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Spin-orbit dynamics of single acceptor atoms in a silicon transistor JOOST VAN DER HEIJDEN, TAKASHI KOBAYASHI, MATTHEW HOUSE, JOE SALFI, Univ of New South Wales, SYLVAIN BARRAUD, ROMAIN LAVIEVILLE, Univ Grenoble-Alpes and CEA-Leti, MICHELLE SIMMONS, SVEN ROGGE, Univ of New South Wales — Acceptor atoms in silicon are promising candidates for spin-orbit qubits, having the possibility for all-electrical control and long-distance qubit coupling via microwave cavities. The unique properties of the acceptor based qubits arise from the spin-orbit coupling between the heavy and light hole states. We have investigated the fundamental interactions between the acceptor spin-3/2 states, on which these potential spin-orbit qubits are based. We experimentally study the spin-orbit dynamics of two interacting boron atoms located in a state-of-the-art CMOS transistor. A strong influence of the spin-orbit coupling on the acceptor states is observed by using a combination of radio frequency gate reflectometry and magneto-transport spectroscopy. Spin-selective tunneling is used as a spin-readout mechanism and used to probe the relaxation processes within this acceptor system. A hotspot behavior in relaxation rate is detected and explained by heavy-light hole mixing, allowing us to extract the coupling between heavy and light holes, an essential parameter for acceptor qubits. Furthermore, the observed two-hole excited state spectrum shows that the quantization axes of the hole spins are rotated with magnetic field. These are the first principles to control single acceptor atoms.

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