Some limitations of the Big Bang Cosmology and a new Self-Gravitational Acceleration based explanation for the Cosmological Red Shift

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Abstract:

As soon as any author proposes alternative interpretation of the cosmological red-shift, it is opposed saying that tired-light explanations are not compatible with the observations of time-dilation of super novae light-curves. So this author had shown [1] that any mechanism which can cause 'cosmological red-shift' will also cause 'time-dilation of super-novae light-curves'. Still the alternative interpretations are not taken seriously. So this author is constrained to show some limitations of the current big-bang cosmology, like: (i) the general relativity theory predicts 'expansion of space' between the galaxies; but the space within the galaxy is not expanding, because galaxy is a gravitationally-bound-structure. The question raised here is: If so, then what happens at the edge of a galaxy whose external space is expanding but the space within is not expanding? Is there a smooth transition from expanding to non-expanding space? If expanding-space can stretch the wavelength of a cosmologically red-shifting photon, then less and less expanding space, at the boundary of the galaxy, should shrink the wavelength back to its original length, isn't it? (ii) According to general relativity the planets, like the earth, orbit around the Sun, because the space around the Sun has got curved; and the planets are in inertial-motion traveling along the geodesic path. Now the question raised here is: Inertial-motion of a body can be at any speed. Can the planets travel along the geodesic-path at any speed they like? Can they take a coffee-brake and then proceed further? (iii) According to general relativity there is a radial-distance at which rate of expansion of space is equal to the speed of light, so the wave-front of light beyond this radius is not able to enter the sphere of observable universe. This means that the speed of light is the same, 3×10^8 meters per second. The question raised here is: Since the speed of light is the same in expanding as well as non-expanding space; and $f \,.\, \lambda = c$, i.e. the product of frequency (f) and wavelength (λ) is always equal to the speed of light (c); then the wavelength (λ) can increase only when frequency (f) gets reduced; and not because of expansion of space. Then a new 'self-gravitational-acceleration based explanation for the

cosmological red-shift is proposed. And it is shown that reduction in energy of 'cosmologically red-shifting photons' matches strikingly with this new explanation.

Introduction:

Einstein's theory of relativity talks of 'contraction of length', 'dilation of time', and 'curvature' and expansion of space. 'Length' of an object is something physical and objective, so length can be measured using a foot-rule. But 'time' is not a physical entity; it is just a mental abstraction. We conventionally talk of 'time' by observing and comparing cyclically repeating physical processes. So talking about dilation of 'time', and measuring it using two atomic clocks at different heights, only means that physical processes within the atomic clocks get affected by gravity; and not dilation of 'time'. And since a decaying particle moving at high speed contains additional energy, namely 'kinetic energy', so it takes longer time to decay! Like this author many scientists have been raising questions against the general-relativistic 'expanding model of the universe'; as can be found from the innumerable peer-reviewed papers. According to Prof. Jayant Narlikar there is too much extrapolation of various formulae in the expanding model, which may not be correct. Another question, raised by some scientists is: Is energy conserved in GR? Some other scientists have gathered one hundred questions against relativity theory. Einstein's reply was: "One question is sufficient for fall of my theory". This author proposes to the open minded scientists to consider whether one of the questions raised in the abstract is not answerable by the general relativity theory? In this paper a new self-gravitational acceleration based explanation for the cosmological red-shift is proposed. And it is shown that: reduction in energy of 'cosmologically red-shifting photons' matches strikingly with this new explanation.

Prior to that some preparatory discussion: P.A.M. Dirac, after receiving the Nobel Prize, when he was on world tour, he got an idea, that: We measure physical quantities in arbitrarily chosen units like: meter, kilogram and seconds. We should use some standard physical length, like the 'classical radius of an electron' (r_e), to measure lengths. As soon as he expressed the 'radius of the universe' R_0 in terms of 'radius of an electron', to his pleasant surprise the ratio (R_0 / r_e) turned out to be equal to the ratio $(e^2/ G m_e m_p) = 10^{40}$. And Eddington found that the ratio $(M_0 /m_p) = (e^2/ G m_e m_p)^2 = 10^{80}$; here M_0 is 'total mass of the universe' and m_p is mass of a proton. Though Dirac's 'Large Number Hypothesis', predicting reduction of 'strength of gravity' with age of the universe, did not match with observations. But the numerology of the above 'Large

Number Coincidence' has been striking. Later in 1997 this writer showed that this coincidence implies that: Mass of the universe is equal to gravitational potential-energy of the universe; and electro-static potential-energy stored in an electron is equal to energy of mass of it [1]. While discussing 'classical radius of an electron' E.W. Wichhman, the author of volume-4 of Berkeley physics course, writes: "We have derived classical radius of an electron as $r_e = e^2/m_e c^2$; though the ghost of infinite self-energy of an electron is still hovering over some scientists." So the conclusion of my paper [1], that electrostatic-energy stored in an electron is equal to energy of mass of it, may have freed the ghost from those scientists! We intend to use here the 'large-number-coincidence'(LNC), (not the large-number-hypothesis predicting reduction of strength of gravity with time, LNH) to reach an interesting conclusion.

Similarly Max Planck tried to derive natural units, of mass, length and time, purely from the fundamental physical constants; but Planck's unit of mass did not match with mass of any physically observed particle; and his unit of length did not match with Compton wavelength of any particle. Later this writer showed [2] that Planck's unit of mass is 'geometric mean value' of two different masses, namely 'total mass of the universe' M_0 and smallest conceivable mass ($h H_0 / c^2$); and similarly Planck's length and time. It may be interesting to see that: just as the 'fine-structure-constant' ($e^2/ h c$) = (m_e / m_{pion}), so exactly the ratio [($G m_e m_{proton}$)/ (e^2)] = [($h H_0 /c^2$) / m_e)] , so it can be termed as 'very-fine-structure-constant'. So the mass ($h H_0 / c^2$) seems to be of significance. It may be the mass of a neutrino or the graviton or some new particle.

Following the line of thinking of Planck, Steven Weinberg tried to derive a fundamental unit of mass by taking four different fundamental constants, including H_0 , and got a value of mass quite close to the mass of a fundamental particle [3]. He found that:

$m_p^3 = h^2 H_0 / c G$, ……..(1)

Here H_0 is Hubble's constant. And the value of mass m_p turned out to be close to the mass of a fundamental-particle, pi meson. Alternatively, m_p^3 can be viewed as m_{proton} x m_{proton} x $m_{electron}$. Weinberg's relation can be written in a meaningful manner as:

$G\ m_p^2 / (h / m_p\ c) = h H_0$ ……..(2)

where ($h / m_p\ c$) can be taken as a 'fundamental-unit of length'; and the quantity $h H_0$ as the 'smallest chunk of energy'. That is the gravitational potential energy of pi-meson at a distance equal to its Compton wavelength is $h H_0$.

Self gravitational acceleration at the "surface" of the pi-meson is:

$G\ m_p / (\ h / m_p\ c)^2 = H_0\ c$ ……(3)

Sivaram C. has shown [4] that gravitational acceleration at the radial-distance of nucleus-of-an-atom, the globular-clusters, spiral galaxies, galactic clusters and the whole observable-universe is also of the order $H_0\ c$.

And it was shown by Tank [5] that the decelerations experienced by Pioneer-10, Pioneer-11, Galileo and Ulysses space-probes were of the order H_0 c; i.e. the space-probes too may be experiencing the self-gravitational acceleration. And cosmologically red-shifting photon can also be viewed as decelerating at the rate $H_0\ c$. Now, in the next section of this paper let us consider the 'self gravitational acceleration, and self gravitational red-shift, experienced by the photons.

Self-gravitational acceleration based explanation for the cosmological red-shift:

Since a photon is a chunk of energy, there is a gravitational-field, or 'curvature of space' around it. This curvature cannot get eliminated instantaneously. So the photon has to climb its own potential well; like the circus-artists walking on safety-net, who have to continuously climb while walking on the net. After a period $t = \lambda / c$ the curvature will get re-adjusted, and will become a new potential-well for the photon.

Let the energy of a photon, at a distance λ from its point of emission is $h f$. Then the gravitational potential-energy at a distance equal to its wavelength λ is:

$G\ (h f_0 / c^2)\ (h f / c^2) / \lambda$ where $h f_0$ is energy of the photon at the time of its emission.

Let us call $(h f_0 / c^2)$ as mass of the photon m_{photon}.

i.e. The gravitational potential energy = $G\ m_{photon}\ (h f / c^2) / \lambda$

i.e. $= [(G\ m_{photon} / c^2) / \lambda]\ h f$

When this energy gets subtracted from the original energy $h f_0$

i.e. $(h f_0)$ - $[(G\ m_{photon} / c^2) / \lambda]\ h f = h f$

i.e. $[h f_0 - h f] / (h f) = [(G\ m_{photon} / c^2) / \lambda]$

i.e. The red-shift $z = [(G\ m_{photon} / c^2) / \lambda]$

i.e. The red-shift $z = [G\ m_{photon}\ (h f / c^2)\ ] / (\ h c)$, because $\lambda = h c / h f$ ……..(4)

Then at the next distance λ_2 the quantity $(h f / c^2)$ will become the new mass of the photon. The wavelength λ will go on increasing; and the quantity $(h f / c^2)$ will go on reducing, as the photon travels a distance D. The red-shift z at a distance D is approximately $[\{G\ m_{photon}\ (h f / c^2)\ \} / (\ h c)]$ time the ratio (D/ λ). Thus z here is automatically a non-linear function of distance.

Now let us compare our theory with the observation of the cosmological red-shift z_c :

(i)

The linear part of the 'cosmological red-shift' is expressed as:

$z_c = (\Delta \lambda / \lambda_0) = (H_0 D / c)$ ……(5)

The right-hand-side of expression-5 can be written as:

$H_0 D / c = h H_0 / (h c / D)$ ……(6)

Based on Weinberg's relation: $m_p^3 = h^2 H_0 / c G$, which we have re-written in a meaningful manner as: $[(G m_p^2) / (h / m_p c)] = (h H_0)$, the 'cosmological red-shift' can be expressed as:

$z_c = \Delta \lambda / \lambda_0 = [G m_p^2 / (h / m_p c)] / [h c / D]$. ……(7).

i.e. $z_c = \Delta \lambda / \lambda_0 = [G m_p^2 / h c] [D / (h / m_p c)]$ ……(8).

where $(h / m_p c)$ is a unit of distance, measured in terms of Compton-wavelength of pi-meson; and the constant $[G m_p^2 / h c]$ denotes the strength-ratio of gravitational and electric forces.

Or, in terms of energy:

$z_c = h \Delta \nu / h \nu = [G m_p^2 / h c] [D / (h / m_p c)]$. ……(9).

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

(ii)

Alternatively, let us define reduction in electrostatic potential-energy of an electron-proton-system 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. $z_e = D / r_e$. ……(10)

From the '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 is total mass, and R_0 radius of the universe.

i.e. $z_e = 10^{40} (D / R_0)$. ……..(11)

Since R_0 is defined as a distance at which the recessional-velocity $H_0 D = c$, so, the product:

$H_0 R_0 = c$;

Therefore, $z_c = H_0 D / c = D / R_0$ ……..…(12)

From the expressions (10), (11) and (12), we get:

$z_c = 10^{-40} z_e$. ……..(13)

That is: 'cosmological-red-shift, at a distance D is ($G m_e m_p / e^2$) times the reduction expected from the 'electrostatic potential energy of an electron at that distance D. This derivation matches strikingly with our 'self gravitational red-shift based explanation.

(iii)

It is currently believed that the expansion of the universe is getting accelerated at the rate $H_0 c$. The following derivation suggests that the cosmologically red-shifting photon can also be viewed as decelerating at the same rate:

$z_c = h \Delta \nu / h \nu = H_0 D / c$

i.e. The loss in energy of the photon at a distance D is:

$h \Delta \nu = (h \nu / c^2) (H_0 c) D$ ……(14)

That is, the loss in energy of the photon at a distance D is equal to its "mass" times the acceleration ($H_0 c$) times the distance D.

Whether the expansion of the universe is accelerating, is still a hypothesis; whereas the cosmologically red-shifting photon is decelerating at the same rate ($H_0 c$), is a consistently observed fact.

Conclusion:

We found that the new, self-gravitational deceleration based explanation for the cosmological red-shift proposed here, matches significantly with the observations. Therefore the current thinking of the majority cosmologists, that 'big-bang-cosmology' is the only model, needs to be made more open-minded; and new interpretation be taken more seriously.

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