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Composite Sequences for Triple-dot Qubits that Compensate for Miscalibration and Hyperfine Gradients

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Exchange-only qubits defined in triple quantum dots form a promising means for all-electrical semiconductor quantum control, but they suffer from both charge noise and random magnetic field gradients. Low-frequency noise sources can be compensated using composite sequences, but the development of such sequences is constrained by the fact that exchange energies are always positive and the control axes are non-orthogonal. Here, we present the results of both analytical approaches and computational searches for composite pulse sequences, which compensate for simultaneous low-frequency miscalibration (due to fixed random electric fields) and hyperfine effects (due to nuclear magnetic fields) in a single triple-dot qubit. We also present compensation sequences for multi-qubit gates. These results can substantially improve the working fidelity of quantum operations in semiconductor quantum dot devices. Sponsored by United States Department of Defense. The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the official policies, either expressly or implied, of the United States Department of Defense or the U.S. Government.