Wave-theoretical-insight into the Relativistic-length-contraction, Time-Dilation of Super-Nova Light-Curves and Five Alternative Interpretations of the Cosmological-red-shift

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This paper makes use of some astronomical-observations to gain deeper insight into the foundations of physics. 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; whereas it is shown here that these curves are time-domain-representations of amplitude of light. So, these curves can be Fourier-transformed into wave-number-domain, and it is this *wide band of waves* which 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, and when transformed back into time-domain, show time-dilation. Thus, time-dilation of super-nova light-curves, or the relativistic-time-dilation, means 'red-shift of light' due to any mechanism. Similarly, the relativistic-length-contraction is also explained using wave-theory. With this explanation, this letter presents five new possible-mechanisms for the 'cosmological-red-shift'; which will also give some insight into pure physics. These alternative-interpretations 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 ($h f / c^2$); 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.

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 2011 and 2013 it was observed that energy lost in cosmological-red-shift is proportional to the strength-ratio of gravitational and electric forces[5,6]. And in 2012 a wave-theoretical-explanation for the strengths of gravitational and electric forces was proposed[7]. 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.

The next section explains in detail how the observations of time-dilation of super-nova-light-curves are not inconsistent with alternative interpretations of the cosmological-red-shift; and then follows the detailed descriptions of five new possible alternative interpretations of the cosmological-red-shift.

2. How the Observations of 'Time-dilation of Super-Nova-light-curves' are not inconsistent with the tired-light-interpretations of the cosmological-red-shift:

Any physical-process taking some 'duration' of 'time' can be mathematically described as a 'gate-function' in the 'time-domain'; and then it can be Fourier-transformed into the 'frequency-domain', as shown in fig.1 [9]. Fig.2 shows that compression in 'time-domain' means expansion in the 'frequency-domain', i.e. widening of the spectrum; and expansion in 'time-domain' means shrinking of spectrum in the frequency-domain. In addition to the 'amplitudes' of every spectral-component in the frequency-domain, there is a phase-spectrum also, not shown in the figures. Shifting of the 'gate' in time does not change the amplitude-spectrum, but it does change the 'phase-spectrum'; i.e. a gate of one-second-duration at the origin of the graph, differs from another gate of one-second-duration between fifth-and-sixth seconds on the graph in terms of phase-difference of every corresponding-spectral-components. Similarly, an object of one meter length at the origin can be mathematically-represented as a 'gate-function' in 'space-domain' and can be Fourier-transformed into 'wave-number-domain'. And another object of one meter length at a distance x meters from the origin will have the same 'amplitude-spectrum' in the wave-number-domain, but a different 'phase-spectrum'; i.e. each

and every component of the spectrum, say thousand-waves-per-meter, has some phase-shift compared to its peer-component at the origin. With this back-ground let us now try to understand the relativistic length-contraction first; and then relativistic-time-dilation-of super-nova-light-curves, as discussed in the next section.
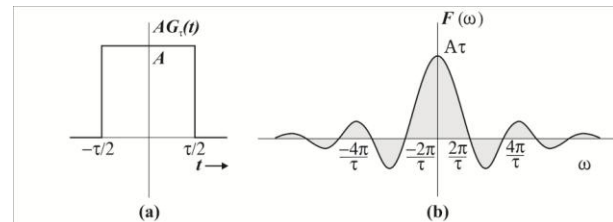

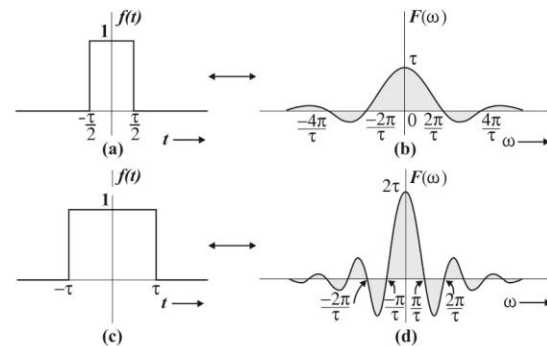Fig.:1 (a) A gate function. (b) Transform of a gate function.

Fig.:2 Compression in the time domain is equivalent to expansion in the frequency domain.

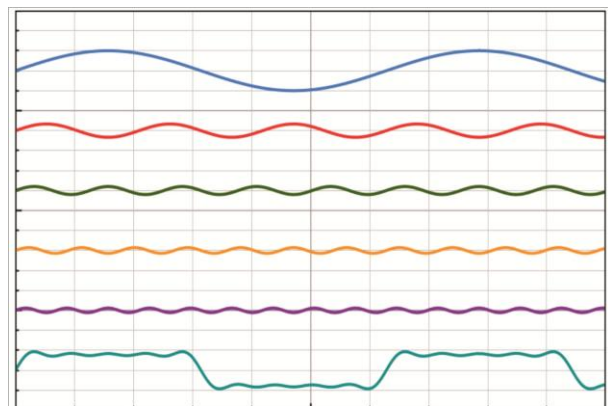## 2.1. Relativistic Length-Contraction with Speed:

Fig.3: Graphs of spectral-components sin(x), sin(3*x)/3, sin(5*x)/5, sin(7*x)/7, sin(9*x)/9 and their superimposition: sin(x)+sin(3*x)/3+sin(5*x)/5+ sin(7*x)/7+ sin(9*x)/9 forming a 'gate-function'. All components are at the same phase 0° at the origin x=0, but they are at different phase-angles at different values of x.

As discussed in the presiding paragraph, an object-of-one-meter-length-at-a-distance x meters from the origin, differs from the object-of-one-meter-length-at-the-origin in terms of 'phase-difference' of each-and-every component of its 'wave-number-spectrum'; though its 'amplitude-spectrum' is identical to the 'amplitude-spectrum' of the object at the origin. Now, when the object at the distance x moves with a velocity v, then the 'phase-difference' of each-and-every spectral-component will keep changing with time; i.e. there will be some 'rate-of-change-of-phase'; and we know, that 'rate-of-change-of-phase' means 'frequency'! That is, when an object moves with respect to the other object at the origin at some speed, then there is a shift in wave-number of each-and-every spectral-component, by some factor, say each spectral component gets multiplied by a factor 1.2. Therefore, if the spectrum corresponding to an object at rest, at the origin, is from one-wave-per-meter to ten-waves-per-meter then the spectrum of the object moving with a speed v will have 1.2 waves-per-meter to 12 waves-per-meter. So, the width of the spectrum, which was $10 - 1 = 9$ wave-numbers, changes to $12 - 1.2 = 10.8$ wave-numbers. And from the fig.2 we find that 'expansion of spectrum in 'wave-number-domain' means 'shrinking-of-length' in 'space-domain'. Special-Relativity describes it as 'Relativistic-length-contraction-with-speed' where as here we understood it in terms of 'Wave-Theory' with the help of Fourier-transform! And super-nova-light-curve can be viewed as a 'gate-function' in the 'time-domain'; and it can be Fourier-transformed into frequency-domain; and it is this wide band of waves which travels in space and reaches us after millions of years. During its travel, when this wide-band of waves gets red-shifted due to any mechanism, including the tired-light-interpretation of the 'cosmological-red-shift', then its band-width shrinks in the frequency-domain; so when it is transformed back into time-domain we find that the duration of the curve has got increased.

Thus, time-dilation of super-nova-light-curves is not an independent observation from the observations of the 'cosmological-red-shift' due to any mechanism. Tired-light-interpretations of the 'cosmological-red-shift' have been rejected on the ground that they are not consistent with the observations of time-dilation of super-nova-light-curves; but now we understand that it is the 'cosmological-red-shift', due to any mechanism, which causes the time-dilation of super-nova-light-curves! So, now we can proceed to consider five new alternative interpretations of the cosmological-red-shift.

3. Five New Possible Alternative Interpretations of the 'Cosmological-red-shift':

(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 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: $z_c = \Delta\lambda / \lambda_0 = H_0 D / c$,

i.e. $z_c = h H_0 / (h c / D)$ ....(1)

Now, Weinberg, (1972) 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)

From the expressions 1 and 2:

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

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

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

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:

$(G m_e m_p / e^2) = (r_e / R_0) = (m_p / M_0)^{1/2} = 10^{-40}$ where M_0 and R_0 are mass and radius of the universe, respectively.

i.e. $z_e = 10^{40} (D / R_0)$

Since $H_0 R_0 = c$, $z_c = H_0 D / c = D / R_0$ …...(5)

i.e. $z_c = 10^{-40} z_e = (G m_e m_p / e^2) z_e$ ....(6)

That is: 'cosmological-red-shift' is $(G m_e m_p / e^2)$ times the reduction expected from the electrostatic-potential-energy .

(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 $\log_{10}$ $P_{Reflected} / P_{Forward} = -60$; That is $P_{Reflected} / P_{Forward} = 1/1000000$ 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-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 (Gm_em_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 ($h f / c^2$). Just as an electron in an atom 'jumps' from higher-orbit to lower-orbit, and 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 (Gm_em_p/e^2) 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.

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