Superconductivity, electronic correlations, and topology in two dimensions

Two-dimensional electronic systems form a bedrock of quantum condensed matter physics. Quantum Hall effects, Hofstadter's fractal spectrum, topological insulators, the Hubbard model, and the planar building blocks of cuprate superconductors are key examples. Two-dimensional materials, like graphene, have played a central role in advancing the field over the last decade, in part due to the ease with which different layers can be integrated together to engineer new systems with new electronic properties. My lab specializes in designing and assembling multiple two-dimensional materials into structures for electrical measurements at millikelvin temperatures and in large magnetic fields.

This project will involve building layered structures of two-dimensional materials to form microscopic electronic devices for cryogenic measurements. This is hands-on work that will give you opportunities to work with bulk crystals, optical and atomic force microscopes, micromanipulators, and CAD design. Along the way, you will learn about engineering electronic bands in two-dimensional materials and in "moiré" materials like twisted bilayer graphene. The goal of this work will be to realize superconductivity, strong electronic correlations, and topological bands by combining layers that have none of these properties on their own.

This project is suitable for a student comfortable with quantum mechanics and familiarity with statistical mechanics and solid state physics.

For more information and a list of relevant publications:

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