# PS-C3 A density functional study of an interaction-driven Chern insulator realized on optical lattice systems

S. Kitamura, N. Tsuji, and H.Aoki

- Interaction-driven topological phases
  - ex) spinless fermion on a honeycomb lattice

Raghu, *et al.* (2008)

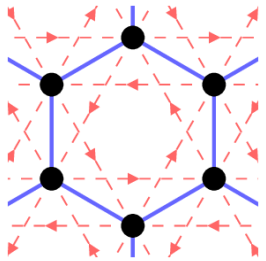
$$H = -t\sum_{ij}^{\text{n.n.}} c_i^\dagger c_j + V_1 \sum_{ij}^{\text{n.n.}} c_i^\dagger c_j^\dagger c_j c_i + V_2 \sum_{ij}^{\text{n.n.n.}} c_i^\dagger c_j^\dagger c_j c_i$$

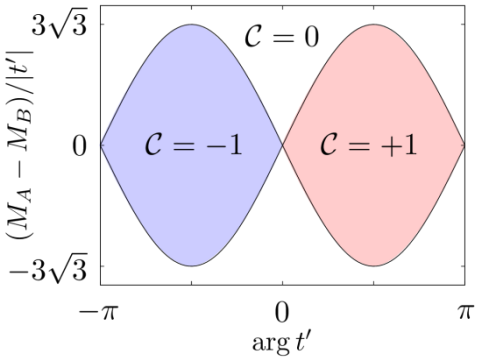
$$H_{\text{MF}} \sim -t\sum_{ij}^{\text{n.n.}} c_i^\dagger c_j + \sum_i \underbrace{V_1 \langle \sum_j^{\text{n.n.}} c_j^\dagger c_j \rangle}_{M} c_i^\dagger c_i - \sum_{ij}^{\text{n.n.n.}} \underbrace{V_2 \langle c_j^\dagger c_i \rangle}_{t'} c_i^\dagger c_j + h.c.$$

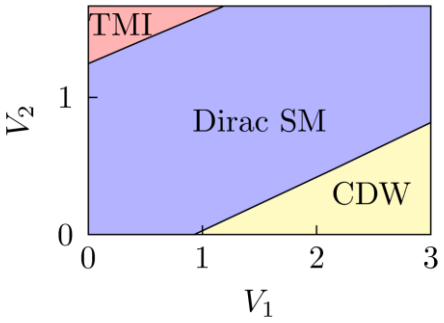
  - Equivalent to the Haldane model

Haldane (1988)

  - SSB of TRS (Im $t'$) makes systems topological
  - Strong inter-site interaction is required
  - No quantitative study on realistic systems






Grushin, *et al.* (2013)

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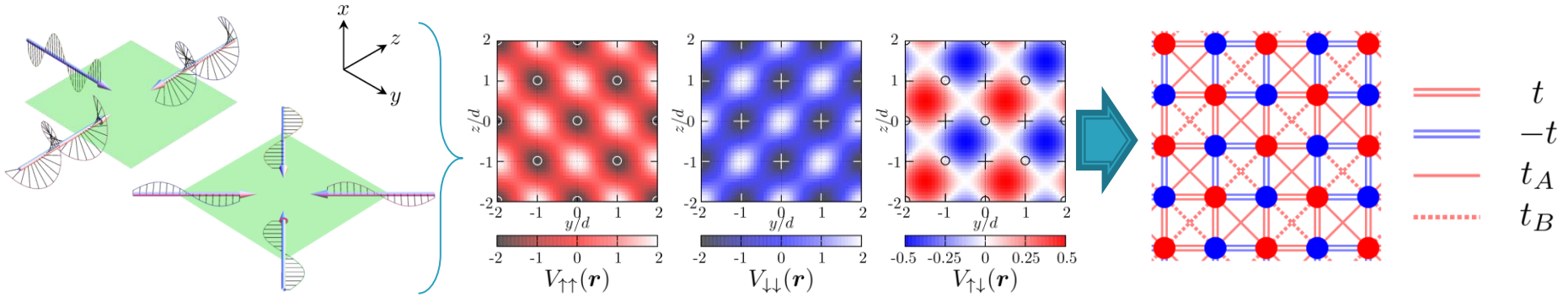
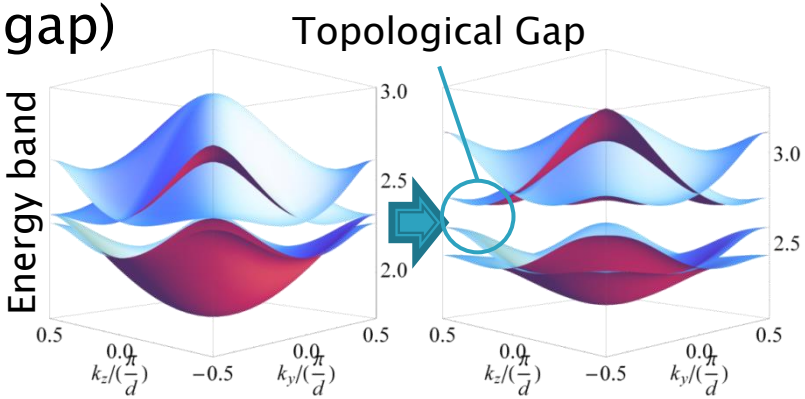
- An optical lattice design for realizing the phase transition
  - seven lasers to construct a spin-dependent optical lattice
  - tight-binding limit = checkerboard lattice w/ n.n. repulsion




- Quantitative verification by density functional theory
  - Strong repulsion (= large topological gap) is obtained in a shallow potential
  - Emergence of the topological gap




See also: arXiv:1411.3345