Relative Acceleration

Gerald Vones

Graz, Austria, European Union
gerald@vones.eu

Abstract

An alternative theory of gravitation is presented where the relativity of acceleration is a first principle.

1 The theory

In General Relativity, an invariance under combined transformations of coordinates and field allows to remove a constant gradient of the field. Despite of early promises this ends up in a mess, primarily what regards quantization.

There is an alternative. A linear relation between the field and spacetime, say $A^0 = const \cdot x^1$ is like the linear dependence $x^1 = const \cdot x^0$ encoding ordinary velocity in Special Relativity. A space with lineelement $\mathrm{d}s^2 = \frac{1}{\ell^2}\mathrm{d}x^{1\,2} \pm \mathrm{d}A^{0\,2} \pm ......$ is the stage where such a rotation or boost can take place. ℓ is the Planck length. While ultimately simple, this is diametrally against the postulate of background-independence. Embarking on a discussion would need dozens of pages. I only remark that especially from information theory emerges overwhelming evidence for the prior existence and direct relevance of a flat space which essentially is phase space.

A straightforward extension of Special Relativity postulates a prior Minkowskian space with the only modification that the 4 macroscopic degrees of freedom z^μ of our universe are complex, where locally $z^\mu = \frac{1}{\ell} x^\mu + \imath A^\mu$. The hermitian linelement is $\mathrm{d}s^2 = \eta_{\mu\nu} \mathrm{d}z^\mu \mathrm{d}z^{\nu\,*}$, where I choose signs as $\eta = diag(1, -1, -1, -1)$. For classical gravitation, only the real part $\Re(...)$ of the metric is kept.

To couple this to matter and radiation the z^μ are regarded to encode both, gravitational field and (nonconserved) source current. To have a manifestly consistent geometric formulation, the sources are included by adding one more spacelike (TIMELIKE? VORZEICHEN NACH BEDARF, HABE NUR VOR LAUTER PLUS UND MINUS DIE UEBERSICHT VERLOREN) complex dimension u. Now the line element reads

$$\mathrm{d}s^2 = \Re \left(\eta_{\mu\nu} \mathrm{d}z^\mu \mathrm{d}z^{\nu\,*} \pm \mathrm{d}u \mathrm{d}u^* \right) \ . \tag{1}$$

In this 10-dimensional (all real degrees of freedom counted separately) flat space is embedded the 4-dimensional universe parametrized by coordinates that shall be called φ^μ. So four of the embedding equations can be written as $z^\mu(\varphi^\nu)$. The two further embedding equations originate from putting $u = \int \rho(z^*_\mu + \imath \dot{z}^*_\mu) \mathrm{d}z^\mu$ and conjungate complex. The idea behind is a flow in embedding space, where the overdot means $\frac{\mathrm{d}}{\sqrt{\mathrm{d}z^*_\mu \mathrm{d}z^\mu}}$. u vanishes for a harmonic oscillator. The density ρ can be complex in the general case. The induced metric on this embedded 4-manifold is

$$g_{\mu\nu} = \Re \left\{ \left[\eta_{\alpha\beta} \pm \rho\rho^* (z^*_\alpha + \imath \dot{z}^*_\alpha)(z_\beta - \imath \dot{z}_\beta) \right] \frac{\partial z^\alpha}{\partial \varphi^\mu} \frac{\partial z^{\beta *}}{\partial \varphi^\nu} \right\} \ . \tag{2}$$

Supplemented with the action

$$S = const \int \sqrt{|\det g|}\, \mathrm{d}^4\varphi \ , \tag{3}$$

this is already the entire local description of pure gravitation. The variation is to be performed in terms of the dependent embedding space degrees of freedom and their derivatives. No independently fluctuating metric field exists.

For the global description, coordinates must be chosen appropriately to reflect the topology. Again evidence is strong that the macroscopic universe topologically is a 4-torus. So in any 1-dimensional complex (2-dimensional real) subspace polar coordinates are chosen, $z^\mu = R^\mu \exp(\imath \varphi^\mu)$, while for η cartesian coordinates can be retained. The radii can be addressed as the gravitational field, while the angles parametrize spacetime.

2 Technicalities

We have $\frac{\partial z^\alpha}{\partial\varphi^\mu} = (\frac{\partial R^\alpha}{\partial\varphi^\mu} + \imath R^\alpha \delta^{\alpha\mu}) \exp(\imath\varphi^\alpha)$.

Inserting this in the pure field term $g_{\mu\nu f} = \Re\left(\eta_{\alpha\beta}\frac{\partial z^\alpha}{\partial\varphi^\mu}\frac{\partial z^{\beta *}}{\partial\varphi^\nu}\right)$ yields $g_{\mu\nu f} = diag(R^{0\,2}, -R^{1\,2}, -R^{2\,2}, -R^{3\,2}) + \frac{\partial R_\alpha}{\partial\varphi^\mu}\frac{\partial R^\alpha}{\partial\varphi^\nu}$. The determinant is $\det g = -(R^0R^1R^2R^3)^2\{1 + \frac{\partial R_\alpha}{R_\mu\partial\varphi^\mu}\frac{\partial R^\alpha}{R^\mu\partial\varphi^\mu} + O[(\partial R)^4]\}$. The first term in the brace is a vacuum term, the second is the dynamic field term.

For the coupling term one derives in lowest order (wenn ich mich nicht verrechnet habe): $\det g = -(R^0R^1R^2R^3)^2\left[1 + \rho^*\rho(R_\mu R^\mu + \dot R_\mu \dot R^\mu + R_\mu R^\mu \dot\varphi^{\mu 2} + 2R_\mu R^\mu\dot\varphi^\mu)\right]$. The meaning of the terms in the paranthesis is quite clear: The first is ???; the second and third are the kinetic terms of the sources; the fourth is the coupling between field and sources.

Gibt es noch einschraenkende Bedingungen, z.B. $\dot R_\mu \dot R^\mu = 0$????? Wohl eher nicht.