A non-geometric interpretation of Lorentzian spin structure

Dmitri Vassiliev*

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We work on a parallelizable time-orientable Lorentzian 4-manifold and prove that in this case the notion of spin structure can be equivalently defined in a purely analytic fashion. Our analytic definition relies on the use of the concept of a non-degenerate two-by-two formally self-adjoint first order linear differential operator and gauge transformations of such operators. We also give an analytic definition of spin structure for the 3-dimensional Riemannian case. A detailed exposition is provided in [1].

The main point of the talk is that one can handle some problems in general relativity without the explicit use of geometric constructs. Our basic observation is that Lorentzian geometry is automatically encoded within the analytic concept of a non-degenerate two-by-two formally self-adjoint first order linear differential operator acting over a 4-manifold. The potential advantage of formulating a field theory in such 'non-geometric' terms is that there might be a chance of describing the interaction of different physical fields in a more consistent, and, hopefully, non-perturbative manner.

References

[1] Z. Avetisyan, Y.-L. Fang, N. Saveliev and D. Vassiliev, Analytic definition of spin structure. Preprint arXiv:1611.08297 (2016).

*Department of Mathematics, University College London, Gower Street, London WC1E 6BT, UK; d.vassiliev@ucl.ac.uk, `http://www.homepages.ucl.ac.uk/~ucahdva/`; DV was supported by EPSRC grant EP/M000079/1.