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Hard-core lattice bosons: new insights from algebraic graph theory RANDALL W. SQUIRES, DAVID L. FEDER, University of Calgary — Determining the characteristics of hard-core lattice bosons is a problem of long-standing interest in condensed matter physics. While in one-dimensional systems the ground state can be formally obtained via a mapping to free fermions, various properties (such as correlation functions) are often difficult to calculate. In this work we discuss the application of techniques from algebraic graph theory to hard-core lattice bosons in one dimension. Graphs are natural representations of many-body Hamiltonians, with vertices representing Fock basis states and edges representing matrix elements. We prove that the graphs for hard-core bosons and non-interacting bosons have identical connectivity; the only difference is the existence of edge weights. A formal mapping between the two is therefore possible by manipulating the graph incidence matrices. We explore the implications of these insights, in particular the intriguing possibility that ground-state properties of hard-core bosons can be calculated directly from those of non-interacting bosons.

Randall W. Squires
University of Calgary

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