Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Vortex-line condensation in three dimensions: A physical mechanism of bosonic topological insulators"

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Abstract: Bosonic topological insulators (BTI) in three spatial dimensions are symmetry-protected topolog-ical phases (SPT) with U(1) and Z_2^T symmetry, where U(1) is boson particle number conservation, andZ_2^T is time-reversal symmetry with T^2 = 1. Such kinds of new quantum phases were recently pro-posed based on group cohomology theory, later, their corresponding surface anomalous topological orders were proposed, which even leads to new BTI phases beyond group cohomology classification. Nevertheless, it is still unclear what is the universal physical mechanism for BTI phases and what kinds of microscopic Hamiltonians can realize them. In this talk, I propose a universal physical mechanism for BTI phases via vortex-line condensation. Based on such a simple physical picture, we find three kinds of BTI root phases, in which two of them are classified by group cohomology theory while the rest is beyond group cohomology class. The vortex-line condensation picture also leads to a "natural" bulk dynamic topological quantum field theory (TQFT) description for BTI phases and gives rise to a physical way of thinking towards experimental realizations. Finally, we generalize the vortex-line condensation picture into other symmetries and find that in three dimensions, even for a unitary Z_2 symmetry, there is a nontrivial Z_2 SPT phase beyond the group cohomology classification.

12:00noon
Wednesday, October 22, 2014
Duboc Seminar Room (4-331)

Host: Xiao-Gang Wen