PRINCETON CENTER FOR THEORETICAL SCIENCE

Princeton Center for Theoretical Science presents

Seventh Annual Visiting Lectureship Series, 2017

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ABSTRACTS

Talk 1: Tuesday, May 2, 2017 Symmetry Protected Topological Insulators and Semimetals
Jadwin Hall, Room 407, PCTS at 2:30 pm

We will discuss recent developments in topological band theory, in which the combination of time reversal symmetry and crystal symmetries lead to novel insulating and semimetallic states. After introducing the interplay between symmetry and topology in the electronic structure of crystalline materials, we will discuss several examples of protected metallic states that can occur on the surface and in the bulk. These include Dirac semimetals in two and three dimensions, double Dirac semimetals and line node semimetals as well as new classes of topological crystalline insulators with surface states that violate symmetry enhanced doubling theorems. We will contrast semimetallic behavior that arises due to band inversion with filling enforced semimetals that arise due to the existence of non-symmorphic space group symmetries.

The Hamilton Lecture: Thursday, May 4, 2017 "Topological Phases of Matter"
McDonnell Hall, Room A-02 at 8:00 pm

Matter can arrange itself in the most ingenious ways. In addition to the solid, liquid and gas phases that are familiar in classical physics, quantum mechanics enables the existence of electronic phases of matter that can have both exotic and useful properties. In the last century, the thorough understanding of the simplest quantum electronic phase - the electrical insulator - enabled the development of the solid state electronics technology that is ubiquitous in today's information age. In the present century, new "topological" electronic phases are being discovered that may enable future technologies by allowing the seemingly impossible to occur: indivisible objects, like an electron or a quantum bit of information, can be split into two, allowing mysterious features of quantum mechanics to be harnessed. Our understanding of topological phases, which was celebrated by the 2016 Nobel Prize in physics, builds on deep ideas in mathematics. We will try to convey that they are as beautiful as they are fundamental.

Talk 2: Friday, May 5, 2017 Clustering in Luttinger liquids and the quantum Hall effect
Jadwin Hall, Room 407, PCTS at 11:00 am

The coupled wire model is a simple formulation of the fractional quantum Hall effect that provides an explicit connection between the bulk topological order and the edge conformal field theory in the context of a solvable electronic model of coupled Luttinger liquids. Here we will consider the effects of pairing and higher order clustering on the Luttinger liquids. We will argue that a single Luttinger liquid can exhibit a pairing transition that is related to the transition between a topological and trivial superconductor. Incoporating pairing in the coupled wire model allows a simple formulation of the Moore-Read state and it's cousins. We will go on to consider higher order clustering of k particles, which leads to a formulation of the Read-Rezayi Z_k parafermion states and identify a class of "orbifold" quantum Hall states that generalize the Z_4 Read Rezayi state.