No Gravity Superposition Induced Wave Function Collapse in a Multi-fold 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 that 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 smalls 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 at large scales and semi-classical model remain valid till smaller scale than usually expected. Gravity can therefore be added to the Standard Model. This can contribute to resolving several open issues with the Standard Model without new Physics other than gravity. These considerations hints at a even stronger relationship between gravity and the Standard Model.

In a multi-fold universe, we predicted that no spontaneous wave function collapse or decoherence is due to gravity induced spacetime or curvature superposition. It was at the difference of a widely held conjecture formalized by Penrose and Diósi. Experimental results seem to confirm that indeed gravity does not induce collapse by curvature superposition, albeit of course fluctuations and interactions could still result in collapse as with any other quantum interactions.

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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 black holes (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 in a multi-fold universe. The resulting gravity model recovers General Relativity at larger scale, as a 4-D process, with massless gravity, but also with

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massive gravity components at very small scale that make gravity significant at these scales. Semi-classical models also turn out to work well till way smaller scales that usually expected.

The present paper summarizes our prediction and links it to recent experimental results in terms of wave function collapse induced by gravity superposition. We see this as a confirmation that GR curvatures are actually effective fields rather than concrete curvatures as derived in [1] for multi-fold universes.

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-fold mechanisms or reconstruction of spacetime. More targeted references for all the material discussed here are compiled in [1] and derived papers.

2. Gravity Induced Collapses

Penrose [5] championed the view that gravity is the source for wave function spontaneous collapse. The latter is motivated by the challenges to explain why quantum effects are not affecting large systems. Penrose argument (presented already by Károlyházy Frigyes and by Diósi [6,10]) relies on incompatibilities of superposition principles of quantum physics with different (unclear what it conventionally means) or a superposition of locations or curvatures. As a result, it is assumed that Physics would attempts to resolve the problem via wave function collapses, and the larger the system, the larger are the tensions introduced by superpositions and hence the faster wave functions collapse. In turn, it could explain why macroscopic systems behave classically. Of course wave function collapse is itself a controversial problem [9].

3. No Gravity induced collapse in Multi-Fold universes

As derived in [1], gravity effects in a multi-fold universe are derived from multi-fold mechanisms that generate attractive effective potentials or effective curvature contribution over a background spacetime (background independent). In other words, curvature due to gravity (and entanglements) can be visualized as associated to gravity, itself dur to entanglement; but it is not what actually happen. It is an effective effect.

As a result the analysis of [5,6] does not apply any more: gravity has no particular reason to induce wave function collapse because of superposition of the field.

Of course this argument applies whenever one is willing to see curvature as a visualization tool and effective field: something fully compatible with GR and even adopted at time by Einstein. Yet we believe that we are forceful through our actual physical characterization of how gravity results from entanglement through the multi-fold mechanisms [1].

4. Experimental confirmation

[7] has given experimental confirmation that gravity does not contribute (significantly) to wave function collapse: they did not detect enough photons expected to be associated to charged particles swerving when their wave function collapse.

Note that [8] argues that swerving may not be associated to the collapse as energy losses would be associated to them; something not really observed. So the results of [7] may not be a conclusive invalidation of wave function collapse induced by gravity.

In addition, if one wanted to argue against a quantum nature of gravity or spacetime, then the same reasoning, as the one that we presented here, can also apply.

5. Conclusions

We argued in [1] that in a multi-fold universe there are no reason to believe that gravity is inducing wave function collapse due to gravity curvature superposition. That conclusions is shared by all effective curvature models. It has been experimentally confirmed in [7]. We therefore provided an explanation for the results reported in [7] in the context of multi-fold universes.

However, there are suggestions that other models might exists where gravity induced wave function collapses would not be associated to swerving. Until such models are examined, nothing is conclusive as this may also explain the results of [7]. Other models, with effective curvature or without spacetime or gravity superposition, including models that do not include quantum gravity or quantum spacetime can also apply our reasoning to justify these results.

Note that the analysis that we presented discusses curvature (and as a result spacetime or spacetime location) superposition effects. We did not discuss other quantum gravity fluctuations or explicit interaction with gravity, or gravitons, that may result into collapse as may any other (quantum) interactions.

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References: (most references come from popular science to make the discussion more approachable)
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