

Publication**Anomalous Zero-Field Splitting for Hole Spin Qubits in Si and Ge Quantum Dots****JournalArticle (Originalarbeit in einer wissenschaftlichen Zeitschrift)****ID** 4661896**Author(s)** Hetényi, Bence; Bosco, Stefano; Loss, Daniel**Author(s) at UniBasel** [Loss, Daniel](#) ;**Year** 2022**Title** Anomalous Zero-Field Splitting for Hole Spin Qubits in Si and Ge Quantum Dots**Journal** Physical Review Letters**Volume** 129**Number** 11**Pages / Article-Number** 116805

An anomalous energy splitting of spin triplet states at zero magnetic field has recently been measured in germanium quantum dots. This zero-field splitting could crucially alter the coupling between tunnel-coupled quantum dots, the basic building blocks of state-of-the-art spin-based quantum processors, with profound implications for semiconducting quantum computers. We develop an analytical model linking the zero-field splitting to the Rashba spin-orbit interaction that is cubic in momentum. Such interactions naturally emerge in hole nanostructures, where they can also be tuned by external electric fields, and we find them to be particularly large in silicon and germanium, resulting in a significant zero-field splitting in the μeV range. We confirm our analytical theory by numerical simulations of different quantum dots, also including other possible sources of zero-field splitting. Our findings are applicable to a broad range of current architectures encoding spin qubits and provide a deeper understanding of these materials, paving the way toward the next generation of semiconducting quantum processors.

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