

Observations on Hyperplanes: I State Reduction and Unitary Evolution

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Abstract

This is the first of two papers responding (somewhat belatedly) to 'recent' commentary on various aspects of hyperplane dependence (HD) by several authors. In this paper I focus on the issues of the relations of HD to state reduction and unitary evolution. The authors whose comments I address here are Maudlin and Myrvold. In the second paper of this set I focus on HD dynamical variables and localizable properties and measurements and address comments of de Koning, Halvorson, Clifton and Wallace. Each paper ends with some reflections on the implications of HD for the ontology of Minkowski space-time. To set the stage for my responses, I begin this paper with some general position statements designed to correct what seem to be widespread and erroneous construals of some of my views. Two central points are argued for in this first paper. First, dynamical evolution occurs not only within foliations of Minkowski space-time. Rather the transition from the physical state of affairs on any one hyperplane to any other, whether the hyperplanes intersect or are parallel, is always an instance of dynamical evolution between them, generated by some active combination of boost-like transformations and/or time-like translations and/or state reductions and 'reconstructions'. This point gives rise to a generalized conception of a history of dynamical evolution, allowing for the use of parameterized families of hyperplanes that multiply cover some portions of space-time. Nevertheless, and this is the second central point, for any two generalized histories, H and H' , the quantum states for a system on all the hyperplanes of H from the asymptotic past up to some hyperplane, h , determine the quantum states for the system on all the hyperplanes of H' from the asymptotic past up to any hyperplane, h' , such that h' lies to the past of all those state reduction regions that lie to the future of all hyperplanes of H that are 'earlier' than h . Consideration of these results should defuse concerns that have been voiced about the coherence and consistency of HD. A position closely related to the second point (albeit restricted to the comparison of histories confined to foliations) has already been argued for by Myrvold (2002).

Keywords: state reduction, unitary evolution, hyperplane dependence, Lorentz covariant quantum theory

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