Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Phosphorus donors in silicon in the strong coupling regime C. W. ZOLLITSCH, K. MÜLLER, Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching, M. S. BRANDT, Walter Schottky Institut, Technische Universität München, Garching, R. GROSS, H. HUEBL, Walther-Meißner-Institut, Bayerische Akademie der Wissenschaften, Garching — In the field of quantum information storage spin ensembles are promising candidates due to their long coherence times. In particular, phosphorus dopants in silicon are very attractive candidates with their record breaking electron and nuclear spin coherence times exceeding 0.5 s [1] and 39 min [2], respectively. Their combination with microwave resonators in the strong coupling regime lays the basis of controlled information transfer between subsystems, i.e. quantum state storage. Here, we report on the observation of a superconducting coplanar niobium microwave resonator and an ensemble of phosphorus donors in an isotopically enriched ^{28}Si host lattice entering the strong coupling regime. By low-power microwave transmission spectroscopy we find at a temperature of 50 mK the characteristic double peak signature. Studying the coupling strength g_{eff} up to 3.5 K shows quantitative agreement with the expected $g_{eff} = g_0\sqrt{N}$ scaling, being proportional to the square root of the thermal spin polarization. The crossover from the strong coupling regime to the weak coupling regime is observed at 200 mK allowing for further investigation of the two regimes. [1] J. T. Muhonen *et al.*, Nat. Nano. (2014) [2] K. Saeedi *et al.*, Sci. 342, 830 (2013)

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Date submitted: 14 Nov 2014 Electronic form version 1.4