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Towards an effective Hamiltonian for $Tb_2Ti_2O_7$ PAUL MCCLARTY, HAMID MOLAVIAN, MICHEL GINGRAS, University of Waterloo — $Tb_2Ti_2O_7$ is a pyrochlore antiferromagnet that has dynamical spins and only short-range correlations even at 50 mK − the lowest temperature explored so far − although the Curie-Weiss temperature is $\theta_{CW} = -14$ K. The absence of long-range order in this material is not understood. Recently, magnetic quantum fluctuations have been shown to be significant in $Tb_2Ti_2O_7$. We present an effective Hamiltonian that takes into account virtual crystal field excitations (VCFEs). The semiclassical ground state phase diagram of this model allows one to see how the physics of spin ice is connected to the possible physics of $Tb_2Ti_2O_7$ and $Tb_2Sn_2O_7$. In addition to the dipolar spin ice model ground states, there is a $\mathbf{q} = \mathbf{0}$ ordered ice state over a large part of the phase diagram − ferromagnetic correlations being preferred by quantum corrections in spite of an antiferromagnetic nearest neighbor exchange in the microscopic model. Frustration is hence seen to arise from VCFEs over and above the effect of dipolar interactions in spin ice in inducing ice-like correlations.

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