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Quantum Monte Carlo study of hard-core bosons in a pyrochlore lattice with six-site ring-exchange interactions CATHERINE TIEMAN, VALERY ROUSSEAU, College of Wooster — Highly frustrated quantum systems on lattices can exhibit a wide variety of phases. In addition to the usual Mott insulating and superfluid phases, these systems can also produce some so-called "exotic phases", such as super-solid and valence-bond-solid phases. An example of particularly frustrated lattice is the pyrochlore structure, which is formed by corner-sharing tetrahedrons. Many real materials adopt this structure, for instance the crystal $Cd_2Re_2O_7$, which exhibits superconducting properties. However, the complex structure of these materials combined with the complexity of the dominant interactions that describe them makes their analytical study difficult. Also, approximate methods, such as mean-field theory, fail to give a correct description of these systems. In this work, we report on the first exact quantum Monte Carlo study of a model of hard-core bosons in a pyrochlore lattice with six-site ring-exchange interactions, using the Stochastic Green Function (SGF) algorithm. We analyze the superfluid density and the structure factor as functions of the filling and ring-exchange interaction strength, and we map out the ground state phase diagram.

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