Contribution ID: **33**

Type: **Invited**

Time and Fermions: General Covariance vs. Ockham's Razor for Spinors

Wednesday, 6 March 2013 15:50 (1 hour)

Supposedly it is trivial to implement formal general covariance for any physical theory; just use tensor calculus. It is also widely believed, going back to Weyl in 1929, that spinors as such cannot exist in coordinates in curved space-time; one needs an orthonormal tetrad with 6 extra fields and extra local O(1,3) gauge group. These (incompatible) claims are both false. In 1965 Ogievetsky and Polubarinov defined spinors as part of a nonlinear representation (up to a sign, near the identity) of general coordinate transformations. But as Bilyalov in effect showed in the 1990s, with an indefinite metric sometimes one must reorder the coordinates to admit 'arbitrary' coordinates, a feature with no analog for bosons. This fact relates to theorems about the non-existence of a suitable square root of matrices with negative eigenvalues. Hence spinors in coordinates in curved space-time exist and are more economical than in the tetrad formalism, as Ockham's razor commends. But the cost is mild trimming of formal general covariance. For fermions time is not quite so much like or mixed with space in GR as has been thought.

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Session Classification: Philosophical Perspectives