Witten, Milgrom, Brown, and Kroupa on Modified Newtonian Dynamics (MOND)

By David Brown

ABSTRACT

Based upon an essay (by Brown) in the Spring, 2015 FQXi contest, quoted comments from Witten are presented followed by quoted comments from Milgrom in response to Witten's comments. Brown's viewpoint is then given, followed by quoted statements made by Kroupa in 2011.

ESSAY LINK

For the FQXi Essay Contest, Spring, 2015, I entered the following:

http://fqxi.org/community/forum/topic/2288 "String Theory and Milgrom's Modified Newtonian Dynamics (MOND)"

The first six comments posted on the website with the essay might be of particular interest.

COMMENTS BY WITTEN

In reply to an email request for criticism concerning my essay, Professor Edward Witten kindly provided the following comments:

"Dear Mr. Brown,

I think the best answer to your question is that the opinions of string theorists about MOND are not very important, what is more important are the opinions of astronomers who really know well all the data. However, I can see a lot of obvious reasons that people are skeptical about MOND. For example, gravitational lenses were discovered after MOND was put forward, and dark matter appears to participate in lensing as one would expect in General Relativity. The universe is a complicated place with a lot of colliding galaxies, clusters of galaxies, large scale structure etc. General Relativity gives a description of all this that appears to work as far as we can test it, which is a lot although not everything one would want to test. MOND is a sort of one-galaxy-at-a-time description so it is probably hard to apply MOND to a lot of things. Finally, one really has to stand on one's head to reconcile MOND with what is well-established about relativistic physics, and the results are pretty obscure and far-fetched looking. None of these comments, however, have anything at all to do with string theory. They are just based on physics that is much better-established and down-to-earth."

COMMENTS BY MILGROM

In reply to an email request, Professor Milgrom sent me his opinions on Professor's preceding comments:

"Hello David,

The first statement (only) I quite agree with. The opinions on MOND and DM do not count much of physicists who do not keep abreast with the developments in this very important field of physics. I suppose this applies to most string theorists, who are only happy to take the word of astrophysicists, so they can bandy DM as one of the few "experimental" motivations for supersymmetry. (On the other hand, the few ST to whom I had a chance to expose MOND came out rather enthusiastic, I thought.)

This is also true of many particle phenomenologists who need some motivation to justify the quest for amazingly far-fetched DM candidates. It is also true, of course, of the many experimentalists who are searching for DM directly, indirectly, or in accelerators. And, unfortunately, it is also true of many astrophysicists (with their own prejudices and vested interests). Since the question of the existence of DM is so central to their work it would behoove them all to spend a little more time to look closely at the up to date evidence for and against DM and MOND and form a first hand opinion. I do wish these important communities will make their opinions count more.

For example, the issue of gravitational lensing used to be leveled at MOND until about 10 years ago, but it is long known not to be an issue. Existing relativistic MOND theories, such as TeVeS, MOND adaptations of Einstein aether theories, BIMOND, and nonlocal theories, even if they leave some other things to be desired, all naturally give gravitational lensing "correctly", in the sense that the "DM" that is indicated by massive test particles, such as from rotation-curve analysis, also gives the observed lensing correctly. Technically, in these theories the weak-field physical metric (whose geodesics are the world lines of test particles) which accounts for the next-to-Newtonian order, is of the same form as in GR, only the gravitational potential is determined not by the Poisson equation but by one of the nonrelativistic MOND theories.

Regarding the performance of DM vs. that of MOND (a good place to consult is my recent article in Scholarpedia:
http://www.scholarpedia.org/article/The_MOND_paradigm_of_modified_dynamics ): In what concerns galaxies, MOND had made many clear-cut and practically unavoidable predictions that have been tested and verified in hundreds of galaxies (including of lensing, as, e.g., in galaxy-galaxy weak lensing). MOND predictions tell you that you can use the baryon distribution alone to predict everything about the dynamics in a galaxy. It is like predicting Kepler's laws from Newtonian dynamics. I think the fact that MOND performs much better than DM in galaxies is now hardly contested, even by DM advocates.

And MOND is by no means "one-galaxy-at-a-time" description; what does that even mean? MOND should be and have been applied to any system. MOND has been successfully applied to galaxy groups and super clusters. I think this must be some distorted echo of the statement that MOND, while it greatly reduces the mass discrepancy in galaxy clusters, does leave a discrepancy of about a factor of two (instead of about 7-10 in Newtonian dynamics). The significance of this has been discussed extensively (see e.g., the above Scholarpedia article).

DM does not come close to doing any of that. At best, it can predict some general properties of the putative DM halos, not the baryons or interrelations (and as you may know many of these turn out to conflict with the data).

In the DM picture, present-day galaxies are the end product of very complicated, haphazard, and indeed unknowable, history of collapse, mergers, accretion, feedback that has ejected away most of the baryons in galaxies, etc. In these processes DM and baryons are affected very differently. And DM advocated would still have us believe that one day we will understand how it is that the puny baryons (making maybe 2 percent of the galactic mass) determine the full dynamics even to radii much beyond where they reside. It is like believing that we will one day understand how Kepler's laws result not from a physical law but from the complicated way in which planetary systems have formed.

Of course, there are things that MOND still does not do (the remaining factor of 2 discrepancy in clusters is one conundrum, which, however has possible conventional explanations), for example, it does not fully account for cosmology, where the DM paradigm introduces various free parameters, such as DM density, power spectrum, and biases, which MOND does not have at its disposal.

But, MOND does achieve a lot, and it does it very well. To me the things still missing just mean that we have to work hard to account for them as well (MOND does not contradict anything we know). Others prefer to look at the remaining deficiencies of MOND and go on working on theories that are perfect in all regards.

Anyway, all this has been discussed at length and many time in various reviews that you can find; so I will not expand on it further.

All the best, Moti"

COMMENTS BY BROWN

I strongly believe the Milgrom Denial Hypothesis: The main problem with string theory is that string theorists fail to realize that Milgrom is the Kepler of contemporary cosmology. I disagree with the string theorists on the value of Milgrom's research. I insist that the majority of experts on dark matter are wrong. Should string theorists incorporate MOND into string theory? What does MOND mean in terms of string theory? My guess is that the answer to the preceding question is the Fernández-Rañada-Milgrom effect. Fernández-Rañada and Tiemblo-Ramos suggested that astronomical time might be different from atomic time. If there is such a difference and the anomalous gravitational redshift obeys Milgrom's acceleration law then we get the Fernández-Rañada-Milgrom Effect. What is the best argument in favor of what I call the Fernández-Rañada-Milgrom Effect?

http://vixra.org/abs/1203.0036 "Does the Rañada-Milgrom Effect Explain the Flyby Anomaly?"

Here is David Brown's view of things. Brown's quantum theory of gravity (one particular version of "Wolframian string theory") makes 3 decisive predictions — if any one of the predictions is wrong then David Brown should be considered a crackpot. If you make a

grandiose claim and your claim is wrong, then you deserve to be labeled a crackpot. I say that string theory has a power, beauty, and inevitability that ensure that Greeen, Schwarz, Witten, Seiberg, Maldacena and the other leading string theorists will have a lasting place in the physics hall of fame.

WITTEN'S VIEWPOINT:
String theory WITH THE INFINITE NATURE HYPOTHESIS predicts gravity, nonabelian gauge symmetry, and supersymmetry.
The majority of experts on dark matter are correct.
BROWN'S VIEWPOINT:
String theory WITH THE FINITE NATURE HYPOTHESIS predicts MILGROMIAN gravity, nonabelian gauge symmetry (approximately), and Wolframian pseudo-supersymmetry. Brown's quantum theory of gravity predicts the Fernández-Rañada-Milgromian effect, the Space Roar Profile Prediction, and the 64 Particles Hypothesis. String theorists have underestimated Fernández-Rañada, Tiemblo-Ramos, Fredkin, Wolfram, Koide, Lestone, and a number of other physicists.
The majority of experts on dark matter are incorrect, and Milgrom, McGaugh, Kroupa, and Pawlowski are correct.
Pavel Kroupa, Marcel Pawlowski, & Mordehai Milgrom. "The Failures of the Standard Model of Cosmology Require a New Paradigm", December 2012, International Journal of Modern Physics D,
http://adsabs.harvard.edu/abs/2012IJMPD..2130003K
BROWN' BACKUP VIEWPOINT: If all (or any 1 of the 3) main predictions of Brown's quantum theory of gravity are empirically wrong, then everyone should consider a Brown a crackpot and ignore all his opinions related to physics EXCEPT the Milgrom Denial Hypothesis. What is the correct formulation of MOND in terms of the foundations of physics? If MOND were wrong, then why would McGaugh and Kroupa have changed their minds from initial skepticism to steady support?

COMMENTS BY KROUPA

I quote Prof. Dr. Pavel Kroupa from a (Nov. 1, 2011) e-mail,
"My criticism is not based on me not liking dark matter, but is a result of rigorous hypothesis testing such that, from a strictly logical and scientific point of view, LCDM is definitely not a viable model of cosmological reality. I do not write such statements because I do not like LCDM and its ingredients, but because every test I have been involved with falsifies LCDM. At the same time, the tests of MOND we performed were done on the same footing as the LCDM tests. The MOND tests yield consistency so far. I am not more "fond" of MOND or any other alternative, but the scientific evidence and the logical conclusions cannot be avoided. And it is

true, I must concede, that MOND has an inherent beauty which must be pointing at a deeper description of space time and possibly associated quantum mechanical effects which we do not yet understand (compare with Kepler laws and the later Newtonian dynamics)."

CLOSING REMARKS

At Phil Gibbs's vixra.org I have made a number of postings. Some of the ideas that I posted there now seem obviously wrong to me. To find the postings google "david brown vixra". As of January 2015 I have no postings on arxiv.org nor have I ever published anything (excepts un-refereed comments) in a refereed journal of physics. However, years ago I did publish 9 articles on theoretical biology in 3 different refereed journals. The best book that I have ever read is Francis Crick's "What Mad Pursuit" — anyone interested in science should carefully study the book. Anyone interested in physics might want to look at the following:

https://en.wikipedia.org/wiki/List_of_unsolved_problems_in_physics