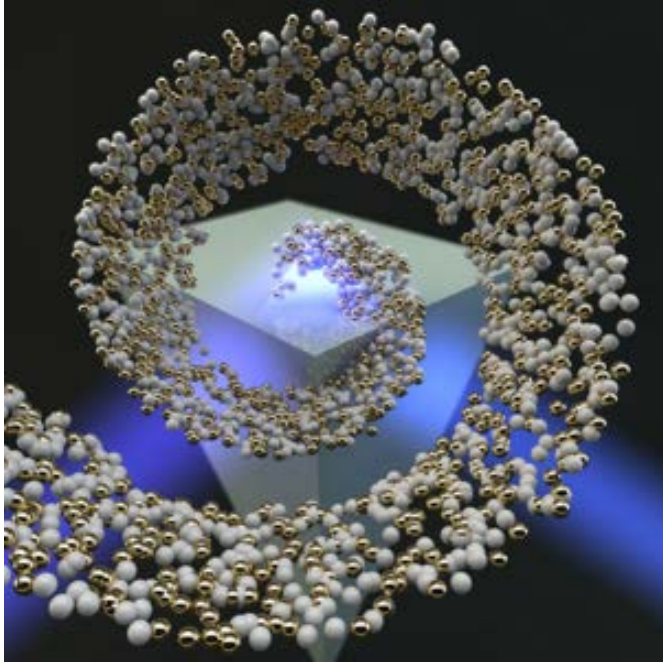


ECE 695: Quantum and Topological Effects in Photonics and Phononics

Instructor: Prof. Zubin Jacob
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Fall 2016

Tue-Thu: 4:30pm – 5:45pm
EE 226



Exciting research trends in the fields of topological electronic materials have motivated a unique set of closely related phenomena in photonics and phononics. This course will introduce graduate students to foundational ideas such as Pancharatnam-Berry Phase, Chern number, topological surface states, spin-momentum locking and quantum spin hall effect. These phenomena will be covered with themes cross-cutting the fields of electronics, photonics and phononics thus making it appealing to a broad audience.

Applications: Throughout the course, quantum and thermal engineering applications will be stressed. These include quantum communications, quantum gates, quantum memories, robust on-chip photonic-routing, spin-sensing, single

photon detectors, ultralow threshold lasing, thermophotovoltaics, thermal sources and sinks, etc.

Pre-requisite: The necessary background in quantum mechanics can be developed along the way and the course assumes very little in-depth knowledge. However, it is useful to have a strong understanding of wave physics.

Module 1: Parity and time symmetry for electrons, photons and phonons

Module 2: Introduction to pseudo-spin and orbital angular momentum for electrons, photons and phonons

Module 3: Band structure and density of states for electrons, photons and phonons

Module 4: Introduction to Geometric Phase and Chern number

Module 5: Topological edge states for electrons, photons and phonons (1D and 2D)

Module 6: Quantum and thermal noise

Module 7: Nonclassical behavior including squeezing, entanglement and quantum reservoir engineering

Module 8: Selected experiments on quantum electronics, photonics and phononics

Course notes: Slides and/or hand-written notes will be provided for each lecture