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Nonlocal interactions and quantum dynamics

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Abstract

The problem of describing the dynamics of quantum systems generated by a nonlocal-in-time interaction is considered. It is shown that the use of the Feynman approach to quantum theory in combination with the canonical approach allows one to extend quantum dynamics to describe the time evolution in the case of such interactions. In this way, using only the current concepts of quantum theory, a generalized equation of motion for state vectors is derived. In the case where the fundamental interaction generating the dynamics in a system is local in time, this equation is equivalent to the Schrödinger equation. Explicit examples are given for an exactly solvable model. The proposed formalism is shown to provide a new insight into the problem of the description of nonlocal interactions in quantum field theory. It is shown that such a property of the equation of motion, such as nonlocality in time, may be important for describing hadron-hadron interactions at low and intermediate energies.

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