Hypothesis of Spontaneous Matter-Antimatter Conversion Under Extreme Density Conditions

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Abstract

We propose that when local matter density exceeds a critical value related to the Planck scale ($\rho > \rho_{\text{cr}}$), spontaneous conversion of matter (M) to antimatter ($\bar{\text{A}}$) occurs. This process generates effective antigravity ($G'' < G$), explaining the absence of singularities in black hole centers and suggesting local violation of baryon number conservation. Unlike models based on exotic matter, our hypothesis uses only standard antimatter in an extreme state.

1 Introduction

Classical general relativity predicts singularities in black hole centers, which is widely considered evidence of the theory's incompleteness at Planck scales. We propose an alternative solution where:

- At densities $\rho \geq \rho_{\text{cr}} \sim 10^{96}$ kg/m^3 matter undergoes spontaneous conversion to antimatter,
- The resulting antimatter generates effective antigravity through modification of the gravitational constant ($G'' < G$),
- The process is fundamentally observationally untestable (consistent with the no-hair theorem), but provides a coherent theoretical explanation.
- This process can be understood as a manifestation of **Le Chatelier-Braun's principle** - spacetime reacts to extreme conditions ($\rho \gg \rho_{\text{cr}}$) by generating a stabilizing mechanism (antigravity G'')

- The resulting antimatter forms a stable core eliminating the singularity

2 Key Equation

Condition for matter-antimatter conversion:

$$\rho > \rho_{\text{cr}} = \frac{3c^5}{4\pi\hbar G^2} \approx 10^{96}\,\text{kg/m}^3, \tag{1}$$

where:

- ρ_{cr} - critical density related to Planck energy,
- c - speed of light,
- $\hbar$ - reduced Planck constant,
- G - Newton's gravitational constant.

3 Consequences

3.1 Absence of Singularities

An antimatter core ($\bar{\text{A}}$) with radius R_{core} (section 4) stabilizes the black hole through:

$$F_{\text{grav}} + F_{\text{anti}} = 0 \quad \text{for} \quad r \leq R_{\text{core}} \tag{2}$$

3.2 Baryon Asymmetry

Local violation of baryon number:

$$\Delta B = \int_{V_{\text{core}}} (n_B - n_{\bar{B}}) dV \neq 0 \tag{3}$$

Global symmetry must be preserved.

4 Stable Core Size

4.1 Fundamental Limits

Minimum core size results from metric quantum fluctuations:

$$R_{\min} = \alpha \cdot l_{\text{Planck}}, \quad 1 \leq \alpha \leq 10^3 \tag{4}$$

4.2 Black Hole Structure

For a black hole of mass M:

$$R_{\text{core}} = \frac{2GM}{c^2}\left(1 - \frac{G''}{G}\right), \quad G'' = G\left(\frac{\rho_{\text{cr}}}{\rho}\right)^n \tag{5}$$

where n is an exponent modeling the antigravity dependence on density.

- For $\rho \gg \rho_{\text{cr}}$: $G'' \to 0$ (strong antigravity)
- For $\rho \approx \rho_{\text{cr}}$: $G'' \approx G$ (phase transition)

5 Discussion

- **Model advantages**:
  - Avoids introducing exotic matter
  - Connects the singularity problem with matter-antimatter asymmetry
  - Is mathematically self-consistent
- **Limitations**:
  - No possibility of direct observational verification

6 Summary

The presented hypothesis offers new perspectives on:

- The singularity problem in general relativity
- Mechanisms generating matter-antimatter asymmetry
- The nature of extreme states of matter

Hypothesis Status

Note: This hypothesis is **purely speculative** and represents an **early conceptual version**. While mathematically consistent, it requires further theoretical development and empirical verification. The author encourages critical discussion and collaboration to refine the model.

References

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