[QMS2020 invited talk]

Topology in Correlated Quantum Insulators

Gil Young Cho

Department of Physics, POSTECH, Pohang, Gyeongbuk 790-784, Korea
email: gilyoungcho@postech.ac.kr

We propose many-body real-space invariants for primary topological insulators including chiral hinge insulators, Chern insulators, Axion insulator/Topological Band Insulator, and Multipole insulators. Unlike band indices which only work for non-interacting translation-symmetric band insulators, our invariants can detect non-trivial topology of generic quantum many-body wave functions. Hence it is applicable to fully interacting and disordered quantum systems. To achieve such invariants, we design several unitaries whose expectation values on the ground states serve as the invariant. We show that the unitaries essentially detect the coefficients of the corresponding topological field theory, which are the defining characteristics of topological states. This allows us to develop a new way of evaluating Chern numbers and invariant for chiral hinge insulator. Furthermore, we will also show that boundary observables such as edge-localized polarizations and corner charges can be measured purely by the same many-body unitaries endowed with appropriate background geometry.