Do we Need a "Trans-Planckian Physics"?

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Abstract

In this paper we will show that there is no need for a Trans-Planckian physics as it is proposed e.g. in [A1] or as the whole string, brane, loops, M-whatever, or bosonic shoelace and so on approaches propose (e.g. [A2]), because this is already contained in Hilbert's original work [A3], only that – apparently – nobody ever looked thoroughly enough to realize it there.

Abstract References

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Introduction

In [1] Hamada suggests an adaptation of the curvature terms of the Einstein field equations [2, 3] in order to assure non-infinite outcomes for the usually problematic cases in the general theory of relativity [3] like big bang or the center of black holes. He also claims to have found a suitable candidate for the quantification of Einstein's great theory. On the other hand, this author has shown in previous papers [4 – 12] how a simple scaling factor to the metric tensor already leads to a quantum gravity field equational outcome. The "problem" with this finding of course is, that Hilbert should get all the credit for already having found a or THE "Theory of Everything" over 100 years ago. There wasn't much to be done, unless one counts adding a scaling factor as "much", which this author definitively does not. He sees such a "work" as a mere finding in another's paper. However, with tens of thousands of jobs at stake because they all depend on the fact that there is no Theory of Everything yet, people apparently don't want to recognize that Hilbert has already done almost all the work. Worse still, it was also shown that – in principle – variational kernels in the Einstein-Hilbert action of the type f[R], as they are necessary to create the field equations Hamada proposes in [12] and as they are also necessary for so many other Trans-Planckian approaches, are not of need, because those could always be substituted by a suitable metric scaling factor [13] without changing the total variational (Hilbert!!!) integral, which – after all – is a scalar.

Quantum Gravity or the "Theory of Everything"

We start with the following scaled metric tensor and force it into the Einstein-Hilbert action variational problem [2] as follows:

$$G_{\alpha\beta} = g_{\alpha\beta} \cdot F[f] \quad \rightarrow \quad \delta W = 0 = \delta \int_V d^n x \sqrt{-G} \cdot \left(R^* - 2 \cdot \Lambda\right) \tag{1}$$

Here Λ is the cosmological constant, G denotes the determinant of the metric tensor from (1) and R^* gives the corresponding Ricci scalar. Performing the variation with respect to the metric $G_{\alpha\beta}$ results in:

$$0=\left(\begin{array}{c}\boxed{R_{\alpha\beta}-R\frac{g_{\alpha\beta}}{2}+\Lambda\cdot g_{\alpha\beta}}\\ -\frac{1}{2F}\left(\begin{array}{c}F_{,\alpha\beta}(n-2)+F_{,ab}g_{\alpha\beta}g^{ab}+F_{,a}g^{ab}\left(g_{\beta b,\alpha}-g_{\beta\alpha,b}\right)-\\ F_{,\alpha}g^{ab}g_{\beta b,a}-F_{,\beta}g^{ab}g_{\alpha b,a}+F_{,d}g^{cd}\left(\begin{array}{c}g_{\alpha c,\beta}-\frac{1}{2}ng_{\alpha c,\beta}-\frac{1}{2}ng_{\beta c,\alpha}\\ +\frac{1}{2}ng_{\alpha\beta,c}+\frac{1}{2}g_{\alpha\beta}g_{ab,c}g^{ab}\end{array}\right)\end{array}\right)\\ +\frac{1}{4F^2}\left(F_{,\alpha}\cdot F_{,\beta}(3n-6)+g_{\alpha\beta}F_{,c}F_{,d}g^{cd}(4-n)\right)\\ +(n-1)\left(\frac{1}{2F}\left(\begin{array}{c}2\Delta F-2F_{,d}g^{cd}{}_{,c}\\ -\frac{n}{(n-1)}F_{,d}g^{cd}g^{ab}g_{ac,b}\end{array}\right)+\frac{g^{ab}F_{,a}\cdot F_{,b}}{4F^2}(n-6)\right)\cdot\frac{g_{\alpha\beta}}{2}\end{array}\right)\delta G^{\alpha\beta} \qquad (2)$$

and shows us that we have not only obtained the classical Einstein Theory of General Relativity [3] (see boxed terms exactly giving the Einstein Field Equations in vacuum plus the cosmological constant term), but also a set of quantum field equations for the scaling function F, clearly playing the role of the wave-function. It was shown in our previous publications [4, 5, 6, 7, 8] that these additional terms are quantum equations, fully covering the main aspects of relativistic classical quantum theory. Everything else can be obtained by a few generalizations, structural shaping and the introduction of the variation with respect to the degrees of freedom or number of dimensions [4, 5, 6, 7, 8]. So, we conclude, that we indeed have a Quantum Gravity Theory or Theory of Everything, as one also calls it, at hand, whereby it should be pointed out that (2) has to be considered the simplest possible – and still general (see [4, 5, 6, 7, 8]) - form for the corresponding quantum gravity field equations.

"Weak Gravity" and Linearity – The Transition to the Classical Quantum Theory

It was shown in [5, 6, 7, 8] that the so-called "weak gravity" condition:

$$\delta G^{\alpha\beta}=G^{\alpha\beta}\cdot\delta_0+\overbrace{G^{ab}\delta_{ab}^{\alpha\beta}}^{\text{Gravity}}\xrightarrow{\forall\,\delta_{ab}^{\alpha\beta}\ll\delta_0}=\frac{g^{\alpha\beta}}{F}\cdot\delta_0, \qquad (3)$$

together with a setting for the scaling function F[f] as follows:

$$F[f]=\begin{cases}C_F\cdot\left(f+C_f\right)^{\frac{4}{n-2}} & n\neq 2\\ C_F\cdot e^{f\cdot C_f} & n=2\end{cases}. \qquad (4)$$

leads to a significant simplification and scalarization of the quantum gravity field equations (2), namely:

$$0=R-\frac{F'}{2F}\left((n-1)\left(2g^{ab}f_{,ab}+f_{,d}g^{cd}g^{ab}g_{ab,c}\right)-nf_{,d}g^{cd}g^{ab}g_{ac,b}\right). \qquad (5)$$

This equation is completely linear in f, which not only has the characteristics of a quantum function, but – for a change – gives us the opportunity to metrically see what QUANTUM actually means, namely, a volume jitter to the metric of the system in question… at least this is one quantum option, because we have already seen others, like the perturbated kernel (e.g. see [8]).

Interestingly, for metrics without shear elements:

$$g_{ij}=\begin{pmatrix} g_{00} & \cdots & 0 \\ \vdots & \ddots & \vdots \\ 0 & \cdots & g_{n-1n-1} \end{pmatrix}; \quad g_{ii,i}=0\,, \tag{6}$$

and applying the solution for F[f] from (4) the derivative terms in (5), which is to say:

$$(n-1)\left(2g^{ab}f_{,ab}+f_{,d}g^{cd}g^{ab}g_{ab,c}\right)-nf_{,d}g^{cd}g^{ab}g_{ac,b}\,. \tag{7}$$

converge to the ordinary Laplace operator, namely:

$$\begin{gathered} R^{*}=0 \quad\rightarrow\quad 0=F\cdot R+F'\cdot(1-n)\cdot\Delta f \\ \Rightarrow \quad 0=\begin{cases} \left(f-C_{f}\right)^{\frac{4}{n-2}}\cdot C_{F}\left(R+\dfrac{4}{n-2}\cdot\dfrac{(1-n)}{\left(f-C_{f}\right)}\cdot\Delta f\right) & n>2 \\ e^{C_{f}\cdot f}\cdot C_{F}\left(R+C_{f}\cdot(1-n)\cdot\Delta f\right) \quad n=2 \end{cases} \cdot \end{gathered} \tag{8}$$

We recognize the relativistic Klein-Gordon equation.

Thus, in the case of n>2 we always also have the option for a constant (broken symmetry) solution of the kind:

$$0=f-C_{f0} \quad\Rightarrow\quad f=C_{f0}\,. \tag{9}$$

In all other cases, meaning where $f\neq C_{f0}$, we have the simple equations:

$$0=\begin{cases} \left(f-C_{f0}\right)\cdot R+(1-n)\cdot\dfrac{4}{n-2}\cdot\Delta f & n>2 \\ R+C_{f0}\cdot(1-n)\cdot\Delta f \quad n=2 \end{cases}. \tag{10}$$

A critical argument should now be that this equation is not truly of Klein-Gordon character as it does contain neither potential nor mass, but this author has already shown that this problem is easily solved by adding additional dimensions carrying the right properties to produce masses and potentials due to entanglement, being provided by the right scaling function F[f] (e.g. [4 – 8]).

Using these results we were able to develop a quantum gravity statistics [9, 10], formulate a Heisenberg uncertainty principle containing gravity [12] and even suggesting a path for answering the riddle of the 3 generations of elementary particles [13].

Do we Need a “Trans-Planckian Physics”?

Observing our variational result (2) and comparing with the classical equations from [3]:

$$R_{\alpha\beta}-\frac{1}{2}R\cdot g_{\alpha\beta}+\Lambda\cdot g_{\alpha\beta}=-\kappa\cdot T_{\alpha\beta}\,, \tag{11}$$

where we have: $R_{\alpha\beta}$, $T_{\alpha\beta}$ the Ricci- and the energy momentum tensor, respectively, while the parameters Λ and κ are constants (usually called cosmological and coupling constant, respectively), we realize that the following terms of (2) are just the most natural energy momentum tensor elements and read:

$$\kappa\cdot T_{\alpha\beta}=\left(\begin{array}{c} -\frac{1}{2F}\left(\begin{array}{c} F_{,\alpha\beta}(n-2)+F_{,ab}g_{\alpha\beta}g^{ab}+F_{,a}g^{ab}\left(g_{\beta b,\alpha}-g_{\beta\alpha,b}\right)- \\ F_{,\alpha}g^{ab}g_{\beta b,a}-F_{,\beta}g^{ab}g_{\alpha b,a}+F_{,d}g^{cd}\left(\begin{array}{c} g_{\alpha c,\beta}-\frac{1}{2}ng_{\alpha c,\beta}-\frac{1}{2}ng_{\beta c,\alpha} \\ +\frac{1}{2}ng_{\alpha\beta,c}+\frac{1}{2}g_{\alpha\beta}g_{ab,c}g^{ab} \end{array}\right) \end{array}\right) \\ \frac{1}{4F^2}\left(F_{,\alpha}\cdot F_{,\beta}(3n-6)+g_{\alpha\beta}F_{,c}F_{,d}g^{cd}(4-n)\right) \\ (n-1)\left(\frac{1}{2F}\left(\begin{array}{c} 2\Delta F-2F_{,d}g^{cd}{}_{,c} \\ -\frac{n}{(n-1)}F_{,d}g^{cd}g^{ab}g_{ac,b} \end{array}\right)+\frac{g^{ab}F_{,a}\cdot F_{,b}}{4F^2}(n-6)\right)\cdot\frac{g_{\alpha\beta}}{2} \end{array}\right). \qquad (12)$$

Now we see that all matter is described by wave-like field equations and that therefore our experience of the Planckian limit is completely natural, because in a universe, where matter is governed by wave equations, nothing can be smaller or finer resolved than the smallest possible wave lengths. Obviously these limits are determined by the Planck units together with the equation (12). Consequently, as these limits are inbuild properties inside the quantum gravity field equations, there is no need for any Trans-Planckian physics. The physics is intrinsically consistent through the field equations (2), which include the Planckian limits simply as smallest wavelength and frequencies, based on and determined by the usual well-known natural fundamental constants like speed of light in vacuum, Planck constant and the Newton constant.

References

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