Is the expansion of universe accelerating or the photons decelerating?

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Abstract:

Astronomical observations of cosmological red-shift are currently interpreted in terms of 'expansion of universe' and 'accelerated-expansion of the universe', at the rate of $H_0\, c$; here H_0 is Hubble's constant, and c is the speed of light. Whereas a straight forward derivation presented here suggests that: rather it is the photon which is decelerating, at the rate of $H_0\, c$. As soon as any alternative interpretation for the 'cosmological red-shift' is proposed, it is argued that: tired-light interpretations of cosmological red-shift' are not compatible with the observations of 'time-dilation of super-novae light-curves'. So in a paper titled: "Wave-theoretical insight into the relativistic 'length-contraction' and 'time-dilation of super-novae light-curves'" (Tank, Hasmukh K. 2013) it has been already shown that any mechanism which can cause 'cosmological red-shift' will also cause 'time-dilation of super-novae light-curves'. Therefore, we now need not remain confined to the Big Bang model of cosmology. Martin Lopez-Corredoira (2013) applied Alcock- Paczynski cosmological test to six candidate cosmological models; and reached a conclusion that only two of them, namely lambda-CDM and static universe with tired light interpretation of the cosmological red-shift, fit the data. Ling Jun Wang, (2014) "On the Flatness of Space-time" has rigorously proven that curvature and expansion of space-time are mathematical entities, not the physically real curvature or expansion of space. So, the static universe with tired-light explanation has remained the only candidate. In this paper 'cosmological red-shift' is explained in terms of deceleration of photons caused by virtual electrons and pi-mesons contained in the extra galactic quantum vacuum. And, as supportive evidence, it is shown here that virtual electrons, and pi-mesons do have gravitational-acceleration of the order $H_0\, c$ at their "surfaces". Since, as per the interpretation of the 'cosmological red-shift' proposed here, in terms of deceleration of photons, the 'reduction-in-energy of the photon' ($h\, \Delta\nu$) goes on reducing with every subsequent unit distance traveled by the photon; so the red-shift-distance-curve automatically becomes non-linear, which has been creating an impression of 'accelerated-expansion of the universe'. As a further supportive evidence for this proposal, it is shown that even the space-probes Pioneer-10, Pioneer-11, Galileo and Ulysses too did decelerate at the same rate $H_0\, c$ (Anderson J.D. et. al.1998).

Keywords: *Cosmology; Cosmological Red-Shift; Expansion of the Universe: Accelerated Expansion of the Universe: Dark-Energy.*

1. Introduction:

E.P. Hubble's observations of 'cosmological red-shift', and subsequent observations till today, are currently interpreted in terms of 'expansion of the universe' and accelerated-expansion of the universe. Cosmologists have accepted this interpretation, as it matches with Einstein's General Theory of Relativity (GR), which predicted 'expansion of space'. This author has been arguing that 'expansion of space' of GR is a 'mathematical terminology' not a physical phenomenon; because: as per GR, if the space between the galaxies is expanding , but the space within the galaxy is not doing so, as a galaxy is a gravitationally-bound structure, then what happens at the boundary of the galaxy? Such uneven expansion of glass would break the glass, and may tear off the space, if expansion-of-space were a physically-real phenomenon. Recently, Ling Jun Wang, (2014) in an article, "On the Flatness of Space-time" has rigorously proven that curvature and expansion of space-time are mathematical entities, not the physically real curvature or expansion of space. Secondly, the accelerated-expansion of the universe demands dark-energy with an unfamiliar property, of repulsive gravity. So dark-energy is a special entity introduced to explain 'accelerated-expansion' of the universe. Not even a trace of dark-energy has been detected so far. In science we try to manage with minimum and already-known entities. Therefore, we proceed in the next section to find how 'cosmological red-shift' can be viewed as deceleration experienced by the photons.

2. The Derivations:

(i) It is currently believed that the expansion of the universe is getting accelerated at the rate $H_0\, c$. The following derivation suggests that rather it is the cosmologically red-shifting photon, which is decelerating at the same rate. The linear part of the cosmological red-shift is expressed as:

$z_c = h\,\Delta f / h f = H_0\, D / c$

That is, the loss in energy of the photon, at a distance D, is:

$h\,\Delta f = (h f / c^2)\,(H_0\, c)\, D$ ……..……(1)

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 ($H_0\, c$), as found here, is an experimentally observed fact.

Attention of the reader is invited to an important difference between the standard expansionist interpretation of the 'cosmological red-shift' and the new interpretation proposed here. As seen in the expression-1, the photon decelerates at the rate $H_0\, c$; so its kinetic-energy goes on reducing after every unit distance. So, the new input-frequency for the next unit distance is smaller than the previous one. And so the loss in energy $h\,\Delta f$ goes on reducing with every subsequent unit distance. The total loss in energy of the photon becomes a non-linear function of distance. This non-linearity of red-shift-distance-curve is being currently being interpreted as the 'accelerated-expansion' of the universe. Whereas, the observed non-linearity is a natural consequence of the photons' deceleration.

The mechanism, which causes this deceleration of the photons, is explained as follows. The inter-galactic space is not a void extension of nothingness. As per quantum mechanics, pairs of virtual particle-and-antiparticles keep on coming in existence for small durations of time permitted by 'Heisenberg's uncertainty principle'. There are many pairs of virtual particles always present in the path of inter-galactic photons. The gravitational-acceleration at the "surface" of these particles is of the order of $H_0\, c$ as shown blow: So all these virtual particles, bit by bit, keep on causing 'gravitational red-shift' in the inter-galactic photons.

Gravitational acceleration at the "surface" of the electron:

$a_e = G\, m_e / (e^2 / 2\, m_e\, c^2)^2 = H_0\, c$ ……(2)

Gravitational acceleration at the surface of the pi-meson can also be derived from Steven Weinberg's formula, that $m_{pi} = [\, h^2\, H_0 / c\, G]^{1/3}$

i.e. $G\, m_{pi} / (\, h / m_{pi}\, c\,)^2 = H_0\, c$ ……..(3)

Even the accelerations at the "surface" of the nucleus-of-atom, the globular-clusters, the spiral-galaxies, and the galactic-clusters too, are of the order of $H_0\ c$ as Siveram C. (1994) has numerically found:

(i) For a typical atomic nucleus of mass m_n , *(A = 150)*

$$a = G\ m_n / r_n^2 \ \sim\ 1.0 \times 10^{-10}\ \text{m / s}^2$$

(ii) For a globular cluster of mass 10^6 solar-masses and radius R_g = 100 pc,

$$a = G\ M_g / R_g^2 \ \sim 10^{-10}\ \text{m / s}^2$$

(iii) For a spiral galaxy of mass $M_{gal} = 10^{12}$ solar-masses and radius R_{gal} = 30 kpc,

$$a = G\ M_{\text{gal}}\ / R_{gal}^2 \sim\ 0.8 \times 10^{-10}\ \text{m / s}^2$$

(iv) For a typical cluster of galaxies, $M_c = 10^{16}$ solar-masses and radius R_c = 3 Mpc,

$$a = G\ M_c / R_c^2 \ \sim\ 10^{-10}\ \text{m / s}^2$$

(v) Also, for the observable-universe as a whole, with a density of 10^{-29} grams/ cm^3 and radius $R = 10^{28}$ cm,

$$a = c\ H_0 = 6.87 \times 10^{-10}\ \text{m/s}^2$$

(vi) And the value of 'critical acceleration of MOND, $a_0 \sim 10^{-10}\ \text{m / s}^2$

(ii) As a supportive evidence for the above theory, let us look at the values of decelerations experienced by Pioneer-10, Pioneer-11, Galileo and Ulysses space-probes , (Anderson J. D. et. al. 1998):

(i) For Pioneer-10, $a = (8.09 \pm 0.2) \times 10^{-10}\ \text{m / s}^2$
(ii) For Pioneer-11, $a = (8.56 \pm 0.15) \times 10^{-10}\ \text{m / s}^2$
(iii) For Ulysses, $a = (12 \pm 3) \times 10^{-10}\ \text{m / s}^2$
(iv) For Galileo, $a = (8.0 \pm 3) \times 10^{-10}\ \text{m / s}^2$

All these decelerations are of the same order of magnitude as $H_0\ c = 6.87 \times 10^{-10}$ m/s^2; and match strikingly with the 'critical-acceleration' a_0 of MOND; an extremely rare-probability coincidence. Matching of four different decelerations of the space-probes, in spite of the differences in their mass, velocities and directions, is itself a striking coincidence; and its matching with the deceleration experienced by the 'cosmologically red-shifting photon' cannot be ignored by a scientific mind as a coincidence. Slight differences in their values can be attributed to mundane effects like thermal radiation. Moreover, the extra-galactic photon experiences some gravitational blue-shift when it enters the gravitational-field of our milky-way galaxy. If we can send Hubble-like telescope out-side our milky-way galaxy then the value of $H_0\ c$ may be found very close to the decelerations of the above space-probes. So the atoms contained in the space-probes got decelerated due to the bit-by-bit decelerations caused by the virtual particles.

3. Summary:

The straight forward derivation presented here suggests that: whether the expansion of the universe is accelerating, is still a hypothesis, whereas the extra-galactic photon is decelerating at the rate $H_0\ c$ is an experimentally-observed fact. The gravitational acceleration at the "surface" of the virtual electrons, virtual positrons, virtual pi-mesons, bit-by-bit keep on causing 'gravitational red-shift' in the extra-galactic photons. This reduction in the energy of the photons is the logically consistent explanation for the observation of 'cosmological red-shift'.

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