Cosmological Redshift from Light Acceleration

by Paul R. Gerber

Gerber Molecular Design, Forten 649, CH-8873 Amden

Email: Paul.Gerber@moloc.ch

95.30.-k Fundamental aspects of astrophysics

95.30.Sf Relativity and gravitation

Abstract

We propose that the cosmological redshift is caused (at least in part) by gravitational damping of light as it moves through the universe. Such damping must occur, because the light is continuously deflected (accelerated) on its path across the universe by the persistent spacial change of the gravitational field.

Introduction

Slipher [1] and in great detail Hubble [2] observed that spectral lines of distant galaxies become increasingly red-shifted with increasing distance, r, of a galaxy. For the observed wavelength, λ, of a spectral line of wavelength λ_0 they obtained a relation

$$z(r) \equiv \frac{\lambda - \lambda_0}{\lambda_0} = \frac{r}{D_H} \quad ,$$

where D_H is the Hubble length. Interpreting this finding as Doppler effect of galaxies that recede at a velocity, v_r, increasing linearly with distance one arrives at the actual Hubble relation

$$v_r = \frac{c}{D_H} r = H r \quad ,$$

valid for $v_r < c$, as was the case in Hubble's measurements. At the time, solutions of the equations of Geneal Relativity were given by Friedmann [3] and Lemaitre [4] which described the Cosmos in terms of a continuous up-scaling of space. In this process the wavelength of light crossing the cosmos is supposed to scale up concurrently. Thus, the cosmological redshift is interpreted as the amount of up-scaling that took place between the time of emission of the light and the time of observation; the light wave is considered to be "stretched" by this scale factor.

There have been attempts to explain the cosmological redshift by "tired light", caused by processes in which light would loose energy by interaction with electrons or atoms. However, such processes were excluded, because they would lead to light spreading or line broadening, in contrast to observation [5].

Remark

In this note we propose that light looses energy by gravitational damping. It is by now commonplace that a body which experiences acceleration in a gravitational field emits a gravitational wave. This has been experimentally verified by the beautiful experiments of the LIGO collaboration [6]. Thus, there is also no doubt that a small body passing a star in a non-bound orbit will loose a tiny amount of energy by emitting, in a common process with the star, a weak gravitational wave. Likewise, a passing light wave is deflected by the star, and thus, must also emit a gravitational wave in this process. It looses some tiny amount of it's energy, which, for light, amounts to a tiny redshift.

Now, light from a distant galaxy is forced to perform a constant slalom of very small changes in movement direction owing to a constantly changing actual gravitational field along the light path (micro-lensing). It thereby continuously looses energy. Of course it is not only the change in direction but also the longitudinal accelerations that contribute to this radiation of gravitons. Thus, we think that at least part of the cosmological redshift originates in the ruggedness of the gravitational landscape the light wave has to move through.

Obviously, we do not expect that these processes of energy loss have the random nature that made the "tired light"-proposal unlikely.

Conclusion

If we were to interpret the cosmological redshift to be caused exclusively by the proposed gravitational damping we would consider the Hubble length as the critical range after which a photon's energy drops to fractional value of 1/e. In numbers, that corresponds a loss of 1 part in a thousand over a distance of some 4 Mps, a typical galaxy-cluster size.

Adhering to this extreme interpretation, we may recall a proposal which describes the development of the universe as a continuous process of de-mixing of matter and anti-matter [7,8] which are assumed to repel each other. In this view the voids in the universe, which occupy roughly half the space, are filled preferentially by antimatter [9,10]. In the process of de-mixing the ruggedness of the gravitational field increases and with it the amount of gravitational damping of crossing light. This would also nicely explain that the expansion rate, which corresponds here to a damping rate, increases with time, as is found experimentally [11,12].

The most radical conclusion is that the expansion of the universe may not exist.

References

1. Slipher V. M., (1917), The Observatory 40, 304
2. Hubble E., (1929), PNAS 15, 168
3. Friedmann A., (1922), Zeitschrift fuer Physik 10, 377
4. Lemaitre G., (1927), Annales de la Societe Scientifique de Bruxelles A47, 49
5. Zel'dovich Y. B., (1964), Sov.Phys.-Uspekhi 6, 475
6. LIGO Scientific Collaboration, LSC
7. Gerber P. R., (2020), viXra:2008.0160
8. Gerber P. R., Youtube: Bipolar Cosmos
9. Gerber P. R., (2013), viXra:1303.0100
10. Gerber P. R., (2019), viXra:1911.0010
11. Riess A. G. et al., (1998), arxiv:9805201
12. Perlmutter S. et al., (1999), arxiv:9812133