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Interface-split Kramers doublets for acceptor-based qubits in silicon JAN MOL, JOSEPH SALFI, University of New South Wales, RAJIB RAHMAN, Purdue University, SVEN ROGGE, University of New South Wales — Single dopants in silicon form a particular attractive platform for hosting spin quantum bits (qubits). The effective spin-3/2 states of acceptor-bound holes in silicon can be used to store bits of quantum information for several μs. Strong coupling of spin and momentum in the silicon valence band allows for rapid electrical manipulation of the hole spin. Acceptors in silicon have a four-fold degenerate ground-state, reflecting character of the top of the valence band. Symmetry breaking, by an electric field, strain or confinement, lifts this degeneracy, resulting in two Kramers doublets. The states within these isolated Kramers doublets are protected against decoherence by time reversal symmetry and form the working levels of a hole spin qubit. Here we investigate the effect of the presence of an interface on the ground-state energy splitting of individual sub-surface acceptors, as a function of dopant depth, by means of low temperature scanning tunneling spectroscopy. The depth of individual acceptors is determined by probing the Coulomb potential of the ionized acceptor nuclei. Resonant tunneling through the localized acceptor states provides a direct measure of the excited state spectrum of single dopants.

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