Comments on "Finsler Geometry and Relativistic Field Theory"

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Abstract

We show that results obtained in paper *Foundations of Physics 33, No. 7, 1107 (2003)* are not correct.

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In a recent paper R. G. Beil claims to have derived Electromagnetism form the so called Finsler geometry [1].

At the beginning, he compares equations of motion for a particle interacting with gravitational and electromagnetic fields and comes to the conclusion that electromagnetic field appears as a part of connections. He tries to realize this idea in the framework of Riemannian geometry. However, this idea has been realized in more general form in [2] long time before [1] in the framework of General geometry. Moreover, it was shown that this idea can not be realized in the framework of Riemannian geometry.

In section 4, R. Beil, after choosing matrix (52) gets connection of Riemannian geometry (59). Then he imposes condition (60)-(61) on field B

$$B_\nu \upsilon^\nu = \frac{e}{mck}, \quad \frac{\partial B_\nu}{\partial x^\mu}\upsilon^\nu = \frac{\partial}{\partial x^\mu}(B_\nu \upsilon^\nu) = 0. \tag{60}$$

Using this condition he represents equation of motion

$$\frac{d\upsilon_\lambda}{d\tau} + \Gamma_{\lambda\mu\nu}\upsilon^\mu\upsilon^\nu = 0$$

in the form (62)

$$\frac{d\upsilon_\lambda}{d\tau} + \frac{e}{mc}(\frac{\partial B_\lambda}{\partial x^\mu} - \frac{\partial B_\mu}{\partial x^\lambda})\upsilon^\mu = 0. \tag{62}$$

However, this result is not correct. The correct result is

$$\frac{d\upsilon_\lambda}{d\tau} + \frac{e}{mc}\frac{\partial B_\lambda}{\partial x^\mu}\upsilon^\mu = 0.$$

Of course, according to condition (60) the second term in the bracket of (62) is equal to zero, but we can replace zero by $f\frac{\partial B_\mu}{\partial x^\lambda}\upsilon^\mu$ with an arbitrary function f. R. Beil chose $f = -1$. This choice does not have any foundation. We can choose $f = 1$ with the same success .

Next, R. Beil compares (62) with equation of motion

$$\frac{d\upsilon_\lambda}{d\tau} + \frac{e}{mc}F_{\mu\lambda}\upsilon^\mu = 0 \tag{i}$$

and claims that

$$F_{\mu\lambda} = \frac{\partial B_\lambda}{\partial x^\mu} - \frac{\partial B_\mu}{\partial x^\lambda}. \tag{63}$$

This claim is not correct even if we choose $f = -1$ as R. Beil did, because by comparing (62) with (i) we obtain

$$F_{\mu\lambda}\upsilon^\mu = (\frac{\partial B_\lambda}{\partial x^\mu} - \frac{\partial B_\mu}{\partial x^\lambda})\upsilon^\mu. \tag{ii}$$

Basic solution to this equation cannot be (63) because υ^μ are not independent due to condition (60). In order to solve (ii) we have to count condition (60) which gives $F_{\mu\lambda} = \frac{\partial B_\lambda}{\partial x^\mu}$.

After formula (63), R. Beil claims that $F_{\mu\lambda}$ can be identified with electromagnetic field. However, any tensor in the form of (63) can not be identified with electromagnetic field, because in order $F_{\mu\lambda}$ to be identified with electromagnetic field it must satisfy Maxwell equations $\partial_\mu F_{\mu\lambda} = 0$.

From physical point of view condition (60) is not acceptable for electromagnetic field and charged particles, because it expresses charge of a particle as a function of its velocity and electromagnetic potential. Also, this condition gives electromagnetic potential as a function of inverse velocities, which is not acceptable as was pointed out in [2].

We also would like to note that the so called Finsler geometry is not a geometry different from Riemannian geometry. It is actually Riemannian geometry with the so called Finsler metric (see for example [3]). R. Beil (as many authors) uses notions of Finsler geometry and Finsler metric interchangeably.

As it is proven in [2], Riemannian geometry with any metric is not suitable for geometrization of electromagnetism because there is no equivalence principle for electromagnetic interaction.

Finally, in sec. 5, R. Beil states that metric with explicit appearance of e/m is introduced by Randers. However, this is not the case. In his work [4], Randers considered Riemannian geometry with metric without any coefficients. Metric and new geometries with explicit appearance of e/m have been introduced in [2](see also [5],[6]).

References

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