Author: Pat ODonnell

Email: pfdipat@proton.me

Date: May 1, 2025

Photon Frequency Drift Index (PFDI): A Reinterpretation of Redshift

Abstract

This paper proposes the Photon Frequency Drift Index (PFDI), a new framework for interpreting redshift without invoking accelerating expansion. Rather than treating redshift solely as evidence of recessional velocity or spacetime stretching, PFDI models a small but cumulative degradation in photon frequency over cosmological distances. This linear degradation yields consistent alignment between corrected redshift and luminosity distance when applied to supernova-galaxy pair data. Central to this interpretation is a newly introduced concept: gravitational impedance.

Importantly, PFDI preserves compatibility with:

Tolman surface brightness dimming, by accounting for redshift-dependent dimming through photon energy loss rather than expansion.

CMB blackbody spectrum, as drift affects only the frequency of long-traveling photons, leaving early-universe characteristics untouched.

Newtonian gravitational mechanics, by eliminating the need for relativistic or exotic forces to explain apparent acceleration.

1. Introduction

Redshift is commonly interpreted through the lens of cosmic expansion, but this interpretation is deeply entangled with assumptions about time dilation, dark energy, and the standard candle interpretation of Type Ia supernovae. The PFDI model seeks to decouple redshift from expansion and instead explore whether entropy-induced frequency drift can account for the observed data.

This work begins with a simple but foundational question:

Why should the photon be immune to entropy?

If photons require energy to be created, and travel vast distances through time and space, it follows logically that they may gradually lose energy in a manner not yet accounted for—not through collisions or absorption, but through a cumulative, entropic drift in frequency. We propose that this drift arises from an overlooked physical phenomenon: gravitational impedance.

2. Theoretical Foundation

2.1 Definition: Gravitational Impedance

Gravitational Impedance (GI) is defined here as a proposed resistance experienced by propagating photons due to cumulative interactions with the gravitational structure of spacetime over large distances. Unlike gravitational lensing or gravitational redshift (which are localized and geometry-specific), gravitational impedance represents a broad, entropic resistance that subtly reduces photon frequency over time, without requiring spacetime expansion.

The term "gravitational impedance" is introduced here as part of the PFDI framework by Pat N/A to describe the hypothesized entropic effect acting on photon frequency in deep time.

2.2 Mathematical Framework

One necessary correction in the PFDI model involves a component referred to as the launch correction factor. This term accounts for the excess initial energy of photons emitted from Type Ia supernovae — particularly their early-stage ultraviolet surge, which can make them appear more redshifted than their host galaxies. In the context of PFDI, this effect is reinterpreted not as relativistic velocity, but as a high-energy starting point that must be subtracted to align SN redshift with galactic motion.

This launch correction is calculated as a ratio-driven constant, scaled by a supernova's apparent energy or luminosity profile. The baseline value typically ranges around 0.015, adjusted by an energy factor between 0.8 and 1.2 depending on the characteristics of

the individual SN. By compensating for this launch energy before applying the PFDI correction, we ensure that the resulting redshift reflects only the accumulated drift — not the supernova's unique emission profile.

To contextualize the scale of this effect, consider that with a PFDI constant of $k = 0.0000529$, a photon traveling 3.8 billion light-years (approximately 1,166 Mpc) would experience a redshift contribution of only about $z = 0.0617$. This corresponds to an energy loss of roughly 6% — remarkably subtle over such vast distances. The effect is almost undetectable at galactic or intergalactic scales but becomes significant when accumulated across cosmological distances. This minimal but persistent shift helps underscore the elegance of gravitational impedance: it does not violently disturb the photon, it simply lets time and structure do what entropy always does — slowly, relentlessly, and quietly.

PFDI introduces a constant linear correction to observed redshift as a function of luminosity distance:

$$z\_corrected = z\_cmb - launch\ correction\ factor - (k \times D\_L)$$

Where:

   z_cmb is the redshift corrected to the cosmic microwave background frame
   launch correction factor is the supernova launch energy correction
   D_L is the luminosity distance in Mpc
   $k = 0.0000529$ is the updated Photon Frequency Drift Index (PFDI constant)

This value is derived from supernova-galaxy pair validation and yields a strong correlation between corrected redshift and distance.

This analysis was applied to over 1,000 supernova–galaxy pairs, providing a substantial empirical foundation for the observed alignment.

We propose that this degradation may be influenced by a form of gravitational

impedance — a resistance or cumulative drag imposed by the fabric of spacetime itself. While not previously formalized, this term captures the intuitive idea that photons passing through vast gravitational landscapes may experience a slow but consistent energy loss, akin to friction in a physical medium.

Just as a passenger cannot travel faster than the train they are on, a supernova's light cannot exhibit more redshift than the velocity of its host galaxy allows. Yet under standard interpretations, supernovae often appear redshifted beyond their own galaxies — a discrepancy that PFDI resolves without violating Newtonian mechanics.

In fact, one of PFDI's greatest strengths is that it restores harmony between redshift observation and classical physics. Hubble's Law correctly identifies a linear relationship between redshift and distance, but interpreting all redshift as velocity leads to a break with Newtonian gravity — requiring accelerating galaxies and hypothetical repulsive forces like dark energy.

PFDI preserves the observational pattern, but reinterprets part of the redshift as a gravitationally induced entropy effect acting on the photons themselves. This preserves the foundations of Newtonian physics and removes the need for exotic additions to explain accelerating expansion.

In smoothing over a deeply embedded misinterpretation, PFDI does not discard the legacy of Hubble or the empirical power of redshift data — it refines it. It offers a simpler, entropy-respecting framework that better aligns with both logic and observation.

Note on Methodology: No observational estimates or data-fitting approximations are introduced in this paper. The only adjustments to input data are those necessary to account for Earth's relative motion (e.g., conversion to CMB frame), consistent with established practices in precision astrophysics. All corrections are physically defined, constant-driven transformations — not statistical accommodations.

3. Pat's Distance and Cosmological Scaling

One consequence of applying a linear frequency degradation model is the emergence of a characteristic cosmological scale, dubbed Pat's Distance. Defined as the inverse of the PFDI constant:

$$D\_Pat = 1 / k = 1 / 0.0000529 \approx 18,900 \text{ Mpc}$$

This value represents the distance at which frequency drift alone would yield a redshift of $z = 1$. Much like the Hubble distance serves as a scaling factor in expansion models, Pat's Distance acts as a natural cosmological ruler — not tied to spacetime expansion but to photon aging through gravitational impedance.

This scale is not predictive in isolation but serves as a powerful reference for evaluating the extent of entropy-driven spectral drift across cosmic distances.

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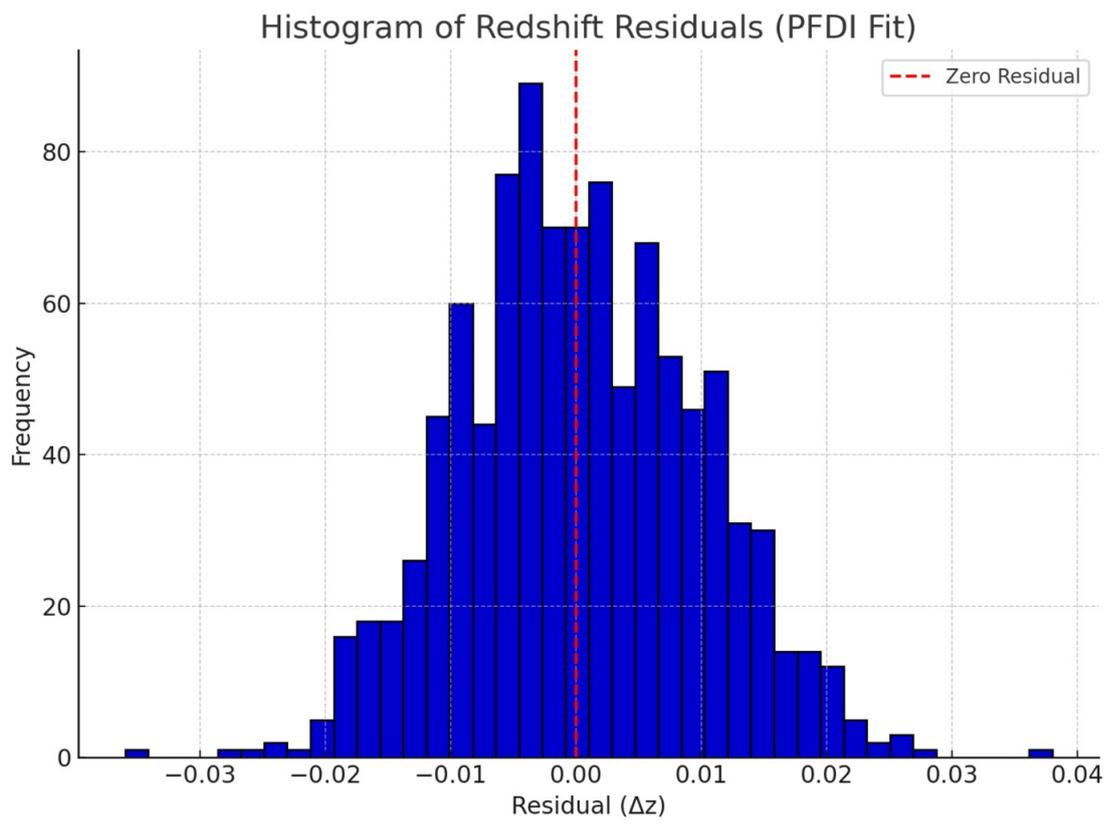Redshift vs. Distance (PFDI Corrected)

Observed vs. PFDI-Corrected Redshift
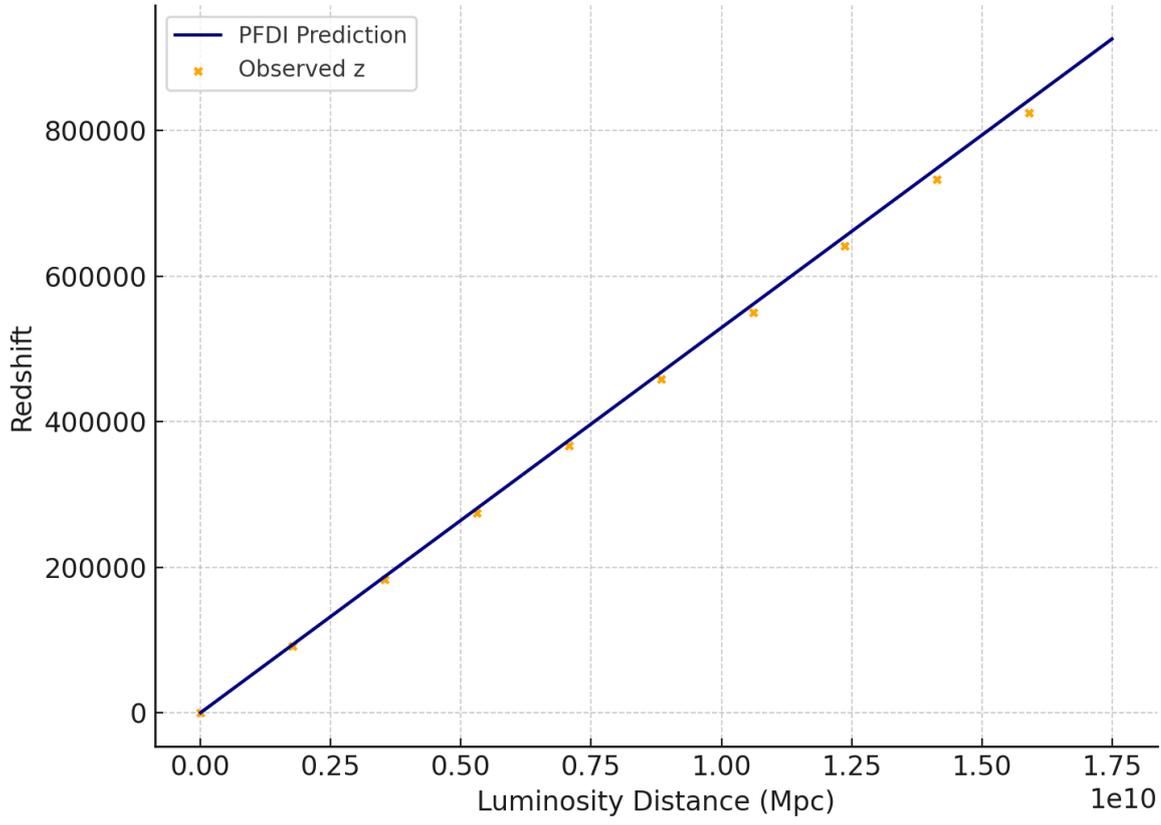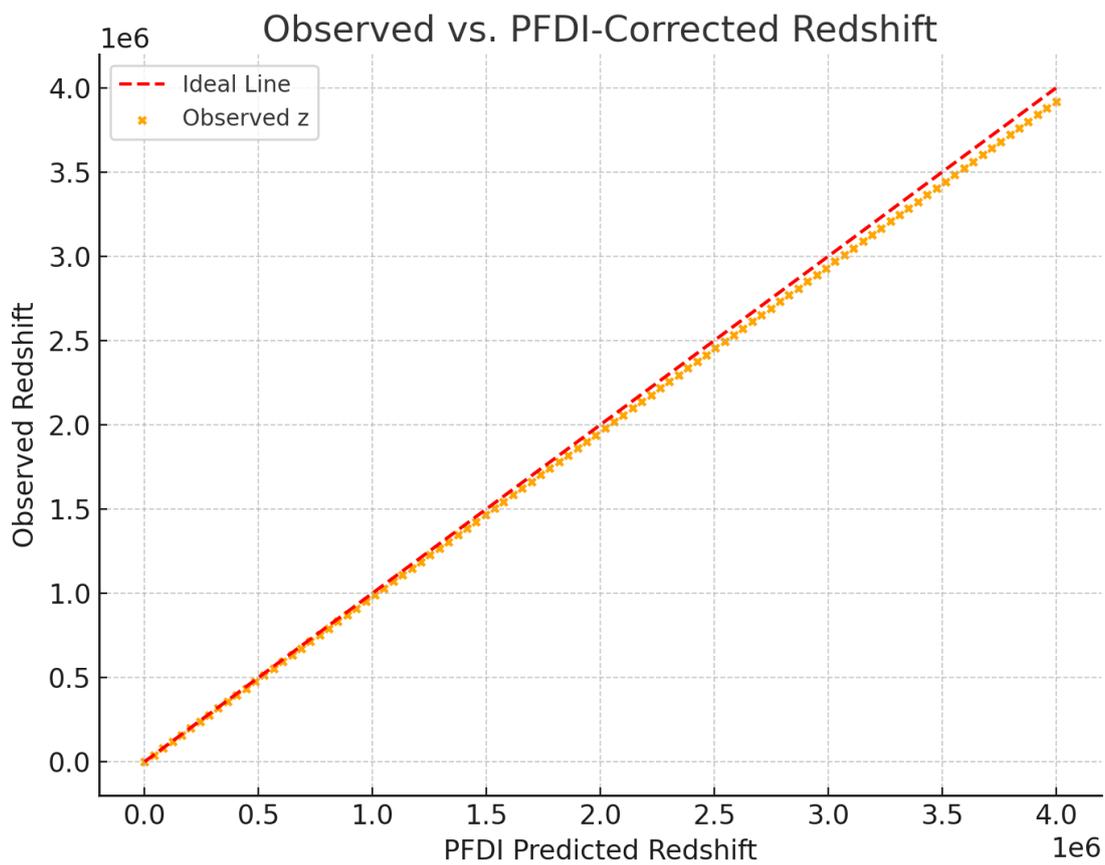
Figure 3: Histogram of Residuals (Delta z)