A Conjecture: No Dark Matter will be discovered at LHC, or elsewhere

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Abstract

CERN restarted the upgraded Large Hadron Collider (LHC), third run, with among its objectives the hope to detect "Dark Matter".

With this paper, based on the multi-fold theory, and its encounter in General Relativity (GR) and Yang Mills theory, we apply the Occam's razor principle to expect that no dark matter, including axions, will the detected at LHC or elsewhere, just as we also predicted that no supersymmetric partners will ever be encountered. The Multi-fold-derived Ultimate Unification (UU) furthers hints at no other fundamental particle above the (gravity) electroweak symmetry breaking energy scale, unless if UU had its own particles, something not likely, or if new and unknown interactions, non-supersymmetric, were to exist. The latter is something that may not be that likely either, especially as we have separately argued that the multi-fold theory predicts the Standard Model (SM) symmetries and can be seen as a quasi TOE that predicts most of its properties. Of course, these predictions do not include the massless Higgs boson, the particle responsible for the random walk, and spacetime location concretization.

Interestingly, the paper also provides a random walk explanation for the absence of supersymmetry in a universe with a positive cosmological constant 4D , or lower dimensions, spacetime, while they exist at higher dimensions.

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1. Introduction

This short paper conjectures that no dark matter or axion will be encountered in the 3rd, or any subsequent, run of the LHC at CERN [4,5,44], nor anywhere else for that matter. We expect the same in terms of supersymmetric partners, or other fundamental particles above the (gravity) electroweak symmetry breaking energy scale [7-11,12-15]. The electroweak symmetry breaking energy scale is defined either as 246 GeV, or as ~159.5 GeV [47]. In this paper, we can take the convention of the upper bound of ~246 GeV, it does not really matter. Note that we speak of gravity electroweak symmetry breaking because of our work in [7-11]. The reader can assume, and just read electroweak symmetry breaking, if not comfortable with adding "gravity".

In the first part of the paper we will shortly review how the multi-fold theory [1,12,13,21] addresses dark matter [1,2], and the strong CP violation problem [1,3]. The results are qualitative. They show possible explanation addressing aspects of the challenges that exist with the SM and the standard cosmological model (ΛCDM) []. We do not rule out other contributions. In the same vein, other open issues with SM and the standard cosmological model can be qualitatively (partially) addressed by the multi-fold theory [*109*]. *Note added on July 20, 2023: In this paper, references in italic denote references added on July 20, 2023.*

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Then, we review how multi-folds have been encountered in GR [16], Quantum Physics [17-19] and Yang Mills theory [20]: our real universe appears multi-fold. *Note added on July 20, 2023: Note also recent results that hint that SM with gravity must exists in a multi-fold universe [128,129].*

On that basic, and despite having only qualitative analyses, repeated application of the Occam's principle [22] leads us to expect that dark matter as particles, or axions, as an example of particles that could explain dark matter and the strong CP violation problem, do not exist; they are just not needed, even if allowed, and therefore possible; hence the conjecture presented in this paper.

When then very briefly refer to analyses of the physicality of supersymmetry. On that basis we rule out the discovery of any super partners. In fact, the Ultimate Unification (UU) [1,23] further hints at a (fundamental) particle desert above the energy scale of the (gravity) electroweak symmetry breaking [7-11,12-15], as defined above. All what remains, are the particles present during UU, and, at smaller scales, when the spacetime is discrete, fractal generated by 2D random walks and non-commutative yet Lorentz symmetric [1,32,59-61,*105,106*], the particle responsible for the random walk and spacetime location concretization is the massless Higgs boson [32,59-61,*105,106*].

Note added on July 20, 2023: Particle random walk provide a model equivalent to QFT as discussed in [34,87,119,122]. Besides the argument already presented in our past work [1,31-34,52,53,72,85,105], the paper offers a random walk based explanation for no supersymmetry in a 4D or lower dimension spacetime with positive cosmological constant, while supersymmetry exists at higher dimensions.

2. Encountering multi-folds in our real universe

Since the original elaboration of the multi-fold theory [1], many developments have taken place. They are tracked in [21], with some compiled in [12,13,*95*], and a summary is provided in appendix A, where we discuss how other contributions of the multi-fold theory could address many open issues with the SM and the standard cosmological model (ΛCDM) [1-94,*95-129*].

Interestingly, such recent developments have directly encountered multi-folds in quantum physics [18,19], quantum gravity, at least in the form of Loop Quantum Gravity (LQG)[19], the Standard model and Yang Mills theory [20], M-theory [87], and most importantly GR [16]. The latter leads us to claim that GR-based universe, like our real universe, encounter multi-folds, and multi-fold spacetime reconstruction via "down, up and upper", recover multi-fold universes and GR [1,16]. *Note added on July 20, 2023: even Quantum mechanics with gravity or QFT with gravity hint the same [119,122]*.

In other words, our real universe is multi-fold, and as a result also discrete, 2D fractal, yet still Lorentz invariant and non-commutative at small enough scales [1,16,61,97,*106*]. At larger scales, it is 4D [85,*122*].

3. Dark matter in a Multi-fold universe

[44] shows some of the main options that the Physics Community are considering when hoping to encounter Dark Matter as particles.

[1,2] shows how dark matter can be modeled as the result of entanglement, and how, in turn, entanglement among fermion-based matter and/or radiations results into gravity effects analogous to having dark matter. It is a

particular case of entanglement of systems result into gravity effects [1,24] and the E/G conjecture [25]. In the multi-fold dark matter effects, no particle is itself Dark Matter.

[12,13,26-29,*100,118,121,130*] then illustrates how the multi-fold dark matter effect proposal can handled many of the dark matter corner cases raised more recently against the Dark Matter models.

So, if our real universe is multi-fold, per section 2, no dark matter particles should be encountered, hence our conjecture.

4. The strong CP violation problem

The multi-fold theory leads to a proposal of the Standard Model (SM), with gravity is no more negligible at its scales [1,12,13,21]. We denote it SM_G.

In the SM_G, the strong CP violation problem can be automatically resolved, again a qualitative result [1,3]. This in turns removes the need to bring in axions to explain this violation. Our work on matter antimatter asymmetry [30] leads us also to believe that we do not need axiogenesys [30].

Again, applying the Occam's razor principle [22], we do not expect to see axions re-introduced in order to explain dark matter.

So if our universe is multi-fold, it seems unwarranted to expect axions to be encountered, but, of course, other reasons may lead to their discovery.

A priori, gravity non negligible at the scales of the SM may be sufficient for these arguments, albeit multi-folds help in the matter anti-matter asymmetry. *Note added on July 20, 2023: [119,122] show that SM_G actually imply a multi-fold universe, thereby closing that possible ambiguity. Furthermore as our real universe combines SM and gravity, it looks like, again, that our real universe is multi-fold.*

5. No supersymmetry and super partners

The multi-fold theory encounters superstrings and supersymmetry, but in a universe tangent to ours [1,31,32,53,72]. It also illustrates their incompatibilities with it in our real universe [1,31,32,54,56,40], because of the positive curvature of our universe which is asymptotically de Sitter [1,31,32], and because we have proven in different ways [32-34,72,79,87] that (GR-based) gravity is asymptotically stable, in our real universe. This latter result is incompatible with a supersymmetric SM (MSSM) [33-36, 46,87], and variations [34,87,*122*]: superstrings and super symmetry can at best only model the 2D regime of gravity at very smalls scales [1,16,31,37], but it would still model it from a "tangent space".

*Note added on July 20, 2023: As we discussed in [87,122], when switching to the quantum cellular automata, that allows modeling QFTs with random walks [*87*,122,133-135], and supersymmetry with non-conservative random walks non-conservative random walks could also contribute to making super Yang Mills available in higher dimensions [122,131,132], where random walk crossings annihilate and generate new ones in opposite directions; something that may be seen as introducing a fermions for every boson (i.e., ~ fermionization, the opposite of bosonization, achieved by combining two bosons. We see that this is not possible if particles are moved away from each other by a positive cosmological constant. The problem does not occur at 5D and above as quantum cellular* *automata can't be used above 4D, also a by-product of Polya's random walk theorem [122,133-136]. It is another interesting case, where we can see that Quantum cellular automata can justify many key QFT behaviors [87,122].*

Therefore, as we live in a 4D spacetime with a small positive cosmological constant, there are no super partners, bosons or fermions, to ever be discovered.

6. About UU

Additional considerations around the Ultimate Unification (UU), proposed in [1,23,*103,105,108*], and also encountered in an upcoming paper that discusses the Standard Model on an (amorphous) lattice (watch the web site at [21], it is about QCD and the mass gap. *Note added on July 20, 2023: It has since been published as [103]*), as multi-fold universes are discrete, also hint at a (fundamental) particle desert above the (gravity) electroweak symmetry breaking energy scale [1,7-15], except if UU ends up involving its own particle. *Note added on July 20, 2023: It is not likely considering that the symmetries propagated from the multi-folds [96,112,119,122] do not justify anything other than the massless Higgs boson involved in 2D random walks [1,32,59-61,105,106].* So there probably are no other fundamental particles to discover, unless if new interactions exist. By new interactions, we do mean non supersymmetric interactions that would not be carried by super partner bosons. Something a priori not likely, and we again apply the Occam's razor principle. Furthermore, we know that we can not add too many new fundamental particles, and remain compatible with the asymptotic safety of gravity [32-36], or even the observed asymptotic freedom of Yang Mills theory [45].

Note that the term of fundamental in this papers, refers to the conventional concept as in the SM. We know that in the multi-fold theory, particles are microscopic result from random walk patterns or condensations of massless Higgs bosons (microscopic black holes) into multi-fold space time matter induced and scattered solitons [1,7,59,60,61,67,69,103,*105,106*]. Therefore, here fundamental particle means not composed of particles other than massless Higgs bosons.

Our supersymmetry analysis was made both with and without multi-fold assumptions, so even without a priori assumptions that our universe is multi-fold, we do not expect to encounter super partners. If our universe is multi-fold, we do not expect anything above the (gravity) electroweak symmetry breaking energy scale. Others have formulate the same conclusions without multi-fold assumptions [14,15].

Note that we mentioned in [48] that one might also consider particles like the maximon, a charged Planck sized particle, as in [49]. It is possible, but not our preferred model, as we prefer to see charges well handled with UU, as Noether's charges from the multi-fold space time matter induction and scattering, and resulting from the symmetries of the induced solitons. Also remember our comment about the multi-fold symmetries. They are not accounting for any such extra particle.

7. Conclusions

Based on the results of the multi-fold theory and our derivation that GR-based universes are multi-folds, or other additional or alternative derivations mentioned in this paper, we conjecture that the 3rd run of the CERN LHC, or any other run or future experiment, will not encounter:

- Dark matter, as particles

- Axions
- Super partners
- Fundamental particles above the (gravity) electroweak symmetry breaking energy scale, unless if new non-supersymmetric interactions are encountered. Occam's razor principle would rather state that we have no indications of such. To that effect, we also invite the reader to look at the considerations that we have with respect to New Physics and alleged discrepancies with the SM as presented in [6,38,39] and the comments on the associated web pages.

Additional UU particle is possible but not likely. We conjecture none will be found either.

This does not include massless Higgs bosons, that we consider to be known, and key to spacetime reconstruction via random walk, and concretized locations.

Of course this is a conjecture presented as a bet[2], not a theorem. The reader is expected to understand it this way. Especially as for all these effects, even if we are right, nothing, other than supersymmetry and super partners, is really absolutely forbidden to also happen, e.g., axions.

For the sake of documenting our view and prediction, the publication of this prediction was done on July 8, 2022 at noon PDT, and published on the web site [21], with tracked updates of any later change of the documents being preserved.

Note also that we are not arguing against the LHC run or other experimentations. We agree in general with [41] However, we discussed in [42,43], we believe that it is time to prioritize a brain drain towards saving the planet with initiatives as for example in [43].

Appendix: Review of the multi-fold theory

Before revisiting the alleged cracks in the context of a multi-fold universe, with otherwise the same Physics and observations as in our real universe, we probably need to provide some points to the multi-fold theory. It was introduced in [1]. Tutorials and overviews can be found at [12,13,21,*95*] while the latest developments, updates and discussions can be found at [22].

In a multi-fold universe [12,13,21,*95*], gravity emerges from entanglement through the multi-fold mechanisms. As a result, gravity-like effects appear in between entangled particles [1,24,25], whether they be real or virtual. Long range, massless gravity results from entanglement of massless virtual particles [1,24]. Entanglement of massive virtual particles leads to massive gravity contributions at very smalls scales [1,58]. It is at the base of the E/G Conjecture [25], and the main characteristics of the multi-fold theory [*95*]. Multi-folds mechanisms also result in 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 [1,7,32,48,59-61,*97*]. All these recover General Relativity (GR) at large scales, and semi-classical model remain valid till smaller scale than usually expected. Gravity can therefore be added to the Standard Model (SM) resulting into what we define as SM_G: the SM with gravity effects non-negligible at its scales. This can contribute to resolving several open issues with the Standard Model without new Physics other than gravity. These considerations hint at an even stronger relationship between gravity and the Standard Model, as finally shown in [*96*].

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[2] Note that it is different from [39], for which it starts to look like we were correct.

Among the multi-fold SM_G discoveries, the apparition of an always-in-flight, and hence non-interacting, right-handed neutrinos, coupled to the Higgs boson is quite notable. It is supposedly always around right-handed neutrinos, due to chirality flips by gravity of the massless Weyl fermions, induced by 7D space time matter induction and scattering models, and hidden behind the Higgs boson or field at the entry points and exit points of the multi-folds. Massless Higgs bosons modeled as minimal microscopic black holes mark concretized spacetime locations. They can condensate into Dirac Kerr-Newman soliton Qballs to produce massive and charged particles [1,48], thereby providing a microscopic explanation for a Higgs driven inflation, the electroweak symmetry breaking, the Higgs mechanism, the mass acquisition and the chirality of fermions and spacetime; all resulting from the multi-fold gravity electroweak symmetry breaking. Massless particle on the other hand result from patterns of the random walks. The multi-fold theory has also concrete implications on New Physics like supersymmetry, superstrings, M-theory and Loop Quantum Gravity (LQG) [1,12,13,21,31-34,40,52,53-57].

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 [1-94,*95-129*]. 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 concretized spacetime coordinates, and metrics between Reissner Nordström [50], and Kerr Newman [51] for massive, and possibly charged, particles – the latter being possibly extremal). Although possibly surprising, this recovers results consistent with others (see [48], and its references), while also being able to justify the initial assumptions of black holes from the models of gravity or entanglement 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 scales, which 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 [16,17] and in Quantum Mechanics (QM) if different suitable quantum reference frames (QRFs) are to be equivalent relatively to entangled, coherent or correlated systems [19]. This shows that GR and QM are different facets of something that they cannot well model: multi-folds.

Considering results as in [16,17,19,20,34,87,*96,110,115,119,122*], and our answers to so many open issues with the SM and the ΛCDM can be qualitatively explained with the SM_G and multi-fold mechanisms, as discussed for example in [1-94,*95-129*], we can then argue that these conclusions can probably apply to our real universe, especially considering how the multi-fold mechanisms recover GR [1,17], and can be encountered in GR at Planck scales, with the spacetime reconstruction [1,*97*], and with the top-down-up-and-upper derivation of the multi-fold theory [16]. At the risk of repeating ourselves, as a result spacetime is, at very scales sales, discrete, generated by random (Levy) walks, and therefore (multi-fractal), non-commutative and yet Lorentz symmetric [HERE] [1,16,34,61,87,*97,103,105,119,122*].

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