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Spin Anisotropy Effects in Dimer Single Molecule Magnets[1]
DMITRI EFREMOV, Technische Universitaet Dresden, Germany, RICHARD KLEMM, Kansas State University — We present a model of equal spin s_1 dimer single molecule magnets. The spins within each dimer interact via the Heisenberg and the most general set of four quadratic anisotropic spin interactions with respective strengths J and $\{J_j\}$, and with the magnetic induction $\mathbf{B}$. For antiferromagnetic Heisenberg couplings ($J < 0$) and weak anisotropy interactions ($|J_j/J| \ll 1$), the low temperature T magnetization $M(B)$ exhibits $2s_1$ steps, the height and midpoint slope of the sth step differing from their isotropic limits by corrections of $\mathcal{O}(J_j/J)^2$, but the position occurring at the energy level-crossing magnetic induction $B^{\rm lc}_{s,s_1}(\theta,\phi)$, where θ,ϕ define the direction of B. We solve the model exactly for $s_1 = 1/2$, 1, and 5/2. For weakly anisotropic dimers, the Hartree approximation yields analytic formulas for $M(B)$ and $C_V(B)$ at arbitrary s_1 that accurately fit the exact solutions at sufficiently low T or large B. Low-T formulas for the inelastic neutron scattering $S(q,\omega)$ and the EPR $\chi(\omega)$ in an extended Hartree approximation are given. Our results are discussed with regard to existing experiments on $s_1 = 5/2$ Fe_2 dimers, suggesting further experiments on single crystals of these and some $s_1 = 9/2$ $[Mn_4]_2$ dimers are warranted.

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