Long-range mutual information and topological uncertainty principle

CHAO-MING JIAN, Stanford Univ, ISAAC KIM, Perimeter Institute, XIAOLIANG QI, Stanford Univ — Ordered phases in Landau paradigm can be diagnosed by a local order parameter, whereas topologically ordered phases cannot be detected in such a way. In this paper, we propose long-range mutual information (LRMI) as a unified diagnostic for both conventional long-range order and topological order. Using the LRMI, we characterize orders in n+1D gapped systems as m-membrane condensates with 0 ≤ m ≤ n-1. The familiar conventional order and 2+1D topological orders are respectively identified as 0-membrane and 1-membrane condensates. We propose and study the topological uncertainty principle, which describes the non-commuting nature of non-local order parameters in topological orders.