Concerning MOND and Its Possible Significance vis-à-vis String Theory

David Brown

Abstract

Milgrom's Modified Newtonian Dynamics (MOND) has many empirical successes. Is the explanation of MOND's empirical successes essential for understanding gravitation and cosmology, as well as understanding string theory? This brief communication offers several questions and speculative conjectures concerning MOND and its possible significance vis-à-vis string theory.

Keywords: Cosmology, General Relativity, Gravitational Theory, Quantum Gravity, Speed of Light.

1. Introduction

In 1983 Professor Milgrom's empirically-derived Modified Newtonian Dynamics (MOND) was published. [1], [2], [3] Consider 2 statements:

(1) Milgrom's MOND has many empirical successes. [4]

(2) MOND's empirical successes require a new paradigm for the foundations of physics. [5], [6]

2. Questions and Conjectures

What are the objections to MOND? Does MOND as originally formulated seem to violate 3 conservation laws: energy, linear momentum, and angular momentum? Is MOND precisely defined only to within about 30% of the predicted deviation from Newtonian dynamics? Why does MOND yield many predictions that are approximately correct given the empirically data? What might the new MONDian paradigm consist of? Is Professor Edward Witten mostly correct about string theory? [7] What are the most important unanswered questions about string theory? [8] Is the main problem with string theory the failure of the string theorists to realize that Milgrom is the Kepler of contemporary cosmology.

Consider 7 conjectures:

(1) String theory is the only mathematically plausible way to unify quantum field theory and general relativity theory.

(2) There are three fundamental levels of physics: classical field theory, quantum field theory, and string theory.

(3) String theory is the basis for a unified theory of mathematics and theoretical physics.

(4) In terms of theoretical physics, Green, Schwarz, and Witten are more-or-less as important as Tomonaga, Schwinger, and Feynman.

(5) String theory is of enormous economic value because it makes quantum field theory somewhat easier to understand.

(6) The key to understanding string theory is explaining the empirical successes of Milgrom's MOND.

(7) Relativistic MOND is essentially the simplest way of modifying Einstein's field equations.

Do some Nobel laureates in physics reject all 7 of the preceding conjectures?

Does astrophysics need a new paradigm? Is something seriously wrong with the theory of cosmological inflation? [9] Is MOND truly great?

Consider questions (a) and (b):

(a) Is Professor Milgrom of the Weizmann Institute the world's greatest living scientist?

(b) Are Louise Riofrio of Insight Optics, Inc. and Professor Yves-Henri Sanejouand of the Faculté des Sciences et des Techniques, Nantes among the world's top 20 living scientists? [10], [11], [12], [13]

Edward Fredkin has conjectured that infinities, infinitesimals, perfectly continuous variables, and local sources of randomness are figments of the imagination and never occur in nature. [14] If Fredkin is correct, then what might be the implications for string theory?

Do both string theory with the infinite nature hypothesis and string theory with the finite nature hypothesis imply that Riofrio's predicted outcome of "an exceptionally simple experiment testing quantum theory and gravity" is completely wrong? [15], [16]

Does string theory with the infinite nature hypothesis imply supersymmetry, D-branes, the Friedmann cosmological model, cosmological inflation, and no MOND?

Does string theory with the finite nature hypothesis imply relativistic MOND (whatever that might be), the Riofrio-Sanejouand cosmological model, no supersymmetry, and no D-branes, together with two cut-offs added to Einstein's field equations and with the replacement of the inflaton field by a deflaton field?

What might be the significance for string theory of Professor Giuseppe Pipino's 2019 article "Evidences for Varying Speed of Light with Time"? [17] and his 2021 article "Variable Speed of Light with Time and General Relativity"? [18]

References

[1] Milgrom, M. (1983) A modification of the Newtonian dynamics as a possible alternative to the hidden mass hypothesis Astrophysical Journal, 270, 365–370. https://doi.org/10.1086/161130

[2] Milgrom, M. (1983) A modification of the Newtonian dynamics - Implications for galaxies. Astrophysical Journal, 270, 371–383. https://doi.org/10.1086/161131

[3] Milgrom, M. (1983) A modification of the Newtonian dynamics - Implications for galaxy systems. Astrophysical Journal, 270, 384–389 https://doi.org/10.1086/161132

[4] Milgrom, M. (2020) MOND vs. dark matter in light of historical parallels. Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics, *71*, 170–195. https://doi.org/10.1016/j.shpsb.2020.02.004

[5] McGaugh, S. (2015) A Tale of Two Paradigms: the Mutual Incommensurability of LCDM and MOND. Canadian Journal of Physics, 93, 250–259. https://doi.org/10.1139/cjp-2014-0203

[6] Kroupa, P., Pawlowski, M. and Milgrom, M. (2012). The failures of the standard model of cosmology require a new paradigm. International Journal of Modern Physics D, 21, 1230003 https://doi.org/10.1142/S0218271812300030

[7] Witten, E. (2005) Unravelling string theory. Nature, 438, 1085–1085. https://doi.org/10.1038/4381085a

[8] Schellekens, A. N. (2013) Life at the intersection of particle physics and string theory. Reviews of Modern Physics, 85, 1491–1540. https://doi.org/10.1103/RevModPhys.85.1491

[9] Ijjas, A., Steinhardt, P. and Loeb, A. (2013) Inflationary Paradigm in Trouble after Planck 2013. Physics Letters B, 723, 261-266.

[10] Riofrio, L. (2004) GM = tc^3 Space/Time Explanation of Supernova Data. Proceedings of the Beyond Einstein Conference, Palo Alto, 12-14 May 2004, 1-3.

https://www-conf.slac.stanford.edu/einstein/talks/aspauthor2004_3.pdf

[11] Sanejouand, Y-H. (2005) A simple varying-speed-of-light hypothesis is enough for explaining high-redshift supernova data. arXiv:astro-ph/0509582 https://arxiv.org/abs/astro-ph/0509582

[12] Sanejouand, Y-H. (2009) About some possible empirical evidence in favor of a cosmological time variation of the speed of light. EPL (Europhysics Letters, 88, 59002

https://doi.org/10.1209/0295-5075/88/59002

[13] Sanejouand, Y-H. (2021) A framework for the next generation of stationary cosmological models. arXiv:2005.07931v5 https://arxiv.org/abs/2005.07931

[14] Fredkin, E. (2003) An Introduction to Digital Philosophy. International Journal of Theoretical Physics, 42, 189–247. https://doi.org/10.1023/A:1024443232206

[15] Riofrio, L. (2019) An Exceptionally Simple Experiment Testing Quantum Theory and Gravity. Journal of Cosmology, 27.

[16] Riofrio, L. (2021) Status of Light as Solution to Dark Energy. Journal of Applied Mathematics and Physics, 9, 2579-2591.

https://doi.org/10.4236/jamp.2021.911166

[17] Pipino, G. (2019) Evidences for Varying Speed of Light with Time. Journal of High Energy Physics, Gravitation and Cosmology, 5, 395–411.

https://doi.org/10.4236/jhepgc.2019.52022

[18] Pipino, G. (2021) Variable Speed of Light with Time and General Relativity. Journal of High Energy Physics, Gravitation and Cosmology, 7, 742–760. https://doi.org/10.4236/jhepgc.2021.72043