More on Multi-fold Particles as Microscopic Black Holes with Higgs Regularizing Extremality and Singularities

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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 (SM) resulting into what we defined as SM_G. 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.

This paper investigates the details of modeling particles as microscopic black holes previously proposed during multi-fold spacetime reconstruction. We reuse work done on Kerr Newman regularization, by modeling the region inside the singularity ring as a Dirac soliton in Kerr-Newman metric within a kind of Q-ball where the Higgs field condense, due to its symmetry being broken. The Q-ball edge appears superconductive with an oblateness that for the electron is given by the fine structure constant. It recovers charged particle scatterings, spin quantization, magnetic momentum. Massless particles and concretized spacetime are modeled by Schwarzschild black holes.

Our analysis is the result of combining different results obtained by others, but re-interpreted when put together in the context of multi-fold mechanisms. The analysis also clarifies and reinforces our proposals for the role of Higgs boson, the Higgs field and the Ultimate Unification (UU) in multifold universes, in term of random walk, spacetime point concretization, and inflation. We also confirm the possible relationship between supersymmetry, superstrings, 2D gravity and multi-fold random walks in multifold spacetime reconstructions. Indeed the formers can approximate the random walks, something we already concluded in recent papers. At large scale, all these models seem to converge even if the challenges related to asymptotic safety and SM remain a problem for superstrings and supersymmetry.

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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.

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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 [2] and Kerr Newman [3] for massive and/or possibly charged particles – 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 4D 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.

The present paper reviews our multi-fold spacetime reconstruction model, and its implications in terms of microscopic black holes, the Ultimate Unification regime or the role of Higgs fields and bosons. We then clarify details not discussed so far in terms of regularization of the singularities and behavior of the beyond extremal models of the Kerr Newman blackholes and the implications for supersymmetry and superstrings.

2. Multi-fold spacetime reconstruction

In [1], we derived from the multi-fold mechanisms that:

- Spacetime can be modeled as a graph of microscopic black holes that can also be seen as the result of spacetime creation and concretization when a particle visits a location by random walk. Concretized points are on a lattice, and points previously visited, constitute the concretized spacetime. When concretized are therefore modeled by minimum Schwarzschild black holes, associated to a minimum neutral massless particle, with a Schwarzschild radius.
- Spacetime is therefore discrete with a fractal structure resulting from random walk. It is Lorentz invariant and non-commutative.
- The initial particle and spacetime point inception can result from uncertainty fluctuations, as in [1] or more subtle initial conditions like big bang with or without inflation or a big bang with explosive total N-body collision as in [5]. These cases can occur as the beginning of time, the result of a big crunch or cyclic universe process, or as multiple such events (e.g., multiverses with or without eternal inflation).

[1,19] also introduced a Ultimate Unification (UU) regime when all interactions have equivalent intensity and associated particles are essentially all equivalent except for the charges they may carry.

Study of the potential mechanisms associated to inflation and justification for the Higgs exception to the tenancy rules of the multi-folds [6] hints that the minimum black hole associated to concretized spacetime locations and to an inflation due to a Higgs field minimally coupled to gravity. On the other hand, the standard model with non-negligible gravity at its scales (SM_G), leads us to propose an explanation to the neutrino mass, by identifying an only in-flight right-handed neutrino, stuck at the multi-fold entry and exit points [1,6-8]. This proposal also helps with the matter antimatter asymmetry [8]. It reveals the profound link that seems to exist between gravity, and the symmetry broken electroweak interactions [1,9]. It is also a way for us to encounter SM_G in a multi-fold universe by looking at space time matter induction, and scattering, from a Ricci flat 7D universe embedding ours, and requires letting multi-fold grow in it (and span a AdS(5) tangent dual space to our multi-fold spacetime [1,9,16,17,23,59].

In general the outcome of the work on multi-fold mechanisms tracked at [10,11], also led to other considerations on Physics. Indeed, we concluded that quantum mechanics and QFTs are continuous, and, loosely said, analytical formalisms that approximate the actual effects of a discrete particle world with random walks [1], even more so for QFTs that have a particle modeling problem [1,60], as well as loose entanglement concepts, and multi-fold effects [12], that even more fundamentally relate to the notion of wave functions, and its QFT equivalents. Many behaviors are actually fundamentally due to the discrete random walk effects [1]. It was especially clear when it comes to understanding UU [1,19], Asymptotic safety of gravity [22], and 2D gravity models of random walk at very small scales, or microscopic blackholes models of particles, and their graph representation of concretized spacetime locations.

In particular, this analysis led us to both reject supersymmetry, supergravity and superstrings, as well as M-theory, and the associated popular GUTs and TOEs, on many considerations [1,13-19,21] but especially the incompatibilities of SM, or rather SM_G, and asymptotic safety with the number of super partners and dimensions required by these theories [20]. At the same time, when surprisingly we were ready to completely throw the towel on relying on these theories, we realized that most quantum gravity theory converged towards a 2D model, our random walk regime with UU, where gravity and spacetime is dominantly a 2D process. Where these theory could very well also suitably approximate the outcome [21,22], as after all they are all approximation or encompassing for the Hilbert Einstein action [1,23].

In the present paper, we review what we want to expand from [1] in terms of as particle and concretized spacetime locations as microscopic black holes. Both models were introduced in [1], with massless particles concretizing spacetime location through random walk [1,6,22,63]. Since [6,22], we have proposed that this massless particle be the massless Higgs boson, possibly also the particle ultimately involved in the Ultimate Unification [1,19].

After recalling about Kerr-Newman (charged rotating), and Reissner-Nordström (charged) black holes. we revisit our proposal of particles as microscopic black holes as initially proposed in [1], inspired by the work of A. Burinskii [4,39-45,49], the subtle connections already encountered among spacetime, particles, blackholes, and their thermodynamics, and between the properties and scattering of particles and black holes [27-33,38,64-68]. We then recast the model, using the latest developments from Burinskii, to argue that black holes are (extremal) solitons of microscopic Kerr Newman black holes, induced by space time matter and microscopically resulting from the condensation of the massless Higgs bosons. The Higgs condensate form Q-balls with superconducting skin, which explains how over extremality is resolves as well as the lack of associated black hole evaporation, lack of singularity problem and potential relationship to spin, massless particles and spin 0 states and particles. The condensation coincide with the QFT / Standard model approximation in the form of (gravity) electroweak symmetry breaking.

3. Details or questions not really discussed yet

A few aspects were glossed over in [1] and following papers.

For example, we did not discuss:

- How the Higgs field (especially as massless particle) would play, as concretized multi-fold spacetime locations?
- How do they relate to the black holes as particles passing by these locations?
- How can over-extremal black holes be consistent (even if we know that, in multi-fold universes, no singularity occurs thanks to discreteness, non-commutativity, of spacetime, possible torsion within black holes, along with multi-fold repulsive dark energy effects [1,24], and asymptotic safety of Gravity (see [20,22,62] and references therein), as well as of Yang-Mills theories with gravity [34.35,77], and therefore of the SM with gravity, i.e., SM_G, that we define as the SM with non-negligible SM at its scales [1,10], *(Note added on 9/29/22: see also [77-80])*?
- How do we envisage UU to take place, and why is there such a relationship between gravity and symmetry broken electroweak interaction as in [6,9,25,26,55]?

- In [1], we also introduced a possibly surprising new way to look at spins but did not connect it to the reconstruction model; nor its quantization. Is there a link?
    - Does the model of [1] works also for massless or particles of spin 0 (scalars or spin-0 states).

The rest of the paper aims at providing a guidance on these issues in multi-fold universes.

4. Some background on Kerr-Newman Black Holes.

Conventional Kerr-Newman Black Holes, i.e. rotating charged black holes, are the less understood types of black holes or metric solutions to Einstein field equations [3,43], at least when it come to the notion of extremal or over extremal solutions.

Indeed, the solutions include a closed ring of naked singularities that can be analytically extended by bifurcated double manifold solutions. It's a foliated (pseudo-)Riemann manifold with one inside solution and one solution outside the singularity ring [27,30]. Such situations present physical interpretation challenges. Yet, it is encountered if (charged) particles are modeled by such microscopic blackholes; something we already encountered in [1], when relying on the works culminating in [4] as basis for massive particle models, with spin 0 instances modeled as a limit where rotations disappears (i.e. à la Reissner-Nordström solutions [37]) and neutrality modeled as cases where the charge goes to zero, while massless particles being modeled by Schwarzschild minimal models propagating with appropriate wavefunction frequency [1]. We will revisit these particular cases in section 7.

To add to the mysteries, the Kerr-Newman solutions are obtained by translating the Schwarzschild solutions by a complex translation; something that has been widely considered, till recently, as not well understood [28,29,32]. If this explanation as to be applied to a particle as a Kerr Newman black hole, we recover exactly the electron magnetic momentum, along with a strange explanation: the associated spin would correspond to translations, via change of coordinates, where the center of mass and center of charge would exactly coincide [28-31].

5. Expanding on microscopic black holes as elementary particles

As mentioned several times already in [1], (charged) particles are modeled by such microscopic, following mostly [4] as basis for our (massive) particle models, with spin 0 instances modeled as a limit where rotations disappears and neutrality modeled as case where charge goes to zero, while massless particles being modeled by Schwarzschild minimal models propagating with appropriate wavefunction frequency [1].

Since [1], we have encountered different papers, especially recent publications, that provided new considerations in terms of the suitability of Kerr-Newman (or Reissner-Nordström) to model particles. In fact, it has been proved that, thanks to the properties of coordinates complex transformation (translations) between Schwarzschild, Reissner-Nordström and Kerr-Newman solutions, the scattering amplitudes of spinning and charged massive particles (with minimal couplings), and the relativistic multipole expansion of potential of Kerr Newman potentials match to all order [32,38]. In other words, at high energy limits, massive charged and spinning particles behave like Kerr-Newman black holes when looking at their interactions, scatterings, (perturbative) Feynman diagrams etc.: a direct recovery of our model in [1], that was inspired from [4,32,67,68]. It is also a result in fact argued for with dimensional, or entropic considerations for high energies (above the Hagedorn temperature) as exemplified in [33]. The high energy limit matches the small scales considerations of [1] in the 2D regime of random walks encountered in multi-fold universes. Recovering such scatterings are another indication of universal, i.e. in conventional Physics, in Multi-fold universes and in Superstring theories and in general most of the consistent quantum gravity theories [22,36], 2D regimes at very small scales [1,22,62].

Continuing from the work of [4], a series of recent papers have evolved the model of Dirac solutions in the context of Kerr-Newman metric solutions or black holes (Dirac Einstein Maxwell Kerr-Newman equations) [30,39-41,43]. Accordingly, Kerr-Newman soliton solutions can be used to model charged spinning elementary particle. The solitons involves different types of solitons, a Higgs field with broken symmetry within the soliton (i.e. massless but with non-zero field value), and a zero-value, massless (no symmetry breaking) outside, where the soliton solution uses the default Kerr-Newman metric. In between, the soliton defines a domain wall between the two phase, inspired from the Landau-Ginzburg superconductor effective field theory. In fact, we know that such phase transition, domain walls and symmetry breaking (Landau-Ginzburg [50] and Anderson-Higgs mechanism [48-50]) also match description of superconductor transitions [43].

In other words, the soliton solution, and the phase transition domain wall overlap, and hide the ring of singularities on one end. On the other hand, the wall or ring of singularities can be seen as a superconductor matching the domain wall and source of the fields associated to the particle. Such a structure would not evaporate, allowing for stability of the particles, unless through decays. Rotation could also contribute. *Note added on 9/29/22: Indeed as indicated in [81], (over) extremal black holes would require discrete winding number discrete, incompatible with Thermal black body radiation.*

[39-41] shows that the solitons can be modeled as a bag, and does not really depend too much of the choices made. In [39-41], the author selects an easy way forward where the potential is expressed in a quadratic form by introducing a supersymmetric potentials [39-41,45]. It simplifies the mathematics and recover results closer in superstrings (see also [46,47]) and hadronic models (MIT and SLAC (hadron) bags).

[39] also obtains a few additional results: a Wilson loop appears along the edge of the soliton / singularity ring [51]. Its computation leads to quantization of the angular momentum with quantized spins. Also the oblateness of the soliton edge for an electron corresponds to the fine structure α [30].

6. Multi-fold Theory Considerations

We need to remember that at the scale considered, the multi-fold spacetime is discrete. So continuous field models are just approximations, and singularities do not exist, they just appear to exist in the continuous formalism.

Similarly, the complex shift property matching Schwarzschild and Kerr-Neman solutions show that the two are the same complex solutions, just with different images on the real slice. This is important as it shows the relationship that we have in multi-fold universe between particles as microscopic blackholes: Kerr-Newman when they are massive, Schwarzschild when massless. It also directly relates to the different group representations between massive and massless particles [52].

The same reasoning about Kerr-Newman solitons and Higgs potentials can be repeated with a not easily expressible potential that matches the shape (à la figure 5 in [39]) of [39], but using a Q-ball [44] instead of the bags. The potentials that we consider are not supersymmetric. In other words, supersymmetric and non-supersymmetric solutions can be considered to lead to same conclusions. Although [39] states the same, the author then derives a need for supersymmetry. We do not share such a conclusion: Q-balls is an as good solution without involving any supersymmetric Higgs potential. The author of [39] seems to rather be searching to justify what did not need to be justified supersymmetry in particle physics. Indeed, consider [20-22,61], *(Note added on 9/29/22: and [77])*. So far, with our analysis of supersymmetry, we a priori cannot justify that easily a supersymmetric potential, and we are rather relieved that non-supersymmetric solutions are as, or rather more, suitable.

However, it is important to note that the ability to support both supersymmetric and non-supersymmetric potentials within the Q-balls recovers the result from [22,30]: at smalls scales, within particles and in the random walk, i.e. the 2D regime, QFT or superstrings with supersymmetry (and other theories) could model well quantum gravity. Yet again beyond that regime, at higher scale, the incompatibilities of superstrings and super symmetry with asymptotic safety remains a blocker: these supersymmetric theories are not compatible with SM_G at larger scale. *Note added on 9/29/22: [77] proves the result (asymptotic safety of gravity) non perturbatively for GR-based universe, and hence most probably our real universe.*

The same variation on the reasoning in [22,30], leads to considering the soliton solutions as open or closed strings between quarks in a hadron model; thereby giving a physical justification for strings as interesting model for the strong interactions: the origin of the string proposals.

Just as we proposed to have a massless Higgs responsible for inflation, random walk and UU, it makes a lot of sense that it be therefore the particle implementing the condensation that creates the Q-balls. That our canonical multi-fold minimalistic model. While possibly requiring other revisits, other field may be also involved in addition or instead for UU and inflations. It is just not what we will in general consider, except, maybe, the maximons mentioned below, when we speak of the multi-fold theory as traced in [1,10], *(Note added on 9/29/22: see also [77-80]).*

The Higgs field the particles remains as proposed:

- Outside the particle, the Higgs field and potential is null before inflation, with possibly an attractive contribution at small scales, as discussed in [22].
- Before electroweak symmetry breaking. Higgs bosons are massless. And yes, they are then characterized by a complex field, used to model the instability above the electroweak scale [18], and the spontaneous symmetry breaking that propagates everywhere exponentially in the future of every particle. Again, aligned with our view on particles in Physics and WFT [1,60] we see this as using scalar field to approximate particle random walk behaviors as in [6,22].
- At all time, within the Q-balls, the Higgs field is non-zero (Higgs condensate), but the Higgs potential is null; it is non-zero only at the edge of the Q-ball. So the Higgs bosons can be considered as massive within the particles, yet at very smalls scale above the energies of the electroweak symmetry breaking, we have individual massless particles behavior. This is why, increasing energy, and reducing scales, is equivalent to revisiting the early times of universe, after the big bang, with the exception of the inflation that is not encountered when reducing scales a due to energy freed by symmetry breaking and the initial big bang, e.g., possibly as in [5].
- During inflation, the Higgs potential outside particles follows the model proposed in [35], expanding on [1,21,22,24]. The Higgs bosons are massless, an a priori not complex, because there is o need to model a spontaneous symmetry breaking, one rather encounter the slow roll [6,24,70].
- Post electroweak symmetry breaking, i.e. below their energy scales, we have a non-zero field (Mexican hat potential) outside the particles, and the Higgs boson is massive, while within the particle as microscopic black hole modeling means that within the massive Higgs boson, massless Higgs condensate exist. Per the model every particle is modeled this way: its proper soliton, from multi-fold space time matter induction and scattering [1,9,59], as a C-ball of Higgs condensates. This is the microscopic explanation of the electroweak symmetry breaking, and one of these imperfect pedagogical image where massive particles swallow massive Higgs bosons, one of the simplified way to teach the effects. We note again that observing at very small spatial scales, reverts to seeing massless contributions to the condensate and explains why again, even at this age of the universe, very small scales shows actors behaving as if we were at energies above the electroweak scale of energy. So, in reality, from a microscopic point of view, that pedagogical and imperfect image is rather that its composing massless Higgs bosons within the Q-bags now contribute their gained collective mass and this is what is

microscopically meant by the QFT approximation of having the massive fermions interacting with massive Higgs bosons.

At very small (spatial) scales, massless particles are involved within the particles per the above, and even post electroweak symmetry breaking, at every concretized spacetime location as these are now occupied, many at a time, by massive Higgs bosons with Q-ball interiors as discussed above. *Note added on 9/29/22: The massive Higgs.*

Outside every massive and massless particles, we have spacetime and metric behaviors that appear continuous. Yet, the Higgs potential are reflections of the random walk processes. As described in [1,6,19,22,24], at very small scales we also have a convergence of the intensity of the different interactions. These particles are the Higgs boson and/or possibly charged particles, maximons, as discussed in [53]. It also provide another angle to argue for SM_G, defined as non-negligible gravity effects at the level of the scales of SM; something derived in the multi-fold universe from the massive contributions to gravity [1,54], and the UU effects.

Note added on 9/29/22: maximons, other variations, and [53], are just possible scenarios to handle, in particular the electromagnetic charge that remains in play at very small scales [1,76]. We are not fan of that view, because with multi-fold space time matter induction and scattering [1,9,59,82,83], this is seen as a symmetry charge resulting from the Noether's theorem [73,74], and it can just be conserved through suitable induction of massless solitons, carrying the charges as needed. This leads us to conjecture a fundamental particle desert at energies above the gravity electroweak symmetry breaking energy scale [84].

The justification for the Higgs potential via the microscopic effects of multi-fold random walk is (therefore) as follows:

- Within a particle Q-ball, Higgs is confined and massless. Particles can overlap and it should not change the intrinsic properties of the particles. It means that a Higgs potential trying to match the microscopic effects must remain constant and null inside. In practice, in a particle, the massive bosons are confined inside the Q-ball, and do not have expanding random walk effect, which correspond to a null potential and a mass that accounts for its inability to escape from confinement. It happens independently of the values encountered in spacetime outside the particle.
- Outside, the potential is null for a non-zero value of the Higgs field before electroweak symmetry breaking in order to support the Kerr-Newman effects, solution of Dirac (or Klein Gordon) equations in Kerr Newman. The Higgs field is complex as already mentioned to support modeling the spontaneous electroweak symmetry breaking. After electroweak symmetry breaking, the potential is associated to a non-zero Higgs field.
- Attraction between the entangled spacetime locations, i.e. between the Higgs bosons, results also into an attractive dark energy effect, as discussed in [21].
- During inflation, the Higgs potential has the values, as in [1,6,24,53], and associated to the exponential growth as described in [1].
- It is also interesting to note the following. We know that at very small scales, gravity and spacetime are essentially 2D [1,22,36,62]. Interestingly, 2D gravity does not admit graviton, and gravitational waves, but admitting black holes, and it is typically dilaton based [57,58,71] *(Note added on 9/29/22: and also [85], and reference therein)*, associated to Kaluza Klein with a non-constant cosmological constant [56-58], something we encounter around the 2D regime of multi-fold and conventional gravity [22]. We see this as another indication that massless Higgs bosons as minimum black holes for concretized spacetime location and random walks, can be modeled as dilaton in a continuous theory, just as they can model the cosmological constant [22], the Higgs potential [6], the gravitation coupling [22], or the inflation potentials [1,6,24].

All these considerations only reinforce the proposal for multi-fold spacetime (re)construction as proposed in [1] and the role of the Higgs boson [6,9] and the electroweak symmetry breaking [9,25,26,27,55] in the concretization of spacetime.

Note on 9/29/22: See [75,76] for a subsequent derivation of the multi-fold gravity electroweak symmetry breaking that aligns with this proposition and will actually link gravity, electroweak symmetry breaking and spacetime orientation. It is at the core modeling the SM, or rather SM_G, especially QCD, and UU [1,19,76,83,84].

More details about the microscopic role of the Higgs boson have been provided in [87,88].

7. Massless, Spin-0 state and Scalar Particles and Spin in General

In the multi-fold theory taking shape with the present paper,

- Non-charged particles can be easily handled as Reissner-Nordström particular cases.
- Spin-0 and scalar particles can be handled as pure Schwarzschild black holes, which is convenient for computations. Yet for consistency and to explain the commonalities with say bosons of the same type, in say spin +1 or -1, we can also see it as particular case of the Kerr Newman (or Reissner-Nordström if chargeless), where we have to Q-ball skins rotating in opposite directions for spin-0 while additive for spin +1 and -1. This recovers the idea linking spin (as internal rotation, yet with a physical angular momentum observable that impact angular momentum conservation) of [1], and multi-fold rotations that could power rotations of the wave function. We are still pondering, a future mor detailed exploration of this idea, initially inspired, even if it is quite different, from [69], not claiming at all at this stage, that it is what happens. At this stage, it is just a conjecture that there might be something there.
- Massless particles, moving at *c*, the speed of light, are solitons with appropriate charges, and minimal Schwarzschild (charge-less massless scalars bosons), minimal extremal Kerr Newman (chargeless massless spin-1 bosons, including the photon, massless quarks, massless charged leptons, massless charged leptons, and (massless/chargeless) (Weyl) neutrinos, all above the electroweak symmetry breaking energy scales), based on the reasoning in [1] inspired from [72].
- Above the electroweak symmetry breaking energy scales, concretized spacetime locations are expected to amount to static chargeless minimum Schwarzschild black holes, with energy capturing the Planck mass. Below the electroweak symmetry breaking energy scales, they are occupied by massive Higgs bosons and their Schwarzschild blackholes, allowing us to repeat the analysis of [1,67,68].

While a good approximation in [1], photons as minimum Schwarzschild is not the best model. Minimum extremal chargeless Kerr Newman black hole is more accurate.

8. Conclusions

We have detailed how massive (charged) spinning particles can be modeled by Kerr-Newman solution solutions. These solutions can be seen as Q-balls matching with their edge the Kerr-Newman ring of singularities. The interior contains a Higgs condensate, resulting from symmetry breaking and it is equivalent to a superconductive layer along the edge. The oblateness of the Q-balls for an electron matches the fine structure constant. The Higgs potential outside the Q-ball matches QFT / SM models to ensure recovery at high energy between black hole multipole expansion of the potential and minimally coupled particle scatterings. We also recover quantized spin and the magnetic momentums of the particles.

Schwarzschild and Kerr-Newman blackholes have complex translated solutions. The former being able to model massless particles. As explained in [1], the resulting graph of black hole model concretized spacetime location and can explain the continuous spacetime used in Physics at larger scales that we macroscopically experience. In a multi-fold universe, the Higgs potential and behavior can be microscopically explained by the spacetime reconstruction model [1]. We also covered the massless cases with minimum black holes.

The superconducting Q-balls with rotating blackholes, prevent evaporation and hide singularities. Their soliton solutions of Einstein Maxwell Dirac Kerr Newman equations, can be seen as the result of multi-fold space time matter induction and scattering, which also provides the charges as Noether's charges. Spin-0 particles are either massive or massless Schwarzschild black holes, or

The analysis also recovers the possible suitability of super symmetry and superstrings (as well as associated GUTs or TOEs), to model the 2D regime, but not for larger scales, as well as the reason why strings are suitable to model confinement aspects of the string interaction.

The implications of the particle model as microscopic black holes reinforced the arguments in favor of SM_G, as SM with non-negligible gravity interactions at its scales, as relevant to particle physics.

The reasoning that we followed can be repeated without multi-fold considerations with or without supersymmetric potentials. After all most of the results that we relied on were developed in such a context. However it is fair to say that they have some challenge sin justifying the effect of gravity at the level of particle Compton wavelength. With SM_G, we don't have the same issues in a multi-fold universe.

Note added on 9/29/2022: By encountering multi-folds, at Planck scales, in GR-based universes [86], it is getting very convincing that our real universe is multi-fold or at least that our result apply to it.

In follow-up papers we expect to revisit the notion of spin in terms of multi-folds and the implication of the present analysis as well as further discuss the multi-fold proposals for the right-handed neutrinos and left-handed anti-neutrinos.

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References:

[1]: Stephane H. Maes, (2020), "Quantum Gravity Emergence from Entanglement in a Multi-Fold Universe", viXra:2006.0088v1, https://vixra.org/pdf/2006.0088v1.pdf (June 9, 2020). (See also https://shmaesphysics.wordpress.com/2021/03/01/quantum-gravity-emergence-from-entanglement-in-a-multi-fold-universe/).

[2]: Wikipedia, "Reissner–Nordström metric", https://en.wikipedia.org/wiki/Reissner%E2%80%93Nordstr%C3%B6m_metric. Retrieved on March 21, 2020.

[3]: Wikipedia, "Kerr–Newman metric", https://en.wikipedia.org/wiki/Kerr-Newman_metric. Retrieved on March 21, 2020.

[4]: Burinskii, Alexander, (2008), "The Dirac-Kerr-Newman electron", arXiv:0507109v4

[5]: Stephane H Maes, (2020), "A Multi-fold Universe Genesis Inspired By Explosive Total Collision: The Source Of The Big Bang?", https://shmaesphysics.wordpress.com/2021/01/17/a-multi-fold-universe-genesis-inspired-by-total-explosion-collision-the-source-of-the-big-bang/, January 12, 2021.

[6]: Stephane H Maes, (2020), "Multi-fold Higgs Fields and Bosons", viXra:2204.0146v1, https://shmaesphysics.wordpress.com/2020/11/10/multi-fold-higgs-fields-and-bosons/, November 6, 2020.

[7]: Stephane H Maes, (2020), "Right-handed neutrinos? Mass? Ask Gravity", viXra:2007.0018v1, https://shmaesphysics.wordpress.com/2020/06/21/right-handed-neutrinos-ask-gravity/, June 23, 2020.

[8]: Stephane H Maes, (2020), "More Matter Than Antimatter, All Falling Down", viXra:2010.0121v1, https://shmaesphysics.wordpress.com/2020/07/05/more-matter-than-antimatter-all-falling-down/, July 5, 2020.

[9]: Stephane H Maes, (2020), "Tracking Down The Standard Model With Gravity In Multi-Fold Universes", viXra:2011.0208v1, https://shmaesphysics.wordpress.com/2020/08/30/tracking-down-the-standard-model-with-gravity-in-multi-fold-universes/, August 20, 2020.

[10]: Stephane Maes, (2020-22), "Web Site Tracking all Publications around the Multi-fold universe", Navigation page listing all papers, https://shmaesphysics.wordpress.com/shmaes-physics-site-navigation/.

[11]: Stephane Maes, (2021), "Current Review - All Publications around the Multi-fold universe – February 2021", https://osf.io/8b69k, https://shmaesphysics.wordpress.com/shmaes-physics-site-navigation/, February 15, 2021. (More recent updates available at the URL in [10]).

[12]: Stephane H Maes, (2020), "The W-type Multi-Fold Hypothesis and Quantum Physics Interpretation of wave Functions and QFT", viXra:2207.0118v1, https://shmaesphysics.wordpress.com/2020/12/24/the-w-type-multi-fold-hypothesis-and-quantum-physics-interpretation-of-wave-functions-and-qft/, December 20, 2020.

[13]: Stephane H Maes, (2020), "Gravity Induced Anomalies Smearing in Standard Model so that Protons May Never Decay, Except in Black Holes ", viXra:2006.0128v1, https://shmaesphysics.wordpress.com/2020/06/12/protons-may-never-decay-except-in-black-holes/, June 13, 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), "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.

[16]: 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.

[17]: 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.

[18]: Wikipedia, "Tachyonic field", https://en.wikipedia.org/wiki/Tachyonic_field. Retrieved on April 5, 2019.

[19]: 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.

[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", viXra:2102.0137v1,

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.

[21]: Stephane H Maes, (2021), “The String Swampland and de Sitter Vacua: A Consistent Perspective for Superstrings and Multi-fold Universes”, viXra:2208.0078v1, https://shmaesphysics.wordpress.com/2021/01/12/the-string-swampland-and-de-sitter-vacua-a-consistent-perspective-for-superstrings-and-multi-fold-universes/, January 9, 2021.

[22]: Stephane H Maes, (2021), “Quantum Gravity Asymptotic Safety from 2D Universal Regime and Smooth Transition to Dual Superstrings”, viXra:2208.0151v1, https://shmaesphysics.wordpress.com/2021/02/07/quantum-gravity-asymptotic-safety-from-2d-universal-regime-and-smooth-transition-to-dual-superstrings/, January 29, 2021.

[23]: Stephane H Maes, (2020), “Circular Arguments in String and Superstring Theory from a Multi-fold Universe Perspective”, viXra:2103.0195v1, https://shmaesphysics.wordpress.com/2020/10/11/circular-arguments-in-string-and-superstring-theory-from-a-multi-fold-universe-perspective/, October 5, 2020.

[24]: Stephane H Maes, (2020), ”Explaining Dark Energy, Small Cosmological Constant and Inflation Without New Physics?”, viXra:2006.0261v1, https://shmaesphysics.wordpress.com/2020/06/19/explaining-dark-energy-small-cosmological-constant-and-inflation-without-new-physics/, June 19, 2020.

[25]: Ted Jacobson , Lee Smolin, (1988), “Nonperturbative quantum geometries”, Nuclear Physics B, Volume 299, Issue 2, 4 April 1988, Pages 295-345.

[26]: Ted Jacobson , Lee Smolin, (1988), “Covariant action for Ashtekar’s form of canonical gravity”, Class. Quantum Grav. 5 (1988) 583-594.

[27]: Carter, B., (1968), “Global structure of the Kerr family of gravitational fields”, Phys. Rev., 174, 1559.

[28]: Newman, E.T., (2002), "On a classical, geometric origin of magnetic moments, spin-angular momentum and the Dirac gyromagnetic ratio", Phys. Rev. D, 66, 104005.

[29]: E. T. Newman and A. I. Janis, (1965), “Note on the Kerr Spinning-Particle Metric”, J. Math. Phys. 6, 915.

[30]: Alexander Burinskii, (2020), "The Kerr–Newman Black Hole Solution as Strong Gravity for Elementary Particles", https://www.researchgate.net/publication/343811848.

[31]: E.T. Newman, J.Winicour, (1974), "A Curiosity Concerning Angular Momentum", J. Math.Phys. 15, 1113, (1974)

[32]: Nima Arkani-Hamed, Yu-tin Huang, Donal O'Connell, (2019-2020), "Kerr Black Holes as Elementary Particles", arXiv:1906.10100v2.

[33]: The Reference Frame, (2009), "CERN: Weinberg on asymptotic safety", https://motls.blogspot.com/2009/07/cern-weinberg-about-asymptotic-safety.html?m=1. Retrieved on September 1, 2020.

[34]: D. F. Litim and F. Sannino, (2014), “Asymptotic safety guaranteed”, arXiv:1406.2337v2.

[35]: Tugba Buyukbese, Daniel F. Litim, (2017), "Asymptotic safety of gauge theories beyond marginal interactions", PoS LATTICE2016, (2017) 233.

[36]: Steven Carlip, (2010), “The Small Scale Structure of Spacetime “, arXiv:1009.1136v1.

[37]: Wikipedia, "Reissner–Nordström metric", https://en.wikipedia.org/wiki/Reissner%E2%80%93Nordstr%C3%B6m_metric, Retrieved for this paper on February 27, 2021.

[38]: Alfredo Guevara, Alexander Ochirov, Justin Vines, (2018-2019), "Scattering of Spinning Black Holes from Exponentiated Soft Factors", arXiv:1812.06895v3.

[39]: Alexander Burinskii, (2015), “Gravitating lepton bag model”, arXiv:1505.03439v1.

[40]: A. Burinskii, (2010), "Regularized Kerr-Newman Solution as a Gravitating Soliton", J. Phys. A: Math. Theor. 43 (2010) 392001.

[41]: A. Burinskii, (2014), “Kerr-Newman electron as spinning soliton”, Int. J. of Mod. Phys. A 29 1450133.

[42]: Tim Adamo, E.T. Newman, (2016), "The Kerr-Newman metric: A Review", arXiv:1410.6626v2.

[43]: Irina Dymnikova, (2015), “Electromagnetic source for the Kerr-Newman geometry”, arXiv:1510.01352v1.

[44]: Sydney Coleman, (1985), "Q-Balls", Nuclear Physics B262 (1985) 263-283.

[45]: Alexander Burinskii, (2019), "Features of spinning gravity in particle physics: supersymmetric core of the Kerr-Newman electron ", IOP Conf. Series: Journal of Physics: Conf. Series 1275, 012031.

[46]: H. B. Nielsen and P. Olesen, (1973), “Vortex-line models for dual strings”, Nucl. Phys. B 61, 45.

[47] A. Achucarro and T. Vachaspati, (2000), "Semilocal and Electroweak Strings", Phys. Rept. 327 347.

[48]: Ryder, L.H., (1996), “Quantum Field Theory”, Cambridge University Press, 2nd Edition.

[49]: P.W. Anderson, (1963), “Plasmons, Gauge Invariance, and Mass”, Phys. Rev. 130, 439.

[50]: Altland A., Simons B.D., (2010), “Condensed Matter Field Theory “, Cambridge University Press.

[51]: Wikipedia, "Wilson loop", https://en.wikipedia.org/wiki/Wilson_loop. Retrieved for this paper on February 27, 2021.

[52]: Wikipedia, "Wigner's classification", https://en.wikipedia.org/wiki/Wigner%27s_classification. Retrieved for this paper on February 27, 2021.

[53]: Ahmed Alharthy and Vladimir V. Kassandrov, (2020), "On a Crucial Role of Gravity in the Formation of Elementary Particles", Universe, 6, 193.

[54]: 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.

[55]: Stephon Alexander, Antonino Marciano, Lee Smolin, (2018), “Gravitational origin of the weak interaction’s chirality”, arXiv:1212.5246v2

[56]: Wikipedia, “Dilaton”, https://en.wikipedia.org/wiki/Dilaton. Retrieved for this paper on February 20, 2021.

[57]: Deniel Grumiller, (2008), “3D quantum gravity?”, https://publik.tuwien.ac.at/files/PubDat_170179.pdf. Retrieved for this paper on February 20, 2021.

[58]: Daniel Grumiller, Rene Meyer, (2006), “Quantum Dilaton Gravity in Two Dimensions with Fermionic Matter”, arXiv:hep-th/0607030v2.

[59]: Stephane H. Maes, (2020), “Particles of The Standard Model In Multi-Fold Universes”, viXra:2111.0071v1, https://shmaesphysics.wordpress.com/2020/11/05/particles-of-the-standard-model-in-multi-fold-universes/, November 4, 2020.

[60]: 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.

[61]: Stephane H. Maes, (2020), “Considerations on supersymmetry”, https://shmaesphysics.wordpress.com/2020/10/11/circular-arguments-in-string-and-superstring-theory-from-a-multi-fold-universe-perspective/#comment-934 and subsequent comments. October 12, 2020.

[62]: Stephane H Maes, (2021), “Spacetime and Gravity are 2D around Planck Scales: A Universal Property of Consistent Quantum Gravity”, https://shmaesphysics.wordpress.com/2021/03/23/spacetime-and-gravity-are-2d-around-planck-scales-a-universal-property-of-consistent-quantum-gravity/, March 20, 2021.

[63]: Stephane H Maes, (2020), “Entanglement Concretizes Time in a Multi-fold Universe”, viXra:2010.0083v1, https://shmaesphysics.wordpress.com/2020/06/28/entanglement-concretizes-time-in-a-multi-fold-universe/, June 28, 2020.

[64]: J. Makela, P. Repo, M. Luomajoki, J.Piilonen, (2000), “Quantum-mechanical model of the Kerr-Newman black hole”, arXiv:gr-qc/0012055v1

[65]: Wikipedia, “Black hole electron”, https://en.wikipedia.org/wiki/Black_hole_electron. Retrieved on April 13, 2020.

[66]: Ted Jacobson, (1995), “Thermodynamics of Spacetime: The Einstein Equation of State”, arXiv:gr-qc/9504004v2

[67]: J. Makela, (2009), “A Simple Quantum-Mechanical Model of Spacetime I: Microscopic Properties of Spacetime”, arXiv:0805.3952v3.

[68]: J. Makela, (2009), “A Simple Quantum-Mechanical Model of Spacetime II: Thermodynamics of Spacetime”, arXiv: 0805.3955v3.

[69]: Jean-Marc Levy-Leblond, (1967), “Nonrelativistic Particles and Wave Equations”, Commun. math. Phys. 6.

[70]: Wikipedia, “Inflation (cosmology)”, https://en.wikipedia.org/wiki/Inflation_(cosmology). Retrieved on March 31, 2019.

[71]: Mann, R. B., Shiekh, A., & Tarasov, L. (1990). Classical and quantum properties of two-dimensional black holes. Nuclear Physics B, 341(1).

[72]: Radhakrishnan C. Nair, 92006), “Photon as a black hole”, SFIN A 1 (2007) 321-326.

[73]: Wikipedia, “Noether's theorem”, https://en.wikipedia.org/wiki/Noether%27s_theorem. Retrieved on December 6, 2020.

[74]: Wikipedia, “Noether's second theorem”, https://en.wikipedia.org/wiki/Noether%27s_second_theorem. Retrieved on December 6, 2020.

Reference added on 9/22/22:

[75]: Stephane H Maes, (2021), “Right-handed Neutrinos and Traversable Wormholes: the key to entanglement, gravity and multi-folds extensions to ER=EPR?”, https://shmaesphysics.wordpress.com/2021/04/03/right-handed-neutrinos-and-traversable-wormholes-the-key-to-entanglement-gravity-and-multi-folds-extensions-to-erepr/, April 3, 2021.

[76]: Stephane H. Maes, (2022), “Invalidation and Proof of the Mass Gap, and Viability of The Standard Model on a Discrete Spacetime”, https://shmaesphysics.wordpress.com/2022/07/15/invalidation-and-proof-of-the-mass-gap-and-viability-of-the-standard-model-on-a-discrete-spacetime/, July 15, 2022.

[77]: Stephane H Maes, (2022), “A Non-perturbative Proof of the Asymptotic Safety of 4D Einstein Gravity, With or Without Matter”, https://shmaesphysics.wordpress.com/2022/05/04/a-non-perturbative-proof-of-the-asymptotic-safety-of-4d-einstein-gravity-with-or-without-matter/, May 4, 2022.

[78]:Stephane H Maes, (2021), ”The Multi-fold Theory: A synopsis”, viXra:2112.0144v1, https://shmaesphysics.wordpress.com/2021/12/24/the-multi-fold-theory-a-synopsis-so-far-v2-end-of-2021/, December 24, 2021. Note that additional links will always be available at https://shmaesphysics.wordpress.com/2021/05/03/the-multi-fold-theory-a-synopsis-so-far/ to track the latest and interim versions of the synopsis, as they may be published under different tittle or URL/publication numbers.

[79]: Stephane H Maes, (2022), “Understanding the Multi-fold theory principles and the SM_G”, https://shmaesphysics.wordpress.com/2022/03/11/understanding-the-multi-fold-theory-principles-and-the-sm_g/, March 11, 2022.

[80]: Stephane H. Maes, (2022), “What is the Multi-fold Theory? Its Main Characteristics in a Few Words”, vixra:2207.0172v1, https://shmaesphysics.wordpress.com/2022/07/28/what-is-the-multi-fold-theory-its-main-characteristics-in-a-few-words/, July 28, 2022.

[81]: Stephane H. Maes, (2022), “No mass loss by evaporation for particles as microscopic black-holes”, https://shmaesphysics.wordpress.com/2021/02/28/more-on-multi-fold-particles-as-microscopic-black-holes-with-higgs-regularizing-extremality-and-singularities/comment-page-1/#comment-4665. September 14, 2022.

[82]: Stephane H Maes, (2021), “Multi-fold Embeddings, Space Time Matter Induction or Gravity Asymptotically Safe and The AdS/CFT Correspondence Conjecture, they all can recover the Standard Model”, https://shmaesphysics.wordpress.com/2021/12/20/multi-fold-embeddings-space-time-matter-induction-or-gravity-asymptotically-safe-and-the-ads-cft-correspondence-conjecture-they-all-can-recover-the-standard-model-or-smg/, December 20, 2021.

[83]: Stephane H. Maes, (2022), “Justifying the Standard Model U(1) x SU(2) x SU(3) Symmetry in a Multi-fold Universe”, https://shmaesphysics.wordpress.com/2022/08/08/justifying-the-standard-model-u1-x-su2-x-su3-symmetry-in-a-multi-fold-universe/, August 8, 2022.

[84]: Stephane H. Maes, (2022), "A Conjecture: No Dark Matter will be discovered at LHC, or elsewhere", https://shmaesphysics.wordpress.com/2022/07/08/a-prediction-no-dark-matter-will-be-discovered-at-lhc-or-elsewhere/, July 8, 2022.

[85]: Stephane H Maes, (2022), "The Replica Trick, Wormholes, Island formula, and Quantum Extremal Surfaces, and How the AdS/CFT Correspondence Conjecture, and Hence the M-theory, Encounters Multi-folds", https://shmaesphysics.wordpress.com/2022/09/20/the-replica-trick-its-wormholes-islands-and-quantum-extremal-surfaces-and-how-the-ads-cft-correspondence-conjecture-and-hence-the-m-theory-encounters-multi-folds/, September 26, 2022.

[86]: Stephane H Maes, (2022), "Deriving the Multi-fold Theory from General Relativity at Planck scale", https://shmaesphysics.wordpress.com/2022/02/22/deriving-the-multi-fold-theory-from-general-relativity-at-planck-scale/, February 22, 2022.

[87]: Stephane H Maes, (2021), "Right-handed Neutrinos and Traversable Wormholes: the key to entanglement, gravity and multi-folds extensions to ER=EPR?", https://shmaesphysics.wordpress.com/2021/04/03/right-handed-neutrinos-and-traversable-wormholes-the-key-to-entanglement-gravity-and-multi-folds-extensions-to-erepr/, April 3, 2021.

[88]: Stephane H Maes, (2021), "Multi-fold Non-Commutative Spacetime, Higgs and The Standard Model with Gravity", https://shmaesphysics.wordpress.com/2021/04/18/multi-fold-non-commutative-spacetime-higgs-and-the-standard-model-with-gravity/, April 11, 2021.