Not so featureless after all: symmetry protected order in an interacting boson state

Brayden Ware
Department of Physics, University of California, Santa Barbara, CA, 93106-6105, USA

Itamar Kimchi
Department of Physics, University of California, Berkeley, CA 94720, USA

S. A. Parameswaran
Department of Physics and Astronomy, University of California, Irvine, CA 92697, USA

Bela Bauer
Station Q, Microsoft Research, Santa Barbara, CA 93106-6105, USA

While the Lieb-Schultz-Mattis theorem forbids the existence of fully symmetric quantum paramagnetic phases on lattices with fractional filling of particles per unit cell, such a phase is in principle allowed with certain fractional numbers of particles per site on non-Bravais lattices, including half-filling on the honeycomb lattice. It has been shown that a non-interacting Hamiltonian of spinless fermions or bosons cannot have such a symmetric insulating ground state, and an explicit construction using interactions is challenging. Recently, Kimchi et al. constructed a wavefunction for bosons at half-filling that does not break any symmetries and is not topologically ordered–and in this sense is a featureless insulator in the bulk. Here, however, we reveal that this wavefunction exhibits non-trivial structure at the edge. We apply recently developed techniques based on a tensor network representation of the wavefunction to demonstrate the presence of a gapless entanglement spectrum and a non-trivial action of combined charge-conservation and spatial symmetries on the edge. We will also discuss the possibility of finding a parent Hamiltonian and analyzing the existence of a symmetry-protected topological phase around this state.

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[1] I. Kimchi, S. A. Parameswaran, A. M. Turner, F. Wang, and A. Vishwanath, "Featureless and non-fractionalized mott insulators on the honeycomb lattice at 1/2 site filling," (2012), arXiv:1207.0498 [cond-mat.str-el].