PhLAM RESEARCH SEMINAR SERIES
April 3th, 2025, 10:30 AM
CERLA Building

Electron optics experiments: from single electrons to anyons.

by

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In two-dimensional conductors placed in a strong perpendicular magnetic field, the propagation of electrons is guided along the edges of the sample that behave as perfect ballistic channels. Combined with the use of electrostatic gates to partition electrical currents, the ballistic propagation of electronic excitations has enabled the realization of electronic interferometers, such as Fabry-Perot or Mach-Zehnder interferometers. Over the past few years, the development of single-electron sources has led to the emergence of electron optics experiments, which aim at manipulating the quantum state of individual electronic excitations propagating in an electrical conductor. While these experiments share many analogies with conventional quantum optics (based on the manipulation of photons), there is a fundamental difference between the two systems: unlike photons, electrons interact strongly with each other through the Coulomb interaction. In strongly correlated conductors, these interactions can give rise to new elementary excitations with exotic behavior. These particles, known as anyons, have properties intermediate between fermions and bosons, characterized by a fractional exchange phase. In my presentation, I will show how two-particle interferometry (also known as Hanbury-Brown and Twiss interferometry) can be used to characterize the elementary excitations of quantum conductors: from electrons when interactions are weak to anyons in strongly correlated conductors.