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Quantum Ice : A Quantum Monte Carlo Study OLGA SIKORA, HH Wills Physics, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, UK, Okinawa Institute of Science and Technology, Japan, OWEN BENTON, HH Wills Physics, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, UK, NIC SHANNON, HH Wills Physics, University of Bristol, Tyndall Avenue, Bristol BS8 1TL, University of Oxford, UK; Okinawa Institute of Science and Technology, Japan, KARLO PENC, Research Institute for Solid State Physics and Optics, H-1525 Budapest, P.O.B. 49, Hungary, PAUL MCCLARTY, FRANK POLLMANN, RODERICH MOESSNER, MPI PKS, Dresden, Germany, PETER FULDE, MPI PKS, Dresden, Germany, Asia Pacific Center for Theoretical Physics, Pohang, Korea — The magnetic "ice" state found in spin ice materials has recently generated great excitement for its magnetic monopole excitations. However the deconfined nature of these monopoles depends crucially on the macroscopic degeneracy of the classical ice ground state. And at very low temperatures we might expect this degeneracy to be lifted by quantum tunneling between different ice configurations. Here we present the results of large-scale Green's function Monte Carlo simulation of ice-type models which include quantum tunneling. We find compelling evidence of an extended quantum U(1)-liquid ground state with deconfined monopole excitations in both the quantum dimer model [1,2] and the quantum ice model on the diamond lattice [3]. This quantum U(1) liquid proves to be remarkably robust against the inclusion of long range dipolar interactions.
[1] O. Sikora *et al.*, Phys. Rev. Lett. **103**, 247001 (2009) [2] O. Sikora *et al.*, Phys. Rev. B **84**, 115129 (2011) [3] N. Shannon *et al.*, arXiv:1105.4196

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