Multi-Fold Dark Matter Effects and Early Supermassive Black Holes

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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 or regions. No New Physics is introduced in terms of new particles beyond the Standard Model or modifying long range gravity: only the modeling of gravity as emerging from entanglement, in a multi-fold universe.

The discovery of early supermassive black holes raises questions of how they could have formed 13 billion years ago. In this paper, we propose a way that can contribute to an explanation in multi-fold universes, with multi-fold dark matter effects due to entanglement.

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1. Introduction

The new preprint [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. All this is achieved in a multi-fold universe that may well model our real universe, which remains to be validated.

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 blackholes (Schwarzschild for photons and spacetime coordinates, and metrics between Reisner Nordstrom [2] and Kerr Newman [3] for massive and possibly charged particles – the latter being possibly extremal). Although surprising, [1] recovers results consistent with other like [4], while also being able to justify the initial assumptions of black holes from the gravity or entanglement model. The resulting gravity model recovers General Relativity at larger scale, as a 4-D process, with massless gravity, but also with massive gravity components at very small scale that make gravity significant at these scales. Semi-classical models also work well till way smaller scales than usually expected.

[1,5] derived an explanation for Dark matter in a multi-fold universe, without requiring New Physics.

In this paper, we remain at a high level of discussion of the analysis and references are generic for the subjects. It makes the points accessible to a wider audience and keeps the door open to further papers or discussions devoted to details of interest. Yet, it requires the reader to review [1], as we do not revisit here all the details of the multi-

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fold mechanism or reconstruction of spacetime. More targeted references for all the material discussed here are compiled in [1].

2. Multi-Fold Explanation to Dark Matter

[1,5] recovers automatically dark matter with its model of attractive effective potential appearing between physical (real) entangled systems [6], 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. This account for extra gravity like attraction towards the center and / or halos around galaxies. It is illustrated in figure 1 (from [5]).

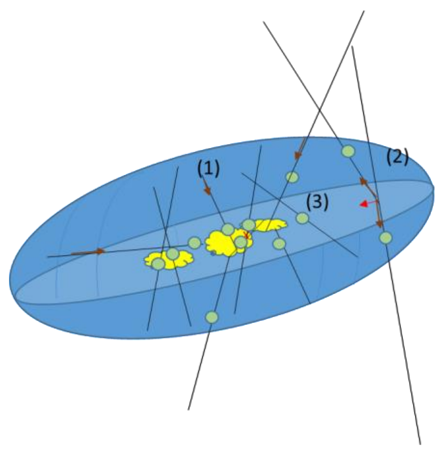

Figure 1: It illustrates how the different entanglements cases, discussed in the text, appear as dark matter with attraction towards the galaxy center and mass in the center or in halos. Green circles represent center of masses. (Reused from [5]).

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

[7,8] provided additional analyses of astronomical observations that challenged conventional dark matter theories. It shows that we can account for all the reported behaviors.

3. Early supermassive blackholes

[9,10] details the discovery of 83 supermassive blackholes 13 billions year old. It is unclear how they did form so early in the universe (i.e. within less than a billion year).

Following the discovery of early galaxies feeding such an early supermassive black hole [11], the author proposed that this is how such black hole grew. They would have formed within huge halos of dark matter that create both black holes and feeding galaxies.

[11] does not explain the source of the estimated $M_{DM\ halo} \sim 10^{12-13}\ M_{\odot}$, that they believe was needed to form the black hole and its feeding galaxies; citing only expected early bias creating the necessary clumps of dark matter. References in [11], including [12], propose an hierarchical model: smaller black matter hallo meet and grow into larger structures but do not explain further. In fact results as in [12] only model younger systems.

4. Multi-fold dark matter effects Can seed as needed

We do not have ambition to detail here anything new, and useful, in terms of the genesis of blackholes, or galaxies. However, we want to present a motivation on why and how large dark matter clumps can occur early on. That's it.

In an early multi-fold universe, one can expect lots of entanglement, analogous to initial dark matter halos, across an early region. It would be due to the random walks described in the spacetime reconstruction phase of [1]. Indeed, then, mostly new spacetime locations are created and entanglements exist for a while across spacetime locations, across region created or concretized by same or entangled particles. The effect is stronger than at later ages. As a result, it is possible to account for strong attractive effect analogous to dark matter. They can then account for the equivalent conventional dark matter mass involved.

5. Conclusions

We extended the use cases supported by the multi-fold dark matter models proposed in [1,5,7,8] to include support for formation of large dark matter halos and structure in an early multi-fold universe. Entanglement in early multi-fold universes can be strong among particles, spacetime points and spacetime point and their concretizing particles.

While this is by no means a validation of the multi-fold universe proposal, we consider that it is another supporting and corroborative hint that should encourage the community to seriously consider our proposed mechanisms and investigate seriously the proposal of attractive gravity-like effect between entangled systems [1,6].

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