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Controlling spin relaxation with a cavity AUDREY BIENFAIT, SPEC, CEA-Saclay, JARRYD PLA, University College of London, YUIMARU KUBO, SPEC, CEA-Saclay, XIN ZHOU, Institute of Electronics, Microlectronics, and Nanotechnology, MICHAEL STERN, University of Bar Ilan, CHEUK LO, University College of London, CHRISTOPHER WEIS, THOMAS SCHENKEL, Lawrence Berkeley National Laboratory, DENIS VION, DANIEL ESTEVE, SPEC, CEA-Saclay, JOHN MORTON, University College of London, PATRICE BERTET, SPEC, CEA-Saclay — Spontaneous emission of radiation is one of the fundamental relaxation mechanisms for a quantum system. For spins, however, it is negligible compared to non-radiative relaxation processes due to their weak coupling to the electromagnetic field. In 1946, Purcell realized [1] that spontaneous emission is strongly enhanced when the quantum system is placed in a resonant cavity - an effect now used to control the lifetime of systems with an electrical dipole [2]. Here, by coupling donor spins in silicon to a high quality factor superconducting microwave cavity of small mode volume, we reach the regime where spontaneous emission constitutes the dominant spin relaxation channel [3]. The relaxation rate is increased by three orders of magnitude when the spins are tuned to the cavity resonance, showing it can be engineered and controlled on-demand. Our results provide a novel way to initialize any spin into its ground state, with applications in magnetic resonance and quantum information processing. They also show for the first time an alteration of spin dynamics by quantum fluctuations, a step towards the coherent magnetic coupling of a spin to microwave photons. [1] E. M. Purcell, Phys. Rev. 1946, 69, 681. [2] P. Goy et al., PRL. 50, 1983. [3] A. Bienfait et al., arxiv :1508.06148

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