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Demonstration of Geometric Landau-Zener Interferometry in a Superconducting Phase Qubit[1] YANG YU, XINSHENG TAN, ZHENTAO ZHANG, SHILIANG ZHU, National Laboratory of Solid State Microstructures, School of Physics, Nanjing University, Nanjing 210093, China, DANWEI ZHANG, Laboratory of Quantum Information Technology and SPTE, South China Normal University, Guangzhou 510006, China, SIYUAN HAN, Department of Physics and Astronomy, University of Kansas, Lawrence, KS 66045, USA — Geometric quantum manipulation and Landau-Zener interferometry have been separately explored in many quantum systems. Here we fill this gap by combining these two approaches in the study of the dynamics of a superconducting phase qubit. We propose and then experimentally demonstrate Landau-Zener interferometry based on pure geometric phases in this solid-state qubit. We observe the interference due to geometric phases accumulated in the evolution between two consecutive Landau-Zener transitions, while the dynamical phase is eliminated by a spin-echo pulse. Our numerical simulation results using measured energy relaxation and dephasing times agree well with the experimental results. The full controllability of the qubit population as a function of intrinsically fault-tolerant geometric phases provides a promising approach to fault-tolerant quantum computation.

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