G-2 Force: Spacetime Adhesion Model with Observational Predictions

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June 22, 2025

1 Mathematical Model

1.1 Density and Buoyancy in CP

- CP density: ρ_{CP} (fundamental constant)
- Buoyancy condition:

$$\rho_A < \rho_{\text{CP}} \quad \text{(antimatter "floats" in CP)}$$

$$\rho_M > \rho_{\text{CP}} \quad \text{(matter "sinks" in CP)}$$

1.2 G-2 Adhesive Potentials

The G-2 force acts on **all masses**, but the effect depends on density:

$$\phi^X_{G-2} = \begin{cases} +\frac{G'' m_X}{r} & \text{for } X = A \quad (\rho_A < \rho_{\text{CP}}), \\ 0 & \text{for } X = M \quad (\rho_M > \rho_{\text{CP}}). \end{cases}$$

1.3 Resultant Potential

For any mass m_X:

$$\phi_X = \underbrace{-\frac{Gm_X}{r}}_{\text{G-1}} + \phi^X_{G-2}$$

- For matter (M): $\phi_M = -\frac{Gm_M}{r}$ (only depression D),
- For antimatter (A): $\phi_A = -\frac{Gm_A}{r} + \frac{G'' m_A}{r}$ (hill H, when $G'' > G$).

1.4 Force Between A and M Masses

$$F_{A-M} = -m_A \nabla \phi_M - m_M \nabla \phi_A = \frac{(G'' - G) m_A m_M}{r^2}$$

Repulsion when $G'' > G$.

1.5 Case $m_A \ll m_M$ (Antihydrogen and Earth)

$$\begin{aligned}\phi_{\text{system}} &\approx \underbrace{-\frac{Gm_M}{r}}_{\text{D from Earth}} + \underbrace{\left(-\frac{Gm_A}{r} + \frac{G''m_A}{r}\right)}_{\text{micro-H from aH}} \\ &\approx -\frac{Gm_M}{r} \quad \text{(Earth's D dominance)}\end{aligned}$$

Force on m_A:

$$F_A = -m_A \nabla \phi_M \approx -\frac{Gm_A m_M}{r^2} \quad \text{(fall like matter)}$$

2 Observational Predictions

2.1 Effects Table

Situation	**Predicted Effect**	**Value**
aH in Earth's field	Reduced acceleration	$g_{\text{aH}} = g(1 - \frac{G''}{G})$
Star M + star A	Gravitational repulsion	$F = \frac{(G''-G)M_A M_M}{r^2}$
Galaxy cluster M + A	Structural segregation	Distance 100 kpc

Table 1: Predicted effects of G-2 force for different systems.

2.2 Calculations for Antihydrogen (aH)

Antihydrogen acceleration in Earth's field (M_Z):

$$g_{\text{aH}} = \frac{F}{m_{aH}} = \frac{GM_Z}{r^2} - \frac{G''M_Z}{r^2} = g_{\text{Earth}} \left(1 - \frac{G''}{G}\right)$$

Percentage difference relative to matter:

$$\Delta g\% = \left(1 - \frac{g_{\text{aH}}}{g}\right) \times 100\% = \frac{G''}{G} \times 100\%$$

For $G'' = 1.01\,G$: $\Delta g\% = 1\%$ (to be measured in future experiments).

2.3 Example of M-A Stars

For a matter star ($M_M = M_\odot$) and antimatter star ($M_A = M_\odot$):

$$F_{\text{repulsion}} = \frac{(G'' - G)M_\odot^2}{r^2}$$

If $G'' = 1.1\,G$, the repulsion force equals 10% of Newtonian gravity.

3 Bibliography

References

[1] ALPHA Collaboration, *Nature* **621**, 716-722 (2023) – Antihydrogen experiment.

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[3] A. Dolgov, *Phys. Rep.* **222**, 309 (1992) – Antimatter cluster theories.