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Semi-classical Theory of Quantum Spin Ice MICHAL KWASIGROCH, CLAUDIO CASTELNOVO, University of Cambridge — The low temperature properties of quantum spin ice compounds $Yb_2Ti_2O_7$ and $Pr_2Zr_2O_7$ are described by spin-1/2 degrees of freedom associated with magnetic Yb or Pr atoms residing on vertices of corner-sharing tetrahedra. Strong Ising exchange enforces the well-known 2-in-2-out rules for each tetrahedron at low temperatures. These describe the macroscopically degenerate spin ice configurations. Recently, it has been shown [Phys. Rev. B 69, 064404 (2004)] that the addition of weak easy-plane exchange can lead to hybridisation of the classically allowed spin-ice configurations and the emergence of a gapless quantum spin liquid. We show that a semi-classical treatment of this U(1) liquid phase captures the QED-like physics and we derive quantitative estimates of the low-energy dispersion and the dynamic structure factor. These compare well with the existing Monte Carlo simulations.

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