Condensed Matter Theory Center Seminar

Monday, May 23
2:00-3:30pm
2205 Physics Building

Two Talks

Mohammad Hafezi, JQI

"Quantum Hall physics with photons and its applications"

&

Haitan Xu, JQI

"Developing a robust approach to implementing non-Abelian anyons and topological quantum computing in a modified Kitaev honeycomb lattice model"

See abstracts below

All are welcome to attend.

DEPARTMENT OF PHYSICS
UNIVERSITY OF MARYLAND

Mohammad Hafezi

Title: Quantum Hall physics with photons and its applications

Abstract: Phenomena associated with the topological properties of physical systems can be naturally robust against perturbations. This robustness is exemplified by quantized conductance and edge state transport in the quantum Hall and quantum spin Hall effects. In this talk, I show how exploiting topological properties of optical systems can be used to implement robust photonic devices. I demonstrate how quantum spin Hall Hamiltonians can be created with linear optical elements using a network of coupled resonator optical waveguides (CROW) in two dimensions. As a specific application, I will show that topological protection can be used to dramatically improve the performance of optical delay lines and to overcome limitations related to disorder in photonic technologies.

Haitan Xu

Title: Developing a robust approach to implementing non-Abelian anyons and topological quantum computing in a modified Kitaev honeycomb lattice model

Abstract: Quantum computation provides a unique opportunity to explore new regimes of physical systems through the creation of non-trivial quantum states far outside of the classical limit. However, such computation is remarkably sensitive to noise and undergoes rapid dephasing in most cases. One potential solution to these prosaic concerns is to encode and process the information using topological manipulations of so-called anyons, particles in two dimensions with non-Abelian statistics. Unfortunately, practical implementation of such a topological system remains far from complete, both in terms of physical methods but also in terms of connecting the underlying topological field theory with a specific physical model, including the imperfections expected in any realistic device. Here we develop a complete picture of such topological quantum computation using a variation of the Kitaev honeycomb Hamiltonian as the basis for our approach. We show the robustness of this system against noise, confirm the non-Abelian statistics of the quasi-particles to be Ising anyons, and develop new techniques for turning topological information into measurable spin quantities.