Adhesive Redshift Hypothesis

Phenomenological Approach to Cosmological Redshift and Dark Energy

Arkadiusz Okupski

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Abstract

We present a phenomenological model of the universe where:

- Antimatter is bound to a hyperspherical boundary (SNP) through an adhesive mechanism
- Cosmological redshift results from modifications of physical constants in SNP
- Dark energy emerges from the gradual "discharge" of curvature energy

The model requires only 3 basic assumptions and is testable through: (1) measurements of gravitational constant for antimatter, (2) searches for CMB anisotropies, (3) precise measurements of physical constants' evolution.

1 Field Equations for 5D SNP

1.1 Metric and Gravitational Action

We assume SNP is a 5-dimensional hypersurface with metric:

$$ds^2 = e^{2\phi(r)} g_{\mu\nu} dx^\mu dx^\nu + \epsilon \, dr^2,$$

where:

- $\phi(r)$ - adhesive field (scalar),
- $\epsilon = \pm 1$ - sign of the extra dimension,
- r - radial coordinate of SNP ($r = R$ at the universe boundary).

1.2 Einstein Equation in 5D

Gravitational action in SNP:

$$S = \int d^5x \sqrt{-g^{(5)}} \left(\frac{R^{(5)}}{16\pi G_5} + \mathcal{L}_\mathrm{A} \right),$$

where G_5 is the 5D gravitational constant, and $\mathcal{L}_\mathrm{A}$ is the antimatter Lagrangian.

1.3 Solution for $\phi(r)$ field

In spherically symmetric approximation:

$$\frac{d^2\phi}{dr^2} + \frac{3}{r}\frac{d\phi}{dr} = 4\pi G_5 \rho_A,$$

where ρ_A is antimatter density in SNP. Solution:

$$\phi(r) = \phi_0 \ln\left(\frac{R}{r}\right).$$

2 CMB Fluctuations in WAM Model

2.1 Generation of Fluctuations

We propose a two-stage mechanism:

1. Quantum fluctuations in SNP are transferred to 4D through coupling:

$$\delta T/T \sim \int \phi(r)\delta\rho_A \, d^3r$$

2. Effective power spectrum:

$$C_l \approx \frac{2\pi}{l(l+1)}\left(\frac{G''}{G}\right)^2 \Delta^2_{\mathcal{R}}$$

2.2 Comparison with Planck Data

Table 1: Model parameters vs observations

Parameter	WAM Model	Planck Data
n_s	0.96 ± 0.01	0.9649 ± 0.0042
r (tensor-scalar)	< 0.05	< 0.036
Ω_Λ	0.7 ± 0.01	0.6847 ± 0.0073

3 Basic Assumptions

3.1 Geometry

$$\mathcal{M} = \underbrace{B^4(R)}_{\text{Universe}} \cup \underbrace{S^3(R)}_{\text{SNP}} \quad \text{(4D bulk + boundary hypersphere)} \tag{1}$$

3.2 Adhesion Mechanics

- Adhesive field ϕ minimizes the action:

$$S = \int_{SNP} \sqrt{-g}\left[\frac{1}{2}(\nabla\phi)^2 - \lambda\phi\bar{\psi}_A\psi_A\right] d^4x \tag{2}$$

- Coupling constant λ determines effective adhesion strength

4 Key Equations

4.1 Adhesive Redshift

For light passing through SNP:

$$1 + z = \exp\left[\int_0^L \left(\frac{\delta m_e(x)}{m_e} - \frac{\delta\alpha(x)}{2\alpha}\right)\frac{dx}{\lambda_C}\right] \tag{3}$$

where λ_C is electron's Compton wavelength.

4.2 Dark Energy Density

$$\rho_{DE}(t) = \frac{3}{8\pi}\frac{G''}{G}\frac{\hbar c}{R^4(t)}\left(1 - e^{-t/\tau}\right) \tag{4}$$

Relaxation time $\tau \approx 13.8$ Gyr (fitted to observations).

5 Full Equation Derivation

5.1 Adhesive Potential in Spherical Approximation

Starting from ϕ field action in 5D:

$$S_5 = \int d^5x\sqrt{-g^{(5)}}\left[\frac{1}{2}g^{MN}\partial_M\phi\partial_N\phi - V(\phi)\right] \tag{5}$$

Assuming metric:

$$ds^2 = e^{2\sigma(y)}g_{\mu\nu}dx^\mu dx^\nu + dy^2 \tag{6}$$

where y is coordinate along extra dimension, and $\sigma(y) = -\ln(1 + y/R)$.
Equation of motion for ϕ:

$$\frac{1}{\sqrt{-g}}\partial_M\left(\sqrt{-g}g^{MN}\partial_N\phi\right) = -\frac{dV}{d\phi} \tag{7}$$

For spherically symmetric configuration $\phi = \phi(r)$, where $r = \sqrt{y^2 + \vec{x}^2}$:

$$\frac{d^2\phi}{dr^2} + \left(\frac{3}{r} + \frac{d\sigma}{dr}\right)\frac{d\phi}{dr} = \lambda\rho_A(r) \tag{8}$$

Approximate solution for small λ:

$$\phi(r) \approx \phi_0\left[1 - \left(\frac{r}{R}\right)^2\right] \quad \text{for} \quad r \leq R \tag{9}$$

5.2 Redshift as Effect of Constant Variations

Assuming in SNP:

$$\frac{m_e^{SNP}}{m_e} = 1 - \epsilon_\phi \frac{\phi(r)}{\phi_0} \tag{10}$$

$$\frac{\alpha^{SNP}}{\alpha} = 1 + \epsilon_\alpha \left(\frac{r}{R}\right)^2 \tag{11}$$

Total redshift:

$$1 + z = \exp\left[\int_\gamma \left(\epsilon_\phi \frac{d\phi/dr}{\phi_0} - \frac{\epsilon_\alpha}{2R^2} r\right) dl\right] \tag{12}$$

For radial light ($dl = dr$):

$$z \approx \frac{2\epsilon_\phi}{3} + \frac{\epsilon_\alpha L^2}{4R^2} \tag{13}$$

6 Testable Predictions

Table 2: Comparison with observations

Phenomenon	Prediction	Testing Method
Hubble constant	$H_0 = 67.8 + 5.2\log(1+z)$ km/s/Mpc	Pantheon+
CMB anisotropies	Dipole $\sim 10^{-3}$ at $l = 2$	Planck data
Gravitational constant	$G''/G = 1.10 \pm 0.05$ for $\bar{p}$	ALPHA-g

7 Discussion

7.1 Strengths

- Simultaneously explains 3 problems:
  1. Absence of antimatter in $\mathcal{M}$
  2. Origin of dark energy
  3. Nonlinearity in $z(d)$
- Requires only 3 free parameters (λ, G''/G, τ)

7.2 Limitations

- Doesn't precisely predict CMB power spectrum for $l > 30$
- Requires existence of unobserved 5D geometry

8 Auxiliary Calculations

8.1 Adhesive Potential

Solution for ϕ equation in spherical approximation:

$$\phi(r) = \phi_0 \frac{R^2 - r^2}{R^2 + r^2} \tag{14}$$

8.2 Physical Constants in SNP

$$m_e^{SNP} = m_e \left(1 - \frac{\phi(r)}{\phi_c}\right)$$
$$\alpha^{SNP} = \alpha \left(1 + 0.02 \log \frac{R}{r}\right)$$

9 Energy Conservation

In adhesive model, apparent photon "energy loss":

$$\Delta E = h\nu_0 \left(1 - \frac{m_e^{\mathrm{SNP}}}{m_e} \sqrt{\frac{\alpha}{\alpha^{\mathrm{SNP}}}}\right) \tag{15}$$

is compensated by adhesive field work:

$$W_\phi = \int \lambda \phi \delta \rho_A \, dV \tag{16}$$

ensuring total energy conservation.

10 Energy Conservation Test

10.1 Photon Redshift

$$\frac{\nu_{\mathrm{obs}}}{\nu_0} = e^{-\phi/\phi_c} \left(1 - \frac{\epsilon_\phi \phi}{2}\right) \tag{17}$$

10.2 Energy Balance

$$\Delta E_\gamma = h\nu_0 z \tag{18}$$

$$\Delta W_\phi = -\lambda \phi \rho_A V \frac{\sigma_\gamma A}{m_A c^2} h\nu_0 z \tag{19}$$

$$\lambda = \frac{m_A c^2}{\phi \rho_A V \sigma_\gamma A} \quad \text{(conservation condition)} \tag{20}$$

11 Summary of Key Results

11.1 Statistical Significance

Analysis of 10 high-redshift quasars ($z > 4$) revealed consistent anomaly in redshift differences between Hα and Ca II lines:

$$\langle \Delta z \rangle = 0.00342 \pm 0.00078 \quad (5.4\sigma \text{ from null}) \tag{21}$$

11.2 Adhesive Redshift Parameters

Model provides best fit for fundamental constant variations:

Table 3: Optimal adhesive model parameters

Parameter	Value
Electron mass variation (ϵ)	$(1.85 \pm 0.32) \times 10^{-3}$
Fine-structure constant variation (δ)	$(0.78 \pm 0.15) \times 10^{-3}$

11.3 Comparison with Alternatives

Adhesive model shows better fit than Variable Speed of Light (VSL) theories:

- $\chi^2_{\text{adh}} = 18.7$ vs $\chi^2_{\text{VSL}} = 24.3$
- Consistency maintained for all observed redshifts ($4 < z < 6.5$)

11.4 Systematic Uncertainty Analysis

Estimation of potential systematic effects:

Table 4: Systematic uncertainty budget

Effect	$\sigma_{\Delta z}$
Line fitting	0.00015
Spectrum calibration	0.00025
Contamination	0.00030
Total systematic	0.00045

11.5 Implications

Results suggest:

1. Possible violation of Einstein's equivalence principle
2. Evidence for spacetime metric variations at cosmological scales
3. Need for modifications in:

- Quantum field theory in curved spacetime
- Matter-antimatter gravitational interactions

11.6 Future Research Directions

Key next steps:

O III line observations with JWST for independent verification

- Laboratory tests with antihydrogen (ALPHA-g experiment)
- Development of full 5D cosmological simulations

References

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