



THE CHINESE UNIVERSITY OF HONG KONG  
*Department of Physics*  
COLLOQUIUM

**Topological Phase Transitions:  
Topology, Edge, Bulk and  
Boundary-Bulk Correspondence**

*by*



**Professor Fei ZHOU (周飛教授)**  
**Department of Physics and Astronomy**  
**University of British Columbia, Canada**

*Date: January 17, 2020 (Friday)*

*Time: 4:00 - 5:00 p.m.*

*Place: L2, Science Centre, CUHK*

*(Light refreshments will be served at SCNB 1/F lobby from 3:30 to 3:50 p.m.)*

**ALL INTERESTED ARE WELCOME**

\*\*\*\*\*

---

**Abstract**

Emergent quantum phenomena in condensed matter have long been puzzling and highly surprising. These phenomena include high temperature superconductivity, superfluids which are conventionally ordered as well as more exotic topologically ordered states such as FQHEs where elementary excitations obey anyonic or even non-Abelian statistics. Transitions between states with and without topological order will be main subject of this colloquium.

I will discuss a broad class of topological phase transitions in superfluids driven by changes of global topologies rather than by formation of conventional (local) order. These phase transitions are always accompanied by emergence or disappearance of Majorana boundary modes, while at the critical point these boundary modes are liberated and evolve into the bulk that breaks the U(1) symmetry. Proliferation of massless Majorana fermions at the transitions leaves unique thermodynamic signatures. For a very broad class of isotropic superfluids or superconductors (with or without time reversal symmetry), we show that the resultant transitions in  $d$ -spatial dimensions are of  $(d+1)$ th order. These gapless relativistic  $d$ -dimension fermions can also be thought as surfaces of  $d+1$  topologically ordered matter, which suggests an intriguing relation between topological quantum criticality in  $d$ -dimensions and gapped topological matter in  $d+1$  dimensions. I will also discuss the possibility of emergent supersymmetric conformal fields of Majorana fermions in topological phase transitions and relations to classical Liquid-Vapor transitions.