Cosmological and Intrinsic Redshifts

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Abstract

In a recent article, a single tired light mechanism, based in the interaction between electromagnetic waves, has been proposed for explaining both redshifts: cosmological (without expansion of the universe) and intrinsic. A second paper specifies that said interaction would be the scattering. This article is to reinforce and clarify the whole idea.

Key words: cosmological redshift, intrinsic redshift, tired light.

1. Introduction

In the Big Bang theory, the redshift of the light emitted from distant galaxies, the so-called cosmological redshift, is interpreted as a Doppler effect and then considered as an indication of the expansion of the universe, following the law of Hubble [1]. Besides, the so-called cosmic microwave background radiation (CMBR) is considered as a product of the Big Bang ("Great Explosion"), the so-called Big Bang "echo". However, in a recent article [2], we have proposed the idea of that the cosmological redshift is due to the interaction between the light and the CMBR, which would be the resultant product of the processes of emission and absorption of thermal radiation in the universe, and not an echo of the Big Bang. In the case of the intrinsic redshift, which is the excess of redshift of the quasars and the radio galaxies, the light interacts with radio waves. And all this is compatible with a static universe with a space temperature of 2.7 ºK. A second paper [3] specifies that said interaction would be the scattering. The purpose of this article [4] is to reinforce and clarify the whole idea.

2. The tired light mechanism

It is assumed that all body with a temperature greater than 0 ºK emits electromagnetic radiation in the form of thermal radiation [5]; consequently, we may suppose that all body emits this type of radiation [6]. As in addition, all body emits the same quantity of thermal radiation than absorbs (and vice versa, all body absorbs the same quantity of thermal radiation than emits) [5], we conclude that there will always be thermal radiation in the intergalactic space (IGS). From the works of Eddington, Regener and

Nernst on the temperature of the IGS, that use the law of Stefan-Boltzmann, [7] we deduce that these processes of emission and absorption of thermal radiation produce a thermal equilibrium at a temperature of 2.7 ºK, which corresponds to the temperature of the CMBR. Therefore, we conclude finally that the thermal radiation inside of the IGS is the CMBR. Now, we suppose that the light emitted by the cosmic light sources (stars, quasars, galaxies) when travels in the IGS interacts with the CMBR losing energy. Specifically, the light opens a linear path (without any change of direction) through the microwaves of the CMBR scattering them. We postulate that the light loses energy in this scattering process following an exponential law, that is, following a so-called "tired" light mechanism. Zwicky coined the concept, after called tired light, of that the light would lose energy (by some type of mechanical interaction) in its journey [8].

In effect, our mechanism would be similar, from a quantum mechanical point of view, to the radiation loss by fast electrons, where the mean energy $\langle E \rangle$ of an electron, with initial energy E_0, after having traversed a length *x* of the medium, is [9, 10]

$$\langle E \rangle = E_0 e^{-x/X_0} \tag{1}$$

X_0 being the so-called radiation length, which is inversely proportional to the density of atoms of the medium. The equation (1) is obtained from the framework of reference of the electron and considering that this one scatters electromagnetic fields. The fast electron sees the electromagnetic fields of the atoms of the medium like virtual photons because its supposed relative speed is $v \cong c$ (where *c* is the light speed in vacuum). The electron loses energy when scatters a virtual photon because suffers an inverse Compton effect.

Now, by analogy, we can deduce that (in place of the electron) our visible light photon (acting like a particle of "effective mass" $h\nu/c^2$, where *h* is the Planck's constant and ν the frequency) scatters (in place of streams of virtual photons) microwaves of the CMBR losing energy following an exponential law similar to (1):

$$E(d) = E(0)e^{-d/\delta} \tag{2}$$

where

$$d = ct \tag{3}$$

is the distance traversed inside of the IGS, *t* being the time, and

$$\delta = \frac{k}{u} \tag{4}$$

is a radiation length, *k* being a constant of proportionality to set and

$$u = nh\nu \tag{5}$$

the energy density of the CMBR, where $n = N/V$ is the number of microwaves per unit of volume. As $E = h\nu$, then

$$\nu(d) = \nu(0)e^{-d/\delta} \tag{6}$$

$$z = \frac{\nu(0) - \nu(d)}{\nu(d)} = e^{d/\delta} - 1 \tag{7}$$

z being the redshift parameter. For $z << 1$

$$z = \frac{d}{\delta} \tag{8}$$

And comparing with the redshift of Hubble [11]

$$z = \frac{v_r}{c} = \frac{Hd}{c} \tag{9}$$

where $v_r = Hd$ and H are, respectively, the law and the constant of Hubble, and v_r is the speed of recession; we have that

$$\delta = \frac{c}{H} \tag{10}$$

Notice that from (4) and (10)

$$H = \frac{c}{k}u \tag{11}$$

Note also that substituting (10) into (7) and since $\nu(0) = \nu_e$ and $\nu(d) = \nu_o$ we obtain the typical redshift expression of the tired light mechanism

$$z = \frac{\nu_e - \nu_o}{\nu_o} = e^{(H/c)d} - 1 \tag{12}$$

where ν_e and ν_o are the light frequencies emitted and observed, respectively. All these equations apply to the cosmological redshift.

For the intrinsic redshift, we know that a quasar (quasi-stellar radio source) or a radio galaxy, are sources of electromagnetic radio waves, hence inside of a radio source the light scatters those radio waves losing energy following (2), but now d and u are referred to the radio source (that is, d would be the distance traversed by the light inside of the radio source and u the energy density of the radio waves inside of the radio source).

Thus, for example, in the case of the pair quasar-galaxy NGC 7319 [12], where the galaxy has a low redshift, $z_G = 0.0225$, and the quasar (which is in front of the galaxy) a high redshift, $z_Q = 2.1140$ (which is contrary to the expansion of the universe); we would have

$$z_G = z_{IGS} = 0.0225 \tag{13}$$

$$z_Q = z_{InsideQ} + z_{IGS} = 2.0915 + 0.0225 = 2.1140 \tag{14}$$

where both z_{IGS} and $z_{InsideQ}$ would be obtained with (7) but with its corresponding values of d and u. Obviously, the energy density of the radio waves inside of the quasar is much greater than the energy density of the CMBR inside of the IGS.

3. Conclusion

We have established that: 1) the CMBR is the result of the processes of emission and absorption of thermal radiation in the universe, and its temperature of 2.7 ºK is inferred from the works of Eddington, Regener and Nernst; and 2) there is an obvious analogy between the radiation loss by fast electrons ($v \cong c$) and a tired light mechanism, and that therefore the light loses energy when scatters the microwaves of the CMBR inside of the IGS and the radio waves inside of the quasars and the radio galaxies, and that this loss of energy is exponential. In summary, we have given, in a very simple way, using a single tired light mechanism, a reasonable explanation of both redshifts: cosmological (without expansion of the universe) and intrinsic. In the first case, the redshift is produced because the light scatters microwaves. In the second, the scattering is of radio waves. And all this is compatible with a static universe with a space temperature of 2.7 ºK. As using this single tired light mechanism, another explanation of the redshift is possible and a simple alternative interpretation can be generated, we think that our hypothesis should be considered plausible.

References

[1] E. Hubble, Proc. Nat. Acad. Sci., 1929, **15**, 168.

[2] José Francisco García Juliá, A Brief and Elementary Note on Redshift, May 26, 2010.
http://www.worldsci.org/pdf/abstracts/abstracts_5474.pdf
Proceedings of the Natural Philosophy Alliance Vol. 7, 17th Annual Conference of the NPA, 23-26 June 2010, at California State University, Long Beach, pp. 239-240:
http://mikamar.biz/book-info/npa-a.htm
http://www.worldsci.org/pdf/abstracts/abstracts_5462.pdf

[3] José Francisco García Juliá, A Note of Widening on the Redshift Mechanism, June 23, 2010.
http://www.worldsci.org/pdf/abstracts/abstracts_5497.pdf

[4] José Francisco García Juliá, Cosmological and Intrinsic Redshifts, November 19, 2010.
http://vixra.org/pdf/1011.0043v1.pdf

[5] Francis Weston Sears, Introducción a la Termodinámica, Teoría Cinética de los Gases y Mecánica Estadística, pp. 338 and 345, in Spanish, Reverté, Barcelona, 1959. Original edition, An Introduction to the Thermodynamics, the Kinetic Theory of Gases, and Statistical Mechanics, Addison-Wesley, Reading, Massachusetts, 1952.

[6] Arthur Beiser, Conceptos de Física Moderna, p. 261, in Spanish, Ediciones del Castillo, Madrid, 1965. Original edition, Concepts of Modern Physics, McGraw-Hill, 1963.

[7] A. K. T. Assis and M. C. D. Neves, History of the 2.7 K Temperature Prior to Penzias and Wilson, Apeiron Vol. 2 Nr. 3 July 1995, 79-87.
http://redshift.vif.com/journalfiles/pre2001/v02no3pdf/v02n3ass.pdf

[8] F. Zwicky, Proc. Nat. Acad. Sci., 1929, **15**, 773.
http://www.pnas.org/content/15/10/773.full.pdf

[9] Emilio Segrè, Núcleos y Partículas, p. 74, in Spanish, Reverté, Barcelona, 1972. Original edition, Nuclei and Particles, Benjamin, New York, 1964.

[10] Donald H. Perkins, Introduction to High Energy Physics, p. 39, Addison-Wesley, Reading, Massachusetts, 1972.

[11] L. D. Landau and E. M. Lifshitz, Teoría Clásica de los Campos, p. 486, in Spanish, Reverté, Barcelona, 1973. Original edition by Nauka, Moscow, 1967.

[12] Pasquale Galianni, E. M. Burbidge, H. Arp, V. Junkkarinen, G. Burbidge and Stefano Zibetti, The Discovery of a High Redshift X-Ray Emitting QSO Very Close to the Nucleus of NGC 7319, arXiv: astro-ph/0409215v1 (2004).
http://arxiv.org/PS_cache/astro-ph/pdf/0409/0409215v1.pdf