Abstract Submitted
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Observing the geometric phase of a superconducting harmonic oscillator M. PECHAL, S. BERGER, A.A. ABDUMALIKOV, J.M. FINK, J.A. MLYNEK, L. STEFFEN, A. WALLRAFF, S. FILIPP, ETH Zurich — Steering a quantum harmonic oscillator state along cyclic trajectories leads to a path-dependent geometric phase [1]. However, the linearity of the system precludes its observation without a non-linear quantum probe. We therefore make use of a superconducting qubit serving as an interferometer to measure the adiabatic geometric phase of a harmonic oscillator realized as an on-chip resonant circuit [2]. We study the geometric phase for a variety of trajectories and show that, in agreement with theory, it is proportional to the area enclosed by the trajectory in the space of coherent states. At the transition to the non-adiabatic regime, oscillatory dephasing effects caused by residual qubit-resonator entanglement are observed and analyzed. We also discuss the possibility of using the harmonic oscillator geometric phase to implement two-qubit phase gates.

[1] S. Chaturvedi, M. S. Sriram, V. Srinivasan, J. Phys. A: Math. Gen. **20**, L1071 (1987).
[2] M. Pechal *et al.*, arXiv:1109.1157v1 [quant-ph].

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