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Spin cat state generation for quadrupolar nuclei in semiconductor quantum dots or defect centers[1] CEYHUN BULUTAY, Bilkent University, Department of Physics, 06800, Ankara — Implementing spin-based quantum information encoding schemes in semiconductors has a high priority. The so-called cat codes offer a paradigm that enables hardware-efficient error correction. Their inauguration to semiconductor-based nuclear magnetic resonance framework hinges upon the realization of coherent spin states (CSS). In this work, we show how the crucial superpositions of CSS can be generated for the nuclear spins. This is through the intrinsic electric quadrupole interaction involving a critical role by the biaxiality term that is readily available, as in strained heterostructures of semiconductors, or defect centers having nearby quadrupolar spins. The persistence of the cat states is achieved using a rotation pulse so as to harness the underlying fixed points of the classical Hamiltonian. We classify the two distinct types as polar- and equator-bound over the Bloch sphere with respect to principal axes. Their optimal performance as well as sensitivity under numerous parameter deviations are analyzed. Finally, we present how these modulo-2 cat states can be extended to modulo-4 by a three-pulse scheme.

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