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*Hard-core bosons on lattices as the symmetric power of cycle graphs*

The complexity for obtaining the energies and wavefunctions for  $n$  interacting bosons on a lattice with  $m$  sites is generally exponential in both  $n$  and  $m$ , underpinning recent quantum supremacy arguments for sampling the output distribution of photon interferometer arrays. Remarkably, for infinitely strong boson-boson interactions corresponding to the hard-core boson (HCB) limit, Tonks and Girardeau found an exact solution for the ground state in one dimension. But, the solution is unwieldy for the calculation of expectation values, and cannot be readily extended to excited states or to other lattices. An equivalent description of the problem in algebraic graph theory is to determine the spectrum of the  $n$ th symmetric power of the  $m$ -cycle adjacency matrix, with the maximum eigenvector corresponding to the HCB ground state. I will discuss both approaches to the HCB problem, and show that the symmetric power provides a much simpler solution as well as new insights.