Down-to-Earth Explanation for the 'Cosmological red-shift' and its Evidence

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We first recall here that (i) the ratio of: (loss in energy of cosmologically red-shifting photon) and (loss in electrostatic potential-energy of an electron at the same distance D) remains equal to the famous ratio $(G\, m_e\, m_p) / e^2$ (ii) Also the ratio $h\, H_0 / m_e\, c^2 = (G\, m_e\, m_p) / e^2$ [1] These findings lead us towards a possibility that 'cosmological red-shift' may be caused by some mechanism in which the photon itself may be radiating out gravitational waves, and loosing its energy. It is well known [2-3-4] that a 'photon' can have 'spin angular momentum (SAM) as well as 'orbital angular momentum (OAM), which is comparable with a particle orbiting around its axis of motion. So, it is proposed here that OAM of the photon is expected to radiate gravitational waves, and cause continuous loss in its energy, which we seem to have been observing as the 'cosmological red shift'.
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1. Introduction:

Since the date Edwin Hubble published his paper on the 'cosmological red-shift', at least sixty different explanations have been proposed by different scientists. Out of them the 'expansion of space' is currently most popular. But it was noticed by this writer [1] that the ratio $z_c / z_e = (G\, m_e\, m_p) / e^2$, that is: the ratio of (loss in energy of cosmologically red-shifting photon at any distance D) and (the loss in electrostatic potential-energy of the electron at that distance D) strikingly remains equal to the famous ratio $(G\, m_e\, m_p) / e^2$. Also the ratio $h\, H_0 / m_e\, c^2 = (G\, m_e\, m_p) / e^2$. These findings lead us towards a possibility that 'cosmological red-shift' may be caused by some mechanism in which the photon itself may be radiating out gravitational waves, and loosing its energy. It is well known that a 'photon' can have 'spin angular momentum (SAM) as well as 'orbital angular momentum (OAM), which is comparable with a particle orbiting around its axis of motion [2-3-4]. So, it is proposed here that OAM of the photon is expected to radiate gravitational waves, and cause continuous loss in its energy, which we seem to have been observing as the 'cosmological red shift'.

Then it is argued that not only the photons, but also every particle, moving linearly, can have 'orbital angular momentum (OAM), and may be emitting gravitational waves and loosing their linear momentum. For the purpose of comparison we express 'cosmological red shift' as the 'deceleration of photons'. Strikingly, the decelerations measured for Pioneer-10, 11, Galileo and Ulysses space-probes match perfectly with the value of deceleration of the photons [5-6] This writer is aware of various explanations for Pioneer anomaly proposed; like 'gas leaks' and 'thermal radiations', but they can not be the same for all the space-probes. Matching of decelerations of four space-probes itself is a striking phenomenon; and its matching with

the deceleration of the photon can not be ignored by a scientific mind as a coincidence. So in the humble opinion of this writer these observations should be considered as evidence for the down-to-earth explanation for the 'cosmological red-shift' proposed here. After a lengthy survey of several years of debate by the authors of the original 1998 paper documenting the Pioneer-anomaly, the authors conclude,[6]: "Until more is known, we must admit that the most likely cause of this effect is an unknown systematic. (We ourselves are divided as to whether 'gas leaks' or 'heat' is this 'most likely cause.')" The writer of this paper humbly feels that the correct explanation for the pioneer anomaly is found only now in this paper.

2. Derivations:

For the purpose of comparison with 'cosmological red-shift' let us define the reduction in electrostatic potential-energy of the electron z_e as:

$$z_e = [(e^2/ r_e) - e^2 / (r_e + D)] \ / \ [e^2 / (r_e + D)]$$

i.e. $z_e = D / r_e$ …………………………(1)

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

Cosmological red-shift :

$$z_c = (h f_0 - h f) / h f = H_0 \ D / c$$

where H_0 is Hubble's constant, and c is the speed of light.

i.e. $z_c = D / R_0$ ………………………….(2)

Where R_0 is known as 'Radius of the universe' and $R_0 = c / H_0$

So the ratio $z_c / z_e = r_e / R_0$

And from the 'Large-Number-Coincidence' of Dirac, and its explanation [9] we know that:

$$r_e / R_0 = (G \ m_e \ m_p) / e^2$$

So the ratio: $z_c / z_e = (G \ m_e \ m_p) / e^2$ ……. (3)

That is, the ratio of: (Reduction in energy of the 'cosmologically red-shifting photon at a distance D) and (The reduction in electrostatic potential-energy of the electron at the same distance D) remains equal to the famous ratio $(G \ m_e \ m_p) / e^2$.

Also the ratio $h \ H_0 \ / \ m_e \ c^2 = (G \ m_e \ m_p) \ / \ e^2$ …..(4)

So the expressions-3 and 4 suggest that 'cosmological red-shift' can be due to some of the possible gravitational radiation caused by the photon. From the Wikipedia pages we find that:

" Systems that have nonzero energy but zero rest mass, such as photons moving in a single direction, do not have 'center-of-mass' frames, because there is no frame in which they have zero net momentum. They always possess a net momentum magnitude that is equal to their energy divided by the speed of light. The angular momentum of light is a vector quantity that expresses the amount of dynamical rotation present in the electromagnetic field of the light. Indeed, a beam of light, while traveling approximately in a straight line, can also be rotating (or "*spinning*", or "*twisting*") around its own axis. This rotation, while not visible to the naked eye, can be revealed by the interaction of the light beam with matter, as shown in the figure below: The total angular momentum of light and matter is conserved in time. But there are actually two distinct forms of rotation of a light beam, one involving its polarization and the other its wave-front shape. These two forms of rotation are hence associated with two distinct forms of angular momentum, respectively named (i) light spin angular momentum (SAM) and (ii) light orbital angular momentum (OAM)."

SAM interaction   OAM interaction
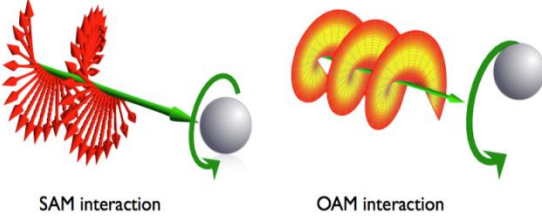
Thus, a photon is comparable with a 'particle' orbiting around its axis of motion. So, it is expected to radiate gravitational waves, and continuously loose its energy, which we seem to have been observing as the 'cosmological red shift'. Works of other researchers also support this possibility [5-6-7]

Now, let us argue that: not only the photons, but also every particle, moving linearly, can have 'orbital angular momentum (OAM), and may be emitting gravitational waves and loosing their linear momentum. For the purpose of comparison we will express 'cosmological red shift' as the 'deceleration of photons', and find that the decelerations measured for Pioneer-10, 11, Galileo and Ulysses space-probes match perfectly with the value of deceleration of the photons [5-6]:

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

$z_c = (h f_0 / h f) / (h f)$

i.e. $(h f_0 - h f) = (h f / c^2) (H_0 \ c) D$

That is, the reduction in kinetic-energy of the photon is equal to its mass ($h f / c^2$) times the deceleration ($H_0 \ c$) times the distance D traveled by it.

Numerically, the quantity ($H_0 \ c$) = 6.87 x 10^{-10} meter/second^2. The carefully measured values of accelerations experienced by the space-probes Pioneer-10, Pioneer-11, Galileo, and Ulysses are [8]

For Pioneer-10, $a = (8.09 \pm 0.2)$ x 10^{-10} meter/sec^2 ,

For Pioneer-11, $a = (8.56 \pm 0.15)$ x 10^{-10} meter/sec^2 ,

For Ulysses, $a = (12 \pm 3)$ x 10^{-10} meter/sec^2 ,

For Galileo, $a = (8.0 \pm 3)$ x 10^{-10} meter/sec^2 , and

Matching of decelerations of four space-probes itself is a striking phenomenon; and its matching with the deceleration of the photon can not be ignored by a scientific mind as a coincidence. The values of deceleration experienced by the space-probes are slightly higher, because: when the inter-galactic photon enters our milky-way galaxy, it experiences certain amount of gravitational blue-shift. If we could launch Hubble-like telescope out-side our milky-way galaxy, then the value of $H_0 \ c$ may match perfectly with the value of space-probes. Values of decelerations of the space-probes may have been partly affected by thermal radiation or gas-leaks too! So in the humble opinion of this writer these observations should be considered as evidence for the down-to-earth explanation for the 'cosmological red-shift' proposed here.

3. Conclusion:

We first found that the ratio of: (loss in energy of cosmologically red-shifting photon) and (loss in electrostatic potential-energy of an electron at the same distance D) remains equal to the famous ratio ($G \ m_e \ m_p$) / e^2. Also the ratio $h \ H_0 \ / \ m_e \ c^2 = (G \ m_e \ m_p) \ / \ e^2$. These findings led us towards a possibility that 'cosmological red-shift' may be caused by some mechanism in which the photon itself may be radiating out gravitational waves, and loosing its energy. So we considered a mechanism in which a 'photon' having 'orbital angular momentum (OAM), which is comparable with a particle orbiting around its axis of motion, radiating gravitational waves, and continuously loosing its energy, which we have been observing as the 'cosmological red shift'. Then we argued that every linearly moving particle can have orbital angula momentum, and can radiate gravitational

waves. The carefully measured decelerations of the Pioneer 10/11…space-probes provide supportive evidence for the down-to-earth explanation proposed here.

Acknowledgements:

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