Topological phase transitions in the repulsively interacting Haldane-Hubbard model

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Using dynamical mean-field theory and exact diagonalization we study the phase diagram of the repulsive Haldane-Hubbard model, varying the interaction strength and the sublattice potential difference. In addition to the quantum Hall phase with Chern number $C = 2$ and the band insulator with $C = 0$ present already in the noninteracting model, the system also exhibits a $C = 0$ Mott insulating phase, and a $C = 1$ quantum Hall phase. We explain the latter phase by a spontaneous symmetry breaking where one of the spin-components is in the Hall state and the other in the band insulating state. [1] This study has been performed using an extended version of our DMFT code [2] which allows the treatment of complex hopping terms.

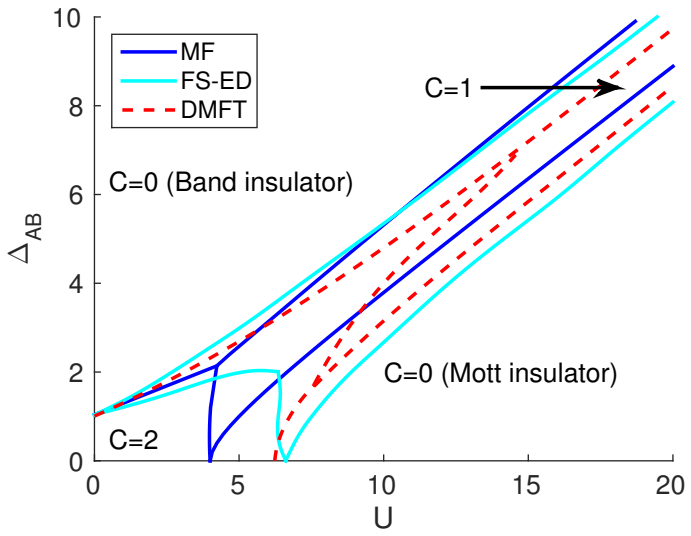

Figure 1: The phase diagram of the model as a function of the Hubbard interaction strength U and the sublattice potential difference Δ_{AB} obtained within mean-field theory (MF), finite size exact diagonalization (FS-ED) and single-site dynamical mean-field theory (DMFT). The lines indicate the topological transitions where the Chern number C changes.

[1] T. I. Vanhala, T. Siro, L. Liang, M. Troyer, A. Harju and P. Törmä, arXiv preprints: 1512.08804.

[2] T. I. Vanhala, J. E. Baarsma, M. O. J. Heikkinen, M. Troyer, A. Harju, and P. Törmä, Phys. Rev. B 91, 144510, 2015.