New Interpretation of the Cosmological Red Shift: Which can do away with the Dark Energy

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ABSTRACT

The currently popular 'Big Bang Theory' is based on 'Doppler Shift Interpretation' of the 'cosmological-red-shift'. But it is shown here that the value of Hubble-constant matches so perfectly with the strength-ratio of gravitational and electric forces, that such a coincidence is very un-likely. Secondly, if the expansion of the universe is accelerating, as the recent observations suggest, e.g.(Paal, G. *et al.* 1992, Adam G. Riess *et al.*1998, and Perlmutter, S. *et al.*1999)[1,2,3], then very large amount of dark-energy may be needed which is still not found. Therefore, it is proposed here that extra galactic photons may be loosing some of their energy through 'vacuum polarization', as described by Levine, I. (1997)[4] and Brown et al (1996)[5]. It is proposed here that: when an extra galactic photon is absorbed by either electron or positron of the virtual electron positron pair, then not only the 'electrostatic potential energy' of the pair is increased, but also its 'gravitational potential energy' as well; but when these 'potential energies' are released, then not only a photon, but also a graviton is emitted; so the input energy gets branched out. And we find here that the energy lost by the 'cosmologically red shifted photons' is strikingly proportional to the 'strength ratio' of gravitational and electric forces. Since, according to this new interpretation for the 'cosmological red shift, the red-shift is a function of distance traveled by the photon, rather than relative velocity of the galaxies; so his study will also do away with the need for the 'dark energy'.

1. Introduction:

If the universe were expanding due to the big bang, then the value of Hubble-constant could have been any. But the measured value of Hubble-constant matches so strikingly with the strength-ratio of gravitational and electric forces, and some other constants, as this study reveals, that we get the strikingly interesting relations, as derived in the next section; which motivate us to consider alternative mechanisms for the 'cosmological red shift'. Alternative mechanisms for the 'cosmological red shift' have been rejected so far, under an assumption that they are not compatible with the observations of 'time dilation of super novae light curves'; but it was shown by this author in (Tank, H. K. Adv. Studies Theor. Phys., Vol. **7**, no. 18, 2013)[6] that any mechanism which can cause 'cosmological red shift', will also cause 'time dilation of super novae light curves'. The following derivations will indicate the need for reconsidering the Doppler shift interpretation of the 'cosmological red shift' and the 'Big Bang Theory'.

Interesting difference between the standard Doppler-shift-interpretation (in which red-shift is a function of relative velocity), and the proposed new one here, of branching-out of input-energy into gravitational and EM-waves, (in which red-shift is a function of distance traveled by the photon), is: that after every unit-distance, say one-light-year, the red-shifted-frequency f becomes the new input-frequency f_0 for the next unit-distance; making the red-shift-distance-curve non-linear, as observed by Perlmutter and Riess; like the telescopic-railway-fare, or like the reducing piano-frequency which gets divided by 1.104 with every key. So, according to this new explanation for the 'cosmological red shift', there is no need for any 'dark energy'. As soon as 'cosmological-red-shift' gets understood as a propagation-property of light, then 'gravity' can be understood as due to 'cosmological-red-shift-effect' on the photons exchanged between the particles.

2. The Derivations:

The cosmological red-shift, smaller than unity, is expressrd as:

$z_c = \Delta\lambda / \lambda_0 = H_0 D / c$ ....(1).

i.e. $H_0 D / c = h H_0 / (h c / D)$.

Now, Weinberg has found an interesting relation that:

$m_p^3 = h^2 H_0 / c G$, where, m_p is mass of a fundamental-particle, pi meson.

i.e. $G m_p^2 / (h / m_p c) = h H_0$ . ...(2).

So, from the expressions 1 and 2, we get:

$z_c = \Delta\lambda / \lambda_0 = [G m_p^2 / (h / m_p c)] / [h c / D]$. ....(3).

i.e. $z_c = \Delta\lambda / \lambda_0 = [G m_p^2 / h c] [D / (h / m_p c)]$.

i.e. $z_c = h \Delta\nu / h \nu = [G m_p^2 / h c] [D / (h / m_p c)]$. ....(4).

That is, the reduction in energy of photon due to cosmological-red-shift is proportional to the strength-ratio of gravitational and electric forces.

Alternatively, let us define z_e as:

$z_e = [e^2 / r_e] - [e^2 / (r_e + D)] / [e^2 / (r_e + D)]$, where, e is electric-charge, r_e is 'classical radius of electron' and D is 'luminosity distance'.

i.e. $z_e = e^2 [r_e + D - r_e] [r_e + D] / [r_e (r_e + D) e^2]$.

i.e. $z_e = D / r_e$.

From Dirac's Large-Number-Coincidence, we know, that:

$(G\, m_e\, m_{\mathrm{p}} / e^2) = (r_{\mathrm{e}} / R_0) = (m_p / M_0)^{1/2} = 10^{-40}$, where, M_0 total mass and R_0 radius of the universe.

i.e. $z_{\mathrm{e}} = 10^{-40} (D / R_0)$. ……………………………………………………………..(5).

Since $H_0 R_0 = c$, $z_{\mathrm{c}} = H_0 D / c = D / R_0$. ……………..…………………………..…..(6).

Comparing the expressions (5) and (6), we get:

$z_{\mathrm{c}} = 10^{-40} z_{\mathrm{e}}$. ……………………………………………………..(7).

That is: 'cosmological-red-shift', at a distance D is $(G\, m_e\, m_{\mathrm{p}} / e^2)$ times the reduction expected from the 'electrostatic potential energy' of an electron at that distance D.

Secondly, the 'self gravitational potential energy' of a fundamental particle also matches strikingly with the energy $h\, H_0$ as follows:

$G\, m_p^{\,2} / (h / m_p\, c) = h\, H_0$, …………………………………………………………(8)

where, m_p is mass of pi-meson, h is Planck's constant, H_0 is Hubble constant, G is gravitational-constant, and c the speed-of-light. This relation is derived from the Steven Weinberg's famous formula, $m_p^{\,3} = h^2 H_0 / c\, G$, where, m_p is mass of a fundamental-particle, pi meson.

Thirdly, in addition to the above, the ratios:

$(h\, H_0 / m_p\, c^2) \sim (G\, m_e\, m_{\mathrm{p}} / e^2)$. ……………………………………………..….(9).

These expressions can be made exactly equal by inserting masses of different particles in the expression, e.g. $(G\, m_e\, m_{\mathrm{p}} / e^2)$ or $(G\, m_p\, m_{\mathrm{p}} / e^2)$, $(G\, m_e\, m_{\mathrm{e}} / e^2)$ or $(G\, m_e\, m_{\mathrm{pi}} / e^2)$…etc.

The above relations strongly suggest that 'cosmological-red-shift' seems to be related to the strengths of gravitational and electric forces. One of the possible mechanisms for the 'cosmological red shift' may be the 'vacuum polarization'. It is well known that according to quantum field theory, the vacuum between interacting particles is not simply empty space. Rather, it contains short-lived "virtual" particle-antiparticle pairs which are created out of the vacuum in amounts of energy constrained by the Heisenberg uncertainty principle. After the constrained time, they then annihilate each other. These particle-antiparticle pairs carry various kinds of charges, such as color charge or the more familiar electromagnetic charge. In the case of Hawking-radiation, one of the particles of the pair gets swallowed by the black-hole, leaving the other particle alone, which can be observed. Such charged pairs of virtual-particles act as an electric dipole. In the presence of an electric field of the extra-galactic-photon these particle–antiparticle pairs reposition themselves, thus partially counteracting the field. The field therefore will be weaker than would be expected if the vacuum were completely empty. During their long journey, the extra-galactic-photons are likely to interact with many virtual-particles. If a photon is absorbed by either electron or positron of the electron-positron-pair, then not only the electrostatic-potential-energy of the pair is increased, but also its 'gravitational potential energy' as well; but when these potential-energies are released, then not only a photon, but also a graviton has to be emitted; so the in-put energy gets branched-out. We found from the above derivations that the energy lost by the 'cosmologically red-shifted photons' is strikingly proportional to the strength-ratio of gravitational and electric forces.

3. The cosmological-red-shift smaller than unity can also be expressed as deceleration experienced by the photons (Tank H. K. 2010)[6]:

The cosmological red shift,

$z_c = \Delta f / f = (f_0 - f) / f = H_0 D/c$. ……………………………………………………(10)

(Where: f_0 is frequency of light emitted by a distant star; f is frequency of light received on the earth; H_0 is Hubble's constant; D is luminosity-distance; and c is the speed of light in vacuum.)
We can write the expression-10 as:

$h \Delta f / h f = H_0 D / c$,
(Where, h is Planck's constant; so that $h \Delta f$ and $h f$ have the dimension of energy)

i.e. $h \Delta f = (h f / c^2)\, \underline{(H_0 c)}\, D$ ....(11)

That is, the loss in energy of the photon ($h \Delta f$) is equal to: its mass ($h f / c^2$) times acceleration ($H_0 c$) times the 'luminosity-distance' (D).

Now, Sivaram has noticed that (Sivaram, 1994)[8]:

$G M_0/R_0^2 = G m_P / r_P^2 = G m_e / r_e^2 = G m_n / r_n^2 = G M_{gc} / R_{gc}^2 = G M_{gal} / R_{gal}^2 = G M_{cg} / R_{cg}^2$

$= H_0 c$ ………………………………………………………………………………….(12)

(Here: M_0 and R_0 are mass and radius of the universe respectively, m_P and r_P are mass and radius of the proton, m_e and r_e are mass and radius of the electron, m_n and r_n are mass and radius of the nucleus of an atom, M_{gc} and R_{gc} are mass and radius of the globular-clusters, M_{gal} and R_{gal} are mass and radius of the spiral-galaxies, and M_{cg} and R_{cg} are mass and radius of the galactic-clusters respectively.)

And, the carefully measured values of accelerations experienced by the space-probes Pioneer-10, Pioneer-11, Galileo, and Ulysses are (Anderson, J.D., et. al. 1998)[9]:
For Pioneer-10, $a = (8.09 \pm 0.2) \times 10^{-10}$ meter/sec^2 ,

For Pioneer-11, $a = (8.56 \pm 0.15) \times 10^{-10}$ meter/sec^2,

For Ulysses, $a = (12 \pm 3) \times 10^{-10}$ meter/sec^2, For Galileo, $a = (8.0 \pm 3) \times 10^{-10}$ meter/sec^2, and

For the cosmologically-red-shifted-photons: $a = 6.87 \times 10^{-10}$ meter/sec$^2 = H_0\, c$:

First of all, the matching of accelerations of four different space-probes, in spite of their different masses, speeds and directions, is itself a striking observation; and their matching with the deceleration of cosmologically-red-shifting-photons (Tank H. K.2010) [6], the 'critical-acceleration' of MOND, ($a_0 = 1.2 \times 10^{-10}$ meter/sec^2), and the 'accelerated-expansion' of the universe (= $H_0\, c$), can not be ignored by a scientific mind as an accidental coincidence.

4. Discussion:

This study raises a question: Can the big bang be so precise? If the universe were expanding due to the big bang, then the value of Hubble's constant could be any. The precise matching of Hubble's constant with the 'self gravitational potential energy' of a fundamental particle, as we found in the expression-2, and the energy lost by the 'cosmologically red shifting photons' at a distance D being equal to ($G\, m_e\, m_p / e^2$) times the reduction in electrostatic potential energy of an electron at that distance, as we found in the expression-7; are strikingly interesting! Secondly, the product $H_0\, c$ matches perfectly with the 'self gravitational accelerations' of the pi-meson, the nucleus, the globular clusters, the spiral galaxies, and the universe; and it also matches with the decelerations experienced by the inter galactic photon, Pioneer-10, Pioneer-11, Galileo, Ulysses space-probes, the 'critical acceleration of MOND, and the 'accelerated expansion of the universe'. Can the Big Bang be so precise, that Hubble constant matches so perfectly with so many gravitation-related quantities? Rather, this study may be found useful for finding theoretically predictable value of Hubble's constant. Currently measured value of Hubble constant may be lesser than the actual value, because, when the extra galactic photon enters our milky-way galaxy, the photon also experiences some gravitational blue shift; so we may be measuring lesser value of Hubble constant. We may need to launch Hubble like telescope out side our milky-way galaxy to get exact experimentally-measured value of Hubble constant! This new interpretation of the 'cosmological red shift' can also do away with the need for 'dark energy'.

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