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Towards a Spin-Ensemble Quantum Memory for Superconducting Qubits

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A multi-mode quantum memory able to store coherently large numbers of qubit states is a desirable resource for quantum information. We report progress towards this direction, using an ensemble of electronic spins (NV centers in diamond) coupled to a superconducting transmon qubit via a tunable resonator. We demonstrate the reversible coherent storage and retrieval of a single microwave photon from the qubit into the spin ensemble [1]. In this experiment the storage time was however limited by inhomogeneous broadening of the ensemble of spins. We propose a realistic protocol [2] that should extend the ensemble storage time by several orders of magnitude, based on spin-echo like pulse sequences; first experimental results will be presented [3].

[1] Y. Kubo et al., PRL **107**, 220501 (2011).
[2] B. Julsgaard, C. Grezes, P. Bertet, and K. Moelmer, **PRL** 110, 205503 (2013).
[3] C. Grezes et al., submitted (2014).