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Quantum Mechanics, Cosmic Acceleration and CMB Radiation

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Quantum Mechanics, Cosmic Acceleration and CMB Radiation

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I. The Reduced Planck's Constant - a Strange Coincidence

Large dimensionless constants and compound physical constants reflects an intrinsic property of nature [1,2]. Whether to consider them or discard them depends on the physical interpretations, experiments and observations. The mystery can be resolved only with further research, analysis and discussions. If m_e and m_p are the rest masses of electron and proton respectively, it is noticed that,

$$\frac{\hbar c}{Gm_p\sqrt{M_0 m_e}} \cong 0.99753 \qquad (1)$$

Where $M_0 \cong c^3/2GH_0$ and the best value [3,4,5] of H_0 is $70.4^{+1.3}_{-1.4}$ Km/sec/Mpc. Surprisingly this ratio is close to unity! How to interpret this ratio?

a) Number of electrons or positrons in the universe

Number of electrons or positrons in the present universe can be expressed as

$$\frac{M_0}{m_e} \cong \left(\frac{\hbar c}{Gm_p m_e}\right)^2 \qquad (2)$$

Considering both the number of electrons and positrons, it is noticed that,

$$\ln\left[\frac{1}{N}\cdot 2\left(\frac{M_0}{m_e}\right)\right] \cong \frac{1}{\alpha} \cong 137.024 \qquad (3)$$

Where N is the Avogadro number and α is the fine structure ratio.

b) To understand the quanta of the angular momentum

Giving a primary significance to the existence of m_e, m_p, G & c, and considering the Machian concept of the distance cosmic back ground [6] in the form of 'distance cosmic mass', $\hbar$ can be considered as the compound physical constant [7,8,9].

$$\hbar \cong \sqrt{\frac{M_0}{m_e}}\cdot\frac{Gm_p m_e}{c} \cong 1.0572\times 10^{-34}\ \text{J.sec} \qquad (4)$$

From the atomic structure point of view also this idea can be strengthened. If electron is revolving round the nucleus, naturally m_p and m_e both are the characteristic physical inputs. By considering the origin of the Bohr radius of Hydrogen atom this proposal can be given a chance. If so: in the expanding universe 'quanta' increases with increasing mass of the universe. Any how this is a very sensitive problem to human thoughts and observations. Considering the 'integral nature' of number of protons, integral nature of $n\cdot\hbar$ can be understood. Considering any two successive integers n and $(n+1)$, their geometric state is $\sqrt{n(n+1)}\cdot\hbar$. if this logic is true, it can be suggested that $\hbar$ is connected with the large scale structure of the expanding universe. The laboratory fine structure ratio is

$$\alpha \cong \sqrt{\frac{m_e}{M_0}}\cdot\frac{e^2}{4\pi\varepsilon_0 Gm_p m_e} \qquad (5)$$

It is the strength of electromagnetic interaction and is an intrinsic property of nature. Cosmic acceleration and dark energy constitute one of the most important and challenging of current problems in cosmology and other areas of physics [10]. If so 'rate of increase in $\hbar$' or 'rate of decrease in α' can also be

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considered as a measure of the cosmic acceleration. With reference to relation (4), magnitude of the Hubble's constant can be fitted as

$$H_0 \cong \frac{Gm_p^2 m_e c}{2\hbar^2} \cong 70.75 \text{ Km/sec/Mpc} \qquad (6)$$

c) Bohr radius of the Hydrogen atom

In hydrogen atom, potential energy of electron in Bohr radius [7, 8] can be expressed as

$$E_P \cong -\frac{e^2}{4\pi\varepsilon_0 G m_p M_0} \times \frac{e^2 c^2}{4\pi\varepsilon_0 G m_p} \qquad (7)$$

Thus, total energy of electron in Bohr radius is

$$E_T \cong -\frac{e^2}{4\pi\varepsilon_0 G m_p M_0} \times \frac{e^2 c^2}{8\pi\varepsilon_0 G m_p} \qquad (8)$$

Considering the integral nature of number of protons (of any nucleus), above relation is

$$E_T \cong -\frac{e^2}{4\pi\varepsilon_0 G\left(n \cdot m_p\right) M_0} \times \frac{e^2 c^2}{8\pi\varepsilon_0 G\left(n \cdot m_p\right)} \qquad (9)$$

where $n = 1, 2, 3, ..$ Thus in a discrete form,

$$E_T \cong -\frac{1}{n^2} \times \frac{e^2}{4\pi\varepsilon_0 G m_p M_0} \times \frac{e^2 c^2}{8\pi\varepsilon_0 G m_p} \qquad (10)$$

Hence 'Bohr radius of hydrogen' atom is

$$a_0 \cong \frac{4\pi\varepsilon_0 G m_p M_0}{e^2} \cdot \frac{G m_p}{c^2} \cong \frac{1}{2}\left(\frac{4\pi\varepsilon_0 G m_p^2}{e^2}\right) \cdot \frac{c}{H_0} \qquad (11)$$

This is a very simple and natural fit. The real beauty of the Mach's principle can be seen here.

$$a_0 \propto M_0 \propto \frac{c}{H_0} \qquad (12)$$

In this way, independent of the telescopic observations, the exact value of the present Hubble's constant can be estimated from the ground based laboratory experiments and thus $\frac{d\alpha}{dt}$ or $\frac{d\hbar}{dt}$ represents a measure of the cosmic acceleration. Since its origin, $\hbar$ is assumed and observed to be a fundamental quantum constant. It means, at present, $\frac{d\hbar}{dt} = 0.$ Hence it can be suggested that, at present there is no expansion or acceleration in the universe.

To establish this fact, one must derive the characteristic cosmic mass $M_0 \cong c^3/2GH_0$ independent of the cosmic critical density $3H_0^2/8\pi G$ concepts. If one is able to show that, H_0 is a cosmic angular velocity variable, then $3H_0^2/8\pi G$ represents the geometric density of the (closed) rotating and expanding universe. Not only that, by considering the universe as a primordial growing and light speed rotating black hole, $(c^3/2GH_0)$ can be obtained and the growing cosmic size can be minimized to (c/H_0).

d) The Coulomb scale: alternative to the Planck Scale

By any chance, if $\hbar$ is a cosmic variable, then what about the validity of 'Planck mass' and 'Planck scale'? Answer is very simple. $\sqrt{\frac{\hbar c}{G}}$ can be replaced with $\sqrt{\frac{e^2}{4\pi\varepsilon_0 G}}$. It can be called as the 'Coulomb mass'. Its corresponding rest energy is $\sqrt{\frac{e^2 c^4}{4\pi\varepsilon_0 G}}$. It can be called as the 'Coulomb energy'. Planck energy can be replaced with the 'Coulomb energy'.

$$M_C \cong \sqrt{\frac{e^2}{4\pi\varepsilon_0 G}} \cong 1.859211 \times 10^{-9} \text{ Kg} \qquad (13)$$

$$M_C c^2 \cong \sqrt{\frac{e^2 c^4}{4\pi\varepsilon_0 G}} \cong 1.042941 \times 10^{18} \text{ GeV} \qquad (14)$$

Here e is the elementary charge and (c^4/G) is the classical limit of force. How to interpret this mass unit? Is it a primordial massive charged particle? If 2 such oppositely charged particles annihilates, a large amount of energy can be released. Considering so many such pairs annihilation hot big bang or inflation can be understood. This may be the root cause of cosmic energy reservoir. Such pairs may be the chief constituents of black holes. In certain time interval with a well defined quantum rules they annihilate and release a large amount of energy in the form of γ photons. In the expanding universe, with its pair annihilation, origin of the CMBR can be understood.

It is widely accepted that charged leptons, quarks, and baryons all these comes under matter or mass carriers and photons and mesons comes under force carriers. If so what about this new mass unit? Is it a fermion? or Is it a boson? or else is it represents a large potential well in the primordial matter or mass generation program? Is it the mother of magnetic monopoles? Is it the mother of all charged particles? By any suitable proportionality ratio or with a suitable scale factor if one is able to bring down its mass to the observed particles mass scale, very easily a grand unified model can be developed.

Clearly speaking e, c and G play a vital role in fundamental physics. With these 3 constants space-time curvature concepts at a charged particle surface can be studied. Characteristic 'Coulomb size' can be expressed as

$$R_C \cong \frac{2GM_C}{c^2} \cong 2.716354 \times 10^{-36} \text{ m} \qquad (15)$$

Considering 'light speed rotation', characteristic 'Coulomb scale angular velocity' is

$$\omega_C \cong \frac{c}{R_C} \cong \frac{c^3}{2GM_C} \cong 1.085672\times10^{44} \text{ rad/sec} \qquad (16)$$

e) To understand the CMBR temperature

Pair particles creation and annihilation in `free space'- is an interesting idea. In the expanding universe, by considering the proposed charged M_C and its pair annihilation as a characteristic cosmic phenomena, origin of the isotropic CMB radiation can be addressed. Where the free space is occupied by a large massive body, there the pair annihilation of M_C cannot be seen and this may be a reason for the observed anisotropy of CMB. At any time t, it can be suggested that

$$k_B T_t \cong \sqrt{\frac{M_C}{M_t}}\cdot 2M_C c^2 \qquad (17)$$

Where M_t is the cosmic mass at time t and T_t is the cosmic temperature at time t. Please note that, at present

$$T_0 \cong \sqrt{\frac{M_C}{M_0}}\cdot\frac{2M_C c^2}{k_B} \cong 3.5175\ ^0\text{Kelvin} \qquad (18)$$

Qualitatively and quantitatively this can be compared with the present CMBR temperature 2.725^0 Kelvin. It seems to be a direct consequence of the Mach's principle. It means - at any time, the cosmic mass or cosmic size play a critical role in the pair annihilation energy of M_C. Initial temperature of the universe can be expressed as

$$T_C \cong \frac{2M_C c^2}{k_B} \cong 2.42\times10^{31}\ ^0\text{Kelvin} \qquad (19)$$

With reference to the present observed CMBR temperature, considering the 3 dimensional average thermal energy $\frac{3}{2}k_B T_t$, above relation can be expressed as

$$\frac{3}{2}k_B T_t \cong \sqrt{\frac{M_C}{M_t}}\cdot 2M_C c^2 \qquad (20)$$

Thus,

$$T_0 \cong \left(\frac{2}{3}\right)\sqrt{\frac{M_C}{M_0}}\cdot\frac{2M_C c^2}{k_B} \cong 2.345\ ^0\text{Kelvin} \qquad (21)$$

In this way, origin of the CMB radiation can be studied. But it has to be discussed in depth. Now, initial temperature of the universe can be expressed as

$$T_C \cong \left(\frac{2}{3}\right)\frac{2M_C c^2}{k_B} \cong 1.61\times10^{31}\ ^0\text{Kelvin} \qquad (22)$$

II. The Critical Density and Its Dimensional Analysis

Assume that, a planet of mass (M) and size (R) rotates with angular velocity (ω_e) and linear velocity (v_e) in such a way that, free or loosely bound particle of mass (m) lying on its equator gains a kinetic energy equal to potential energy as,

$$\frac{1}{2}mv_e^2 = \frac{GMm}{R} \qquad (23)$$

$$R\omega_e = v_e = \sqrt{\frac{2GM}{R}} \quad \text{and} \quad \omega_e = \frac{v_e}{R} = \sqrt{\frac{2GM}{R^3}} \qquad (24)$$

i.e Linear velocity of planet's rotation is equal to free particle's escape velocity. Without any external power or energy, test particle gains escape velocity by virtue of planet's rotation. Using this idea, 'Black hole radiation' and 'origin of cosmic rays' can be understood. Note that if Earth completes one rotation in one hour then free particles lying on the equator will get escape velocity. Now writing, $M = (4\pi/3)R^3\rho_e$

$$\omega_e = \frac{v_e}{R} = \sqrt{\frac{8\pi G\rho_e}{3}} \quad \text{Or} \quad \omega_e^2 = \frac{8\pi G\rho_e}{3} \qquad (25)$$

$$\text{Density, } \rho_e = \frac{3\omega_e^2}{8\pi G} \qquad (26)$$

In real time, this obtained density may or may not be equal to the actual density. But the ratio, $(8\pi G\rho_{real}/3\omega_{real}^2)$ may have some physical meaning. The most important point to be noted here, is that, as far as dimensions and units are considered, from equation (26), it is very clear that, proportionality constant being $3/8\pi G$,

$$\text{density} \propto (\text{angular velocity})^2 \qquad (27)$$

Equation (26) is similar to ''flat model concept'' of cosmic ''critical density''

$$\rho_c = \frac{3H_0^2}{8\pi G} \qquad (28)$$

Comparing equations (26) and (28) dimensionally and conceptually,

$$\rho_e = \frac{3\omega_e^2}{8\pi G} \text{ with } \rho_c = \frac{3H_0^2}{8\pi G} \qquad (29)$$

$$H_0^2 \to \omega_e^2 \quad \text{and} \quad H_0 \to \omega_e \qquad (30)$$

In any physical system under study, for any one 'simple physical parameter' there will not be two

different units and there will not be two different physical meanings. This is a simple clue and brings ''cosmic rotation'' into picture. This dimensional analysis cannot be ignored.

III. Modified Hubble's Law

Ever since the late 1920's, when Edwin Hubble discovered a simple proportionality between the redshifts in the light coming from nearby galaxies and their distances, we have been told that the Universe is expanding. Hubble found the recession speed v of a nearby galaxy was related to its radial distance r, $v = H_0 r$, where H_0 is the constant of proportionality. This relationship- dubbed the Hubble law- has since been strengthened and extended to very great distances in the cosmos. This was the incomplete interpretation that changed the destiny of the modern cosmology. Based on this interpretation modern cosmologists arrived at the conclusion that - at present, universe is flat and is accelerating. Later in his life Hubble varied from his initial interpretation [11] and said that the Hubble law was due to a hitherto undiscovered mechanism, but not due to expansion of space - now called cosmological expansion.

For the same observations it can also be possible to state that, in a closed and expanding universe, from and about the cosmic center, rate of increase in galaxy redshift is a measure of cosmic rate of expansion. This statement includes 3 points. 1) Light from the galaxy travels opposite to the direction of cosmic expansion and shows redshift and thus redshift is a measure of galaxy distance from the cosmic center. 2) In the expanding universe, increase in redshift is instantaneous due to instantaneous increase in galaxy distance (which is due to instantaneous increase in cosmic volume) and 3) Rate of increase in redshift indicates the cosmic rate of expansion.

a) The proposed 4 assumptions

Starting from the Coulomb scale, it is assumed that, at any time (t),

1) The universe can be treated as a primordial rotating and growing black hole.
2) With increasing mass and decreasing angular velocity, the universe is always rotating with speed of light.
3) 'Rate of decrease' in CMBR temperature is a measure of cosmic 'rate of expansion'.
4) 'Rate of decrease' in laboratory fine structure ratio is also a measure of cosmic 'rate of expansion'.

At time t, cosmic size is $R_t \cong 2GM_t/c^2$ and cosmic angular velocity is $\omega_t \cong c/R_t \cong c^3/2GM_t$. Thus $M_t \cong c^3/2G\omega_t$.

b) Universe – the primordial cosmic black hole

Based on the big bang concepts- in the expanding universe, rate of decrease in CMBR temperature is a measure of the cosmic rate of expansion. Modern standard cosmology is based on two contradictory statements. They are - present CMBR temperature is isotropic and the present universe is accelerating. In particle physics also, till today laboratory evidence for the existence of dark matter and dark energy is very poor. Recent observations and thoughts supports the existence of the cosmic axis of evil. Independent of the cosmic red shift and CMBR observations, cosmic acceleration can be verified by measuring the 'rate of decrease' in the fine structure ratio. In this connection an attempt is made to study the universe with a closed and growing model of cosmology.

If the primordial universe is a natural setting for the creation of black holes and other non-perturbative gravitational entities, it is also possible to assume that throughout its journey, the whole universe is a primordial (growing and rotating) cosmic black hole [12-16]. Instead of the Planck scale, initial conditions can be represented with the Coulomb scale.

c) Light speed rotating Black Holes: The special holes

Origin of 'rotating black hole' formation can be understood with the classical power limit (c^5/G) and (Mc^2) within 3 steps. For any rotating celestial body

$$\text{torque}, \tau \le Mc^2 \tag{31}$$

$$\text{power}, P = \tau\omega \le \frac{c^5}{G} \tag{32}$$

$$\text{thus}, \ \omega \le \frac{\mathrm{c}^3}{\mathrm{GM}} \ \text{and} \ \omega_{\max} = \frac{\mathrm{c}^3}{\mathrm{GM}} \tag{33}$$

When the celestial body rotates at light speed, to have maximum angular velocity, size should be minimum as,

$$R_{min} = \frac{c}{\omega_{max}} = \frac{GM}{c^2} \tag{34}$$

This expression is similar to the 'Schwarzschild radius' of a black hole. The only change is that coefficient 2 is missing. This is really a very interesting case. This obtained expression indicates that, to get 'light speed rotation', celestial body should have a 'minimum size' of GM/c^2. Clearly speaking this proposal is entirely different from the existing concepts of General theory of relativity. It is not speaking about the gravitational collapse of stars or space-time curvature or singularity. Now this is the time to re-examine the foundations of modern black hole physics. If the concept of 'Schwarzschild radius' is believed to be true, for any rotating celestial body or black hole of rest mass (M) the critical conditions can be stated as follows. 1) Magnitude of 'kinetic energy' never crosses 'rest energy'. 2) Magnitude of 'torque' never crosses 'potential energy' and 3) Magnitude of mechanical

power never crosses (c^5/G). Note that, based on the Virial theorem, potential energy is twice of kinetic energy and thus, $\tau \leq 2Mc^2$.

IV. Conclusion

The proposed methodology is very simple. Searching, collecting, sorting and compiling the cosmic code is an essential part of unification. Further research and analysis in this new direction may reveal the facts.

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