HQOC

Harvard Quantum Optics Center

ITAMP

Institute for Theoretical Atomic Molecular and Optical Physics

Joint Quantum Sciences Seminar

Wednesday, April 4, 4:30 pm

Jefferson 250

Falko Pientka

Polaron drag of excitons in semiconductors

Mobile quantum impurities interacting with a fermionic bath form quasiparticles known as Fermi polarons. We demonstrate that a force applied to the bath particles can generate a drag force of similar magnitude acting on the impurities, realizing a novel, nonperturbative Coulomb drag effect. We apply our theory to excitons interacting with a bath of charge carriers in a doped semiconductor. Our findings establish transport measurements as a novel, powerful tool for probing the many-body physics of mobile quantum impurities.

Javier Sanchez-Yamagishi

Current instability in a driven 2d electron liquid probed by nanoscale magnetometry

A moving fluid can become unstable in the presence of an obstruction, leading to a flow pattern that fluctuates in time due to nonlinear dynamics. It has been recently found that some materials host electrons that behave like a collective fluid. In particular, experiments with graphene electrons have demonstrated linear hydrodynamic phenomena, such as viscous drag at sample boundaries, but nonlinear effects have yet to be reported. We observe a AC current instability that develops when driving a DC current through a graphene device in the electron hydrodynamic regime. The current fluctuations are substantially larger than typical electronic noise and broadly peaked in the GHz frequency range. To probe the local structure of the instability, we use diamond NV magnetometry to measure the current fluctuations at the nanoscale. We find that the current fluctuations vary across the sample. Remarkably, some regions exhibit fluctuations that are strongly dependent on the direction of the current, breaking the directional symmetry of the device as would be expected for a fluid instability seeded by disorder. The combined global and local measurements indicate non-linear effects which arise when driving the graphene electron liquid. In addition, this work demonstrates the power of using local magnetometry probes in combination with traditional global measurements to gain deeper insight into electronic phenomena.

Presentations will begin at 4:30 PM Refreshments will be provided