Mathematical Physics Seminar, Amanda Young, UIUC, BRNG 1255

Tuesday, Mar 19th 1:30 - 2:30pm

Title: A bulk gap for a truncated Haldane pseudopotential
Abstract: The Fractional quantum Hall effect (FQHE) is the collective behavior of interacting electrons on a two-dimensional manifold subject to a perpendicular magnetic field. When the magnetic field is tuned to certain values, the strong, repulsive interactions between the electrons lead to two key phenomena that characterize this phase of matter: the incompressibility of the fluid into which the electrons condense, and a ground state energy gap above which are fractional excitations. The first theoretical explanation for the FQHE was given by Laughlin's famous Ansatz for the many-body ground state wavefunction. Shortly thereafter, Haldane introduced his family of pseudopotentials as Hamiltonian models for the FQHE. These Hamiltonians are tailored to have a Laughlin wave function as a maximally filled ground state and are expected to exhibit the other hallmarks of the FQH phase. Moreover, these properties as expected to be robust in the choice of two-dimensional manifold. Despite numerical confirmation of these properties, it is still a major open problem to prove the existence of the ground state gap in the thermodynamic limit.

In this talk, we discuss recent work which proved a bulk gap for a truncated version of the 1/3-filled pseudopotential in the infinite cylinder geometry that is expected to well-approximate the original model for small radii. One of the main obstacles for proving this result was the presence of edge states for finite cylinders, which produce spectral gap estimates that do not accurately reflect the behavior of the bulk gap. To overcome this challenge, a new scheme based off separating edge states and ground states into distinct invariant subspaces was developed, which allowed for a more refined application of gap estimating techniques. This is based on joint work with S. Warzel.