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Spin echo measurements for hybrid qubit systems

HANS MALISSA, Department of Electrical Engineering, Princeton University, DAVID SCHUSTER, Department of Physics, University of Chicago, ALEXEI TYRYSHKIN, ANDREW HOUCK, STEPHEN LYON, Department of Electrical Engineering, Princeton University — We have performed electron spin echo measurements on donor spins in silicon samples using micro resonator structures fabricated in thin superconducting niobium films on sapphire substrates. The ability to implement refocusing pulses is an important constituent towards the realization of spin memories for hybrid superconducting/spin qubit applications. The resonators consist of quarter wavelength sections of coplanar waveguide with one end shorted and the other end capacitively coupled to a common feed line. These devices are suitable for pulsed ESR experiments on a commercial spectrometer at microwave frequencies between 9 and 10GHz, and in-plane magnetic fields of about 0.35T, which is well below the critical field of the thin film superconductor. Samples are flip-chip mounted on the resonator, and the magnetic component of the microwave radiation that extends into the sample is used for ESR excitation and detection. The high filling factor due to the small resonator size and the high quality factors that can be obtained with superconductors lead to high sensitivity to small numbers of spins, making our devices an attractive alternative to conventional resonators for certain ESR applications. The low microwave power requirements are appealing for low temperature measurements.

Stephen Lyon
Department of Electrical Engineering, Princeton University

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