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ISM I

Research Assessment #4

Date: September 24, 2023

Subject: Negative Mass Annotated Bibliography

MLA Citation:

- [1] Landis, Geoffrey A. Negative Mass in Contemporary Physics, and Its Application to Propulsion, ntrs.nasa.gov/api/citations/20190033453/downloads/20190033453.pdf. Accessed 24 Sept. 2023.
- [2] Goutam, Rudradeep. 5 VII July 2017 - IJRASET, www.ijraset.com/files/serve.php?FID=9155. Accessed 21 Sept. 2023.
- [3] Du, Meining. "The theoretical basis and feasibility of Time Travel." *Advances in Social Science, Education and Humanities Research*, 2022, <https://doi.org/10.2991/assehr.k.220105.048>.
- [4] "Geoffrey Landis." NASA, NASA, mars.nasa.gov/MPF/bios/landis.html. Accessed 24 Sept. 2023.

Assessment:

Geoffrey A. Landis delves into the concept of negative mass and energy in this research paper, exploring their behaviors and implications. The article is structured into four main sections: negative matter and the general theory of relativity, the behavior of negative matter, the structure and creation of negative matter, and negative matter's application in physics.

I selected this article since the other time travel research articles I've read often mentioned the terms “negative mass” and “negative energy.” For instance, Goutam, in his publication “An Introduction to Time Travel,” discussed the possibility of bending the universe using negative energy, a concept crucial for warp drive [2]. Meanwhile, in his publication “The Theoretical Basis and Feasibility of Time Travel,” Du explained how wormholes, with their strong gravity, could potentially be stabilized by negative energy [3]. So, to deepen my understanding of time travel, I realized I needed to grasp the concept of negative matter, as it is crucial to the existence of wormholes and warp drive, two prominent methods associated with time travel.

The author of this research paper, Geoffrey A. Landis, is a reputable scientist with the Ohio Aerospace Institute on permanent assignment to the Photovoltaics Branch of the N.A.S.A. Lewis Research Center. He holds bachelor's degrees in physics and electrical engineering from MIT and obtained his Ph.D. in physics from Brown University. With a publication record comprising over a hundred scientific papers in areas such as photovoltaics, space power systems, and astronautics, Landis is a highly credible author [4].

Throughout the article, Landis maintains a slightly biased tone, leaning toward the plausibility of negative matter's existence rather than its implausibility. However, he consistently employs a scientific tone, backing up his claims with proven facts, widely accepted scientific hypotheses, and mathematical and physical reasoning. The article is also well-cited with in-text citations, further enhancing the article's credibility.

Additionally, Landis explains the importance of negative matter in the context of wormholes and time travel. The hypothesis he mentioned in this context also aligned with the

hypothesis mentioned in the other time travel articles I've read. This further proves the article's credibility and relevance.

For me, this article served as an excellent introductory resource for understanding the concept of negative mass and energy. Landis effectively explains negative matter and its unique properties using terminology accessible even to high school students. Moving forward, I plan to seek out additional resources that delve deeper into negative matter, particularly those pertaining to its connection with wormholes and time travel. I also need to understand how relevant negative matter is in the real world: is it only a theoretical concept, or are there proven practical and experimental implications of its existence? Based on this, I need to decide whether I can build my research on time travel on the concept of negative matter or not. I also have numerous questions about the concepts explored in the article, which I have annotated. I plan to ask the physics teachers at my school and some post-doctorates I know to gain further insights, as online searches didn't really help.