

Abstract Submitted  
for the MAR13 Meeting of  
The American Physical Society

**Monopole Hopping through Quantum Spin Tunnelling in Spin Ice**

BRUNO TOMASELLO, University of Kent & ISIS, GABRIELE SALA, Royal Holloway University of London & ISIS, JORGE QUINTANILLA, University of Kent & ISIS, CLAUDIO CASTELNOVO, Cambridge University, Royal Holloway University of London & ISIS, SEAN GIBLIN, Cardiff University & ISIS, RODERICH MOESSNER, Max Planck Institute for the Physics of Complex Systems — The low temperature dynamics in spin ice materials is governed by the density and mobility of elementary excitations that behave as emergent magnetic monopoles. The diffusion of such monopoles proceeds via flipping of large electronic spins with Ising-like anisotropy (due to their crystal field environment). Experimental evidence suggests that, at temperatures relevant for spin ice physics, this flipping occurs as a quantum-mechanical tunnelling through a large anisotropy barrier. Here we investigate this process at the microscopic, single-ion level by computing the quantum dynamics resulting from the interplay between the crystal field Hamiltonian and the Zeeman coupling with magnetic fields (either applied or due to other spins). We interpret our results in terms of monopole hopping rates, and we compare our predictions with existing experiments for both  $\text{Ho}_2\text{Ti}_2\text{O}_7$  and  $\text{Dy}_2\text{Ti}_2\text{O}_7$ .

Bruno Tomasello  
University of Kent & ISIS

Date submitted: 16 Nov 2012

Electronic form version 1.4