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The Fabrication and Physics of Locally Gated Graphene Devices

Most graphene experiments to date depended on the presence of a heavily doped Si substrate which serves as a global back gate, inducing charge density via the electric field effect. Although such a global gate approach yields interesting transport phenomena, it represents only the first step towards more complex devices. Such devices require lithographically patterned locally gated graphene nanostructures; examples range from Klein tunneling and electron Veselago-lens to spin qubits. From an application point of view these new phenomena promise novel devices with strongly enhanced functionalities and novel operating principles.

I will present a simple process which combines *both* the patterning of graphene sheets into any desired planar nanostructure *and* the local top gating of the latter. Employing this method, I have fabricated graphene nanoconstrictions with local tunable transmission and characterized their electronic properties. A complete turn off of the device is demonstrated as a function of the local gate voltage. Next, I will discuss experiments with locally top gated graphene devices in the quantum Hall (QH) regime. By independently varying the voltage on the back gate and local top gate, we have studied bipolar QH transport in graphene p-n-p heterojunctions in different charge density regimes. We find a series of fractional QH conductance plateaus as the local charge density is varied in the p and n regions. I will conclude my talk with experiments on charge transport in top gated graphene bilayer samples.