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Transport in nanoscale systems: hydrodynamics, turbulence, and local electron heating
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Transport in nanoscale systems is usually described as an open-boundary scattering problem. This picture, however, says nothing about the dynamical onset of steady states, their microscopic nature, or their dependence on initial conditions [1]. In order to address these issues, I will first describe the dynamical many-particle state via an effective quantum hydrodynamic theory [2]. This approach allows us to predict a series of novel phenomena like turbulence of the electron liquid [2], local electron heating in nanostructures [3], and the effect of electron viscosity on resistance [4]. I will provide both analytical results and numerical examples of first-principles electron dynamics in nanostructures using the above approach. I will also discuss possible experimental tests of our predictions. Work supported in part by NSF and DOE.