Four Alternative Possibilities that the Universe

May not be Expanding

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Abstract

Alternative-interpretations of cosmological-red-shift are generally rejected on the ground that ‘tired-light-interpretations’ are inconsistent with the observations of time-dilation of super-nova-light-curves; but those curves are time-domain-representations of amplitude of light. These curves can be Fourier-transformed into wave-number-domain, and it is this band of waves that propagates in inter-galactic-space, and reaches us after millions of years. These Fourier-transformed-components, being electromagnetic-waves, get red-shifted by any mechanism that can cause spectral-shift. Thus, time-dilation of super-nova light-curves is not different from red-shift of light due to any mechanism. With this explanation, this letter presents five new possible-mechanisms for the ‘cosmological-red-shift’. They are: (i) Inter-galactic-photons can also get red-shifted due to vacuum-polarization-mechanism; (ii) Spherically-expanding-wave-front of light can be viewed as a spherically-expanding cavity, continuously changing its impedance, causing around -400 dB reflected-power back to the source; (iii) Cumulative-phase-alteration of extra-galactic-photons caused by the cosmic-microwave-background; (iv) Electric-field and magnetic-field of extra-galactic-light in the transverse-directions, causing virtual-electrons to oscillate, and
generating gravitational-field in the longitudinal-direction; losing part of their energy in the form of ‘gravitational-waves’; (v) Though the rest-mass of photon is zero, it has a ‘relativistic-mass’ equal to its momentum-divided-by-its-speed \( \left( \frac{h f}{c^2} \right) \); so this ‘relativistic-mass’ of the photon can radiate gravitational-waves, branching-out its energy into gravitational-wave and electromagnetic-wave; and as a supportive-evidence, it is shown here that the energy lost by ‘cosmologically-red-shifting-photons’ is strikingly proportional to the strength-ratio of gravitational and electric forces.

**Keywords**: Cosmology, Astrophysics, Cosmological-Red-Shift, Vacuum-Polarization, Dark-Matter, Dark-Energy

### 1. Introduction

If the expansion of the universe is accelerating, as the current interpretation of the observations suggest \([1,2,3]\), then very large amount of dark-energy may be needed (68.3 % of total) for the closer-density. And to understand the flattening of galaxies’ rotation-curves, 26.8% dark-matter is needed. But we know very little whether dark-matter and dark-energy really exist; and if so, what is their nature. So, as an alternative possibility, ‘cosmological-red-shift’ was expressed by Tank \([4]\) as a deceleration experienced by the extra-galactic-photon. In \([5\text{ and }6]\) it was observed that energy lost in cosmological-red-shift is proportional to the strength-ratio of gravitational and electric forces. Then in \([7]\) a wave-theoretical-explanation for the strengths of gravitational and electric forces was proposed. Now in this letter five new possible mechanisms, which can contribute to good percentage of the cosmological-red-shift; and possible reasons, why ‘cosmological-red-shift’ is proportional to the strength-ratio of gravitational and electric forces are proposed. 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. Therefore, it will be interesting for the experts to consider these possibilities in detail.

### 2. Detailed Description of Various Possibilities

(i) 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
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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. It is shown, in the next paragraph, that the energy lost by the cosmologically-red-shifted-photons is strikingly proportional to the strength-ratio of gravitational and electric forces.

Cosmological red-shift: 

\[ z_c = \frac{\Delta \lambda}{\lambda_0} = \frac{H_0 D}{c} \], i.e. \[ z_c = h \frac{H_0}{(h c / D)} \] ..........(1)

Now, Weinberg has found an interesting relation [8], that:

\[ m_p^3 = \frac{h^2 H_0}{c G} \] where \( m_p \) is mass of a fundamental-particle, pi-meson.

i.e. \( G \frac{m_p^2}{(h / m_p c)} = h H_0 \) ..................................................(2)

From the expressions 1 and 2:

\[ z_c = \frac{\Delta \lambda}{\lambda_0} = [G m_p^2 / (h / m_p c)] / [h c / D] \]

i.e. \( z_c = \frac{\Delta \lambda}{\lambda_0} = [G m_p^2 / h c] [\{(e^2 / (h / m_p c)) / (e^2 / D)\}] \) ..............................................(3)

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

That is, the reduction in energy of a photon due to cosmological-red-shift is proportional to the strength-ratio of gravitational and electric forces [5].

Alternatively, let us define \( z_e \) as:

\[ z_e = \left[ \frac{e^2}{r_e} \right] - \left[ \frac{e^2}{(r_e + D)} \right] / \left[ \frac{e^2}{(r_e + D)} \right] \] where: \( e \) is electric-charge, \( r_e \) is classical-radius-of-electron, and \( D \) is luminosity-distance.
i.e. \( z_e = e^2 \left[ r_e + D - r_e \right] \left[ r_e + D \right] / \left[ r_e \left( r_e + D \right) e^2 \right] \)

i.e. \( z_e = D / r_e \)

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

\[
\left( G \frac{m_e m_p}{e^2} \right) = \left( \frac{r_e}{R_0} \right) = \left( \frac{m_p}{M_0} \right)^{1/2} = 10^{-40} \text{ where } M_0 \text{ and } R_0 \text{ are mass and radius of the universe, respectively.}
\]

i.e. \( z_e = 10^{-40} \left( D / R_0 \right) \)

Since \( H_0 R_0 = c \), \( z_e = H_0 D / c = D / R_0 \) ...........................(5)

i.e. \( z_e = 10^{-40} z_e = \left( G m_e m_p / e^2 \right) z_e \) ...........................(6)

That is: ‘cosmological-red-shift’ is \( \left( G m_e m_p / e^2 \right) \) times the reduction expected from the electrostatic-potential-energy [6].

(ii) Spherically-expanding-wave-front of light can be viewed as a spherically-expanding cavity, continuously changing its impedance, causing some reflected-power back to the source; so the energy in the direction-of-observer goes on reducing with distance. In the man-made-wave-guides a standing-wave-ratio of -60 dB is considered as ‘excellent’. -60 dB means: \( 10 \log_{10} \frac{P_{\text{Reflected}}}{P_{\text{Forward}}} = -60 \); That is \( P_{\text{Reflected}} / P_{\text{Forward}} = 1/1000000 \) is considered as excellent. Whereas, the strength-ratio of electric-forces to gravitational-forces is of the order \( 10^{40} \). That means, some -400 dB power may be getting reflected back towards the star, due to continuously-changing impedance of the expanding-spherical-cavity, which is not very improbable. It will be interesting for the physicists to recall the Huygens–Fresnel principle, in which every point on the wave-front is viewed as a point-source. These point-sources must radiate energy in all the directions, including backward direction.

(iii) Cumulative-phase-alteration of extra-galactic-photons by the cosmic-microwave-background: Let us imagine the electric-field of the galactic-light as a vector in horizontal-direction, and magnitude 3 cm; and electric-field of ‘cosmic-microwave-back-ground’ (CMB) as a vector at minus 30°, and magnitude 3 mm. So the resultant-vector gets shifted back by some angle theta. This process of vector-addition of 4° Kelvin CMB to the galactic-light continues for millions of years, producing cumulative-phase-alteration of the galactic-light. We communications-
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engineers use band-pass-filters to remove unwanted noise, but in extra-galactic-space there are no filters, so the phase alterations get accumulated for millions of years.

(iv) Electric-field and magnetic-field of light in the transverse-directions, can cause the virtual-electrons to oscillate. Since the electron contains some ‘mass’ in addition to the ‘charge’, a gravitational-wave is also expected to get produced; thus photons losing part of their energy in the form of ‘gravitational-waves’. We noted earlier, that the reduction-in-energy of the ‘cosmologically-red-shifting-photons’ is \( \frac{G m_e m_p}{e^2} \) times the reduction expected of electro-static-potential-energy’ at that distance \( D \). This is a very interesting thing noticed here about the ‘cosmological-red-shift; providing supportive-evidence for our hypothesis; that cosmological-red-shift can be due to branching-out of radiated-energy into electromagnetic-wave and gravitational-wave.

(v) Though the rest-mass of photon is zero, it has a ‘relativistic-mass’ equal to its momentum-divided-by-its-speed \( \left( \frac{h f}{c^2} \right) \). Just as an electron in an atom ‘jumps’ from higher-orbit to lower-orbit, radiating a photon, the photon can be viewed as jumping from one position to another position. And the ‘relativistic-mass’ of the photon can radiate gravitational-waves, branching-out its energy into gravitational-wave and electromagnetic-wave. It was shown in the previous section that the energy lost by ‘cosmologically-red-shifting-photons’ is strikingly proportional to the strength-ratio of gravitational and electric forces.

3. Conclusion

Energy lost by the cosmologically-red-shifted photons is \( \left( \frac{G m_e m_p}{e^2} \right) \) times the loss expected due to reduction in electrostatic-potential-energy of electron at that distance \( D \) is an interesting new finding. Possible reason for it may be either (i) branching out of radiated energy into gravitational-waves and the electromagnetic-waves, in the presence of virtual-particles due to vacuum-polarization; or (ii) a small part of energy of light (around -400 dB) getting reflected back to the source due to continuous change of impedance of the cavity formed by the spherically-expanding wave-front of extra-galactic-light; or (iii) extra-galactic-photons may be experiencing ‘cumulative-phase-alteration’ due to ‘cosmic-microwave-background’; or (iv) oscillations of virtual-electrons due to electromagnetic-field of the extra-galactic light giving rise to both, gravitational as well as electromagnetic waves, or (v) ‘relativistic-mass’ of the photon radiating gravitational-waves, branching-out its
energy into gravitational-wave and electromagnetic-wave, proportional to the strength-ratio of gravitational and electric forces; are indicated here as possible new mechanisms for the ‘cosmological-red-shift’; for the experts to consider the details. Interesting difference between the standard Doppler-shift-interpretation and the proposed new one here, of branching-out of input-energy into gravitational and EM-waves, 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. 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. Therefore, it will be interesting for the experts to consider these possibilities in detail.

**References**


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