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Electron Spin Resonance Detected by a Superconducting Qubit¹ YUIMARU KUBO, SPEC, CEA-Saclay, IGOR DINIZ, Institut Néel, CNRS, 38042 Grenoble, France, CÉCILE GREZES, SPEC, CEA-Saclay, JUN-ICHI ISOYA, Research Center for Knowledge Communities, University of Tsukuba, 305-8550 Tsukuba, Japan, VINCENT JACQUES, LPQM (CNRS, UMR 8537), ENS de Cachan, 94235 Cachan, France, ALEXIA AUFFEVES, Institut Néel, CNRS, 38042 Grenoble, France, DENIS VION, DANIEL ESTEVE, PATRICE BERTET, SPEC, CEA-Saclay — We have realized a highly sensitive electron spin resonance (ESR) spectrometer. We use a superconducting qubit as a single-microwave-photon detector for the microwave signal emitted by the spins. We implement such an ESR spectrometer in a hybrid quantum circuit [1] where an ensemble of electron spins is coherently coupled to a superconducting qubit via a frequency tunable "quantum bus" cavity [2,3]. The electron spins are nitrogen-vacancy (NV) centers in a diamond crystal. A very weak excitation microwave pulse is first applied to a spin ensemble, during which the quantum bus cavity is far detuned from the resonance frequency of the spins. Immediately after the excitation pulse, the quantum bus cavity is rapidly tuned at resonance with the spins for a certain time such that the weak excitation is transferred to the cavity. Finally, the excitation in the cavity is swapped to the qubit; then the excited state probability of the qubit is measured. Small values of the magnetization, ~ 15 m_B, can be detected out of 10^{11} spins by this spectrometer [4]. [1] Kubo et al., PRL, 107, 220501 (2011). [2] Kubo et al., PRA, 85, 012333 (2012). [3] Kubo et al., PRL, 105, 140502 (2010). [4] Kubo et al., PRB, 86, 064514 (2012).

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