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Layered kagome spin ice JAMES HAMP, SIAN DUTTON, University of Cambridge, MARTIN MOURIGAL, Georgia Tech, PAROMITA MUKHERJEE, University of Cambridge, JOSEPH PADDISON, Georgia Tech, HARAPAN ONG, CLAUDIO CASTELNOVO, University of Cambridge — Spin ice materials provide a rare instance of emergent gauge symmetry and fractionalisation in three dimensions: the effective degrees of freedom of the system are emergent magnetic monopoles, and the extensively many 'ice rule' ground states are those devoid of monopole excitations. Two-dimensional (kagome) analogues of spin ice have also been shown to display a similarly rich behaviour. In kagome ice however the ground-state 'ice rule' condition implies the presence everywhere of magnetic charges. As temperature is lowered, an Ising transition occurs to a charge-ordered state, which can be mapped to a dimer covering of the dual honeycomb lattice. A second transition, of Kosterlitz-Thouless or three-state Potts type, occurs to a spin-ordered state at yet lower temperatures, due to small residual energy differences between charge-ordered states. Inspired by recent experimental capabilities in growing spin ice samples with selective (layered) substitution of non-magnetic ions, in this work we investigate the fate of the two ordering transitions when individual kagome layers are brought together to form a three-dimensional pyrochlore structure coupled by long range dipolar interactions. We also consider the response to substitutional disorder and applied magnetic fields.

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