For favour of Posting

THE HONG KONG UNIVERSITY OF SCIENCE & TECHNOLOGY

Department of Mathematics

PHD STUDENT SEMINAR

Topological obstruction, characteristic classes, and their quantization

By

Mr Jiantong HOU

Abstract

Physicists focus on wave-functions, but mathematicians concern about the collection of all of them - the state space. When each point of a manifold X smoothly admits a vector space, the total data forms a vector bundle. K-theory and characteristic class are powerful tools for classifying the category of vector bundles over X up to an isomorphism. A vector bundle is called trivial iff it is isomorphic equivalent to a Cartesian product, $X \times V$. When a vector bundle is topologically nontrivial, it is possibly characterized by some particular nonzero characteristic class(es). In quantum physics, this nontriviality is reflected in quantized response coefficients - for the ground state without a global well-defined phase - known as topological charge or the TKNN invariant, as well as in the distinct transport properties between the bulk of the material and its boundary. In this report, we will introduce the minimal necessary knowledge to K-theory, characteristic classes and obstruction theory. We will show that topological insulator does NOT originate from topological invariants, but rather from topological obstruction. Furthermore, when the translation symmetry breaks down, there is no concept of bands or Brillouin zone, and therefore, TKNN is undefined. We prove that the response function and the index of the system remain quantized in lattice QFT. Thus, the theorems of bulk-edge correspondence still hold for the Fermi liquid picture. The topological information is encoded in the operator K-theory and noncommutative geometry, which may be applied to amorphous or disordered systems.

Date : 4 May 2026, Monday

Time : 2:00pm

Venue : Room 4472 (Lifts 25/26)

All are Welcome!