Redshift, Distance, and the Illusion of Dark Matter: A Test Based on 175 Galaxies

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Abstract

Standard cosmology interprets galactic redshift as cosmic expansion and relies on dark matter to explain anomalous rotation curves. This work proposes an alternative redshift-distance relation from first principles, independent of General Relativity. The average gravitational field $\bar{g} = 2 \times 10^{-9}\,\mathrm{m/s^2}$ is physically derived from cosmic large-scale structure, not a fitting parameter. Using 175 SPARC galaxies, we find that the true distance is systematically 4–5 times smaller than the standard luminosity distance. After consistent rescaling of distance, radius, and mass-to-light ratio, 96% of galaxies can be explained by baryons alone without dark matter. We perform three layers of empirical tests: rotation curve fitting with χ^2 comparison, high-redshift behavior relative to SNe Ia, and angular-diameter distance tests against strong lensing and BAO. The model remains consistent with current observations, while providing a self-contained, empirically testable alternative to the dark matter paradigm.

1 Wavelength Stretching Equation

We propose a first-principles relation for light propagation:

$$\frac{d\lambda}{dt} = \frac{g}{c}\lambda \tag{1}$$

Converted to spatial form:

$$\frac{d\lambda}{dr} = \frac{g}{c^2}\lambda \tag{2}$$

This describes cumulative wavelength stretching in the cosmic gravitational field.

2 Physical Origin of $\bar{g}$

Within the Hubble scale $R_H = c/H_0$, the total mass is $M = \rho_m \cdot \frac{4\pi}{3} R_H^3$. The gravitational acceleration at the surface is $g = GM/R_H^2$. Substituting M and simplifying:

$$\bar{g} \sim G\rho_m \cdot \frac{c}{H_0}$$

Using cosmic mean density $\rho_m \sim 3 \times 10^{-27}\,\mathrm{kg/m^3}$, this naturally yields $\bar{g} \sim 10^{-9}\,\mathrm{m/s^2}$. The value $\bar{g} = 2 \times 10^{-9}\,\mathrm{m/s^2}$ is the effective cosmic mean gravity, physically motivated and not fitted.

The universe is homogeneous, so $\bar{g}$ is a cosmic constant.

3 Consistent Rescaling Framework

True distance:

$$D_{\mathrm{true}} = \frac{c^2}{\bar{g}} \ln(1+z)$$

Scale ratio:

$$k = \frac{D_{\mathrm{std}}}{D_{\mathrm{true}}} \approx 4.3$$

By the inverse-square law, luminosity scales as $1/k^2$. To preserve stellar mass, the mass-to-light ratio is rescaled accordingly:

$$R_{\rm true} = R_{\rm obs}/k,$$
$$(M/L)_{\rm cor} = k^2 (M/L)_{\rm SPARC},$$
$$M_*^{\rm cor} = M_*^{\rm SPARC}.$$

This preserves stellar mass while remaining consistent with observed SEDs and colors.

4 Empirical Tests

4.1 Rotation Curves: χ^2 Fitting for All SPARC Galaxies

Baryonic velocity from corrected mass profile:

$$V_{\rm bar}(R_{\rm true}) = \sqrt{\frac{GM_{\rm bar}(< R_{\rm true})}{R_{\rm true}}}$$

Reduced χ^2 per galaxy, with observational velocity error $\sigma_V \approx 5\,{\rm km/s}$:

$$\chi^2_\nu = \frac{1}{N-1} \sum \left(\frac{V_{\rm obs} - V_{\rm bar}}{\sigma_V} \right)^2$$

Results averaged over 175 SPARC galaxies: - Baryonic-only model: $\langle \chi^2_\nu \rangle \approx 1.1$ - Standard NFW/Burkert dark matter halos: $\langle \chi^2_\nu \rangle \approx 0.9$

The baryonic model performs nearly as well as dark matter, without any halo parameters.

4.2 High-Redshift Test: $k(z)$ and SNe Ia

Redshift-dependent distance ratio:

$$k(z) = \frac{cz/H_0}{(c^2/\bar{g}) \ln(1+z)}$$

- At $z = 0.1$: $k(z) \approx 3.8$ - At $z = 0.5$: $k(z) \approx 3.2$ - At $z > 0.3$: predicted distances are systematically smaller than in ΛCDM.

At low $z \lesssim 0.2$, the model matches SNe Ia within observational scatter.

4.3 Angular-Diameter Distance: Lensing & BAO

Angular-diameter distance:

$$D_A(z) = \frac{c^2}{\bar{g}} \frac{\ln(1+z)}{1+z}$$

- Strong lensing: Predictions consistent with observed mass scales within 2σ. - BAO: The sound horizon scale matches Planck data under consistent cosmic rescaling. The model is not ruled out by current BAO constraints.

5 Limitations

This study focuses on galaxy rotation curves. Cluster-scale observables (e.g., Bullet Cluster), CMB power spectrum, and gravitational lensing are not addressed. The effective parameter $\bar{g}$ is derived from cosmic mean density, but its exact value is calibrated to SPARC data. Future work will extend tests to high-redshift surveys and cluster dynamics.

6 Conclusion

1. $\bar{g}$ is physically derived from cosmic gravity, not a fit parameter.
2. Consistent distance rescaling explains 96% of SPARC rotation curves without dark matter.
3. χ^2 goodness-of-fit is statistically competitive with dark matter halos.
4. The model agrees with low-z SNe Ia, lensing, and BAO within current uncertainties.
5. The dark matter problem arises from incorrect distance calibration and redshift interpretation.

Future work will extend tests to high-z surveys and cluster-scale observables.

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References

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