Abelian and non-Abelian Anyons in the Fractional Quantum Hall Regime

Topological phases are now conjectured to occur in an astonishingly vast array of different material systems with a wide range of physical properties predicted – a subset of which may even be useful! The archetype of a strongly interacting topological phase is the fractional quantum Hall effect. Low energy excitations carry fractional charge, and when traversing closed trajectories around one another, are believed to exhibit either Abelian or non-Abelian braiding statistics depending on the exact filling factor. While fractional charge is well-established, unambiguous demonstration of quasiparticle statistics remains elusive.

I will describe our attempts to build and interrogate devices in AlGaAs/GaAs heterostructures that can be used to probe coherent phenomena in the quantum Hall regime. I will focus on basic physical principles underlying device operation, illustrated with a few key examples. The potential utility of such systems for quantum computing will also be discussed.