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Shortcut to adiabatic two-qubit state swap in a superconducting circuit QED via effective drivings. (English) Zbl 07451756

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Summary: Optimal two-qubit operation is of significance to quantum information processing. An efficient scheme is proposed for realizing the shortcut to adiabatic two-qubit state swap in a superconducting circuit quantum electrodynamics (QED) via effective drivings. Two superconducting qutrits are coupled to a common cavity field and individual classical drivings. Based on two Gaussian-type Rabi drivings, two-qubit state swap can be adiabatically implemented within a reduced three-state system. To speed up the operation, these two original Rabi drivings are modified in the framework of shortcuts to adiabaticity, instead of adding an extra counterdiabatic driving. Moreover, owing to a shorter duration time, the decoherence effects on the accelerated quantum operation can be mitigated significantly. The strategy could offer an optimized method to construct fast and robust quantum operations on superconducting qubits experimentally.

MSC:

81P68	Quantum computation
78A55	Technical applications of optics and electromagnetic theory
81P15	Quantum measurement theory, state operations, state preparations
81V10	Electromagnetic interaction; quantum electrodynamics
81P65	Quantum gates
81Q37	Quantum dots, waveguides, ratchets, etc.
82D55	Statistical mechanics of superconductors
70H11	Adiabatic invariants for problems in Hamiltonian and Lagrangian mechanics
81S22	Open systems, reduced dynamics, master equations, decoherence

Keywords:

state swap; superconducting qubit; circuit QED; shortcuts to adiabaticity

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