A bold prediction on the muon anomalous magnetic moment, and expected resulted to be published on April 7, 2021 by the Fermilab Muon g-2, and its explanation

Stephane H. Maes[1]

April 1, 2021

Abstract:

The proposed model of particles as Kerr Newman black hole (regularized Qballs of condensed Higgs bosons matching Kerr Newman solitons), as derived in the multi-fold theory, or in Burinskii works, implies a composite and extended model. As a result, the form factors involved in the computation of the anomalous magnetic moment of the muon have to be corrected, not just by all the radiative corrections to consider, but also to account for the fact that the Landé g-factor will differ now from 2.

Also, in an experimental setup as in the Fermilab muon g-2, the soliton/Qball will be deformed by inertial effects (e.g. centripetal force) that can add an additional effect to the measured magnetic moment of the muons (or any other particle). However, effects remain negligible even if gravity at the Standard Model scales were to become non-negligible.

We predict that the first discrepancy will be confirmed and that it is not linked to new particles or new forces. We will see if the results published on April 7, 2021 will agree.

____

1. Introduction

With respect to the muon anomalous magnetic moment, and expected resulted to be published on April 7, 2021.

For an overview, see [1,2]. A complete computation of the electron anomalous magnetic moment is detailed in [15], including its problems [16].

Tutorial and the technical details of the discrepancy between the theoretically expected magnetic moment, and the observations can be found at [3-6]. [5,6] represent the predictions of different collaborations as discussed in [1].

2. Not Just Loop Radiation Corrections

[1] shmaes.physics@gmail.com

2.1 Away from 2 as Landé g-Factor

Considering [7,8,12], the electron and the muon are modeled as microscopic black holes regularized by a superconducting edge that confines a condensate of massless Higgs boson inside. Even if surprising to many, this proposal recovers many results in physics e.g. [11, 17,18]. A high-level overview can be found in [19], albeit without the twist and microscopic model of Q-balls and Higgs potentials.

Note that in a multi-fold universe, gravity increases at the scales of the Standard Model (something that we denote as SM_G) and we expected it to be non-negligible (even if small) with all the massive gravity contributions that start to contribute [12,20]. Accordingly, the microscopic radii involved are smaller than what is discussed in [19]. The massive black holes remain beyond extremal.

All particles are now composite. While [18] showed that the scattering at high spins are equivalent, for fermion with 1/2 spins, there are some corrections. Or said different, there are no additional effects to consider at the SM scales beyond what is described by the Dirac equation: extended objects and their interactions and composite behavior like a Hadron bag à la MIT or SLAC bags [8]. So the Landé g-Factor will evolve away from 2, albeit staying close to it as otherwise all the analyses of [8,17,18] would have been wrong.

It means that the computations performed in [5,6] and explained for example in [16] are not sufficient: another correction is to be introduced (based on updated F1(0) and F2(0)≠0 (See equation (6.37) and following two paragraphs in [15]); just as in the case of a proton which is a composite particle (involving also other interactions) only approximated by Dirac equation; a much coarser approximation. For the proton, the difference is at 40%. For the muon, or for the electron for that matter, the corrections would be way smaller, but non-zero. The greater the mass the greater the effect.

Therefore, the effect has more chances to be detected with muons than with electrons, and as shown in [3], the measurements of the tauon are still way too imprecise to detect anything relevant. Other particles are composite or not leaning themselves to a setup as in muon g-2 at Fermilab (and before Brookhaven).

A quantitative analysis would be worth applying. It is for future work, but it could be initiated with a model or simulations extracted from [8,17,18].

2.2. Any additional internal effects?

Considering [7], and in particular its references (e.g. [8]) that discusses the fine structure constant and the electron magnetic momentum as geometrical properties of the Kerr-Newman solution as an electron, it is fair to expect that the soliton geometry is affected by gravity / inertial forces. The larger the mass or object, the larger de deformation.

Examples of such deformations can be found in [9] (due to external field in this reference). It is logical to expect that, based on the proposal mapping the Qball edges as soliton solution to Dirac-Kerr-Newman discussed in [7], the solution in an external field (external gravity field or internal effects per the equivalence principle) will be similarly deformed and therefore provide a (slight magnetic moment variation, considering for example [10,14]) vs. the original one liked to the not-deformed Kerr Newman metric/soliton: e.g. [11]).

Considering the experiment muon g-2 setup described in [2], In the present case, the field in [9] would be replaced, per the equivalence principle, by the inertial effects due to the rotation in the Fermilab rings (see figures in [2] , and think of tidal effects). The inertial / centrifugal / centripetal effect could deform the muon Qball slightly and as a result create a discrepancy in the measured magnetic momentum, that would be greater and hence more noticeable than say in a similar electron experimentation. Such an effect would be missing from the prediction estimates [5,6].

However, quick estimates show that the dominant effects coming into play at the centripetal effect from the experimentation and the angular momentum of the microscopic black holes. Corrections to the magnetic momentum end up being roughly 10^{14} times smaller than the anomalous magnetic moment of the muon. The effects are negligible. It is a good lessons, in general we do not have to consider Qballs as deformable beyond being able to scatter, split or merge.

3. Predictions

Based on the above, we predict an extra term, for the corrections to the anomalous magnetic moment of the muon (and electron and other particles in similar conditions), that captures the drift of the Landé g-Factor away from 2. It is due to the microscopic black hole model, in addition and independently to the other radiative loop corrections.

Therefore, the result of Fermilab should confirm Brookhaven initial results, and, in our view, it is not an indication of New Physics beyond the Standard Model (SM), i.e. no new forces or particles, but instead a confirmation of [7] originally derived from the multi-fold theory [12] built on Burinksii's proposals.

4. Conclusions

We presented a prediction for the result of the Fermilab muon g-2 experimental results to be published on April 7, 2001. We also provided a theoretical microscopic explanation for it. In particular we showed that qualitatively there is an effect that should appear for muon as well as other particles under similar settings. We did not provide quantitative estimates so it is possible that the effect is too small to explain the observations, in which case other considerations would need to be added.

If our prediction is not confirmed, we believe that it would rather be due to the effect being too small rather than the effect not taking place.

On that basis, we recommend that any explanation of the Fermilab muon g-2 experimental results consider tis and other explanations that do not involve New Physics, in the sense of new particles or new forces; although this proposal does not exclude them. Other analyses in [20] lead us to be skeptical, at least for now of additional particles especially, if tied to supersymmetry or additional Higgs bosons.

The prediction is based on the bet that our real universe is a multi-fold universe, where we derived the model of particles as regularized microscopic black holes and SM_G. It should also hold if Burinskii's theory holds even in a non-multifold universe.

As the analysis is not quantitative, the absence of observation of a different value from the conventional predictions [5,6], may just mean that the effect in section 2.2. are still too small. It would still be of great interest to seek validation future technology would make it possible.

Let us see what April 7, 2021 will bring us.

Note also the interest to collaborate to compute the actual correction to the muon (and electron) anomalous moments due to the Kerr-Newman Qball solutions.

Note added on April 7, 2021, post Fermilab result publications.

The results have been published [21,22]. There is a discrepancy as predicted. The press labels it a sign or even proof of New Physics as in new particles and new forces (e.g. [23]). The present paper shows that we do not need New Physics, à la new particles or new forces. Also as we already knew another paper argues the absence of tension of the results with SM [6,24]. We suspect that actual the situation is a mix: no tension but some discrepancies as we described here.

Our next prediction, for the long run: no New Physics is needed no matter what: this is not due to new particles or forces and even if such were to exist they are not behind this effect.

____

References

[1]: Davide Castelvecchi, (2021), "Long-Awaited Muon Physics Experiment Nears Moment of Truth. A result that has been 20 years in the making could reveal the existence of new particles and upend fundamental physics", https://www.scientificamerican.com/article/long-awaited-muon-physics-experiment-nears-moment-of-truth/. Retrieved on April 1, 2021.

[2]: Elizabeth Gibney, (2017), "Muons' big moment could fuel new physics. Fermilab experiment to measure muon magnetic moment more precisely might reveal unknown virtual particles.", https://www.nature.com/news/muons-big-moment-could-fuel-new-physics-1.21811. Retrieved on April 1, 2021.

[3]: Wikipedia, "Anomalous magnetic dipole moment", https://en.wikipedia.org/wiki/Anomalous_magnetic_dipole_moment. Retrieved on April 1, 2021.

[4]: A. Hoecker and W.J. Marciano, (2019), "57. Muon Anomalous Magnetic Moment", in M. Tanabashi et al. (Particle Data Group), Phys. Rev. D 98, 030001 (2018) and 2019 update, https://pdg.lbl.gov/2019/reviews/rpp2018-rev-g-2-muon-anom-mag-moment.pdf. Retrieved on April 1, 2021.

[5]: T. Aoyama, at al. (2020), "The anomalous magnetic moment of the muon in the Standard Model", Physics Reports, Volume 887, 3 December 2020, Pages 1-166, https://www.sciencedirect.com/science/article/pii/S0370157320302556?via%3Dihub.

[6]: Bipasha Chakraborty, at al. (2017-2018), "Strong-isospin-breaking correction to the muon anomalous magnetic moment from lattice QCD at the physical point", arXiv:1710.11212v2.

[7]: Stephane H Maes, (2021), "More on Multi-fold Particles as Microscopic Black Holes with Higgs Regularizing Extremality and Singularities", https://shmaesphysics.wordpress.com/2021/02/28/more-on-multi-fold-particles-as-microscopic-black-holes-with-higgs-regularizing-extremality-and-singularities/, February 25, 2021.

[8]: Alexander Burinskii, (2020), "The Kerr–Newman Black Hole Solution as Strong Gravity for Elementary Particles", https://www.researchgate.net/publication/343811848.

[9]: N. Bretón, A. A. García, V. S. Manko, and T. E. Denisova, (1998), "Strong-isospin-breaking correction to the muon anomalous magnetic moment from lattice QCD at the physical point", Phys. Rev. D 57, 3382, https://www.researchgate.net/publication/238967158_Arbitrarily_deformed_Kerr-Newman_black_hole_in_an_external_gravitational_field.

[10]: Marcus Ansorg, Jörg Hennig, Carla Cederbaum, (2011-2010),), "Universal properties of distorted Kerr-Newman black holes", arXiv:1005.3128v2.

[11]: Newman, E.T., (2002), "On a classical, geometric origin of magnetic moments, spin-angular momentum and the Dirac gyromagnetic ratio", Phys. Rev. D, 66, 104005.

[12]: Stephane H. Maes, (2020), "Quantum Gravity Emergence from Entanglement in a Multi-Fold Universe", viXra:2006.0088v1, https://vixra.org/pdf/2006.0088v1.pdf (June 9, 2020).

[13]: Wikipedia, "Anomalous magnetic dipole moment", "Anomalous magnetic dipole moment", https://en.wikipedia.org/wiki/Muon_g-2.

[14]: Andrey A. Shoom, (2015), "Distorted stationary rotating black holes", arXiv:1501.06579v1.

[15]: Peskin, Michael Edward and Schroeder, Daniel V., (1995), "An Introduction to Quantum Field Theory", Westview Press.

[16]: Zhong-Zhi Xianyu, (2016), "A Complete Solution to Problems in "An Introduction to Quantum Field Theory" by Peskin and Schroeder", Harvard University. https://zzxianyu.files.wordpress.com/2017/01/peskin_problems.pdf. Retrieved for this paper on April 1, 2021.

[17]: Burinskii, Alexander, (2008), "The Dirac-Kerr-Newman electron", arXiv:0507109v4

[18]: Nima Arkani-Hamed, Yu-tin Huang, Donal O'Connell, (2019-2020), "Kerr Black Holes as Elementary Particles", arXiv:1906.10100v2.

[19]: Wikipedia, "Black hole electron", https://en.wikipedia.org/wiki/Black_hole_electron. Retrieved on April 13, 2020.

[20]: Stephane Maes, (2020), "Web Site Tracking all Publications around the Multi-fold universe", Navigation page listing all papers. https://shmaesphysics.wordpress.com/shmaes-physics-site-navigation/.

References added April 7, 202, post publication of the results:

[21]: B. Abi, et al. (2021), "Measurement of the Positive Muon Anomalous Magnetic Moment to 0.46 ppm", PHYSICAL REVIEW LETTERS 126, 141801

[22]: Daniel Garisto, (2021), "Long-Awaited Muon Measurement Boosts Evidence for New Physics. Initial data from the Muon g-2 experiment have excited particle physicists searching for undiscovered subatomic particles and forces", Scientific American, April 7, 2021. https://www.scientificamerican.com/article/long-awaited-muon-measurement-boosts-evidence-for-new-physics/. Retrieved on April 7, 2021.

[23]: Pallab Ghosh, (2021), "Muons: 'Strong' evidence found for a new force of nature", BBC News, April 7, 2021. https://www.bbc.com/news/56643677. Retrieved on April 7, 2021.

[24]: Quanta Magazine, April 7, 2021. https://www.quantamagazine.org/muon-g-2-experiment-at-fermilab-finds-hint-of-new-particles-20210407/. Retrieved on April 7, 2021.