Non-equilibrium classification of topological quantum phases

Xiong-Jun Liu

International Center for Quantum Materials, Peking University

Topological phase of matter is now a mainstream of research in condensed matter physics, of which the classification, synthesis, and detection of topological states have brought many excitements over the recent decade while remain incomplete with ongoing challenges in both theory and experiment. In this talk I present a universal dynamical characterization of the topological quantum phases classified by integers, and show its application to detecting topological physics with high precision [1]. The framework of the theory consists of basic findings. First, we uncover that classifying a generic d-dimensional (dD) gapped topological phase can reduce to a (d-1)D invariant defined on so-called band inversion surfaces (BISs), rendering a fundamental bulk-surface duality. Further, we show in quenching across phase boundary the (pseudo)spin dynamics to exhibit unique topological patterns on BISs, which are attributed to the post-quench bulk topology and manifest a dynamical bulk-surface correspondence. The topological phase is then classified by a dynamical topological invariant measured from dynamical spin-texture field on the BISs. Applications to quenching experiments on feasible models are proposed and studied. In particular, a dynamical detection with high precision of the topological quantum physics has already been achieved in experiment [2]. The future interesting issues will be discussed.

References:

[1] L. Zhang, L. Zhang, S. Niu, and X.-J. Liu, Dynamical classification of topological quantum phases, arXiv: 1802.10061v2.

[2] W. Sun, C.-R. Yi, B.-Z. Wang, W.-W. Zhang, B.C. Sanders, X.-T. Xu, Z.Y. Wang, J. Schmiedmayer, Y. Deng, X.-J. Liu, S. Chen, and J. -W. Pan, 1804.08226.