Brief Demonstration that the Expansion of the Universe is Decelerating

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Abstract

Considering redshift as an indicator of the speed of the Earth's move away from the source, rather than a scale factor of the expansion of the Universe, the fact that the luminosity distance of type Ia supernovae increases more than proportionally respect redshift, demonstrates that the expansion is slowing down, thus easily explaining the arrival of the CMBR on Earth after a journey of almost 14 billion years, despite having started from locations not very far away at the time.

Keywords:
Redshift, Universe, expansion, deceleration, speed of move away, CMBR

Introduction

Light is composed of electromagnetic waves that therefore need a medium to manifest themselves, like sound relative to air, therefore, its speed can be isotropic only relative to the medium and not also relative to celestial objects, including the Earth, that move in the medium.
Physicists of the late 19th and early 20th centuries, devised a series of experiments to detect the motion of the Earth relative to the medium, but without ever succeeding, because the speed of light was found to be isotropic relative to the Earth as well.
To justify these results, some physicists have hypothesized that all objects, as a function of their speed relative to the medium, undergo a time dilation and a length contraction, making the speed of light appear isotropic even if in reality it is not, so that said isotropy **would be** only apparent.
Instead I was able to demonstrate that the speed of light is not isotropic relative to the Earth, through the CMBR and thus I demonstrated that this isotropy **is** only apparent (1).
However, at least initially, the scientific community interpreted redshift as an indicator of the speed of celestial objects relative to a stationary Earth, obtaining speeds and distances that were increasingly incompatible with observations, and so it later decided to consider redshift as the scale factor of the expansion of the Universe.
But about thirty years ago it was discovered that the distance based on the apparent brightness of very distant type Ia supernovae, is greater than that based on the scale factor, thus demonstrating that the redshift does not represent it.
In fact, as I will demonstrate below, **the redshift indicates the speed of move away from the source**, but **of the Earth relative to the source** and not the opposite, as at least initially considered by the scientific community.

Demonstrations

The space is expanding at the same rate everywhere in the Universe. Therefore any location move away from any other location at a speed that depends on distance.
In practice any location in the Universe may be considered as its centre because any other location moves away from it and also because photons that move through it have the same speed, i.e. about 300,000 km/s, in all directions.
However, if the photons move at a speed of about 300,000 km/s relative to the locations they are passing through, and those locations move increasingly faster from their location of emission, even photons move increasingly faster relative to their location of emission.
For example the photons emitted by a galaxy and going towards the Earth, at a the emission have a speed of about 300,000 km/s relative to the galaxy's location, but far smaller relative to the Earth's location, because it is moving away from the galaxy's location. But as the photons move towards the Earth's location, through locations that move increasingly away from the galaxy's location, the photons move at an increasingly speed relative to the Earth's location, reaching it at about 300,000 km/s relative to it and 300,000 km/s plus the increase in speed, compared to the galaxy's location.
This increase in speed corresponds to the speed of the receiving location relative to the sending location and is calculated using the Doppler effect formulas which consider the receiver in motion and the emitter motionless, i.e.:

$$\mathrm{v_r} = \mathrm{c} - \frac{\mathrm{c}}{1+z}$$

Where "vr" represent the speed of the receiver move away and z represent the redshift, which therefore indicates that of the receiver from emitter.
For example, a redshift of 0.59 measured on Earth indicates that the Earth (I use the names of celestial objects rather than their locations, for simplicity) is moving away from the galaxy, at 111,321 km/s.

$$\mathrm{v_r} = 300{,}000 - \frac{300{,}000}{(1+0.59)} = 111{,}321$$

So the redshift indicates the speed of the Earth's move away from the source. And from observations it turns out that the higher the redshift, the greater the distance from the source, calculated on the basis of the apparent brightness.

If the speed of the Earth's move away from the sources, which is due to the expansion of space, had always been the same over time, the redshifts would be directly proportional to the distances from the sources based on their apparent brightness, that is, to the observed distances.
Instead from observations of the apparent brightness of type Ia supernovae, it appears that their distance increases more than proportionally relative to the redshift. This means that the average speed of the move away from these supernovae has been greater than the current one and, therefore, that in the past the expansion speed of the Universe was greater than now and, therefore, that the expansion of the Universe is decelerating. As one might expect after a Big Bang.

The deceleration of the expansion of the Universe makes it easy to explain why photons from the CMBR arrived on Earth only after 14 billion years of travel at the speed of light and despite having started from locations relatively close to Earth, given that the Universe had not yet expanded much.
In fact, the Earth's location was moving away at a speed much greater than that of the photons, so over time it distanced them considerably. But then, due to the slowing of the expansion, it slowed down to a speed of move away lower than that of light, allowing the photons to reduce the distances and reach it and, therefore, also arrive on Earth.
So this is a simple explanation, especially when compared to that provided by those who support the acceleration of the expansion, as can be seen in a more in-depth article of mine, where you can also find a simulation of the journey of photons of the CMBR towards the Earth, using an Excel table (2).

To demonstrate that the expansion of the Universe is slowing down, I propose to verify that the redshift of a celestial object decreases over time. Verification could be possible by comparing current observations of certain celestial objects with those made in Hubble's time, as a very precise definition should not be necessary to determine only whether the redshift has increased or decreased. In any case, it should be possible to verify this in the next few years thanks to the new Extremely Large Telescope, which among its objectives also has that of measuring the changes in the redshift of the same celestial object over time, while it would be sufficient to know only whether it is increasing or decreasing.

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