

## Particles of The Standard Model In Multi-Fold Universes

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November 4, 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 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 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.*

*A subsequent analysis described how embedding a multi-fold universe in a 7D unconstrained, i.e. non compact, Kaluza-Klein (KK) flat spacetime can induce the standard model in the multi-fold spacetime.*

*In this paper, we illustrate how computations previous derived by others in the context of a more cabalistic model can be reused and adapted to hint at extracting, from 7D unconstrained KK flat spacetime containing the multi-fold universe, many particles of the Standard Model, and very closely predicting their masses and charges. Illustrating and progressing concretely our previous assertions.*

*With the model of our previous papers and the results obtained in this paper, the way that multi-fold mechanisms repurpose KK and other models result while avoiding many of their problems or gaps in physical interpretations; further weights in for the pertinence of multi-fold models in Physics.*

*Our approach may also have found a duality hidden behind the Unified GEM theory in a multi-fold universe.*

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## 1. Introduction

The 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 (SM) 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

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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 Reissner 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 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 than usually expected.

The present paper presents how one can, heuristically, derive the mass of many Standard Model particles with an approximation of a multi-fold universe embedded in a flat 7D unconstrained KK spacetime.

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. Unified GEM Theory

In the abstract, we refer to the GEM (Gravity-Electromagnetism) unification theory, because it is a model that has not been widely exposed to the Physics community, rightfully so considering its many assertions that are hard to follow or motivate as rigorously as usually demanded by the community. It seems to have rather been published and discussed in Plasma engineering and other aero spatial engineering circles. The latter have had their doses of controversies with Physics. As such, it raises much more skepticism, including ours.

In fact we do not want to evangelize this model; but rather just borrow its numerical computations and results adapted to multi-fold universes in 7D unconstrained KK flat spacetime.

But to do so we need a little bit of introduction to the GEM unification theory. As most useful review references, for our needs, we refer to [5,6].

[5] presents the original plasma analysis and analogy between a traditional model for gravity and a model where particles' movements take place as drift of a spatially varying electromagnetic Poynting field and where subsequent pressures, against particle cross sections, match gravity effects. It makes two considerations:

- At very high energy (very small scale), Gravity fields are equivalent to a spatially varying Poynting, such that the geometry of space requires self-cancellation of ultra-strong electromagnetic fields.
  - Absence of such observations are attributed to a vacuum with cells of locally random high electromagnetic fields generating a consistent Poynting field but cancelling on average across cells. This maintains Lorentz invariance of the vacuum.
  - The handwaved interpretation is that at very small frequencies, these large electromagnetic fields would create spacetime while at lower frequencies they are the conventional electromagnetic fields.
- At very small scales or very high frequencies, electrons and protons become equivalent (except for opposite charge signs). It would be fundamentally due to the plasma effects and the considerations that a sea of plasma particles can modify the perceived size or mass of the particles and screening their electrostatic properties. In Physics of Plasmas, it is modeled with the Debye length [13].

Playing with these considerations, [5] shows recovery, within the Plasma universe, of quantum uncertainties for gravity, models vacuum and its fluctuations, recovers correct estimates for the proton to electron mass ratio, of the fine structure constant  $\alpha$  and of the Newton gravity constant  $G$ , or even of the CMB radiation temperature. When considering all the strange dualities and numerology considered by others when it comes to particle physics, very small-scale physics and quantum gravity, these results warrant pursuing further the analogies, even if just as what-ifs.

Along that vein, building on [5], [6] proposes additional refinements to the model, including refining the Newton gravity constant  $G$  estimates mentioned above: instead of just modeling the universe as a plasma, it adds a fifth compact dimension, à la KK, that it uses to map a charge as distance (an analogy to KK theory) and to introduce scattering, in 4D, on geometrical objects that live in 5D. The scattering model is based on classical Mie scattering resonances, and higher order resonance scenarios. Doing so, the model recovers particles and their mass and charges including the proton and neutron [14] masses, proton as composed on 3 quarks, gluons, meson  $\pi^0$ ,  $\eta_c$ , (and as such the strong interaction),  $W^\pm$ ,  $Z^0$  (and as such the weak interaction), and Higgs boson (predicted at 124 GeV, before discovery of the Higgs boson – although their numerological exercises have also provided a 127.69 GeV as a more recent estimate [14]) as well as a neutral particle around  $\sim 21\text{MeV}$  ( $M^*$ , a never observed particle that would be the outcome of the convergence of proton and electrons) and more. All these particles would be excitations of the plasma vacuum and/or resonance with 5D objects.

These amazing results, even if originally built on strange justifications, especially with its focus on protons and electrons as the key elements emerging from the vacuum plasma, allegedly motivated by the dominance of hydrogen in the universe, hint, independently from the induced space – time -matter models [7-9] (i.e. flat 5+D non compact KK flat spacetime), at how 5D geometrical objects can produce the SM particles as we predicted in [10].

Of course, it is and could be dismissed as another case of a theory built on numerology coincidences as many have been encountered in physics, especially high energy physics. But could it rather be another consequence of the dualities that also appear all over small scale / high energy Physics.

*(\*) Note: Our references to the Unified GEM Theory, in general, and the many additional considerations in [14] and other unified GEM papers, force us to again caution the reader about these publications. In fact, we mention [14], because we assert estimate updates only found in [14], but we do not encourage investing too much in this reference, unless the readers understand that it is either just a numerological exercise or is willing to consider an associated duality, that we haven't spent time validating or explaining at this stage. Again we are just happy to show that this exercise extracts particle estimates from the multi-fold 7D induces space time matter theory as already predicted in [10]. Extracting a duality, if any exists, is for future work, even if the next section may actually provide the bases for explaining the validity such a duality.*

### 3. Appropriation for a Multi-fold universe in 7D unconstrained KK flat spacetime

Without endorsing the Unified GEM theory, or analyzing a possible duality, let us see if we can somehow justify the assumptions of the GEM unification theory for a multi-fold universe. Indeed, we believe that its Mie and higher-level scattering considerations in 5D could be relevant to, at the minimum, illustrate the analysis initiated in [10].

Regarding the Unified GEM Theory principles, the model only needs to work at very small scales. So instead of arguments for a duality gravity  $\equiv$  EM, and/or the universe, or should we say spacetime in this case, is like a plasma of proton and electron (This is why duality is not obvious), we will rather consider the interior of a neutron, with a quark gluon plasma inside (with electron also randomly present in the plasma as now well known in quantum physics e.g. with all the effects of the Lamb Shift). When about to decay into a proton, the neutron could be seen as a plasma of quarks, (anti) neutrinos and electrons; at least at times. Inside the neutron at very small scales,

gravity induced curvature of spacetime would be entirely driven by electromagnetic contributions (as strong and electroweak effects converge per UU) and so that EM and gravity effects cancel as in the Unified GEM Theory unification principles. Doing so, we may have justified the Unified GEM theory, yet we stick to our (\*) caveat. In any case, our discussion here seems a better reasoning for explaining the focus on proton and electron as a plasma (vacuum) universe for the numerology exercises as in GEM unification theory. It works for protons also of course; that it be when formed by neutron decay, *but also later due to the QCD physics inside a proton as discussed for example in [18]. [this last sentence was added on 11/14/21]*. The analysis essentially extends to any hadron (particle composed of quarks). If we wanted to repeat the analysis to the vacuum (or spacetime), we may also make describe it as part of vacuum fluctuations (relying on the democratization discovered with the Ultimate Unification (UU) analysis [1,15] to focus on electron and protons) as in [6]: therefore, the vacuum can also be seen as such a plasma which satisfy the same principles and, per UU: in a multi-fold universe, the UU model implies that all particles become essentially the same in terms of the interaction that they carry and their charges and mass (which will become massless at small enough scales). So the approximation that, at very small scales, electron and proton converge as apparent particles in the plasma, of same size and mass, could hold; and the unified GEM theory, no matter how it looks, may indeed suitably characterize very small scale spacetime,  $SM_G$  (the standard model where gravity is considered as non-negligible at its scales, e.g. see [1]) and quantum gravity. Note that without UU, e.g. if the real universe is not multi-fold, the extension to all particles and vacuum/spacetime maybe more tenuous.

Eventually in a multi-fold universe, every particle feels locally, due to uncertainty, the multi-folds in a 7D spacetime which holds for the interactions with 5D objects [10]. As multi-folds are essentially a set of folds that have spin-2 symmetry, 7D space is mostly felt as 3 times 1D when it comes to the degrees of freedom. They usually see the multi-folds they created, which can be seen here as providing also Mie and higher order scattering and therefore can reuse the approximations of [6] (just for that part). And with particle propagating along a 1D path, ne can argue that the dominant effect felt by a particle in a 4D multi-fold universe is 5D.

Also, 7D adds 3 degrees of freedom therefore modeling the colors of QCD (*Added on 11/14/21: but without effect on flavors, that is rather handled by  $SM_G$  [19]*). Also, one could envisage that one of the new particles (or some of them) could be a mixture of neutrinos (tau neutrino or a mix) with both chiralities but only the left-handed neutrino interacting, a single chirality (hence confused as spin 0 in [6]) or two particles with respectively left and right handed chirality ( $M^*$  and  $M^{**}$ )<sup>2</sup>. This neutrino encounter is our speculation based on the estimated mass (i.e. mass upper bound for tau neutrino [16]). If it was the case, then every SM particle is covered by the interactions with 5D objects or as resonance or excitations.

Of course, our multi-fold theory is not the Unified GEM theory. So, in the multi-fold version, the plasma hypothesis only explains some quantities used to bootstrap the model and hint at the geometry derived from 5D (in fact 7D but 5D is the dominant effect)) geometrical objects as predicted in [10]. Yet, the analysis presented here certainly goes a long way to also assuage our unease with the motivations in GEM unification theory presented in [5,6,14].

On that basis, we have shown that is possible to repeat the approximations and numerology of [5,6], based on multi-fold universe. Doing so confirm the possibility of finding 7D geometrical objects that model the SM, or  $SM_G$  (Standard Model with gravity non-negligible at its scales [1], which naturally can result from the multi-fold models with impact compiled across the papers in [16]) particles in a multi-fold universe spacetime. This conclusions was the objective of the present paper.

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<sup>2</sup> As a rather purely speculative idea, it is possible that the right-handed neutrino chirality itself be always present rather in the multi-folds (not in 7D as chirality is undefined in 5D or 7D), therefore not interacting other than with the Higgs and left-handed neutrinos when these enter the folds at the entry points. That would explain its absence for all purpose except contributing to the mass of the left-handed neutrino mass, as proposed in [11,12]. Determining if such an interpretation is sensible is for future work. *Note added on 11/14/21: explanations of these considerations can be found in future papers [21-23].*

Of course, we still want to aim at deriving the actual 7D objects in 7D unconstrained KK flat spacetime that model each of the SM particles. This is for future work. *Note on 11/14/21: the work presented in [20] goes a long way to further understand such solutions in a 4D multi-fold universe.*

## 4. Conclusions

We have provided approximations where many (all if we accept the neutrino proposal and that the other missing ones in [5,6,14] are the result of other quark combinations or just other excitations – [14] shows that explicitly with the muon as such an excitation) of the SM particles can be modeled in a multi-fold universe by geometrical objects in a 7D unconstrained KK flat spacetime that embeds the multi-fold universe. Doing so, we validated such a thesis from [10] and the original hypothesis behind space-time-matter theory [7-9].

We believe that even if based on approximate models and concerning hypotheses, as well as rather numerology, the result is a significant step reinforcing the relevancy of both multi-fold universes and  $SM_G$ .

We also may have encountered the neutrino and postulated an explanation for the sole physical visibility of the right-handed neutrino.

While it was not a claim nor an objective of the paper, we may have also uncovered an interesting duality validating aspects of the Unified GEM theory model for a multi-fold universe.

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