Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Theory for magnetic excitations in quantum spin ice SHIGEKI ONODA, Condensed Matter Theory Lab., RIKEN and Quantum Matter Theory Research Team, RIKEN Center for Emergent Matter Science, TRINANJAN DATTA, Dept. of Chemistry and Physics, Georgia Regents Univ. — Magnetic excitations in magnetic rare-earth pyrochlore oxides called quantum spin ice (QSI) systems such as $Yb_2Ti_2O_7$, $Pr_2Zr_2O_7$, and $Tb_2Ti_2O_7$ have attracted great interest for possible observations of the quantum dynamics of spin ice monopoles and emergent photon excitations. However, their spectral properties remain open especially for cases relevant to experimental systems. Here, we develop a theoretical framework that incorporates gauge fluctuations into a modified gauge mean-field approach, so that it reproduces key features of recent quantum Monte-Carlo results on the double broad specific heat in the simplest QSI model and can describe a continuous growth of a coherence in gauge-field correlations on cooling down to Coulomb-phase ground states. Using this new approach, we provide a theory for magnetic neutron-scattering spectra. It is found that spin-flip exchange interactions produce dispersive QSI monopole excitations which create a particle-hole continuum neutron-scattering spectrum. Gauge fluctuations give multi-particle contributions to the spectrum, which will be possibly detected in Higgs phases.

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Date submitted: 06 Nov 2015 Electronic form version 1.4