Not so accidental degeneracies: origin of dimensional-reduction in the Quantum Spin Ice Yb$_2$Ti$_2$O$_7$

LUDOVIC JAUBERT, Okinawa Institute of Science and Technology, HAN YAN, Northwestern University, OWEN BENTON, NIC SHANNON, Okinawa Institute of Science and Technology — Despite being the best-characterised example of a “quantum spin ice” [1], Yb$_2$Ti$_2$O$_7$ remains an enigma. One of its most striking, and puzzling, features are the diffuse, rod-like structures seen in quasi-elastic neutron scattering [2]. These suggest that spin fluctuations in Yb$_2$Ti$_2$O$_7$ decouple into independent Kagome planes, even though magnetic ions occupy a fully three-dimensional pyrochlore lattice [3]. Here, we use a combination of lattice gauge theory, spin-wave calculations and Monte Carlo simulation, to show how the dimensional-reduction seen in Yb$_2$Ti$_2$O$_7$ follows from a two-dimensional branch of excitations “inherited” from a nearby phase transition. This analysis sheds new light on ground state selection in a wide range of rare-earth pyrochlore oxides, including the model “order-by-disorder” system Er$_2$Ti$_2$O$_7$.