Everything, including Photons, Seem to be 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'. Whereas a straight forward derivation presented here suggests that: it is not the universe, which is expanding, rather it is the photon which is decelerating, at the rate of $H_0 c$; here H_0 is Hubble's constant, and c is the speed of light. (As soon as a new mechanism 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'" [1] 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 Cosmology, to understand the universe.) Since, as per this new interpretation of the 'cosmological red-shift', the 'reduction-in-energy of the photon' ($h \Delta v$) 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 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 $H_0 c$ [2]. And to counter-balance this deceleration, the accelerations at the boundaries of: the nucleus-of-atom, the globular-clusters, the spiral-galaxies and the galactic-clusters too, are of the same order as $H_0 c$. This coincidence was numerically found by Sivaram [3]; and is explained here, in terms of equilibrium between self-gravitational-acceleration of structures and the acceleration of the un-manifest-energy contained in space.

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 of the opinion 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. The mathematical-model of GR is able to predict certain phenomena, so it is a useful model; but we need to think further, to understand the cosmos.

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. In science we try to manage with minimum, and already-known entities, and properties. This paper is an attempt in this direction. Here we accept that 'dark-energy' may be there, but it need not have a new property of repulsive gravity. To distinguish it from the conventional meaning of dark-energy, we call it 'un-manifest energy'. Some 5% of this 'un-manifest-energy' manifests itself as the 'baryonic-matter', visible to us. Each and every moving object has to pass through this sea of 'un-manifest-energy', (U_{UM}); so their velocity gets decelerated. The 'cosmological red-shift' is a result of deceleration of photons passing through the sea of un-manifest-energy'(U_{UM}). Similarly, each and every moving object, passing through the U_{UM} gets decelerated at the same rate $H_0\,c$.

As soon as a new mechanism 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'" [1] it has already been 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 Cosmology to understand the universe. We proceed in the next section to find how 'cosmological red-shift' can be viewed as deceleration experienced by the photons.

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 the cosmologically red-shifting photon can be viewed as decelerating at the same rate. The linear part of the cosmological red-shift is expressed as:

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

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

$h\,\Delta\nu = (h\,\nu\,/c^2)\,(H_0\,c)\,D$ ……………………………………………….(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 shown here, is a consistently 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 $h \Delta v$ 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 interpreted as the 'accelerated-expansion' of the universe. Whereas, as per our new interpretation, this non-linearity is a natural consequence of the new mechanism.

(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 [2]:

(i) For Pioneer-10, $a = (8.09 \pm 0.2) \times 10^{-10}$ m / s^2

(ii) For Pioneer-11, $a = (8.56 \pm 0.15) \times 10^{-10}$ m / s^2

(iii) For Ulysses, $a = (12 \pm 3) \times 10^{-10}$ m / s^2

(iv) For Galileo, $a = (8.0 \pm 3) \times 10^{-10}$ 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, 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.

(iii)

This value of acceleration ($H_0 c$) also seems to play its role in the formations of structures of: nucleus-of-atom, globular-clusters, spiral-galaxies, galactic-clusters and the whole universe; as Sivaram C. has numerically-found the following interesting coincidences, [3] that:

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

   $a = G m_n / r_n^2$ ~ 1.0 x 10^{-10} 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,

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

(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, $a_0 \sim 10^{-10}$ m / s^2

These coincidences can be explained as follows: For stability of a structure, the self-gravitational-acceleration of a structure should be equal and opposite of the acceleration of the un-manifest-energy; to establish equilibrium between the two.

References:

[1] Tank Hasmukh K., "Wave-theoretical insight into the relativistic length-contraction and time-dilation of super-nova light-curves" *Adv. Studies Theor. Phys.,* Vol. **7,** (2013), no. 20, 971–976 http://dx.doi.org/10.12988/astp.2013.39102

[2] Anderson, J.D., Laing, P.A., Lau, E.L., Liu, A.S., Nieto M. M., and Turyshev.S.G. "Indication, from Pioneer 10, 11, Galileo, and Ulysses Data, of an Apparent Anomalous, Weak, Long-Range Acceleration". *Phys. Rev. Letters.* **81** (1998) 2858-2861 [(Comment by Katz J.I.: *Phys. Rev. Lett.* **83**, 1892 (1999); Reply: *Phys. Rev. Lett.* **83,** 1893 (1999)].

[3] Sivaram, C. : 1994, *Astrophysics and Space science* **215,** 185-189