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Quantum computing on long-lived donor states of Li in Si V.N. SMELYANSKIY, NASA Ames Research Center, Moffett Field, CA 94035, A.G. PETUKHOV, South Dakota School of Mines and Technology, Rapid City, SD 57701, V.V. OSIPOV, NASA Ames Research Center, Moffett Field, CA 94035 — We predict a gigantically long lifetime of several excited states in the ground-state (*1s*) manifold of an interstitial lithium donor in silicon. The nature of this effect roots in the anomalous level structure of the *1s* Li manifold under external stress. In particular, the coupling via the deformation potential between the lowest two states of the opposite parity is very weak and occurs via intervalley phonon transitions only. We propose to use these states under the controlled ac and dc mechanical stress to process quantum information. We find an unusual form of the elastic-dipole interaction between different donors. This interaction scales with the inter-donor distance R as R^{-3} or R^{-5} for the transitions between the states of the same or opposite parity, respectively. The long-range R^{-3} interaction provides an extremely high fidelity mechanism for 2-qubit operations.

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