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How quantum are classical spin ices?[1] MICHEL J P GINGRAS, JEFFREY G RAU, Univ of Waterloo — The pyrochlore spin ice compounds $Dy_2Ti_2O_7$ and $Ho_2Ti_2O_7$ are well described by classical Ising models down to low temperatures. Given the empirical success of this description, the question of the importance of quantum effects in these materials has been mostly ignored. We argue that the common wisdom that the strictly Ising moments of non-interacting Dy^{3+} and Ho^{3+} ions imply Ising interactions is too naive and that a more complex argument is needed to explain the close agreement between the classical Ising model theory and experiments. By considering a microscopic picture of the interactions in rare-earth oxides, we show that the high-rank multipolar interactions needed to induce quantum effects in these two materials are generated only very weakly by superexchange. Using this framework, we formulate an estimate of the scale of quantum effects in $Dy_2Ti_2O_7$ and $Ho_2Ti_2O_7$, finding it to be well below experimentally relevant temperatures.

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