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

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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].