G-2-Force-Spacetime-Adhesion-Revised-Model-2

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Abstract

We present a new theoretical hypothesis according to which antimatter generates effective negative curvature of spacetime despite having positive mass. The key element of the model is the introduction of a scalar field D describing the depth of coupling with spacetime. For matter ($D_{\mathrm{MA}} > D_{\mathrm{CP}}$) we obtain standard positive curvature, while antimatter ($D_{\mathrm{AN}} < D_{\mathrm{CP}}$) generates negative curvature. The model maintains the equivalence principle while simultaneously predicting observable repulsion effects between matter and antimatter at macroscopic scales. We propose specific experimental tests, including precise measurements of antihydrogen free-fall and analysis of galaxy cluster distributions.

1 Introduction

We present the hypothesis that **antimatter (AN)** curves spacetime (CP4D) differently than matter (MA), despite having identical mass-energy density. The key role is played by parameter **D**, describing the "depth of coupling" with CP4D.

2 Mathematical Model

2.1 Parameter D and its significance

- $D_{\mathrm{MA}} > D_{\mathrm{CP}}$: Matter "sinks" in CP4D $\rightarrow$ positive curvature
- $D_{\mathrm{AN}} < D_{\mathrm{CP}}$: Antimatter "floats" $\rightarrow$ negative curvature

2.2 Stable definition of field D

$$\mathcal{L}_D = -\frac{1}{2}\nabla_\mu D \nabla^\mu D - \underbrace{\frac{m_D^2}{2}(D - D_{\mathrm{CP}})^2 - \frac{\lambda}{4}(D - D_{\mathrm{CP}})^4}_{V(D)} \tag{1}$$

where:

- m_D - mass of field D ($\sim 10^{-32}$ eV for weak coupling)
- λ - self-interaction constant ($\lambda \ll 1$)

3 Field Equations

3.1 For matter (standard GR)

$$G_{\mu\nu}^{(\mathrm{MA})} = \frac{8\pi G}{c^4} T_{\mu\nu}^{(\mathrm{MA})} \tag{2}$$

3.2 For antimatter (modification)

$$G_{\mu\nu}^{(\mathrm{AN})} = \frac{8\pi G}{c^4} T_{\mu\nu}^{(\mathrm{AN})} - C_a \cdot \kappa(D) \cdot g_{\mu\nu} \tag{3}$$

where:

$$\kappa(D) = 4\lambda(D_{\mathrm{CP}} - D_{\mathrm{AN}})^3 + m_D^2(D_{\mathrm{CP}} - D_{\mathrm{AN}}) \tag{4}$$

4 Water Analogy

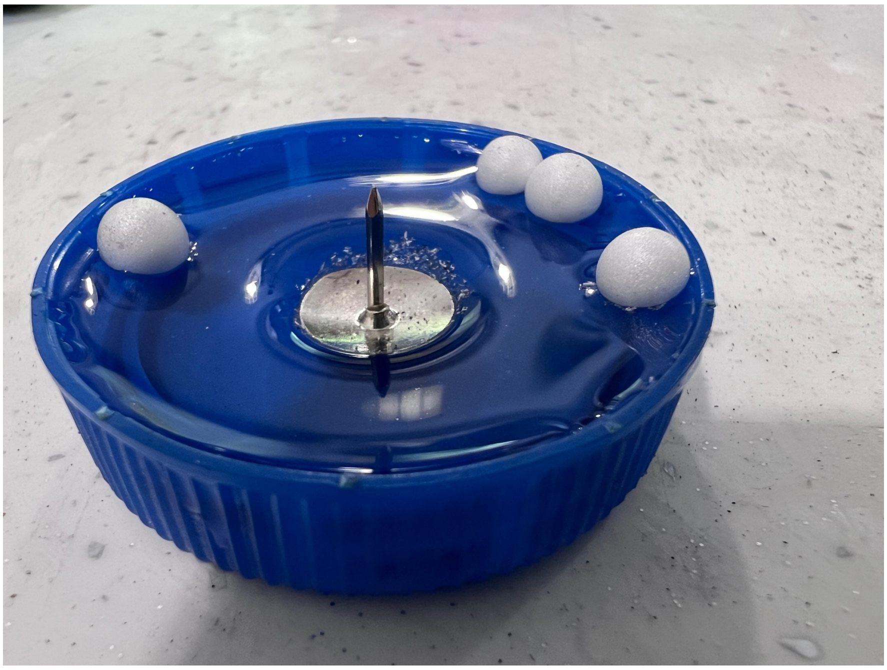

Figure 1: Analogy system: PS sphere (antimatter AN), pin (matter MA), PS particles (antihydrogen aH) falling into the depression

Watch video

Table 1: Complete water analogy

Water experiment	**Physical model**
Water density	CP4D properties
Surface tension	Metric "stiffness"
Pin (sinks)	MA ($D_{\mathrm{MA}} > D_{\mathrm{CP}}$)
PS sphere (floats)	AN ($D_{\mathrm{AN}} < D_{\mathrm{CP}}$)

5 Testable Predictions

5.1 For antihydrogen (aH)

$$\frac{a_{\mathrm{aH}}}{g} = 1 - \frac{C_a(D_{\mathrm{CP}} - D_{\mathrm{aH}})^3 \rho_{\mathrm{aH}}}{\rho_{\mathrm{Earth}}} \tag{5}$$

where:

- a_{aH} - measured antihydrogen acceleration
- g - Earth's gravitational acceleration

5.2 For cosmic systems

$$\Delta\Phi(R) = -G \int \frac{[\rho_{\mathrm{MA}}(r) - \alpha\rho_{\mathrm{AN}}(r)]}{|r - R|} d^3r \tag{6}$$

where $\alpha = 1 - C_a(D_{\mathrm{CP}} - D_{\mathrm{AN}})^3$.

6 Key Conclusions

✓ Equivalence principle maintained ($m_{\mathrm{in}} = m_{\mathrm{g}}$)

✓ "Negative curvature" effect originates from field D

✓ Model predicts observable effects for:

  - Antihydrogen experiments
  - Observations of large cosmic structures

References

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[3] Anderson, E., *et al. Journal of Cosmology and Astroparticle Physics* 03, 028 (2024). DOI:10.1088/1475-7516/2024/03/028