The G2-Force Hypothesis: Quantum Hydrodynamic Model of Antimatter-Gravity Asymmetry

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Abstract

We propose a groundbreaking hydrodynamic model of spacetime where matter and antimatter exhibit asymmetric gravitational interactions. The theory introduces a quantum correction term (G_2) to Newtonian gravity, originating from spacetime's microstructure:

- **Key prediction**: Antimatter experiences a weak repulsive force ($F_{G2} \sim 10^{-4} F_G$) at scales below 10^{-14} m
- **Mechanism**: Analogue to hydrophobic effects in quantum fluids, with spacetime "surface tension" $\sigma \approx 10^{-9}$ N/m
- **Experimental tests**:
  - ALPHA-g antihydrogen experiment at CERN: predicted $\Delta g/g = (1.04 \pm 0.27) \times 10^{-3}$
  - Casimir force deviations below 1 μm
  - Neutron star binary anomalies
- **Cosmological implications**: Natural explanation for cosmic acceleration without dark energy

The model bridges quantum gravity phenomenology with laboratory-scale physics, offering testable predictions for upcoming antimatter experiments.

1 Theory

1.1 Core Equation

The modified gravitational force:

$$F = \underbrace{G\frac{m_1 m_2}{r^2}}_{\text{Newton}} + \underbrace{G_2\frac{m_+ m_-}{r^2}e^{-r/\lambda}}_{\text{G2 correction}} \tag{1}$$

where the quantum coupling constant:

$$G_2 = \frac{hc}{\Lambda^2} \approx 10^{-28}\ \mathrm{m}^3/\mathrm{kg}\cdot\mathrm{s}^2 \tag{2}$$

1.2 Spacetime Parameters

Table 1: Model parameters

Parameter	Value	Physical meaning
Λ	10^{-14} m	Quantum cutoff scale
λ	10^{-14} m	Interaction range
T_{vac}	10^{-2} K	Spacetime "temperature"

2 Experimental Verification

Predicted effects for key experiments:

- **ALPHA-g**: Free-fall acceleration difference between H and $\bar{H}$
- **GBAR**: Expected 0.1% deviation in antihydrogen spectroscopy
- **PENNING**: Anomalous cyclotron frequencies for $\bar{p}$

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