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Hints of Multi-fold Dark Matter Effects in the Universe

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Abstract:

In a multi-fold universe, gravity emerges from Entanglement through the multi-fold mechanisms. As a result, gravity-like effects appear in-between entangled particles, whether they be real or virtual. Long range, massless gravity results from entanglement of massless virtual particles. Entanglement of massive virtual particles leads to massive gravity contributions at very small scales. Multi-folds mechanisms also result into a spacetime that is discrete, with a random walk fractal structure and non-commutative geometry that is Lorentz invariant, and where spacetime nodes and particles can be modeled with microscopic black holes. All these recover General Relativity (GR) at large scales and semi-classical models remain valid till smaller scale than usually expected. Gravity can therefore be added to the Standard Model resulting into what we define as SM_G . This can contribute to resolving several open issues with the Standard Model without New Physics other than gravity, i.e. no new particles or forces, or with the standard cosmological model (Λ CDM) in terms of dark matter and dark energy. These considerations hint at an even stronger relationship between gravity and the Standard Model. Multi-folds can be encountered in GR at Planck scales, in spacetime quantization starting from the Hilbert Einstein action, and in the equivalence principle of suitable quantum reference frames in relational quantum physics. Conversely, GR and Quantum physics, including path integrals, the Born rule, and wave functions, can be recovered through different paths from multi-fold spacetime reconstruction and the W-type multi-fold hypothesis. In a multi-fold universe, GR and Quantum Physics are not incompatible, they are just different facets of multi-fold mechanisms, something that neither theory can well model.

Several multi-fold papers have emphasized how multi-fold dark matter effects qualitatively fit recent observations, especially when it comes to the recent observations of galaxies without dark matter.

In the present paper, we show that the excess of disk galaxies observed versus simulations, and the hints of dark matter halos “expanding” with time, are fully consistent multi-fold dark matter mechanisms.

Considering the recent theoretical encounters of multifold mechanisms with GR at Planck scales, this is very important as multi-fold dark matter effects contributions would be a best candidate to validate the link between quantum entanglement and gravity fluctuations due to multi-fold, and therefore confirm the E/G Conjecture as factual in our real universe.

1. Introduction

The multi-fold paper [1] proposes contributions to several open problems in physics, like the reconciliation of General Relativity (GR) with Quantum Physics, explaining the origin of gravity proposed as emerging from quantum (EPR- Einstein Podolsky Rosen) entanglement between particles, detailing contributions to dark matter and dark energy, and explaining other Standard Model mysteries without requiring New Physics beyond the Standard Model other than the addition of gravity to the Standard Model Lagrangian [1,4-12,20-98]. All this is achieved in a multi-fold universe that may well model our real universe, which remains to be validated. *(Note added on March 13, 2023: In this paper, references in Italic were added on March 13, 2023).*

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With the proposed model of [1], spacetime and Physics are modeled from Planck scales to quantum and macroscopic scales, and semi-classical approaches appear valid till very small scales. In [1], it is argued that spacetime is discrete, with a random walk-based fractal structure, fractional and noncommutative at, and above Planck scales (with a 2-D behavior and Lorentz invariance preserved by random walks till the early moments of the universe). Spacetime results from past random walks of particles. Spacetime locations and particles can be modeled as microscopic black holes (Schwarzschild for photons and concretized spacetime coordinates, and metrics between Reisner Nordstrom [2] and Kerr Newman [3] for massive, and possibly charged, particles – the latter being possibly extremal). Although possibly surprising, [1] recovers results consistent with others (see [4] and its references), while also being able to justify the initial assumptions of black holes from the gravity or entanglement model in a multi-fold universe. The resulting gravity model recovers General Relativity at larger scale, as a 4D process, with massless gravity, but also with massive gravity components at very small scale that make gravity non-negligible at these scales. Semi-classical models also turn out to work well till way smaller scales than usually expected.

Multi-folds are encountered in GR at Planck scales [5,6] and in Quantum Mechanics² (QM), if different suitable quantum reference frames (QRFs) are to be equivalent relatively to entangled, coherent or correlated systems [7]. This shows that GR and QM are different facets of something that they cannot well model: multi-folds.

The paper starts with an overview of the multifold dark matter mechanisms [1,8] and past papers discussing qualitative alignment with observations and simulations [9-11]. Then, we present a few more recent results in terms of revisiting galaxies without dark matter [13,14], the excess of disk galaxies in the universe versus expectation from simulations based on Λ CDM and other recent data collection campaigns [15,16], and finally the analysis of the expansion with time of the halo of dark matter around galaxies [18,19].

Such results challenge Λ CDM, and the usually accepted models for dark matter effects, or, in the case of the excess of disk galaxies, they could even be seen as favoring alternatives to GR like the MOND theory of gravity [17]. On the other hand, the paper shows the compatibility of the multi-fold dark matter effects with these results.

2. Multi-Fold Explanation to Dark Matter

[1,8] qualitatively recover dark matter effect with its model of attractive effective potential appearing between physical (real) entangled systems [12], at the difference of virtual ones that already account for gravity.

Accordingly, emitted massless (or quasi massless, i.e. neutrinos) particles are entangled in pairs or with their source or intermediate systems that would not have broken entanglement. It account for extra gravity-like attraction towards the center and / or halos around galaxies. It is illustrated in figure 1 (from [8]).

² Standing in for Quantum Physics in general.

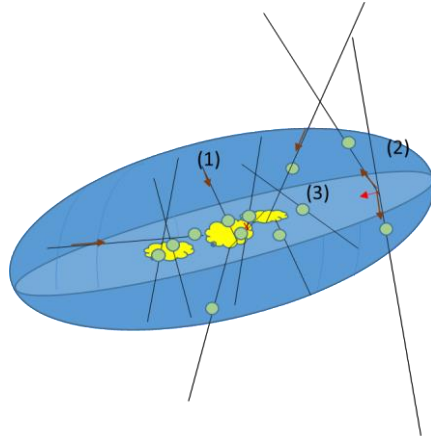


Figure 1: It illustrates how the different entanglements cases, discussed in the text, appear as dark matter with attraction towards the galaxy center and mass in the center or in halos. Green circles represent center of masses. (Reused from [8]).

[8] (see its figure 2) explains that it can also account for globular galaxies where no significant dark matter is detected.

[9] provided additional analyses of astronomical observations that challenged conventional dark matter theories. It, and other papers show that we can account for all the reported behaviors [73,81,90,97].

3. Galaxies with No or Low Dark Matter

Simulated examples have been encountered of galaxies without, or with very little, dark matter as we as the mechanisms provided to explain this: close passage of smaller galaxies near bigger ones [13,14]. The dark matter captures and losses, proposed in these papers, match exactly what we discussed in [10]: instead of capturing dark matter, entangled content is captured. In both cases dark matter effects are reduced.

4. Excess of disk galaxies vs. Λ CDM and other conventional cosmological prediction

Simulations show that the Standard Cosmological Model (Λ CDM) cannot account for the observed ratio of disk galaxies out there. It is because if such galaxies are formed by mergers, many should have lost angular momentum during the merger, and therefore the output would often not rotate fast enough to be disk-shaped [15,16].

However, the MOND theory of gravity [17] would seem to be compatible with the observed ratio. Indeed, with MOND, no dark matter is introduced. With less dark matter per galaxies, less attraction between neighboring galaxies takes place (MOND effect is inwards for the galaxies), and therefore there are not as many mergers as with Λ CDM. It means less angular momentum dissipation, and so the possibility of more disk-shaped galaxies.

In a multi-fold universe, dark matter effects occur between entangled systems, not beyond. It is therefore mostly inwards, unless if entangled particles extend to cover the other galaxies So one can therefore also conclude that

the effects do not really attract as many other galaxies passing by, and the results from [15,16] are also qualitatively compatible with multi-fold dark matter effects.

5. Dark matter halo expansion with time

Another recent paper [18,19] studied galaxies analogous to those nearby us. Doing so, they determined that all have dark matter with roughly constant density into a sphere halo with a radius expanding in time, i.e. a larger radius for galaxies that are closer by ours. It is argued that this is not consistent with Λ CDM, because such expansion would require an additional interaction with dark matter, as indeed dark matter should conventionally only interact through attractive gravity.

However, this is absolutely consistent with the multi-fold dark matter effects: entanglement expands in time as entangled systems are radiated away (e.g., photons and neutrinos). So as times goes by, in the absence of destruction of the entanglement, or interactions as discussed in section 3, the entangled system induce attractive potentials towards a region (green circles in figure 1) expanding in time³. Consider figure 1 as a good illustration.

6. Conclusions

This short paper illustrates how multi-fold dark matter effects [1,8] can qualitatively match some recent results in terms of galaxies with no / low dark matter, dark matter expanding in time and the ratio of disk galaxies. In particular, as the latter two results are considered as discrepancies with the Λ CDM, this may offer a suitable explanation. Indeed, besides the details of the explanation for dark matter, the multi-fold theory can qualitatively align with Λ CDM. Note added on March 13, 2023: Hints of quantitative alignments have been encountered in [1,4-12,20-98].

It adds to the multiples recent results that hints that the real universe may be well modeled by the multi-fold theory⁴, especially following [5-7]. In the present case, it is a step in the direction to validate the E/G conjecture as factual in the real universe [12,20]. Indeed we have long argued that multi-fold dark matter effects may be the best way to obtain a first experimental validation of the multi-fold theory and the E/G conjecture.

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³ Consider for example one entity is related to the galaxy source while the other is radiated. As times passes by, the center of mass expands.

⁴ Details and all results of the multi-fold theory can be tracked at [1,21-23]. Papers are tracked at [21].

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