

Peer Review

Review of: "Dirac's Large Number Hypothesis: An Ongoing Quest for Correlations Between the Infinitesimal and the Infinite"

Elia Battistelli¹

1. Physics, Sapienza University of Rome, Italy

General Overview

This manuscript reviews Paul Dirac's Large Number Hypothesis (LNH), a groundbreaking idea proposed in 1937, which speculates on the deep connections between numerical relationships observed in the universe and fundamental constants. The manuscript offers a thought-provoking exploration of the hypothesis's implications, including variability in the gravitational constant, continuous mass creation, and its interplay with dark matter, dark energy, and the Anthropic Principle.

The paper is written in a poetic and captivating style that draws attention to the broader philosophical and scientific implications of Dirac's hypothesis. However, while engaging, the manuscript would benefit from greater precision, clarity, and elaboration on key points. Below, I provide specific feedback to improve the paper's rigor and impact.

Strengths

1. Engaging Presentation:

The narrative style is imaginative and succeeds in emphasizing the significance of Dirac's hypothesis in cosmology and theoretical physics.

2. Comprehensive Scope:

The manuscript addresses a wide range of topics, including the variability of physical constants, continuous mass creation, and the philosophical implications of the Anthropic Principle.

3. Relevance of Research Directions:

The paper's call for further exploration of variable gravitational constants and continuous mass creation is aligned with the exploratory spirit of theoretical physics.

Weaknesses and Suggestions

1. Lack of Precision in Language:

- **Issue:** The manuscript uses metaphorical language (e.g., "cosmic symphony," "harmonies that connect the infinitesimal with the infinite") that detracts from scientific precision.
- **Suggestion:** Replace metaphorical expressions with more direct and scientifically rigorous language to enhance the paper's credibility. For example, instead of "oscillates on the precipice of scientific acceptance," describe specific debates, experimental challenges, or theoretical limitations associated with the LNH.

2. Focus on Unique Contributions:

- **Issue:** The abstract and introduction do not explicitly outline the unique contributions of the manuscript.
- **Suggestion:** Clearly state whether the paper provides new theoretical insights, reviews historical developments, or analyzes recent observational data. Highlight what distinguishes this paper from existing literature.

3. Ambiguity in Key Themes:

- **Issue:** While the manuscript mentions variable gravitational constants and continuous mass creation, it does not specify whether these are reviewed historically, discussed within modern theories, or proposed as new ideas.
- **Suggestion:** Clearly define the scope of these discussions and include specific examples or case studies to provide context.

4. Anthropic Principle and LNH:

- **Issue:** The connection between the Anthropic Principle and LNH is intriguing but underdeveloped.
- **Suggestion:** Briefly explain the philosophical or scientific justification for linking the two concepts. Address whether the Anthropic Principle offers explanatory power for LNH or merely philosophical context.

5. Conflict with Established Models:

- **Issue:** The discussion about the LNH's conflict with the Friedmann-Lemaître-Robertson-Walker (FLRW) metric is vague.
- **Suggestion:** Clarify the nature of this conflict and explain how scale covariant theories address or complement the issue. Provide examples or references to recent research supporting these ideas.

6. Dark Energy and Dark Matter Connections:

- **Issue:** The LNH's relevance to dark energy and dark matter is mentioned but not explored in depth.
- **Suggestion:** Include specific mechanisms or hypotheses that link LNH to these phenomena. For example, discuss how variability in gravitational constants or continuous mass creation might influence our understanding of dark matter or dark energy.

7. Variability of Gravitational Constant:

- **Issue:** The discussion on the variability of the gravitational constant is compelling but lacks empirical context.
- **Suggestion:** Discuss any observational evidence, such as measurements of the fine-structure constant or constraints from cosmological data, that could support or refute the idea of a time-varying gravitational constant.

8. Continuous Mass Creation:

- **Issue:** The concept of continuous mass creation is introduced but not well-developed.
- **Suggestion:** Differentiate between additive and multiplicative mass creation processes and explore their implications for modern cosmology. Provide examples from existing or speculative theories that support these mechanisms.

Recommendation

With revisions addressing the points outlined above, this manuscript has the potential to make a meaningful contribution to the literature on Dirac's Large Number Hypothesis and its implications for modern physics and cosmology. Its engaging narrative style and comprehensive coverage of themes provide a strong foundation, but greater precision and depth are necessary to enhance its scientific rigor and impact.

Decision: Revisions Required.

Declarations

Potential competing interests: No potential competing interests to declare.