Cite as: Stephane H Maes, (2020), "Multi-fold Gravitons In-N-Out Spacetime", viXra:2010.0155v1, https://vixra.org/pdf/2010.0155v1.pdf, https://shmaesphysics.wordpress.com/2020/07/27/multi-fold-gravitons-in-n-out-spacetime/, July 27, 2020, (posted September 6, 2020)

Multi-fold Gravitons In-N-Out Spacetime

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July 27, 2020

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.

In this paper, we discuss how in a multi-fold universe, gravitons live in AdS(5) and affect spacetime via effective attractive potential or curvature. They attach to entangled particles. These effects in spacetime result into quasi particle effect in spacetime. Quantum uncertainties spread gravity effects within the extra dimensions from the multi-fold, resulting into the impression of a local 7D embedding governed by general relativity (GR) that induces properties of space time and matter in the multi-fold spacetime and can explain the Standard Model with gravity.

On the other hand, GR may or may not govern AdS(5) and multi-fold dynamics, with implications for superstrings and related theories. So, in a multi-fold universe, particle live in a 4D spacetime with properties induced by a 7D vacuum geometrical effects, while gravitons live in a AdS(5) space surround every point of spacetime. Other particles in AdS(5)(+additional dimensions) may simply be unphysical.

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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

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initial assumptions of black holes from the gravity or entanglement model in a multi-fold universe. The resulting gravity model recovers General Relativity (GR) 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 turn out to work well till way smaller scales that usually expected.

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].

2. Multi-fold and Gravitons in AdS(5) surrounding multi-fold universe spacetime

The multi-fold mechanism proposed in [1] argues that when two particles are entangled in spacetime of a multi-fold universes, folds are activated, and doing so, new paths are available for particles whose paths cross the support domain of a mapping of the space between the entangled particles. As a result an attractive effective potential appears towards the center of mass of the entangled particles. It can also be seen as contribution to an effective curvature. We speak of multi-folds because many folds are activated with a spin-2 symmetry along the axis between the entangled particles.

Gravity (including recovering GR at larger scales) is achieved with all the entangled pairs of virtual particles emitted by a particle or energy source [1,5,7]. When the virtual particles are massless, or with virtual neutrinos, we recover massless gravity. Massive gravity correspond to massive virtual particle pairs contributions at small scales. [5] shows that using virtual particles does not lead to problems or gravity shields. The approach and the massive gravity at small scales leads to the suggestion that gravity should be considered non-negligible at the level of standard model (SM), something denoted as SM_G. Within SM_G, many open issues in the SM and the Standard Cosmological Model can be explained (and the Standard Model can even be justified). Related papers summarizing these aspects from [1] or extending it can be found at [6] and a list of the proposals to address these open issues is captured in [6].

The set of all the multi-folds, associated to entangled pairs emitted by a particle, constructs an AdS(5) space. For that reason we argue that multi-folds exists in AdS(5) surrounding any particle (or spacetime point). Yet, their dynamics are not necessarily described by GR [1,6].

The multi-fold approach is covariant (because relying on path integrals), background independent, which we know eliminates problems of divergences and singularities; as do also the facts that the multi-fold mechanisms predict torsion in matter and a discrete spacetime. Indeed, reconstruction analysis of a multi-fold universe spacetime leads to a discrete spacetime that is generated by fractal random paths, Lorentz invariant as well as non-commutative. The reconstruction process also shows that the multi-fold are quantized with “units” of growths of the discrete spacetime, hence the confirmation that they can be considered as gravitons. They exist massive or massless (depending on the entangled particles (massive or massless) that they are associated to).

No conserved quantities are lost in the multi-folds because they are associated to arbitrarily tiny path contributions and the proposed dynamics of the multi-folds can ensure that all is recovered when disentanglement takes place. The processes remain unitary.

3. Quasi particles in the multi-fold universe spacetime – A tamed model

As mentioned above, the multi-fold mechanisms of [1] result into effective attractive potentials (and effective curvatures) in the spacetime of a multi-fold universe. These recover GR and propagate was the multi-folds follow the entangled particles. The effect exists for gravity [1] and for entanglement [7]. These effects are more like quasi particles or collective excitations although at the difference say of phonons or excitons, their behavior is dictated by the virtual particles to which they are attached. As such this is reminiscent of aspects of Rosen's bi-gravity (although a different model) [9].

In the case of multi-fold universes, gravitons live in the AdS(5) surrounding the multi-fold spacetime and result into fields of potentials or curvatures propagating in the multi-fold spacetime, which in turn result into gravity-like attraction between entangled particles and into gravity (and recovering GR at suitable scales).

So conventional gravitons (not the stringy ones also living in AdS(5)) are these sorts of quasi particles. Because they are only effects of the gravitons/multi-fold, we can start to understand why the problems encountered in linearization of gravity, quantum gravity (e.g. lack of renormalizability, divergences etc.) may not matter physically.

In [8], we also discussed alternative models where gravity would result from entablement of virtual graviton in the multi-fold spacetime. They are plausible would still work with our model but they would be less consistent (e.g. why other entangled virtual particles would not contribute or what would it add if graviton virtual pairs were in addition to the others?). These latter considerations and the lessons from superstrings and the AdS/CFT conjecture correspondence[8,12] leave us to not further consider these cases and only consider gravitons in AdS(5) with effects or quasi particles in spacetime.

4. Gravitons and extended dimensions unconstrained Kaluza-Klein (KK)

Because of the multi-folds, the multi-fold spacetime points and particles feel a local embedding in a 7D spacetime (flat, i.e. vacuum) [6]. This can induce space time and matter behaviors that can describe masses, charges and quantum equations and quantum fields and can justify the Standard Model. Empty / source less gravity (metric objects, without curvature) in 7D explains SM_G in the multi-fold spacetime, as induced model with sources. Also, in a multi-fold case, the problems of chiral fermions in odd dimensions and of extra forces, unobserved precessions and broken conversation laws can be resolved. Magnetic monopoles can also be avoided.

GR rules in this 7D spacetime: quantum uncertainties and fluctuations, in the multi-fold universe spacetime, create multi-fold effects in the extended space and hence we can recover GR in 7D. So gravitons also appear in the resulting surrounding AdS(8), but only the ones in AdS(5) create the effective potentials and curvature in the 4D spacetime.

The possibility to recover SM_G presents an interesting match to claims and hopes of superstrings. Yet the model and processes are quite different.

5. Multi-fold Gravitons and Superstrings

[1,10,13] position dualities, differences and lessons learned with respect to superstrings. A key observation is that the apparition of gravitons in superstrings results first and foremost from the fact that the action of strings extremizes their world sheet areas which is also the Hilbert Einstein action. There is therefore nothing magic about the graviton in superstrings and no reason why this should be taken a sign that superstrings would be on the right track.

Multi-fold mechanisms do not make any such postulate to recover gravity, GR and their own factual version of the AdS/CFT correspondence conjecture and ER=EPR conjecture. Note that in a multi-fold universe these are facts not conjectures any more. However, there are differences [6,11]. Other difference exist, for example, related background independence, modeling entanglement and tracking particles.

In fact, [6] illustrates that among the differences mentioned above, we recover that while GR in AdS(5) is implied by entanglement rules in the CFT space in the conventional AdS/CFT correspondence; it is not necessarily the case for the AdS(5) resulting from the multi-fold mechanisms. It leads to significant challenges for superstrings and related theories (supersymmetry, supergravity, M-theory) [10,11,13]. The analysis questions physicality of the superstrings in AdS(5) (Plus additional dimensions) that would be associated to particles other than gravitons. Other consideration question many Grand Unifications Theories and Theories of Everything [13] especially if they imply magnetic monopoles [14].

While GR in AdS(5) (plus extra dimensions) is not ruled out in a multi-fold universe, because of the limitations of ER=EPR in terms of traversable wormholes, it is questionable if GR can governs AdS(5) and support suitable multi-fold mechanisms. If it can't, it would be another argument against the physicality of superstring particles other than the gravitons, identified with multi-folds.

We do not encounter similar issues, as for superstrings, when explaining SM as the 7D induced space-time-matter in a multi-fold universe. This alternative geometrical justifications for SM, noted as SM_G, may avoid much of the challenges behind the program to do the same with superstrings, where the strings landscape and swampland [16], and the amount of possible Calabi Yau manifold geometries to consider, present daunting tasks, possibly doomed in advance, considering the negative cosmological constraints already established and [17,10,12]).

On the other hand, with the ability to only generate positively curved spacetimes (unless if initially negatively curved), multi-fold universes corroborate why superstring can only be stable and live in a negatively curved spacetime; and that it is ok to be so.

In any case, with or without GR in AdS(5), there are complementarities between superstrings and multi-fold universe that are worth exploring and understanding if anything beyond their graviton models has physical impact is worth better understanding.

6. LQG and Multi-fold universe

[1,15] also provide an analysis of the relationship between LQG and multi-fold universes. There are many similarities, analogies and complementarities worth exploring. In fact, some LQG aspects have more similarities with multi-fold universes than with superstrings.

However, at the difference of LQG, [1] builds a macroscopically recoverable spacetime from particle random walks and gravity from entanglement; while LQG has challenges to model particles and entanglement and to recover a macroscopic spacetime. Models have tried to extend LQG to AdS(5) (+extra dimensions), but as analyzed above it may be moot if, in multi-fold universes, GR does not reign in the AdS(5) surrounding the spacetime of a multi-fold universe; or if superstrings are unphysical for that matter.

6. Conclusions

We have summarized results across several papers explaining or extending [1]. As a result, we observed that in a multi-fold universe, multi-folds are associated to gravitons. Gravitons live in a AdS(5) (plus possible extra dimensions); but GR may not govern in that AdS(5). Multi-fold mechanisms including the mapping result into

virtual attractive potentials in the multi-fold universe 4D spacetime that are responsible for gravity, massive or massless as well as attraction between (suitably, [1] has an exclusion rule) entangled systems [7]. In the 4D spacetime, these can be seen as quasi particle although not exactly fitting the definition of collective excitations: it is how we recover the conventional notion of graviton, rather than having gravitons in spacetime.

Quantum uncertainties, around the multi-fold mechanisms, imply local embedding and feelings of a 7D spacetime where multifold mechanisms exist and hence GR also rule. It allows to derive a unconstrained 7D KK model with induction of spacetime and matter (as well as quantum behaviors) for source-less gravity / geometry in 7D (vacuum i.e. flat but it could also be an Einsteinian universe with a positive cosmological constant). When involving a multi-fold universe, these 7D unconstrained KK models can justify the standard model with multi-fold gravity SM_G. SM_G. in turn, can contribute explanations to many open issues with SM and with the standard cosmology model.

In the AdS(5) (plus extra dimensions), surrounding the spacetime and particles of a multi-fold universe, it is no more certain that GR rules. If it does not, superstrings are unphysical beyond modeling gravitons. If GR does rule, then we know that other problems still exist related to the implied positive curvature from the observed universe and implied by the multi-fold mechanisms and instability of superstring in such positively curved / with positive cosmological constant universes. Furthermore, the challenges with traversability of wormholes in AdS(5)(plus additional dimensions) with GR, threatens possible compatibility of ER=EPR with multi-fold mechanisms and hence possible derivation of gravity from ER=EPR.

Note (10/5/20): *By having the multi-fold (and graviton) evolving in AdS(5), we escape any issues from spin-2 massive terms (e.g. Issues from no-go theorems, if any issues really existed, as discussed in [18]). Massive gravity is also not to be affected by the Weinberg-Witten no-go theorem [19]). We also have no particular constraint imposed on the multi-folds massive or massless (and higher spin physics in general).*

Note (10/18/20): *More problems for supersymmetries and superstrings, as well as many conventional GUTs and TOEs, are discussed in [20].*

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References: (most references come from popular science to make the discussion more approachable)
[1]: Stephane H. Maes, (2020) “Quantum Gravity Emergence from Entanglement in a Multi-Fold Universe”, viXra:2006.0088v1, (June 9, 2020).
[2]: https://en.wikipedia.org/wiki/Reissner%E2%80%93Nordstr%C3%B6m_metric
[3]: https://en.wikipedia.org/wiki/Kerr-Newman_metric
[4]: Burinskii, Alexander, (2008), "The Dirac-Kerr-Newman electron", arXiv:0507109v4
[5]: Stephane H Maes, (2020), ”Massless and Massive Multi-Gravity in a Multi-fold Universe”, viXra:2010.0095v1, https://shmaesphysics.wordpress.com/2020/06/30/massless-and-massive-multi-gravity-in-a-multi-fold-universe/, June 19, 2020.
[6]: Stephane H Maes, (2020), “Tracking Down The Standard Model With Gravity In Multi-Fold Universes”, https://shmaesphysics.wordpress.com/2020/08/30/tracking-down-the-standard-model-with-gravity-in-multi-fold-universes/, August 20, 2020.
[7]: Stephane H Maes, (2020), “Gravity-like Attractions and Fluctuations between Entangled Systems?”, viXra:2010.0010v1, https://shmaesphysics.wordpress.com/2020/06/25/gravity-like-attractions-and-fluctuations-between-entangled-systems/, June 24, 2020.
[8]: Stephane H Maes, (2020), “Particles, Especially Virtual Particles, in a Multi-fold Universe vs. QFT”, viXra:2010.0133v1, https://shmaesphysics.wordpress.com/2020/07/11/particles-especially-virtual-particles-in-a-multi-fold-universe-vs-qft/ , July 10, 2020.
[9]: Rosen, Nathan (1973), "A bi-metric Theory of Gravitation", Gen. Rel. Grav., 4 (6): 435–447

[10]: Stephane H Maes, (2020), “Dualities or Analogies between Superstrings and Multi-fold Universe”, viXra:2006.0178v1, https://shmaesphysics.wordpress.com/2020/06/14/dualities-or-analogies-between-superstrings-and-multi-fold-universes/, June 14, 2020.
[11]: Stephane H Maes, (2020), “Area Laws Between Multi-Fold Universes and AdS”, https://shmaesphysics.wordpress.com/2020/08/10/area-laws-between-multi-fold-universes-and-ads/, August 10, 2020.
[12]: Stephane H Maes, (2020), ”Superstrings Encounter of the Second, Third or Fourth Types?”, viXra:2010.0140v1, https://shmaesphysics.wordpress.com/2020/07/19/superstrings-encounter-of-the-second-third-or-fourth-types/, July 5, 2020.
[13]: Stephane H Maes, (2020), ”Ultimate Unification: Gravity-led Democracy vs. Uber-Symmetries”, viXra:2006.0211v1, https://shmaesphysics.wordpress.com/2020/06/16/ultimate-unification-gravity-led-democracy-vs-uber-symmetries/, June 16, 2020.
[14]: Stephane H Maes, (2020), ”Gravity or Magnetic Monopoles? You Cannot Have Both!“, viXra:2006.0190v1, https://shmaesphysics.wordpress.com/2020/06/15/gravity-or-magnetic-monopoles-you-cannot-have-both/ , June 15, 2020.
[15]: Stephane H Maes, (2020), ”Ultimate Unification: Gravity-led Democracy vs. Uber-Symmetries”, viXra:2006.0211v1, https://shmaesphysics.wordpress.com/2020/06/16/ultimate-unification-gravity-led-democracy-vs-uber-symmetries/, June 16, 2020.
[16]: Cumrun Vafa, (2005), "The String Landscape and the Swampland", arXiv:hep-th/0509212v2
[17]: Georges Obied, Hirosi Ooguri, Lev Spodyneiko, Cumrun Vafa, (2018), "De Sitter Space and the Swampland", arXiv:1806.08362v3
[18]: Sarah Folkerts, Cristiano Germani, Nico Wintergerst, (2013), "Massive spin-2 theories", arXiv:1310.0453v2
[19]: https://en.wikipedia.org/wiki/Weinberg%E2%80%93Witten_theorem
[20]: Stephane H Maes, (2020), “Renormalization and Asymptotic Safety of Gravity in a Multi-Fold Universe: More Tracking of the Standard Model at the Cost of Supersymmetries, GUTs and Superstrings”, https://shmaesphysics.wordpress.com/2020/09/19/renormalization-and-asymptotic-safety-of-gravity-in-a-multi-fold-universe-more-tracking-of-the-standard-model-at-the-cost-of-supersymmetries-guts-and-superstrings/, September 18, 2020.