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Quantum spin ice under a [111] magnetic field: from pyrochlore to kagomé TROELS BOJESEN, SHIGEKI ONODA, RIKEN — We present the global phase diagram of a minimal XXZ quantum spin ice model on the pyrochlore lattice under a [111] magnetic field, obtained by unbiased quantum Monte-Carlo simulations. In zero field and for moderate quantum fluctuations, the model crosses over from classical pyrochlore spin ice to a U(1) quantum spin liquid upon cooling. Increasing the field takes the system into the kagomé spin ice region with a 1/3 magnetization plateau, where the fluctuations are mainly restricted to the kagomé layers perpendicular to the field direction. Then, short-range longitudinal spin correlations of a $\sqrt{3}\times\sqrt{3}$ pattern gradually appears, as they evolve into a long-range order at the ground state in the decoupled pure kagomé limit. A further increase in the magnetic field below the saturation field induces a finite-temperature phase transition to a 3D long-range ordered phase of the transverse spin components perpendicular to the local $\langle 111\rangle$ axes. This transition either belongs to the 3D XY universality class or is weakly first-order. The possible relevance to magnetic rare-earth pyrochlore oxides is discussed.

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