Stability of Fractional Chern Insulator states on kagome lattice

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We investigate Fractional Chern Insulator (FCI) phases on kagome lattice and indicate their most stable areas within interactions parameter space. FCI are quantum phases related to partially filled Chern Insulators - insulators with nontrivial bands topology exhibiting a nonzero Hall conductance but contrary to Landau level physics, preserving lattice translational symmetry. While FCI phases were observed for several lattice models and different filling fractions, factors responsible for their stability are not fully determined.

In this work, we focus on FCI phases on kagome lattice. We consider states with filling factors 1/5, 1/7, 2/5, 3/7. Exact diagonalization is performed and phase stability maps in nearest and next nearest neighbor interaction parameters are analyzed. FCI phases are confirmed by looking at many-body ground state degeneracy, spectral flow upon flux insertion, and quasi-particle excitation spectra. A correlation between large many-body energy gap separating the ground state manifold with low energy excitations and constant berry curvature is shown [8]. We have found that for Laughlin-like series 1/n, next nearest neighbour (NNN) interaction play a crucial role, in analogy to higher angular momentum pseudo potentials in fractional quantum Hall effect (FQHE). An evolution of phase diagrams with systems sizes are shown predicting a set of parameters for FCI phase existence in a thermodynamic limit. Sensitivity to periodic boundary condition are also observed.

[1] F. D. M. Haldane, Phys. Rev. Lett., **61**, 2015 (1998).
[2] T. Neupert, L. Santos, C. Chamon, and C. Mudry, Phys. Rev. Lett., **106**, 236804 (2011).
[3] N. Regnault and B. A. Bernevig, Phys. Rev. X, **1**, 021014 (2011).