Statistical Physics of Quantum Matter 2013

Phase diagram of the Kane-Mele Hubbard model

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In this talk I will review our present understanding of the phase diagram of the Hubbard model on the honeycomb lattice and in the presence of a spin-orbit coupling which leads to a non trivial topological band structure. By introducing magnetic pinning terms in the Hamiltonian, we can greatly improve our determination of the local moment. With this improved accuracy we will provide data which suggest that the transition from the semi-metal to the Mott insulating state is in the Gross-Neveu universality class [1]. In the presence of correlations, it is challenging to detect quantum spin-Hall (QSH) states. We will use magnetic π fluxes to achieve this goal and as a by-product provide a tool to build quantum spin systems within the bulk gap of topological insulators [2]. Our results are obtained on the basis of auxiliary field quantum Monte Carlo simulations which turn out to be free of the infamous minus sign problem for this class of Hamiltonians.

[1] F. F. Assaad and I. Herbut, arXiv:1304.6340.
[2] F. F. Assaad, M. Bercx, M. Hohenadler, Phys. Rev. X 3, 011015 (2013).