The Dimensional Mass – A 2-Pager

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Abstract

It will be shown that in the metric picture mass is additional dimensions with certain properties.

Dimensional Mass Creation

We know from basic quantum theory (e.g. [1]) that many fields and potentials couple into the quantum equations via the so-called weak coupling. Picking the example of the electromagnetic field with the potential A_μ, this would be done as follows:

$$f_{,\alpha} = \partial_\alpha f \rightarrow \left(\partial_\alpha + A_\alpha\right) f \,. \tag{1}$$

This could be interpreted as a coordinate transformation x→X, Y with:

$$\begin{gathered}
f = f\left[x^\sigma\right] \rightarrow f\left[X^i\left[x^\sigma\right], Y^j\left[x^\sigma\right]\right] = f\left[x^\sigma, Y^j\left[x^\sigma\right]\right] = f_X\left[x^\sigma\right]\cdot f_Y\left[Y^j\left[x^\sigma\right]\right] \\
\rightarrow \\
f_{,\alpha} = \frac{\partial f}{\partial\left(X^i\right)}\frac{\partial X^i}{\partial x^\alpha} + \frac{\partial f}{\partial\left(Y^j\right)}\frac{\partial Y^j}{\partial x^\alpha} = \frac{\partial f}{\partial\left(X^i\right)}\frac{\partial X^\sigma}{\partial x^\alpha} + \frac{\partial f}{\partial\left(Y^j\right)}\frac{\partial Y^j}{\partial x^\alpha} \\
= \frac{\partial f}{\partial\left(X^i\right)}\delta^i_\alpha + \frac{\partial f}{\partial\left(Y^j\right)}\frac{\partial Y^j}{\partial x^\alpha} = \frac{\partial f}{\partial X^\alpha} + \frac{\partial f}{\partial\left(Y^j\right)}\frac{\partial Y^j}{\partial x^\alpha} = f_Y\frac{\partial f_X}{\partial X^\alpha} + f_X\frac{\partial f_Y}{\partial\left(Y^j\right)}\frac{\partial Y^j}{\partial x^\alpha} \\
\xrightarrow{\frac{\partial f_Y}{\partial\left(Y^j\right)}\frac{\partial Y^j}{\partial x^\alpha} = f_Y A_\alpha} = f_Y\frac{\partial f_X}{\partial X^\alpha} + f_X f_Y A_\alpha = \left(\frac{\partial}{\partial X^\alpha} + A_\alpha\right) f
\end{gathered} \,, \tag{2}$$

with an additional coordinate Y, which agrees with our earlier findings about dimensional mass creation [2 – 6] and the construction of various potentials via additional dimensions [7, 8].

The same recipe can be applied when introducing mass. In this case we just substitute the potential in (1) by the mass, leading us to:

$$f_{,\alpha} = \partial_\alpha f \rightarrow \left(\partial_\alpha + m\right) f \,. \tag{3}$$

With this type of "operator transformation" we might assume that there exists a simple transformation of the type:

$$
\begin{aligned}
&f = f\left[\tilde{E}^i_\sigma \cdot x^\sigma\right] \\
&\rightarrow \\
f_{,\alpha} &= \frac{\partial f}{\partial\left(\tilde{E}^i_\sigma x^\sigma\right)} \frac{\partial \tilde{E}^i_\sigma x^\sigma}{\partial x^\alpha} = \frac{\partial f}{\partial\left(\tilde{E}^i_\sigma x^\sigma\right)} \left(\tilde{E}^i_\sigma \frac{\partial x^\sigma}{\partial x^\alpha} + x^\sigma \frac{\partial \tilde{E}^i_\sigma}{\partial x^\alpha} \right), \\
&= \frac{\partial f}{\partial\left(\tilde{E}^i_\sigma x^\sigma\right)} \left(\tilde{E}^i_\sigma \delta^\sigma_\alpha + x^\sigma \frac{\partial \tilde{E}^i_\sigma}{\partial x^\alpha} \right) = \frac{\partial f}{\partial\left(\tilde{E}^i_\sigma x^\sigma\right)} E^i_\alpha = f_{,i} E^i_\alpha
\end{aligned}
\tag{4}
$$

giving us linearized field equations from our quantum gravity equation:

$$
0 = \left\{
\begin{array}{c}
\boxed{R_{\alpha\beta} - R\frac{g_{\alpha\beta}}{2} + \Lambda \cdot g_{\alpha\beta}} \\
-\frac{1}{2F}\left(
\begin{array}{c}
F_{,\alpha\beta}(n-2) + F_{,ab} g_{\alpha\beta} g^{ab} + F_{,a} g^{ab}\left(g_{\beta b,\alpha} - g_{\beta\alpha,b}\right) - \\
F_{,\alpha} g^{ab} g_{\beta b,a} - F_{,\beta} g^{ab} g_{\alpha b,a} + F_{,d} g^{cd} \left(
\begin{array}{c}
g_{\alpha c,\beta} - \frac{1}{2} n g_{\alpha c,\beta} - \frac{1}{2} n g_{\beta c,\alpha} \\
+\frac{1}{2} n g_{\alpha\beta,c} + \frac{1}{2} g_{\alpha\beta} g_{ab,c} g^{ab}
\end{array}
\right)
\end{array}
\right) \\
+\frac{1}{4F^2}\left(F_{,\alpha} \cdot F_{,\beta}(3n-6) + g_{\alpha\beta} F_{,c} F_{,d} g^{cd}(4-n)\right) \\
+(n-1)\left(\frac{1}{2F}\left(
\begin{array}{c}
2\Delta F - 2F_{,d} g^{cd}{}_{,c} \\
-\frac{n}{(n-1)} F_{,d} g^{cd} g^{ab} g_{ac,b}
\end{array}
\right) + \frac{g^{ab} F_{,a} \cdot F_{,b}}{4F^2}(n-6) \right) \cdot \frac{g_{\alpha\beta}}{2}
\end{array}
\right\} \delta G^{\alpha\beta}
\tag{5}
$$

as derived in e.g. [9, 10, 11].

Thereby, most interestingly, regarding those E-objects, we have already seen that the Dirac matrices [9 - 12] would exactly give us what we need, because the satisfy the condition:

$$
\gamma^i_\alpha \gamma^j_\beta + \gamma^j_\beta \gamma^i_\alpha = 2I^{ij} g_{\alpha\beta},
\tag{6}
$$

which, would make the non-linear term in our quantum gravity equation (5) (with the setting F[f]) to:

$$
\begin{aligned}
f_{,\alpha} \cdot f_{,\beta} &= \frac{\gamma^{ik}_\alpha f_{,i} f_{,j} \gamma^j_{k\beta} + \gamma^j_{\beta k} f_{,j} f_{,i} \gamma^{ik}_\alpha}{2} = \frac{\gamma^{ik}_\alpha \partial_i f \partial_j f \gamma^j_{k\beta} + \gamma^j_{\beta k} \partial_j f \partial_i f \gamma^{ik}_\alpha}{2} \\
&= \frac{\gamma^{ik}_\alpha \partial_i f \gamma^j_{k\beta} \partial_j f + \gamma^j_{\beta k} \partial_j f \gamma^{ik}_\alpha \partial_i f}{2} = f_{,i} f_{,j} I^{ij} g_{\alpha\beta} = f_{,i} f_{,j} E^{ij} g_{\alpha\beta}
\end{aligned}
\quad .
\tag{7}
$$

As in the classical Dirac theory [12], f is supposed to be a function vector (spinor), we might conclude that this cannot be the right approach. But a) the spinor is not really a spinor but only a list of eigenvalues [10, 11] (see also appendix of this paper) and b) there are also other options to obtain linearized field equations as it was shown in [11], where no vector is needed.

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