

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 Ω_R is anisotropic. Here, we present a study of the variations of $\Omega_R(H \rightarrow 0)$ with the magnitude and direction of the static magnetic field $H \rightarrow 0$ for the odd Er167 isotope in a single crystal $\text{CaWO}_4:\text{Er}^{3+}$. The hyperfine interactions split the $\Omega_R(H \rightarrow 0)$ 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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