Cosmological Redshift, Compton Effect and Age of the Stars

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The Compton effect, in conjunction with the age of the stars, might explain any case of light redshift.

Key words: cosmological redshift, Compton effect, age of the stars.

1. Introduction

Generally, it is considered that the universe was originated in the Big Bang, and since then it is expanding. In that 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. This empirical law is stated as [1] (p. 486)

$$v_r = Hd \tag{1.1}$$

where v_r is the velocity of recession, namely the speed at which a light source moves away from the observer, due to the expansion of the space between them; H is the constant of Hubble, and d is the distance between the observer and the light source. The light redshift parameter is defined as

$$z = \frac{\nu_e - \nu_o}{\nu_o} \tag{1.2}$$

being ν_e and ν_o the light frequencies emitted and observed, respectively. For low redshift ($z << 1$) [1] (p. 486)

$$z = \frac{v_r}{c} = \frac{Hd}{c} \tag{1.3}$$

being c the light speed in vacuum, therefore the redshift of the galaxies is proportional to their distances to the observer. That is, the greater the distance, the greater the redshift.

However, we are going to consider, using only very elemental arguments, that the redshift in the light coming from the stars might be produced by Compton effect in conjunction with the age of the stars.

2. The Compton effect, the age of the stars and the cosmological redshift

When a visible photon collides (or interacts) with an electron, the energy of the photon ($h\nu$, where h is the Planck's constant) decreases and the kinetic energy of the electron (T) increases:

$$h\nu_e - h\nu_o = \Delta T \tag{2.1}$$

This process is known as the Compton effect or Compton scattering. As a consequence, the photon is red shifted: $\nu_o < \nu_e$.

When a hydrogen atom of a star emits a photon, this photon can collides with the electron of another hydrogen atom and suffer such a redshift. This happening will occur more in a young star, because this has more hydrogen. Hence, the younger the star, the greater the redshift. As the distance from a star to us, for a light signal, is

$$d = ct \tag{2.2}$$

being t the time, then the more distant the star, the younger was when emitted its light, and therefore, the greater its redshift. Hence, the greater the distance, the greater the redshift, which would explain the cosmological redshift.

3. Anomalous redshift

In 2004, it was reported [2] the discovery (contrary to the expansion of the universe) of a quasar with high redshift, $z = 2.114$, in front of a galaxy, NGC 7319, with low redshift, $z = 0.0225$. In the enlarged photograph of the event, it can be seen that exists a "V" shaped jet of matter between the quasar and the galaxy that might confirm that the quasar was ejected by the nucleus of the galaxy. In such a case, the quasar would be much younger than the galaxy. Therefore, the stars of the quasar would be much younger than the stars of the galaxy, so the redshift of the quasar would be much greater than the redshift of the galaxy, which would explain the anomalous redshift. Notice that the quasar is also an ultra luminous X-ray (ULX) source; this might be explained by the inverted Compton effect in which the electron loses kinetic energy and the photon gains energy turning into an X-photon.

3. Conclusion

We conclude that the Compton effect, in conjunction with the age of the stars, might explain any case of light redshift.

References

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[2] 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).