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Strong spin relaxation anisotropy in a single-electron quantum dot LIUQI YU, L. C. CAMENZIND, D. E. F. BIESINGER, University of Basel, J. ZIMMERMAN, A. C. GOSSARD, UCSB, D. M. ZUMBHL, University of Basel — Spin coherence and relaxation is of crucial importance in operating spin based qubits. In a magnetic field, spins relax predominately through spin-phonon coupling mediated by spin-orbit interaction (SOI) [1]. Here we present measurements of the spin relaxation rate anisotropy in a gate defined single-electron GaAs quantum dot. The spin relaxation rate W is measured at applied magnetic fields of 4 T in the plane of the 2D electron gas. W exhibits strong anisotropy: a sinusoidal dependence on the B-field angle φ with a period of 180 degrees, as reported recently [2]. The extrema are observed at fields pointing nearly along the [110] and [1-10] crystal axes, modulated by a factor of about 14 from minimum to maximum. The periodicity is attributed to the interplay of Rashba and Dresselhaus SOIs. To decipher the role of SOI, we perform pulsed-gate spectroscopy to extract orbital excited-state energies, and obtain very good agreement with theory also for the angular dependence $W(\varphi)$, indicating that α and β, Rashba and Dresselhaus coefficients respectively, have the same relative sign and are within 20% of each other. With controllable manipulations of the dot orbitals by varying gate voltages, it is possible to precisely extract values of α and β. Meanwhile, top- and back gates have been implemented on the device structure, which allows full electrical control over the Rashba SOI in the 2D electron gas [3]. [1] V. N. Golovach et al., Phys. Rev. Lett. **93**, 016601 (2004). [2] P. Scarlino et al., Phys. Rev. Lett. **113**, 256802 (2014). [3] F. Dettwiler et al., arXiv:1403.3518 (2014).

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