Quantum Limited Thermal and Thermoelectric Transport in Graphene

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In low-dimensional systems, a growing number of many-body quantum phenomena have emerged from the combination of reduced dimensionality, strong interactions, and topology. Thermal and thermoelectric transport, which is sensitive to energy- and entropy-carrying degrees of freedom, provides a discriminating probe of emergent excitations in quantum materials. In this talk, I will discuss several recent developments in the measurement of thermal and thermoelectric transport in graphene-based nanostructures in the quantum limit. In the first part, we discuss electronic thermal conduction in bilayer graphene near charge neutrality as a function of external field strengths. We use nonlocal noise thermometry to probe the quantum Hall-ferromagnetic phase diagram. Here we show clear signatures of phase transitions between different broken symmetry states in strongly correlated states that appear in the quantum limit. In the second part of the talk, we will discuss thermoelectric transport in the lowest Landau level formed in disordered graphene quantum dots. Here, the combination of quantum confinement and disorder effects leads to a novel non-Fermi liquid behavior. We will discuss the implications of electrical and thermoelectric transport in this system in the context of strongly entangled quantum systems that is enabled by the strong interactions between localized states engineered in graphene quantum structures.