the general science journal

The Big Bang Universe and the Principle of Energy Conservation

Pavle I. Premović,
Laboratory for Geochemistry, Cosmochemistry&Astrochemistry,
University of Niš, pavleipremovic@yahoo.com, Niš, Serbia

Abstract

The energy of light measured by an observer comoving with a nearby or distant galaxy emitting this light would be N (a rational number) times larger than the energy of the galaxy's light measured by Earth's observer. The difference between these two energies in the case of nearby galaxies would be quantized by photon quantum energy $\varepsilon = hH_0$ where h is Planck's constant and H_0 is Hubble constant.

Keywords: Big Bang, Universe, redshift, Doppler effect, energy.

Introduction

The Big Bang theory states that the observable Universe began 13.8 Gy ago, in an enormous and swift expansion. General relativity claims that this expansion is an expansion of space (or better space-time) itself and still is (uniformly) occurring. According to this theory, the wavelength of light coming from nearby or distant galaxies[1] increases or shows cosmological redshift (or simply redshift).

Let us denote with λ (or ν) the wavelength (or frequency) of light emitted by the (nearby or distant) galaxy source (or generated by the same source on the Earth) and λ_G (or ν_G) the wavelength (or frequency) of light measured by an Earth observer. As we noted above, if $\lambda_G > \lambda$ (or $\nu_E > \nu$) then the galaxy's light is redshifted.

The redshift of a galaxy z_G in cosmology is characterized by the relative difference between the observed wavelength λ_G and emitted wavelength λ of light (or in general electromagnetic radiation) sourced by nearby or distant galaxies. This is mathematically expressed by the following equation

$$z = (\lambda_G - \lambda)/\lambda \quad \dots (1).$$

The vast majority of nearby and distant galaxies[2] show redshift in their spectra.

[1] We define nearby galaxies as those galaxies whose redshift z is from 0.001 to 0.1 (or $0.001 \leq z \leq 0.1$) and distant galaxies as those having $z > 0.1$. Of course, there is no sharp boundary between nearby and distant galaxies [1].
[2] Almost all nearby and distant galaxies are redshifted; they are moving away from the Earth. There are about 100 galaxies that have blueshifts and are heading towards the Earth. Most of these are Local Group (dwarf) galaxies.

In contrast to the Big Bang model, the ultraviolet surface brightness data of galaxies, over a very wide redshift range imply that the observable Universe is the non-expanding (Euclidean) Universe (NEEU) [2, and references therein]. A detailed analysis of the gamma-ray burst sources performed by Sanejouand [3] supports this view suggesting that this Universe has been Euclidean and static over the last 12 Gy. To explain redshift, Premović [4] hypothesized that the speed of light emitted by nearby/distant galaxies in NEEU is superluminal.

The conservation of energy (the Principle energy of conservation) is one of the fundamental laws of physics that is not violated by any known process. For example, in quantum physics, energy is conserved. In contrast, one of the problems that the Big Bang Universe is facing is the apparent violation of this law by the cosmological expansion.

Another problem that has received little attention despite its importance is the fact that we do not know the recessional speed of any nearby or distant galaxies at all (for example, see https://www.loop-doctor.nl/hubble-and-humason-measured-redshift/). Moreover, we do not know the distance between the Earth and these galaxies except for a few nearby so-called "megamaser" galaxies [4]. In further text, we will assume that the peculiar speed of nearby/distant galaxies is negligible. Indeed, almost all these galaxies have such peculiar speeds [5].

Derivations and Discussion

Let us assume that a nearby or distant galaxy is moving from the Earth emitting the photon toward Earth's observer and who performs a measurement on it. Assume that the frequency of this photon is ν_G and its energy, according to Planck's equation, is $E_G = h\nu_G$ where h is Planck's constant (6.63×10^{-34} J sec). This is only the energy that we could assign to the photon in question following the Conservation energy law. On the other hand, an observer comoving with a nearby or distant galaxy would measure a higher frequency ν and calculate higher energy, $E = h\nu$, which is also conserved. In other words, the energy of the photon emitted by these galaxies in the Big Bang Universe is conserved in the two different (galaxy and Earth) reference frames. This is in accord with Special relativity which allows the observers in different frames of reference can measure different energies for the same event.

Denote with $\mathcal{N}_G$ the number of periods T_G (= $1/\nu_G$) for the light emitted by a nearby or distant galaxy to the Earth and observed by an Earth observer. Analogously, denote by $\mathcal{N}$ the number periods T (= 1/ν) of this light but viewed by an observer comoving with any of these galaxies. The distance, D_G, between the Earth and a nearby or distant galaxy, is identical regardless of whether the Earth or galaxy is moving away. Mathematically speaking we state

$$D_G/c = \mathcal{N}/\nu = \mathcal{N}_G/\nu_G \quad \ldots (2).$$

where c ($\approx 3\times10^8$ m sec^{-1}) is the speed of light. After some rearrangement of this equation, we get

$$\mathcal{N}\nu_G = \mathcal{N}_G\nu. \quad \ldots (3).$$

Since $\nu > \nu_G$, then $\mathcal{N} > \mathcal{N}_G$.

Elementary physics shows that

$$\nu = c/\lambda \text{ and } \nu_G = c/\lambda_G$$

Combining these two formulas with eqn. (2) we have

$$D_G = \mathcal{N}\lambda = \mathcal{N}_G\lambda_G$$

Since $\mathcal{N}_G$ and $\mathcal{N}$ are extremely large natural numbers.[3] then the ratio ($\mathcal{N}/\mathcal{N}_G$) is a rational number that will be denoted as N or N = $\mathcal{N}/\mathcal{N}_G$. After a bit of algebra, we get

$$\lambda_G/\lambda = \mathcal{N}/\mathcal{N}_G$$

or

$$\lambda_G/\lambda = N \quad \ldots (4)$$[4]

Multiplying eqn. (3) with h and after a bit of algebra we get

$$h\nu/h\nu_G = E/E_G = \mathcal{N}/\mathcal{N}_G.$$

For convenience, we write

$$E = (\mathcal{N}/\mathcal{N}_G)E_G$$

or

$$E = NE_G \quad \ldots (5).$$

Eqn. (2) and all subsequently derived equations are valid for all nearby/distant galaxies with an identical source of emitting light.

In summary, the energy (or frequency) of light emitted by a nearby or distant galaxy measured by an observer commoving with the galaxy would be N times larger than the energy (or frequency) of

[3] Each large rational number (say $\geq$ 10000) can be approximated with a corresponding natural number since the approximation error is small (< 0.01 %). In the case of nearby or distant galaxies, we are dealing with an extremely large rational number of the periods, therefore the approximation error is extremely small – i. e. completely negligible.
[4] We know that $\lambda_G/\lambda = z + 1$. In the case of nearby galaxies $0.001 \leq z \leq 0.1$ (footnote 1) so $\lambda_G/\lambda \approx 1$. Then $N \approx 1$.

this light measured by an Earth observer. In contrast, the wavelength of this light measured by an Earth observer would be (apparently) N times its wavelength determined by an observer commoving with the galaxy.

Let us denote with ΔE a difference of energy between $E = h\nu$ and $E_G = h\nu_G$ then

$$\Delta E = E - E_G = h\nu - h\nu_G \quad \ldots (6).$$

If we combine the middle part of this equation with eqn. (5) we get

$$\Delta E = (N - 1)E_G.$$ [5]

Cosmologists consider Hubble's law as a direct consequence of the expansion of the Universe from the initial Bing Bang. This law states that there is a linear relationship between the distance D_G to nearby galaxies and the redshift z of their light. It can be expressed as

$$z = D_G H_0/c \quad \ldots (7)$$

where H_0 is Hubble's constant representing the constant rate of the Universe expansion and it ranges from 50 km sec^{-1} $(Mpc)^{-1}$- 100 km sec^{-1} $(Mpc)^{-1}$. We usually use $H_0 = 72$ km sec^{-1} $(Mpc)^{-1}$.

Combining eqn. (1) and eqn. (7) we arrive at

$$\Delta E = (D_G/\lambda_G)hH_0 = \boldsymbol{N}_G hH_0 \quad \ldots (8).$$

As we noted above, $\boldsymbol{N}_G$ is an extremely large natural number so the difference of energy ΔE is quantized. This possibility was just mentioned in our previous communication [6]. Then we defined hH_0 as the Hubble photon quantum of energy ε or

$$\varepsilon = hH_0.$$

Using the above value for H_0 we estimated that $\varepsilon = 1.5 \times 10^{-51}$J. {For further details see [6]}. In fact, this energy represents the minimum photon quantum energy of the observable Universe.

Combining eqn. (7) equation and eqn. (8), and after a bit of algebra, we simply derive

$$z_G = \Delta E \lambda_G/hc \quad \ldots [8]$$

All equations derived, using eqn. (7), are only valid for nearby galaxies.

[5] For the nearby galaxies $\Delta E \approx 0$ J.

References

[1] P. I. Premović**,** *Nearby and distant galaxies: a brief note*. The General Science Journal, August 2024.
[2] E. J. Lerner, *Observations contradict galaxy size and surface brightness predictions that are based on the expanding universe hypothesis*. Monthly notices the Royal Astron. Soc. (MNRAS) 477, 3185-3196 (2018).
[3] Y. –H Sanejouand, *About some possible empirical evidences in favor of a cosmological time variation of the speed of light*. Europhys. Lett., 88, 59002 (2009).
[4] P. I. Premović, *Distant galaxies in the non-expanding (Euclidean) Universe: the light speed redshift.* The General Science Journal, December 2021.
[5] T. M. Davis and M. I. Scrimgeour, *Deriving accurate peculiar velocities* (*even at high redshift*). MNRAS, 442, 1117–1122 (2014).
[6] P. I. Premović, *The Hubble photon quantum of energy of the observable Universe*. The General Science Journal, September 2024.