

## Simulation of electrical control of a solid-state flying qubit

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**ABSTRACT:** Solid-state approaches to quantum information technology are attractive because they are scalable. The coherent transport of quantum information over large distances, as required for a practical quantum computer, has been demonstrated by coupling solid-state qubits to photons. As an alternative approach for a spin-based quantum computer, single electrons have also been transferred between distant quantum dots in times faster than their coherence time. However, there have been no demonstrations to date of techniques that can coherently transfer scalable qubits and perform quantum operations on them at the same time. The resulting so-called flying qubits are attractive because they allow for control over qubit separation and non-local entanglement with static gate voltages, which is a significant advantage over other solid-state qubits in confined systems for integration of quantum circuits. Here a numerical investigation has been performed over the transportation of coherent electrons. The simulation has been done in order to model a quantum point contact (QPC), tunnel-coupled wire, Aharonov-Bohm ring and finally a complete system for control of a solid-state flying qubit by means of Landauer-Büttiker formalism. A complete system consists of an Aharonov-Bohm ring connected to two-channel wires that have a tunable tunnel coupling between channels. The flying qubit state is defined by the presence of a travelling electron in either channel of the wire, and can be controlled without a magnetic field.

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