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Quantum motion in superposition of Aharonov–Bohm with some additional electromagnetic fields

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ABSTRACT

The structure of additional electromagnetic fields to the Aharonov–Bohm field, for which the Schrödinger, Klein-Gordon, and Dirac equations can be solved exactly are described and the corresponding exact solutions are found. It is demonstrated that aside from the known cases (a constant and uniform magnetic field that is parallel to the Aharonov–Bohm solenoid, a static spherically symmetrical electric field, and the field of a magnetic monopole), there are broad classes of additional fields. Among these new additional fields we have physically interesting electric fields acting during a finite time or localized in a restricted region of space. There are additional time-dependent uniform and isotropic electric fields that allow exact solutions of the Schrödinger equation. In the relativistic case there are additional electric fields propagating along the Aharonov–Bohm solenoid with arbitrary electric pulse shape.

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