

Since the Time-Dilation of Super-Novae Light-Curves Is Not a Confirmative-Evidence for Expansion of Space-Time and the Universe, Some Alternative Possibilities that the Universe May Not Be Expanding

By:



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ABSTRACT

This paper makes use of some astronomical-observations to gain deeper insight into the fundamental questions of physics and astrophysics. 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 (hf/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. These new alternative explanations also explain the non-linearity of red-shift-distance-curve, observed by Perlmutter and Reiss, without any need for ‘dark-energy’.

Key Words: Cosmology, Cosmological-red-shift, Super-nova-light-curves, Vacuum-polarization, Cosmic-microwave-background,

1. Introduction

According to Einstein, all velocities are relative. And the length of a moving-object gets shrunk as per the formula: $L'=L[1-v^2/c^2]^{1/2}$. Then what would be the diameter of the planet-earth when hundred different space-ships approach the earth at hundred different velocities? Can the diameter of the earth simultaneously shrink to hundred different sizes? Even if it shrinks, where from the thousands of mega-Joules of energy required to shrink the earth’s diameter would come? This paper proposes a casual wave-theoretical-explanation for the Special Relativity.

According to the current interpretation of the cosmological-red-shift, the universe is expanding; and rate of its expansion is getting accelerated with time [1,2,3]. It is said that the distance between the galaxies is getting increased with the expansion of space; but since the galaxies are ‘gravitationally-bound-structures’, the space within the galaxies is not expanding. Now, the question is: what would happen at the edge of the galaxies, whose external-space is expanding but the space within it remains un-expanded? Particularly, when the expansion of space is said to stretch the wavelength of extra-galactic-photon, then why the photon’s wavelength does not shrink-back to its original-length, when it enters the un-expanded space of our milky-way-galaxy?

According to Einstein, the photons are ‘point-particles’. Then the said expansion of space can only increase the path-length of photons; their arrival-time may get delayed, but there should be no other change in them.

According to Copenhagen-interpretation-of-quantum-mechanics, the wavelength of light means the distance between two peaks of highest-density-detections of the particles called photons. If so, then ‘expansion of space’ can only increase the distance between two peaks of highest-

density-detections of the photons, and not the quality of the ‘particle’. Whereas in the case of ‘cosmological-red-shift’ we find that their energy and momentum gets reduced. Is the interpretation of q-m not correct; or the belief of ‘expansion of space’ is not correct?

Supposing, you are traveling along a curved road on a hill. You want to choose the shortest distance; but the road is curved, so curved-road is the shortest path for you. According to Einstein's General-Relativity, the planets are in inertial-motion in the curved space. But the question is: while traveling on a hilly road, you can take a coffee-break for half-an-hour, and then proceed further. Similarly, if planets were traveling in the 'curved-space', then they should be able to halt for a while, and then proceed further. If not, then the 'curved-space-model' of GR is questionable. Moreover, inertial-motion can be at any speed; can the planets travel at any speed in the curved space around the Sun?

Some astrophysicists have noticed the ‘cosmic-coincidence’; that the ratio of (i) radius-of-the-universe and classical-radius-of-the-electron, and ratio of (ii) ‘total-mass-of-the-universe’ and ‘mass-of-the-proton’, matching strikingly with the ratio of (iii) electric-forces and gravitational forces; has happened only in the current epoch, neither in the past, nor in future! This is a very-very improbable coincidence. It implies that the Doppler-shift-interpretation of ‘cosmological-red-shift’ is questionable.

P.A.M. Dirac’s Large Number Coincidence (LNC) suggested that the strength of gravitational-interactions should vary with the expansion of the universe; but observations did not support such variation of G with time; so Dirac’s Large-Number-Hypothesis was abandoned. But the strikingly matching of the three ratios on one hand, and non-observation of any variation of G on the other hand, implies that the universe may not be expanding. The Doppler-shift-interpretation of the cosmological-red-shift may not be correct.

According to Hoyle-Narlikar’s Perfect Cosmological Principle (PCP), the universe must be homogenous and isotropic not only in space but also in time. But PCP-based Steady-State-Theory needed continuous creation of matter, which is not supported by experimental observations. The beauty of PCP on one hand, and non-observation of any spontaneous-creation of matter on the other hand, implies that the Doppler-shift-interpretation of the cosmological-red-shift may not be correct, and the universe may not be expanding; it is homogenous and isotropic always, as we see it to-day.

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. The lack of observation of ‘dark-energy’ should mean that the Big Bang Model is questionable.

These questions motivate us to consider some new explanation for the cosmological-red-shift. ‘Cosmological-red-shift’ was expressed by Tank [4] as a deceleration experienced by the extra-galactic-photon; and this deceleration matches strikingly with the decelerations of Pioneer-10, Pioneer-11, Galileo and Ulysses space-probes. In 2011 and 2013 it was observed by Tank, 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 paper some 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 descriptions of some 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’[9], as shown in fig.1. And 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.

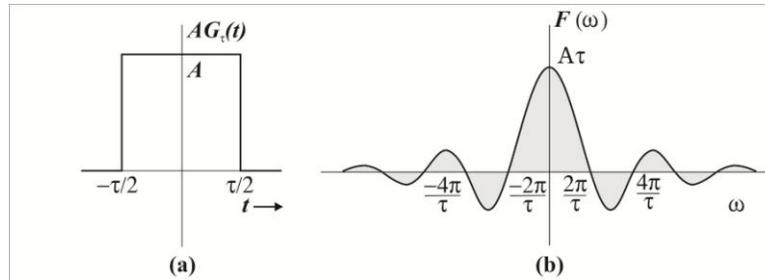


Fig.:1 (a) A gate function. (b) Transform of a gate function.

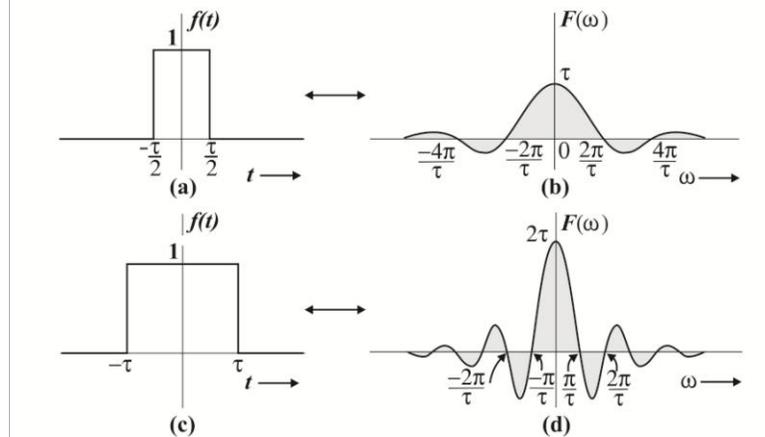


Fig.:2 Compression in the time domain is equivalent to expansion in the frequency domain.

2.1. Relativistic Length-Contraction with Speed:

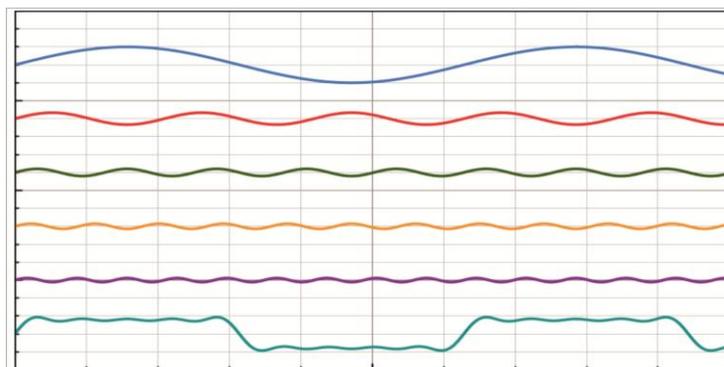


Fig.3: Graphs of spectral-components $\sin(x)$, $\sin(3*x)/3$, $\sin(5*x)/5$, $\sin(7*x)/7$, $\sin(9*x)/9$ and their superimposition: $\sin(x)+\sin(3*x)/3+\sin(5*x)/5+\sin(7*x)/7+\sin(9*x)/9$ forming a 'gate-function'. All components are at the same phase 0° at the origin $x=0$, but they are at different 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 supposed 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 can also cause the time-dilation of super-nova-light-curves! So, now we can proceed to consider some new alternative interpretations of the cosmological-red-shift.

3. Some New Possible Alternative Mechanisms 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: $z_c = \Delta\lambda / \lambda_0 = H_0 D / c$,

$$\text{i.e. } z_c = h H_0 / (h c / D) \dots\dots\dots(1)$$

Now, Weinberg, (1972) has found an interesting relation, that:

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

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

From the expressions 1 and 2:

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

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

$$\text{i.e. } z_c = h \Delta v / h v = [G m_p^2 / h c] [\{e^2 / (h / m_p c)\} / (e^2 / D)] \dots\dots\dots(4)$$

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:

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

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

$$\text{i.e. } z_e = D / r_e$$

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.

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

$$\text{Since } H_0 R_0 = c, \quad z_c = H_0 D / c = D / R_0 \dots\dots\dots(5)$$

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

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: $10 \log_{10} P_{\text{Reflected}} / P_{\text{Forward}} = -60$; 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-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 $(Gm_e m_p / e^2)$ times the reduction expected of electrostatic-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.

(vi) What expands is, certainly, the wave-front of light, not necessarily the universe. We can visualize a ‘photon’ as a pulse of very-small-width [4, 5, 6, 7]; not an impulse of zero width; and this pulse occupies a small fraction of the spherical-shell of the wave-front of light. This can be imagined as a small dot marked on slightly-inflated-balloon. The spherically-expanding-wave-front of light can be imagined as an expanding-balloon; and with the expansion of the balloon, the size of the marked-dot, representing the ‘photon’, also gets increased. That is, the ‘width’ of the pulse gets increased. This process, when Fourier- transformed into the wave-number-domain, shows that with the increase of width of the pulse, called ‘photon’, its spectrum in the wave-number-domain shrinks towards zero-wave-number, which is currently believed to be ‘the cosmological-red-shift’.

These new interpretations of the ‘cosmological-red-shift’, in terms of propagation-property of light, are also useful for the unification of gravitational and electric forces, for which Einstein struggled for the last forty years of his life.

4. Conclusion

Energy lost by the cosmologically-red-shifted photons is $(Gm_e m_p / e^2)$ 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.**

References:

- [1] Paal, G. *et al.* (1992) *AP&SS* **191**: 107–24
- [2] Adam G. Riess *et al.* (1998) *Astronomical J.* **116** (3): 1009–38
- [3] Perlmutter, S. *et al* (1999) *Astrophysical Journal* **517** (2): 565–86
- [4] Tank, H. K. (2010) *Astrophys. Space. Sci* **330** p 203
- [5] Tank, H. K. (2011) *Adv Studies Theor Phys* **5** no.-1 p 45
- [6] Tank, H. K. (2013) *Adv. Studies Theor. Phys.*, **7**, no. 15 p 745 – 750
- [7] Tank, H. K. (2012) *Proc Indian Natn Sci Acad A* **78**, no.4 p 645
- [8] Giacobbe, F. W. (2005). "How a Type II Supernova Explodes". *Electronic Journal of Theoretical Physics* **2** (6): 30–38.
- [9] Lathi, B. P. *Communication Systems*, Oxford University Press, 1998.
- [10] Weinberg, S., "Gravitation and Cosmology", John Wiley & Sons, (1972), p-620