Physical Sciences Seminar

[Webinar] Long-Lived Excitations, Directional Memory and Hydrodynamic Transport in Two-Dimensional Electron Fluids

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It was found recently that 2D electron fluids can support collective excitations that are not subject to Landau's T^2 dissipation [1,2,3]. This surprising behavior originates from the head-on carrier collisions, a process that dominates angular relaxation at not-too-high temperatures T<<T_F due to the joint effect of Pauli blocking and kinematic constraints. As a result, a large family of exceptionally long-lived excitations emerges, associated with the odd-parity harmonics of momentum distribution. This leads to "tomographic" dynamics: fast 1D spatial diffusion along the unchanging velocity direction accompanied by a slow angular dynamics that gradually randomizes velocity orientation. The abnormally slow angular relaxation originates from correlated angular dynamics involving "lock-step'' angular displacements along the Fermi surface occurring in collinear two-particle collisions. The slow loss of directional memory is described as non-Brownian angular random walk, "superdiffusion" on the Fermi surface. The collective behavior with directional memory dominates at moderately long times, pushing the onset of conventional hydrodynamics to abnormally large timescales. The tomographic regime features an unusual hierarchy of time and length scales, resulting in scale-dependent transport coefficients. The scale dependence manifests itself in fractional-power current flow profiles and unusual conductance scaling vs. temperature and sample size. This exotic behavior can be directly probed by transport measurement techniques, as well as by momentum-resolved tunneling measurements.1. P J Ledwith, H Guo, L Levitov, The Hierarchy of Excitation Lifetimes in Two-Dimensional Fermi Gases, Annals of Physics 411, 167913 (2019)2. P J Ledwith, H Guo, A V Shytov, L Levitov, Tomographic Dynamics and Scale-Dependent Viscosity in Two-Dimensional Electron Systems, Phys Rev Lett 123, 116601 (2019)3. P J Ledwith, H Guo, L Levitov, Angular Dynamics and Directional Memory in Two-Dimensional Electron Fluids, 2019

Tuesday, April 14, 2020 04:00pm - 06:00pm

Webinar

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