Relative Acceleration

Gerald Vones

Graz, Austria, European Union
gerald@vones.eu

Abstract

It is argued that acceleration is relative, what corresponds to boosts in a prior space.

The equivalence principle is contemplated as one of the basic elements of General Relativity. Regard a spaceship accelerated off a geodesic - which shall be straight without loss of generality - by means of a nongravitational force (a usual rocket motor). From outside, one will say that there is no gravitational field. Objects not locked to the spacecraft stay in motion as they had been, while objects locked to the spacecraft suffer acceleretion a from the rocket motor. An astronaut sitting inside the spacecraft and locked to it will say that there is a gravitational field. Objects not locked to the spacecraft fall due to gravitational acceleration $-a$, while the locked objects stay at rest because they suffer total acceleration zero (a from the propulsion, $-a$ from gravitation). In other words, the existence of a gravitational acceleration is as observer dependent as velocity is in Special Relativity. The interesting aspect is that General Relativity does not really exploit this fact. Indeed, its matter coupling term is just as in Special Relativity which is special only insofar as the metric is flat, namely $\mathrm{d}S = -m\sqrt{g_{\mu\nu}\mathrm{d}x^\mu\mathrm{d}x^\nu}$ for each mass point, with standard meaning of the symbols.

If A^0 is the Newtonian field, then the associated gravitational acceleration is $-\frac{\mathrm{d}A^0}{\mathrm{d}x^1}$, where x^1 is the spatial coordinate along which the acceleration takes place, like ordinary velocity is $\frac{\mathrm{d}x^1}{\mathrm{d}x^0}$ in Special Relativity. One can conclude that this originates from a rotation or a boost in a space equipped with lineelement $\mathrm{d}s^2 = (\frac{\mathrm{d}x^1}{\ell})^2 \pm \mathrm{d}A^{0\,2}$, where ℓ is the Planck length while the relative sign is open so far.

This symmetry can cause lot of dismay among physicists. It assumes a background eqipped with a prior metric. However, if one regards pyhsics from the point of view of information, there is overwhelming evidence for the prior existence of a flat background which in the essence is phase space. Inter alia, a mathematical theorem says that for any intrinsic geometry - irrespective of what its physical interpretation may be - there **exists** a flat embedding in a space of sufficient number of dimensions. Mathematicians like Riemann may allow themselves to neglect this background, but in physics this is not so. The Einsteinian theory obviously is a good quantitative approximation in some limit, however its roots are not sound.

From here, it is quite straightforward to complete this idea as far as the 4 macroscopic degrees of freedom of the uninverse are concerned. One can combine the respective spacetime degree of freedom and the gravitational field to a complex variable $a^\mu = \frac{x^\mu}{\ell} + \imath A^\mu$ and equip this 4-dimensional complex space with the Minkowski metric. From each pair of a and its complex conjugate a^+ one can construct the tensor basis to arrive at the metric as well as the symplectic 2-form coexisting on the manifold $\mathcal{C}^1$

$$\mathbf{d}a^+ \otimes \mathbf{d}a = \frac{\mathbf{d}x}{\ell} \otimes \frac{\mathbf{d}x}{\ell} + \mathbf{d}A \otimes \mathbf{d}A + \imath\, \frac{\mathbf{d}x}{\ell} \wedge \mathbf{d}A\ . \tag{1}$$

For the full space this is to be tensor multiplied by the Minkowski metric.

It can be clarified that these are just a local relations like Special Relativity is local. If this is corrrectly glued to the cosmological geometry (Vones 2001), spacetime factually are angle degrees of freedom while the field are action degrees of freedom.

In case of classical gravitation, only the metric part is relevant. The field term is a pure membrane term, namely the 4-volume of the 4-dimensional submanifold produced by 4 embedding equations $A^\mu(x^\nu)$. The variation directly is in terms of these variables. Again, this may cause dismay. There is no curvature scalar and there is no independent tensor field in the action. In total, this is the pure opposite to background-independence. History of physics teaches that things typically go such way: Those propositions which have appeared as most out of question, even with apparent quantitative evidence behind, turn out to be errorous philosophical pre-judgements.