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Effects of Arbitrarily Directed Field on Spin Phase Oscillations in Biaxial Molecular Magnets

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Abstract: Quantum phase interference and spin-parity effects are studied in biaxial molecular magnets in a magnetic field at an arbitrarily directed angle. The calculations of the ground-state tunnel splitting are performed on the basis of the instanton technique in the spin-coherent-state path-integral representation, and complemented by exactly numerical diagonalization. Both the Wentzel-Kramers-Brillouin exponent and the pre-exponential factor are obtained for the entire region of the direction of the field. Our results show that the tunnel splitting oscillates with the field for the small field angle, while for the large field angle the oscillation is completely suppressed. This distinct angular dependence, together with the dependence of the tunnel splitting on the field strength, provides an independent test for spin-parity effects in biaxial molecular magnets. The analytical results for the molecular Fe_8 magnet are found to be in good agreement with the numerical simulations, which suggests that even the molecular magnet with total spin S=10 is large enough to be treated as a giant spin system.

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