What Is Relativistic MOND? Is Einstein's Equivalence Principle True for Dark Matter?

ABSTRACT

The empirical successes of Milgrom's MOdified Newtonian Dynamics (MOND) suggest that there is a serious problem with Newtonian-Einsteinian gravitational theory. Could dark matter have positive gravitational mass-energy and zero inertial mass-energy? Einstein wrote ("The Meaning of Relativity", 5th edition, page 57) that "A little reflection will show that the law of the equality of the inert and the gravitational mass is equivalent to the assertion that the acceleration imparted to a body by a gravitational field is independent of the nature of the body. For Newton's equation of motion in a gravitational field, written out in full, is (Inert mass) * (Acceleration) = (Intensity of the gravitational field) * (Gravitational mass). It is only when there is numerical equality between the inert and gravitational mass that the acceleration is independent of the nature of the body." Is it necessarily true that IT IS ONLY WHEN THERE IS NUMERICAL EQUALITY between inertial mass-energy and gravitational mass-energy that THE ACCELERATION IS INDEPENDENT OF THE NATURE OF THE BODY? There is a possibility that the acceleration is independent of the nature of the body but THERE IS A SYSTEMATIC DEVIATION between the inertial mass-energy and gravitational mass-energy. Consider Einstein's field equations: R(mu,nu) + (-1/2) * g(mu,nu) * R = - κ * T(mu,nu) - Λ * g(mu,nu) — what might be wrong? Consider the possible correction R(mu,nu) + (-1/2 + dark-matter-compensation-constant) * g(mu,nu) * R = - κ * (T(mu,nu) / equivalence-principle-failure-factor) - Λ * g(mu,nu), where equivalence-principle-failure-factor = (1 - (T(mu,nu)/T(max))^2)^(1/2) — if dark-matter-compensation-constant = 0 and T(max) = +∞ then Einstein's field equations are recovered. Empirical evidence shows that black holes exist. The event horizons of black holes might be figments of the imagination caused by believing in Einstein's equivalence principle. John P. Lestone's ideas might suggest that something is wrong with Einstein's field equations. This brief communication argues that relativistic MOND is the Fernández-Rañada-Milgrom effect.

EINSTEIN'S FIELD EQUATIONS: TWO QUESTIONS

Is gravitational energy conserved? Does energy-density exhibit perfect scaling with respect to gravitational bending of the Minkowski metric?

STRING THEORY AND THE MILGROM DENIAL HYPOTHESIS

"... string theory describes quantum gravity in spacetime. But it does not describe quantum gravity only. It describes quantum gravity unified with various particles and forces in spacetime." — Edward Witten

http://scitation.aip.org/content/aip/magazine/physicstoday/article/68/11/10.1063/PT.3.2980 "What every physicist should know about string theory" by Edward Witten, Physics Today, Nov. 2015

String theory might be the only game in town for the mathematics of quantum gravity, but string theorists have ignored Milgrom. I conjecture the MILGROM DENIAL HYPOTHESIS: The main problem with string theory is that string theorists have failed to realize that Milgrom is the Kepler of contemporary cosmology.

BULLET CLUSTER AND EL GORDO

The empirical evidence from the Bullet Cluster and El Gordo might make the ΛCDM concordance cosmological model somewhat unlikely.

http://arxiv.org/abs/1412.7719 How rare is the Bullet Cluster (in a ΛCDM universe)? by Kraljic & Sarkar, 2015

http://arxiv.org/abs/1511.02578 Simulating the galaxy cluster “El Gordo" and identifying the merger configuration by Zhang, Yu, & Lu, 2015

WHAT IS RELATIVISTIC MOND?

McGaugh finds that (non-relavistic) MOND matches the evidence, but he does not know what relativistic MOND is.

https://www.youtube.com/watch?v=C0oZQpQbFx4 Dark Matter or Modified Gravity? - Stacy McGaugh, 2015

MOND seems to be empirically valid, but (non-relativistic) MOND has a problem explaining the data from the Bullet Cluster.

http://www.weizmann.ac.il/particle/milgrom/ Welcome letter, Mordehai (Moti) Milgrom, Weizmann Institute

According to Fernández-Rañada and Tiemblo-Ramos, astronomical time might be different from atomic time.

http://arxiv.org/abs/gr-qc/0602003 "Time, clocks, parametric invariance and the Pioneer Anomaly" by Antonio Fernández-Rañada and Alfredo Tiemblo-Ramos, 2015

If we combine Fernández-Rañada and Tiemblo-Ramos’s idea with Milgrom's MOND, we get the Fernández-Rañada-Milgrom effect, i.e. replace the -1/2 in the standard form of Einstein's field equations by -1/2 + D-M-C-C, where D-M-C-C (dark-matter-compensation-constant) is approximately sqrt((60±10)/4) * 10^-5 (with some doubt about the precise size of D-M-C-C). Non-relativistically this means ((1 – 2 * D-M-C-C)^-1) * G * M * m / r^2 = Newtonian-force + weird-excess-force .

Look at zones of galactic gravitational acceleration where the acceleration is approximately constant and introduce one scaling factor per zone to get non-relativistic MOND. Is there empirical evidence showing that the Fernández-Rañada-Milgrom effect is empirically invalid? (I say that the Gravity Probe B science team misinterpreted their own data — the 4 gyroscopes worked correctly.)

CONJECTURE

Milgrom will win the Nobel prize by the end of the year 2020 C.E.

LESTONE’S IDEAS CONCERNING THE FINE STRUCTURE CONSTANT

In the Los Alamos report LA-UR-16-20131 "Semi-classical Electrodynamics" (January 2016), Lestone wrote:

"Quantum electrodynamics is complex and its associated mathematics can appear overwhelming for those not trained in this field. Here semi-classical approaches are used to obtain a more intuitive physical feel for several QED processes including electrostatics, Compton scattering, pair annihilation, the anomalous magnetic moment, and the Lamb shift. These intuitive arguments lead to a possible answer to the question of the nature of charge. The corresponding calculated elementary charge is $q=1.602177\times10^{-19}$ C with a corresponding calculated inverse fine structure constant of $\alpha^{-1}=137.036$. These calculations suggest elementary particles have properties that resemble quantum micro black holes, and that electromagnetism and general relativity are intimately connected via virtual Hawking radiation. ...

If the presented speculations are confirmed by quantum field theory calculations (not semi-classical arguments) the implications are too numerous to be discussed here. However, an important one is that the strength of electromagnetism would be controlled by simple geometrical factors and QED corrections, and α would be a mathematical constant like π and e, and not a physical one (at least in flat space-time). This would have significant consequences for ideas related to possible time dependencies of α, the

anthropic principle, string theories, and multiverse scenarios. ..."
My guess is that Lestone's work is valuable for understanding the foundations of physics, but if leptons resemble quantum micro black holes in accord with Lestone's ideas then my guess is that it would be necessary for Einstein's field equations to be slightly wrong (in non-quantum terms). Even if my particular suggestions for correcting the field equations are wrong, then Lestone's approach might be valid.
https://en.wikipedia.org/wiki/Black_hole_electron
http://en.wikipedia.org/wiki/Micro_black_hole
http://www.thehindu.com/sci-tech/science/elementary-particles-may-be-thought-of-as-small-black-holes-says-ashoke-sen-string-theory-expert/article6335341.ece
http://physics.stackexchange.com/questions/6009/are-elementary-particles-ultimate-fate-of-black-holes
http://arxiv.org/abs/0905.1667 "A Scenario for Strong Gravity in Particle Physics: An alternative mechanism for black holes to appear at accelerator experiments" by D. G. Coyne and D. C. Cheng, 2009
IS THERE AN EMPIRICALLY VALID SEMI-CLASSICAL QUANTUM THEORY OF GRAVITY?
One might think of Lestone's 2016 "Semi-classical Electrodynamics" as a semi-classical quantum theory of gravity (at least in the sense that electrons resemble quantum micro black holes). My guess is that Lestone's ideas are basically correct and he has the correct approach to a semi-classical quantum theory of gravity. However, even if my guess is wrong, there might indeed be a valuable, empirically valid semi-classical quantum theory of gravity. The goal of such a theory would be to do (at least) 3 things: (1) Recover semi-classical QED. (2) Give a reasonably good approximation to the fine structure constant from first principles. (3) Suggest an approach to a quantum theory of gravity in which string theory can calculate an empirically successful prediction for the fine structure constant. In a semi-classical quantum theory of gravity, there might be 4 (and only 4) stable micro black holes: real electrons, real positrons, virtual electrons, and virtual positrons.
https://en.wikipedia.org/wiki/Virtual_black_hole
IS MOND RELEVANT TO GRAVITATIONAL METROLOGY?
According to Speake and Quinn, "So far, both the equivalence principle and Newton's inverse square law have survived experimental scrutiny. To maximize sensitivity and to relieve the burden of metrology, however, those experimental tests are cleverly designed to give a substantial signal only if nature misbehaves in the way sought out by the experimentalists."
http://scitation.aip.org/content/aip/magazine/physicstoday/article/67/7/10.1063/PT.3.2447 "The search for Newton's constant" by Clive Speake and Terry Quinn, Physics Today, July 2014
Are gravitational metrologists confused because they have ignored Milgrom's MOND?