Title: Tunable contributions from charge-rectification and momentum transfer to 1D Coulomb drag

Abstract:
Coulomb drag is a powerful tool to probe the interaction between closely-spaced low-dimensional systems. Historically, this effect has been understood in terms of momentum transfer between carriers in the two nearby conductors, resulting in a friction-like effect. In one-dimensional systems, Coulomb drag is especially helpful, as single wire conductance measurements seldom yield information on the nature of the Luttinger liquid forming in there strongly confined systems. In this talk, I will present the experimental observation highlighting an alternate drag-inducing mechanism occurring in mesoscopic one-dimensional systems: charge rectification. In contrast to momentum transfer, whose polarity depends on the drive current direction, the charge rectification mechanism consistently generates a drag signal in a set direction, regardless of the drive current direction. After presenting the signatures of this novel drag-inducing mechanism in laterally-coupled quantum wires, I will present our studies of Coulomb drag in vertically-coupled quantum wires separated by a barrier only 15 nm wide. In these vertically coupled devices, fabricated through an Epoxy-Bond-And-Stop-Etch (EBASE) process, notable contributions from both momentum transfer and charge rectification are observed simultaneously. Moreover, the relative strength of both contributions is tunable through both gate voltage and temperature. Through a careful temperature dependence study of the drag signal, we observe a non-monotonic temperature dependence characteristic of Luttinger liquid physics. Furthermore, we confirm the exponential dependence of Coulomb drag with kfd for both charge rectification- and momentum transfer-induced Coulomb drag. Results on Coulomb drag in the non-linear regime will also be presented. These study opens up the possibility of studying the physical mechanisms behind the onset of both momentum transferred and charge rectified drag simultaneously in a single device, ultimately leading to a better understanding of Luttinger liquids in multi-channel wires and paving the way for the creation of energy harvesting devices.