

凝縮系物理学ゼミナール

Condensed Matter Seminar

Location: Room 413, School of Science Bldg. 5 (理学5号館413号室)

Date: 13:30–15:00, Wednesday, 5 June 2013

“Ground-state properties of a two-dimensional correlated topological insulator”

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Abstract:

Recently, the topological band insulator (TBI) has attracted much interest in condensed matter physics. In TBI, spin-orbit coupling leads to a time-reversal invariant band structure with a full insulating gap in the bulk and gapless edge states on the boundaries. While the essential features of the TBI can be described as a one-body problem, the electron correlation effects are expected to create novel topological states [1].

In this study, we investigate a generalized Bernevig-Hughes-Zhang model [2] having electron correlations with the variational Monte Carlo (VMC) method. In order to study how interactions the edge states and bulk states respectively, it is important to consider spatial dependence due to the lack of translational symmetry perpendicular to the boundaries. For this purpose, we introduce spatially-dependent variational parameters. We calculate the ground-state energy and the double occupancy, and show that a first-order transition occurs in this model. In order to discuss how the correlations affect electronic properties in the TBI, we also calculate the momentum distribution and the spin and charge structure factors.

Reference:

- [1] D.A. Pesin and L. Balents, Nat. Phys. **6**, 376 (2010).
- [2] B.A. Bernevig, T.L. Hughes and S.C. Zhang, Science, **314**, 1757 (2006).