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Nonlocality in Quantum Theory Understood in Terms of Einstein's Nonlinear Field Approach[1]

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We discuss Einstein's ideas on the need for a theory that is both objective and local and also his suggestion for realizing such a theory through nonlinear field equations. We go on to analyze the nonlocality implied by the quantum theory, especially in terms of the experiment of Einstein, Podolsky, and Rosen. We then suggest an objective local field model along Einstein's lines, which might explain quantum nonlocality as a coordination of the properties of pulse-like solutions of the nonlinear equations that would represent particles. Finally, we discuss the implications of our model for Bell's inequality.

1. INTRODUCTION

It is well known that Einstein did not accept the fundamental and irreducible indeterminism of the usual interpretation of the quantum theory, e.g., as revealed in his statement[(2)]: "God does not play dice." However what is much more important is his rejection of another fundamental and irreducible feature of the quantum theory, i.e., nonlocality. Indeed it was implicit in his entire world view that connections between any elements whatsoever had to be local. That is, they could take place either when such elements were in contact at the same point in space-time, or else, they could be propagated continuously, across infinitesimal distances by the actions of fields. He regarded the failure of quantum mechanics to fit in with this notion of locality as a fundamental criticism of the whole structure of quantum mechanics, which indicated the need for developing a basically new kind of theory, making possible a deeper concept of reality that would ultimately

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