Alternative Hypothesis for Cosmological Redshift

Felipe A. Wescoup, PE

2320 Point Star Drive

Arlington TX 76001

Abstract

This paper proposes an alternative hypothesis for the cosmological redshift based on energy conservation between photons and the intergalactic medium (IGM). The hypothesis suggests that photons lose energy to the IGM during their propagation through space according to ΔE_IGM = -ΔE_photon, following an exponential decay model. This energy transfer results in the observed redshift without requiring the existence of dark energy. The paper presents the fundamental equations governing this interaction and suggests methods for testing the hypothesis through systematic redshift studies.

1 INTRODUCTION

The cosmological redshift is commonly attributed to the expansion of space-time itself, causing wavelength elongation of photons during their propagation through space [1]. While this interpretation has been successful in explaining many cosmological observations, it requires the existence of dark energy [2] - a hypothetical form of energy that has yet to be directly detected. This paper proposes an alternative mechanism: energy loss of photons to the intergalactic medium during their propagation through space. This hypothesis does not require the existence of dark energy.

2 IGM ENERGY TRANSFER HYPOTHESIS

The proposed hypothesis is based on energy conservation during photon propagation through the intergalactic medium (IGM). As a photon travels through space, it transfers energy to the IGM according to the conservation relationship:

$$\Delta E\_IGM = -\Delta E\_photon \quad \text{(Equation 1)},$$

where ΔE_IGM represents the energy gained by the IGM and ΔE_photon represents the energy lost by the photon. This energy transfer results in a decrease in the photon's frequency, manifesting as the observed redshift.

The rate of energy transfer between the photon and IGM follows an exponential decay model, where A(t) represents the photon's energy at time t, A_0 is the initial photon energy, and r is the fractional energy loss rate per unit time.

$$A(t) = A_0(1-r)^t \quad \text{(Equation 2)}$$

This exponential relationship suggests that the energy loss occurs continuously during propagation, with the rate of loss proportional to the photon's current energy level. The parameter r, which must be determined empirically, represents the coupling strength between the photon and the IGM.

3 EXPONENTIAL DECAY EXAMPLE

To illustrate the application of this model, consider a Lyman-alpha photon with initial energy $A_0 = 1.635 \times 10^{-18}$ Joules. If this photon is observed with one-tenth of its initial energy ($A(t) = 1.635 \times 10^{-19}$ Joules) after traveling for 13.8 billion years, we can solve for the fractional energy loss rate r using Equation 3:

To calculate r:

$$r = 1 - (A(t)/A_0)^{(1/t)} \quad \text{(Equation 3)}$$

where: $A_0 = 1.635 \times 10^{-18}$ Joules

$A(t) = 1.635 \times 10^{-19}$ Joules

$t = 13.8 \times 10^9$ years

Solving Equation 3 yields $r = 1.67 \times 10^{-10}$ per year, indicating the fractional energy loss rate required to explain the observed redshift over the age of the universe.

4 ASSUMPTIONS

To better understand this hypothesis, it is helpful to discuss the assumptions that affect the hypothesis and those that do not. Below is a list of assumptions and their affect or non-affect on the hypothesis:

- Expansion of the universe – this hypothesis requires neither an expanding universe nor a static universe. This hypothesis does not require a big bang or dark energy.
- General relativity – this hypothesis makes no assumptions regarding general relativity. This hypothesis does not require general relativity. It also does not contradict general relativity.
- Speed of light – this hypothesis, as proposed, assumes the speed of light to be a constant. However, the equations are still valid for variable speed of light theories.

- Constancy of the fractional energy loss rate – the fractional energy loss rate is not a constant. It depends on the density of the IGM along the photon’s path, which is assumed to have some variability.
- Distance of the observed galaxy – the fractional energy loss rate depends on the assumed distance of the observed galaxy. As discussed in the following section, Future Work, this hypothesis can be developed using the distance of closer galaxies to better estimate the distance of distant galaxies.

5 FUTURE WORK

Validation of this hypothesis requires systematic redshift studies starting with nearby galaxies to establish baseline r values, extending progressively to more distant objects. This will allow refinement of r across different spatial regions and distances.

Additional investigations include:

- Examining correlations between IGM temperature variations and r
- Comparing redshift patterns between dense galaxy clusters and sparse regions
- Testing the model against cosmic microwave background observations
- Developing computational models using known IGM density distributions

These studies will help validate the hypothesis and quantify how IGM properties affect photon energy loss across cosmic distances.

References:

1. "Redshift." Wikipedia, Wikimedia Foundation, 25 Oct. 2024, en.wikipedia.org/wiki/Redshift. Accessed 9 Nov. 2024.
2. "Hubble's Law." Wikipedia, Wikimedia Foundation, 31 October 2024, en.wikipedia.org/wiki/Hubble's_law. Accessed 9 November 2024.