About the So-Called 3-Generations Problem of Elementary Particles More Tasks

Norbert Schwarzer, www.worldformulaapps.com

contact via: www.worldformulaapps.com/#contact-module

The Three Generations of Particles, by Livia Schwarzer

Summing up what we have found (see recent posts or [1, 2, 3])

A) **When introducing a scale-variated metric of the kind $G_{\alpha\beta}=F[f]*g_{\alpha\beta}$ we obtain a Ricci-scalar R^* which contains the function f in such a form, that we can extract both, Dirac and Klein-Gordon equations [1 – 6]. As the origin is completely geometry, respectively of 100% metric character, we consider our approach as a quantum gravity one and, thus, consequently, the function F[f], respectively f as a quantum gravity wave function.**

B) **Adding dimensions with special dependencies to the "main (space-time) dimensions", which we here saw AND treated as entanglement, brings all forms of inertia, spin and stuff, even when demanding the total scalar curvature R^* to vanish.**

C) **Not demanding the total scalar curvature to vanish and assuming that there are eigen-solutions to the differential equation of the Ricci-scalar R^* for the function f, leads to algebraic equations allowing for 3 different solutions to the combined product of mass and the quantum gravity wave function f. We think that this is the answer to the riddle of the 3 generations of elementary particles.**

D) **The interesting point is here, that all classical quantum effects, including an obviously rather potent solution to the 3-generaion problem, arise from a simple scale factor F[f] to the metric $g_{\alpha\beta}$.**

E) **We also saw, even though we were not able - so far anyway - to completely solve the subsequent complex eigen equation for the function f resulting from the adapted Ricci scalar, that the so-called "particle at rest" sports the usual oscillations in time with mass as a factor and the known matter and anti-matter solutions (forward and backward movement in time) as we already know them from the classical Dirac theory [7].**

F) **From this automatically also follows (among other things, which should be discussed later on) that particle masses are apparently just static (or quasi-static) scale oscillations of space and time. In other words, where space-time vibrates there is mass and where space-time vibrates in a stable manner, there are stable particles with mass.**

Theory: The Ricci Scalar for a Scaled Metric

In [1, 2, 3] (and quite some other papers by this author) it was demonstrated how we can find a direct extraction of the Klein-Gordon, the Schrödinger and the Dirac equation from the Ricci scalar R^* of a modified metric of the kind $G_{\alpha\beta}=F[f]*g_{\alpha\beta}$. Namely: With a yet arbitrary scalar function F[f] the corresponding modified Ricci scalar R^* reads:

$$R^* = \frac{1}{F[f]^3}\cdot\left(\begin{array}{c}\left(C_{N1}\cdot\left(\frac{\partial F[f]}{\partial f}\right)^2 - C_{N2}\cdot F[f]\cdot\frac{\partial^2 F[f]}{\partial f^2}\right)\cdot\overbrace{\left(\tilde{\nabla}_g f\right)^2}^{=f_{,\alpha}g^{\alpha\beta}f_{,\beta}} \\ -C_{N2}\cdot F[f]\cdot\frac{\partial F[f]}{\partial f}\cdot\Delta_g f\end{array}\right) \quad . \tag{1}$$

$$\xrightarrow{n=4} = \frac{1}{F[f]^3}\cdot\left(\left(\frac{3}{2}\cdot\left(\frac{\partial F[f]}{\partial f}\right)^2 - 3\cdot F[f]\cdot\frac{\partial^2 F[f]}{\partial f^2}\right)\cdot\left(\tilde{\nabla}_g f\right)^2 - 3\cdot F[f]\cdot\frac{\partial F[f]}{\partial f}\cdot\Delta_g f\right)$$

Thereby the C_{N1} and C_{N2} are constants depending on the number of dimensions n of the space-time being considered. For illustration we also gave the case n=4 (n=number of dimensions). Thereby f is to be understood as a function of the coordinates $f=f[x_0, x_1, x_2, \ldots]$. It was shown in [1 - 6] (especially [2]) that we can write:

$$\begin{array}{c} C_{N1} = -\frac{3}{2}+\frac{7}{4}\cdot n-\frac{1}{4}\cdot n^2 \\ C_{N2} = n-1 \end{array}, \tag{2}$$

Demanding certain conditions for the function F[f] and / or f then gives us Dirac or Klein-Gordon equations [1, 2, 3]. Thus, when demanding f to be a Laplace function, we obtain from (1):

$$\begin{array}{l} R^* = \frac{1}{F[f]^3}\cdot\left(\left(C_{N1}\cdot\left(\frac{\partial F[f]}{\partial f}\right)^2 - C_{N2}\cdot F[f]\cdot\frac{\partial^2 F[f]}{\partial f^2}\right)\cdot\overbrace{\left(\tilde{\nabla}_g f\right)^2}^{=f_{,\alpha}g^{\alpha\beta}f_{,\beta}}\right), \\ \xrightarrow{n=4} = \frac{1}{F[f]^3}\cdot\left(\left(\frac{3}{2}\cdot\left(\frac{\partial F[f]}{\partial f}\right)^2 - 3\cdot F[f]\cdot\frac{\partial^2 F[f]}{\partial f^2}\right)\cdot\left(\tilde{\nabla}_g f\right)^2\right) \end{array} \tag{3}$$

which – so it was shown in [1, 2, 3] – gives the metric equivalent to the Dirac equation [7]. It was also shown in [1, 2] how this gives the classical Dirac equation in flat space Minkowski metrics [7].

But there are also other settings as it was shown in our previous (and most recent) posts here.

The Klein-Gordon Setting and 3 Generations of Masses

So, for instance, by setting F[f] to fulfill the following condition:

$$C_{N1}\cdot\left(\frac{\partial F[f]}{\partial f}\right)^2-C_{N2}\cdot F[f]\cdot\frac{\partial^2 F[f]}{\partial f^2}=0, \tag{4}$$

we obtain from (3):

$$\begin{aligned} R^* &= -\frac{1}{F[f]^3}\cdot C_{N2}\cdot F[f]\cdot\frac{\partial F[f]}{\partial f}\cdot\Delta_g f \\ &\xrightarrow{n=4\ \ \&\ \ F[f]=\left(f+\frac{C_f}{M^2}\right)^2} = -\frac{1}{F[f]^2}\cdot 3\cdot\frac{\partial F[f]}{\partial f}\cdot\Delta_g f \xrightarrow{F[f]=\left(f+\frac{C_f}{M^2}\right)^2} = -\frac{6}{\left(f+\frac{C_f}{M^2}\right)^3}\cdot\Delta_g f\cdot \\ &\Rightarrow \frac{R^*}{6}\cdot\left(f+\frac{C_f}{M^2}\right)^3+\Delta_g f=0 \end{aligned} \tag{5}$$

Now we simply assumed an eigenvalue solution to the Laplace operator in the last line in (5)of the kind:

$$M^2\cdot f-\Delta_g f=0, \tag{6}$$

which gave us an algebraic equation of 3rd order as follows:

$$M^2\cdot f\equiv\frac{m^2\cdot c^2}{\hbar^2}\cdot f=\frac{R^*}{6}\cdot\left(f+\frac{C_f}{M^2}\right)^3. \tag{7}$$

As already shown in a previous post here (see also [2]), a bit of reshaping the last equation is going to help us to realize how this will possibly also solve the 3-generations mass problem:

$$\begin{aligned} \Psi\equiv M^2\cdot f\equiv\frac{m^2\cdot c^2}{\hbar^2}\cdot f=\frac{R^*}{6}\cdot\left(f+\frac{C_f}{M^2}\right)^3=\frac{R^*}{M^6\cdot 6}\cdot\left(\Psi+C_f\right)^3 \\ \xrightarrow{R^{**}=\frac{R^*}{M^6\cdot 6};\ \ R^{***}=C_f} R^{**}\cdot\left(\Psi+R^{***}\right)^3-\Psi=0 \qquad . \\ =\left(\Psi+R^{***}\right)^3-\frac{\Psi}{R^{**}}=\left(R^{***}\right)^3-\frac{\Psi}{R^{**}}+3\cdot\left(R^{***}\right)^2\cdot\Psi+3\cdot R^{***}\cdot\Psi^2+\Psi^3 \end{aligned} \tag{8}$$

The general solution to a three-order polynomial could be given via the following product form:

$$\begin{aligned} (\Psi-\Psi_1)\cdot(\Psi-\Psi_2)\cdot(\Psi-\Psi_3)= \\ \Psi^3-\Psi^2\cdot(\Psi_1+\Psi_2+\Psi_3)+\Psi\cdot(\Psi_1\Psi_2+\Psi_1\Psi_3+\Psi_2\Psi_3)-\Psi_1\Psi_2\Psi_3\,. \\ \left(R^{***}\right)^3-\frac{\Psi}{R^{**}}+3\cdot\left(R^{***}\right)^2\cdot\Psi+3\cdot R^{***}\cdot\Psi^2+\Psi^3 \end{aligned} \tag{9}$$

Comparing the latter with the last line in (8) gives us:

$$\begin{aligned} 3\cdot R^{***}=3\cdot C_f=-(\Psi_1+\Psi_2+\Psi_3) \\ 3\cdot\left(R^{***}\right)^2-\frac{1}{R^{**}}=3\cdot(C_f)^2-\frac{6\cdot M^6}{R^*}=\Psi_1\Psi_2+\Psi_1\Psi_3+\Psi_2\Psi_3\,. \\ (C_f)^3=-\Psi_1\Psi_2\Psi_3 \end{aligned} \tag{10}$$

Thus, we have obtained “the” three generations of quantum gravity solutions to the combined mass²-times-f-function, given via $\Psi \equiv M^2 \cdot f \equiv \frac{m^2 \cdot c^2}{\hbar^2} \cdot f$, as functions or dependencies of the Ricci scalar R* of the quantum-gravity (just scalar) variated metric $G_{\alpha\beta}=F[f]*g_{\alpha\beta}$, the mass-values $M^2 \equiv \frac{m^2 \cdot c^2}{\hbar^2}$ and a constant C_f.

Please note: As the expression $\Psi_1\Psi_2 + \Psi_1\Psi_3 + \Psi_2\Psi_3$ on the right-hand side in the second line in (10) should be just a constant and thus, could not depend on the various masses M_i, we have to demand the Ricci-scalar R^* to be directly connected with the M_i via a constant const:

$$\frac{6 \cdot M^6}{R^*} = \text{const} \quad \Rightarrow \quad R^* = \frac{6 \cdot M^6}{\text{const}}. \tag{11}$$

This gives two equations for the extraction of two of the three states Ψ_i out of the other:

$$\begin{gathered} R^{***} = C_f = -\frac{\Psi_1 + \Psi_2 + \Psi_3}{3} \\ \Rightarrow \begin{cases} \frac{1}{3} \cdot \left(\Psi_1 + \Psi_2 + \Psi_3\right)^2 - \frac{6 \cdot M^6}{R^*} \\ = \frac{1}{3} \cdot \left(\Psi_1 + \Psi_2 + \Psi_3\right)^2 - \text{const} = \Psi_1\Psi_2 + \Psi_1\Psi_3 + \Psi_2\Psi_3 \end{cases} . \\ \Rightarrow \left(\frac{\Psi_1 + \Psi_2 + \Psi_3}{3}\right)^3 = \Psi_1\Psi_2\Psi_3 \end{gathered} \tag{12}$$

We find with a vanishing constant const (the curvature term) we would obtain one solution, namely:

$$\Psi_1 = \Psi_2 = \Psi_3. \tag{13}$$

We also find that with a vanishing constant C_f (the shift of the function f with the value F[f]=f=0 moving away from the origin), we would only obtain the solution

$$\Psi_2 = \Psi_3 = \frac{1}{2}\left(-\Psi_1 \pm \sqrt{4 \cdot \text{const} - 3 \cdot \Psi_1^2}\right). \tag{14}$$

More discussion is presented in [2].

More to Do

The task of solving the 3-generations problem cannot be considered complete as long as we have not derived the masses of elementary particles out of very first principles. So far, however, we have only derived important quantum equations from a completely metric origin and thereby found a peculiar dependency of mass and curvature, which lead to an algebraic equation with 3 solutions for the masses. What we have not found are metrics suitable to code elementary particles and direct paths, which is to say completely first geometric principle based, to derive their masses.

We think that the key to solve the problem in a more complete manner is, apart from the fact to find the right metrics, to be found in a direct solution of equation (5) (last line).

Unfortunately, even in the simple case of the particle at rest, we obtain a fairly difficult differential equation. So, for instance, in the case of vanishing constant C_f, we have the equation:

$$\Rightarrow \frac{R^*}{6}\cdot f^3 - \frac{1}{c^2}\cdot\frac{\partial^2}{\partial t^2} f = 0 \quad \Rightarrow R^{**}\cdot f^3 - \frac{1}{c^2}\cdot\frac{\partial^2}{\partial t^2} f = 0 . \qquad (15)$$

Please note, that we have assumed a simple Minkowski metric and f=f[t] (particle at rest). A solution can be found via the so-called Jacobi elliptic function and reads:

$$f[t] = \pm i\cdot C_{t1}\cdot\sqrt{\frac{1}{\sqrt{R^{**}}}}\cdot \mathrm{sn}\left[C_{t1}\cdot c\cdot\frac{\sqrt{\sqrt{R^{**}}\left(t+C_{t2}\right)^2}}{2},-1\right], \qquad (16)$$

which are, in the case of negative curvatures R^{**}, oscillations and thus, not so much different from the classical matter and anti-matter solutions for the particle at Rest from Dirac. In the case of positive curvature values R^{**}, we would also obtain oscillations, but with poles, like the tangent or co-tangent function. With a constant $C_f \neq 0$ we have to solve:

$$\Rightarrow \frac{R^*}{6}\cdot\left(f+\frac{C_f}{M^2}\right)^3 - \frac{1}{c^2}\cdot\frac{\partial^2}{\partial t^2} f = 0 \quad \Rightarrow R^{**}\cdot\left(f+\frac{C_f}{M^2}\right)^3 - \frac{1}{c^2}\cdot\frac{\partial^2}{\partial t^2} f = 0 , \qquad (17)$$

which leads us to an ordinary equation containing the hypergeometric function ${}_2F_1$, namely:

$$\frac{\left(C_f + M^2\cdot f[t]\right)^2\cdot {}_2F_1\left[\frac{1}{4},\frac{1}{2};\frac{5}{4};-c^2\cdot\frac{R^{**}\cdot\left(C_f+M^2\cdot f[t]\right)^4}{2M^8\cdot C_{t1}}\right]^2}{M^4\cdot C_{t1}} - \left(t+C_{t2}\right)^2 = 0 , \qquad (18)$$

Taylor expansion with respect to R^{**} at $R^{**}=0$ gives us a solvable equation when ignoring powers of R^{**} of higher order than one, namely:

$$\begin{aligned}&\frac{\left(C_f + M^2\cdot f[t]\right)^2}{M^4\cdot C_{t1}} - c^2\cdot\frac{\left(C_f + M^2\cdot f[t]\right)^6 R^{**}}{10\cdot M^{12}\cdot C_{t1}^2} \\ &+\overbrace{\frac{7\cdot c^4\left(C_f + M^2\cdot f[t]\right)^{10} R^{**2}}{300\cdot M^{20}\cdot C_{t1}^3}+\ldots}^{\approx 0} = \left(t+C_{t2}\right)^2\end{aligned} . \qquad (19)$$

We can obtain somewhat more convenient outcomes when writing equation (17) as follows:

$$\Rightarrow \frac{R^*}{6}\cdot\left(f+\frac{C_f}{M^2}\right)^3-\frac{1}{c^2}\cdot\frac{\partial^2}{\partial t^2}f=0 \quad \xrightarrow{\frac{R^*}{6\cdot M^6}} \quad R^{**}\cdot\left(f\cdot M^2+C_f\right)^3-\frac{1}{c^2}\cdot\frac{\partial^2}{\partial t^2}f=0. \qquad (20)$$

Then results for (18) and (19) would be:

$$\frac{\left(C_f+M^2\cdot f[t]\right)^2\cdot {}_2F_1\left[\frac{1}{4},\frac{1}{2};\frac{5}{4};-c^2\cdot\frac{R^{**}\cdot\left(C_f+M^2\cdot f[t]\right)^4}{2M^2\cdot C_{t1}}\right]^2}{M^4\cdot C_{t1}}-\left(t+C_{t2}\right)^2=0, \qquad (21)$$

and:

$$\begin{aligned}&\frac{\left(C_f+M^2\cdot f[t]\right)^2}{M^4\cdot C_{t1}}-c^2\cdot\frac{\left(C_f+M^2\cdot f[t]\right)^6 R^{**}}{10\cdot M^6\cdot C_{t1}^2}\\&+\overbrace{\frac{7\cdot c^4\cdot\left(C_f+M^2\cdot f[t]\right)^{10} R^{**2}}{300\cdot M^8\cdot C_{t1}^3}}^{\approx 0}+\ldots=\left(t+C_{t2}\right)^2\end{aligned}. \qquad (22)$$

We might expect further simplification when extracting the square root in (21) before performing the series expansion:

$$\frac{\left(C_f+M^2\cdot f[t]\right)\cdot {}_2F_1\left[\frac{1}{4},\frac{1}{2};\frac{5}{4};-c^2\cdot\frac{R^{**}\cdot\left(C_f+M^2\cdot f[t]\right)^4}{2M^2\cdot C_{t1}}\right]}{M^2\cdot\sqrt{C_{t1}}}=\pm\left(t+C_{t2}\right), \qquad (23)$$

where we now get:

$$\begin{aligned}&\frac{C_f+M^2\cdot f[t]}{M^2\cdot\sqrt{C_{t1}}}-c^2\cdot\frac{\left(C_f+M^2\cdot f[t]\right)^5 R^{**}}{20\cdot M^4\cdot C_{t1}^{3/2}}\\&+\overbrace{\frac{c^4\cdot\left(C_f+M^2\cdot f[t]\right)^9 R^{**2}}{96\cdot M^6\cdot C_{t1}^{5/2}}}^{\approx 0}+\ldots=\pm\left(t+C_{t2}\right)\end{aligned}. \qquad (24)$$

This gives us 10 solutions, 5 for the “+” and 4 for the “-“ on the right hand side of (24).

More Tasks

So far it is not clear to the author why or how the equations (18) or (21) should produce three outcomes for the combined product of mass squared times f[t] M^2*f[t]. While this was rather evident for the simple algebraic equation (7), which we obtained when assuming eigenvalue solutions to the Klein-Gordon equation in its classical form (6), we cannot see such an outcome so easily anymore.

Perhaps the interested and mathematically skilled reader could help.

It may also be possible that a true solution can only be found by considering structurally intrinsic functionalities as we have them with the Dirac and the elastic approaches (e.g. see [2]).

But - nevertheless – let us have a few guesses about the peculiar situation:

A) While in the case with the – after all postulated – eigenvalue assumption, mass M was explicitly brought into the subsequent algebraic equation (7), namely as factor M^2 to the eigenfunction f, we now wanted to appear it somehow automatically. Avoiding this factor in (20), we end up with obviously too simple solutions of the type (16) again, namely:

$$f\left[t\right]=-C_f \pm i\cdot C_{t1}\cdot\sqrt{\frac{1}{\sqrt{R^{**}}}}\cdot \mathrm{sn}\left[C_{t1}\cdot c\cdot\frac{\sqrt{\sqrt{R^{**}}\left(t+C_{t2}\right)^2}}{2},-1\right] \qquad (25).$$

The fact that we have already introduced M^2 via the constant C_f, respectively – which is the same – as factor to the function f could be seen as similarly arbitrary. In other words, we had to put mass in, but did not get it automatically out.

B) We still have no inkling what could be the right metric to describe one of our known elementary particles. It is very likely that a Minkowski metric cannot be the right choice, simply because it does not contain any mass as parameter. This automatically makes Schwarzschild and Kerr metrics (plus the corresponding charged metrics) more suitable candidates.

C) We may also conclude that – in general – the particle at rest model is too simple to ever properly describe our usual elementary particles.

D) So far, we have not though about the potentially complex functional structure of the curvature term R^{**}. Assuming a source of gravity, the curvature should decrease with the distance to the source and it should be directly dependent on the mass, which is to say, the bigger the mass, the bigger the curvature.

References

[1] N. Schwarzer, “Societons and Ecotons - The Photons of the Human Society - Control them and Rule the World”, Part 1 of “Medical Socio-Economic Quantum Gravity”, Self-published, Amazon Digital Services, 2020, Kindle

[2] N. Schwarzer, “Masses and the Infinity Options Principle - Can We Explain the 3-Generations and the Quantized Mass Problem?”, Part 5 of “Medical Socio-Economic Quantum Gravity”, Self-published, Amazon Digital Services, 2020, Kindle

[3] N. Schwarzer, "The World Formula: A Late Recognition of David Hilbert ‘s Stroke of Genius", ISBN: 9789814877206 (hardcopy available in print in December 2020 from T&F and Jenny Stanford Publishing)

[4] N. Schwarzer, “Humanitons - The Intrinsic Photons of the Human Body - Understand them and Cure Yourself”, Part 2 of “Medical Socio-Economic Quantum Gravity”, Self-published, Amazon Digital Services, 2020, Kindle

[5] N. Schwarzer, “Mastering Human Crises with Quantum-Gravity-based but still Practicable Models - First Measure: SEEING and UNDERSTANDING the WHOLE: Part 3 of Medical Socio-Economic Quantum Gravity”, Self-published, Amazon Digital Services, 2020, Kindle

[6] N. Schwarzer, “Self-Similar Quantum Gravity - How Infinity Brings Simplicity”, Part 4 of “Medical Socio-Economic Quantum Gravity”, Self-published, Amazon Digital Services, 2020, Kindle

[7] P. A. M. Dirac, “The Quantum Theory of the Electron”, Published 1 February 1928.DOI: 10.1098/rspa.1928.0023