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Landau-Zener interferometry in a Cooper pair box MIKA SILLANPÄÄ, TEIJO LEHTINEN, ANTTI PAILA, Low Temperature Laboratory, Helsinki University of Technology, Finland, YURIY MAKHLIN, The Landau Institute of Theoretical Physics, Moscow, Russia, PERTTI HAKONEN, Low Temperature Laboratory, Helsinki University of Technology, Finland — Quantum-mechanical systems having two crossing energy levels are ubiquitous in nature. The rate $v = d(E_1 - E_0)/dt$ at which such levels in a driven system approach each other determines the probability P_{LZ} of a Landau-Zener (LZ) tunneling between them. The traditional treatment of the LZ process, however, ignores quantum-mechanical interference. Here we report an observation of phase-sensitive interference between consecutive LZ tunneling attempts in an artificial two-state system, a superconducting charge qubit. We interpret the experiment in terms of a multi-pass analog to the optical Mach- Zehnder interferometer: The beam splitting occurs by LZ tunneling at the charge degeneracy, while the arms of the Mach- Zehnder interferometer in energy space are represented by the ground and excited state. In accord with theory, we observe constructive interference when the Stokes phase ϕ_S picked up during the LZ interaction, and the dynamical phase of one drive period $\phi = \int (E_1 - E_0)dt$ satisfy the condition: $(\phi - 2\phi_S) = m \cdot 2\pi$. Our LZ interferometer can be used as a high-resolution detector for phase and charge owing to interferometric sensitivity-enhancement.

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