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$T_{1\rho}$ experiment as a noise spectrum analyzer FEI YAN, SIMON GUSTAVSSON, JONAS BYLANDER, Massachusetts Institute of Technology, FUMIKI YOSHIHARA, The Institute of Physical and Chemical Research, YASUNOBU NAKAMURA, The Institute of Physical and Chemical Research, NEC, DAVID CORY, University of Waterloo, WILLIAM OLIVER, MIT Lincoln Laboratory — We performed a $T_{1\rho}$ (spin-locking) experiment on a superconducting flux qubit, enabling us to resolve the environmental noise in the intermediate-frequency range. By driving the qubit along its state polarization, in the rotating frame, it is effectively spin-locked: the decohering effect of low-frequency noise is thereby dramatically reduced compared to Rabi oscillations. We measured the $T_{1\rho}$ relaxation rate in the rotating frame, under different driving amplitudes and flux biases. Relating this driven relaxation rate to the noise at the corresponding Rabi frequency, we extracted the noise power spectral densities of the energy-bias (flux) and tunnel-coupling terms of the qubit's Hamiltonian at frequencies ranging from 0.5 to 100 MHz. In the flux-noise spectrum, we observed features due to non-Gaussian noise, which can be modeled by a strong random-telegraph fluctuator, supporting observations in the decoherence of a spin-echo.

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