass of an elementary particle. If now assume that velocity v corresponds to the radial velocity of the individual "particle" galaxies we can further assume that their velocities are those of the expansion of the universe's horizon, and will be equal to speed of light c, so that we obtain:

$$M_U = \left(1+\sqrt{3}\right)^4 \left[\frac{c^3}{GH}\right]. \tag{4}$$

Substituting for the known values of constants in (4), and using $H = 1.7\times 10^{-18}$ s^{-1} we obtain for the mass of the universe to be

$$M_U = 1.326\times 10^{58} \text{ g}. \tag{5}$$

The mass of the universe found here is actually higher than the universes's actuall mass of 7.5×10^{55} g as given in [6] That could also be due to the contribution of the numerical term that enters the calculations from the definition of the cosmic $\hbar_g$. Since not all the objects in the universe are within such a great cosmic distances to allow $v \approx c$, this could also mean that the cosmic quantum mechanics idea could apply to the universe at very early times when the objects were closer together. To ensure numerically the value of the mass of the universe from (3) a galaxy would have to have a radial velocity $v = 0.254\,c = 7.640\times 10^9$ cm/s. Objects of this redshift are observationally quite frequent. Quasistellar objects or quasars hold the record for redshifts up to $z = 5$ [7]. Therefore it could be that at those cosmic distances that quasars exist qualifies them for possible candidates of cosmic quantum mechanics, which somehow could be effecting their physics. Now suppose that this superparticle universe contains a number of particles in an Euclidean sphere of radius c/H_0 then, following Narlikar [8] we have that:

$$N = \frac{c^3}{2m_p GH}. \tag{6}$$

Using (6) and (4) we can also obtain for the mass of the universe:

$$M_U = \left(1+\sqrt{3}\right)^4 \left[2m_p N\right] = 1.86\times 10^{58} \text{ g}, \tag{7}$$

and where m_P is the mass of the proton, 1.672×10^{-24} g, and $N \approx 10^{80}$ is the total number of particles in the universe.

Let us now consider relation (4) and from that let us try to obtain the mass of the "super-particle" universe at very early times, and near Planck time. For that a very early Hubble constant should be taken into account. Since the age of the universe in general is equal to the inverse of the Hubble constant, then $\frac{1}{H_p} = t_p = \frac{\hbar}{m_{pl}c^2}$ we finally have after simplifying that

$$M_U = \left(1+\sqrt{3}\right)^4 m_{pl} = 1.114\times 10^{-3} \text{ g}. \tag{8}$$

Now let us define the maximum value of the cosmological constant Λ which is defined below [9]

$$\Lambda_{max} = \frac{c^3}{G\hbar} \approx 10^{66}\ \text{cm}^{-2} \tag{9}$$

and occurs during the quantum era of the early universe and using (1) we can now obtain the corresponding $\Lambda_{max}(\hbar_g)$ under cosmic quantum mechanics and so we have

$$\Lambda_{max}\left(\hbar_g\right) = \frac{c^3}{G\hbar_g} = 5.782\times10^{-37}\ \text{cm}^{-2}. \tag{10}$$

Using now (10) together with (4) we can also write for the mass of the universe

$$M_U = \left(1+\sqrt{3}\right)^4 \left[\frac{\Lambda_{max}\left(\hbar_g\right)}{H}\right]\hbar_g = \\ = 1.894\times10^{-17}\hbar_g = 1.325\times10^{58}\ \text{g}. \tag{11}$$

From the above we see that the mass of the universe becomes a multiple of the cosmic $\hbar_g$, or in other words the mass of the universe is now quantized in units of the cosmic $\hbar_g$. That could probably indicate that if cosmic quantum mechanics is in effect in the universe, basic quantities like mass, energy, or angular momentum could also be quantized, in an analogy with ordinary quantum mechanics.

Next if we try to obtain the cosmic quantum mechanical equivalent of Planck time by again substituting $\hbar \to \hbar_g = 7\times10^{74}$ ergs we have:

$$t_{pl_{cos}} = \sqrt{\frac{\hbar_g G}{c^5}} = 4.383\times10^{7}\ \text{s}. \tag{12}$$

This period is well into the radiation era of the universe which lies between $10\ \text{s} \leqslant t \leqslant 10^{12}\ \text{s}$ [10]. Next we can obtain the possible maximum cosmic Planck time for $\hbar_g = 2.228\times10^{94}$ ergs

$$t_{pl_{cos}} = \sqrt{\frac{\hbar_g G}{c^5}} \approx \frac{1}{H_0} = 2.472\times10^{17}\ \text{s}. \tag{13}$$

The time found in (13) is almost the value of the Hubble constant today. This is the matter era of the universe. For the value of time in (13) a temperature close to the microwave background should be calculated. Therefore we have:

$$T = \frac{1.5\times10^{12}}{t^{2/3}} = 3.808\ \text{K}. \tag{14}$$

Next a relation can be derived which connects the mass of the "super-particle universe" to its gravitational energy under the cosmic $\Lambda_{max}(\hbar_g)$. In general the energy of a hadron particle is given by [11]:

$$E_{grav} = \frac{Gm^3c^2}{\hbar^2} \cong NH_0\,. \tag{15}$$

Therefore (4) becomes:

$$M_U = \left(1+\sqrt{3}\right)^4 \left[\frac{\Lambda_{max}\left(\hbar_g\right)}{H_0^2}\right] E_{grav}\left(\hbar_g\right) = \\ = 1.114\times10^{1} E_{grav}\left(\hbar_g\right) = 1.894\times10^{57}\ \text{g}. \tag{16}$$

Conclusions

A relation for the mass of the universe has been derived in the grand scheme of a possible quantum mechanics, an idea that emanates from a probable redshift quantization in observational data. The mass of the universe has been found to depend on three fundamental quantities: i.e. the speed of light, the gravitational constant, and the Hubble parameter. Its numerical value is almost two hundred times higher than the actual mass of the universe. From that another expression for the mass of the universe at very early times has also been retrieved. The mass of the universe at Planck time seems to be slightly larger than the Planck mass by a factor of a hundred. Next making use of a max quantum cosmic cosmological term (lambda) we obtained the mass of the universe, which now appears quantized in the units of cosmic $\hbar_g$. Also the Planck cosmic quantum mechanical time equivalent was obtained for the two different values of $\hbar_g$. The first lies in the radiation era of the universe, and the second in the matter era, being almost the same in magnitude with today's Hubble parameter, from which a temperature of 3.8 K is obtained. Finally the mass of universe was obtained in relation to its gravitational energy. Hence it might be that a relation between ordinary and cosmic quantum mechanics based on the results found might exists, a relation between microcosm and macrocosm an idea, which had been suspected for long.

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