the general science journal

Light dispersion in Our Universe

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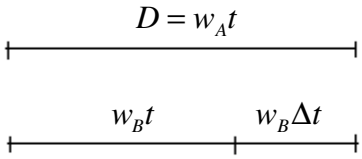
Abstract – There are two types of light dispersion in our universe. The one is inside our galaxy with a negative value (the greater the frequency the greater speed) due to the existence of an almost uniform electron density. The other is for intergalactic distances or distances near the radius of the universe, with a positive value (the greater the frequency the lower the speed) due to the quantum mechanics vacuum.

General speed variation



$$\Delta w = w_A - w_B \quad \Leftrightarrow \quad \frac{\Delta w}{c} = \frac{c\Delta t}{D}$$

To know the speed variation we only need to know the time delay and the distance.

In our galaxy

- Negative dispersion due to electron density

$$D = 7.3\times10^4 \frac{\Delta t f^{2.7}}{\Delta f} \qquad \text{(SI units)}$$

D – Distance; Δt -- time delay; f – average frequency; Δf -- bandwidth

$$\frac{\Delta w}{c} = \frac{1.7\times3.7\times10^{20} f^{-2.7}\Delta f}{2c^2} \qquad \text{with}$$

$$w = \sqrt{c^2 - kf^2} \qquad \text{and} \qquad k = \frac{3.7\times10^{20}}{f^{3.7}}$$

We have tested the formulas and conclude that they are exact.

In the universe

- Positive dispersion due to quantum mechanics vacuum.

- Low red shift.

$$w = \sqrt{c^2 - kf^2} \qquad \text{and} \qquad k = 2\times10^{-34}$$

$$\frac{\Delta w}{c} = \frac{k\left(f_B{}^2 - f_A{}^2\right)}{2c^2} \qquad \text{(SI units)}$$

$$D = \frac{c^2\Delta t}{\Delta w}$$

- High red shift

$$\frac{\Delta w}{c} = \frac{k\left(f_B{}^2 - f_A{}^2\right)}{2c^2}\frac{c-v}{c+v}$$

$$D = \frac{c^2\Delta t}{\Delta w} \qquad \text{and} \qquad v = DH_0 \qquad \text{with} \qquad H_0 = 2.91\times10^{-18}$$

v is the relative expansion speed (another way of expressing the red shift), H_0 is the Hubble constant and D is the distance.

This formula is exact according to all known data. So, the measurement of the time delay of any celestial object with variable emission in a frequency bandwidth is a method of exact distance measurement.