Causally Symmetric Bohm Model

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Abstract

The aim of this paper is to construct a version of Bohm ' s model that also includes the existence of backwards-in-time influences in addition to the usual forwards causation. The motivation for this extension is to remove the need in the existing model for a preferred reference frame. As is well known, Bohm ' s explanation for the nonlocality of Bell ' s theorem necessarily involves instantaneous changes being produced at space-like separations, in conflict with the " spirit " of special relativity even though these changes are not directly observable. While this mechanism is quite adequate from a purely empirical perspective, the overwhelming experimental success of special relativity (together with the theory ' s natural attractiveness), makes one reluctant to abandon it even at a " hidden " level. There are, of course, trade-offs to be made in formulating an alternative model and it is ultimately a matter of taste as to which is preferred. However, constructing an explicit example of a causally symmetric formalism allows the pros and cons of each version to be compared and highlights the consequences of imposing such symmetry. In particular, in addition to providing a natural explanation for Bell nonlocality, the new model allows us to define and work with a mathematical description in 3-dimensional space, rather than configuration space, even in the correlated many-particle case.

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