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Spin-Orbit qubits of rare-Earth-Metal ions in axially symmetric crystal fields

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Abstract

Contrary to the well-known spin qubits, rare-earth-metal qubits are characterized by a strong influence of crystal field due to large spin-orbit coupling. At low temperature and in the presence of resonance microwaves, it is the magnetic moment of the crystal-field ground state which nutates (for several μs) and the Rabi frequency ΩR is anisotropic. Here, we present a study of the variations of ΩR(H→0) with the magnitude and direction of the static magnetic field H→0 for the odd Er167 isotope in a single crystal CaWO4:Er3+. The hyperfine interactions split the ΩR(H→0) curve into eight different curves which are fitted numerically and described analytically. These "spin-orbit qubits" should allow detailed studies of decoherence mechanisms which become relevant at high temperature and open new ways for qubit addressing using properly oriented magnetic fields. © 2009 The American Physical Society.

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