Ephemeral Point-Events: Is There a Last Remnant of Physical Objectivity ?

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Abstract

For the past two decades, Einstein's Hole Argument (which deals with the apparent indeterminateness of general relativity due to the general covariance of the field equations) and its resolution in terms of "Leibniz equivalence" (the statement that pseudo-Riemannian geometries related by active diffeomorphisms represent the same physical solution) have been the starting point for a lively philosophical debate on the objectivity of the point-events of space-time. It seems that Leibniz equivalence makes it impossible to consider the points of the space-time manifold as physically individuated without recourse to dynamical individuating fields. Various authors have posited that the metric field itself can be used in this way , but nobody so far has considered the problem of explicitly distilling the "metrical fingerprint" of point-events from the gauge-dependent elements of the metric field. Working in the Hamiltonian formulation of general relativity, and building on the results of Lusanna and Pauri (2002), we show how Bergmann and Komar's "intrinsic pseudo-coordinates" (based on the value of curvature invariants) can be used to provide a physical individuation of point-events in terms of the true degrees of freedom (the "Dirac observables") of the gravitational field, and we suggest how this conceptual individuation could in principle be implemented with a well-defined empirical procedure. We argue from these results that point-events retain a significant kind of physical objectivity.

Keywords:	Hole Argument, Indeterminism, Leibniz equivalence, Physical individuation, Intrinsic coordinates, Dirac Observables, Gauge-fixings, GPS.
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