Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Atomic Scale Observation of Electron-Electron Interactions in Single-Layer Graphene Devices on Boron Nitride Dielectrics SUYONG JUNG, JUNGSEOK CHAE, NIKOLAI ZHITENEV, JOSEPH STROSCIO, National Institute of Standards and Technology, ANDREA YOUNG, CORY DEAN, LEI WANG, JAMES HONE, KEN SHEPARD, PHILIP KIM, Columbia University, NIST COLLABORATION, COLUMBIA UNIVERSITY COLLABORATION — We have performed scanning tunneling spectroscopy measurements on gated-graphene devices in the quantum Hall regime under varying disorder potential landscapes. Relatively thin hexagonal boron-nitride (h-BN) crystals are mechanically exfoliated on SiO2/Si substrates and single-layer graphene films are later transferred on pre-located h-BN crystals. In this device scheme, we can investigate the interactions of Dirac particles with local impurities ranging from strongly disordered to weakly perturbed environments by adjusting the thickness of h-BN crystals, while varying both the Fermi-energy with respect to a Dirac point and magnetic field. In the h-BN devices, we have observed that the electron-hole puddles are larger in lateral size than those observed on SiO2 devices, and resonance scatterings are significantly reduced due to weakened disorder potentials. Accordingly, we start observing well-defined Landau levels (LLs) as early as 0.5 T and the width of individual LLs, broadened by the scattering of charged carriers, is much narrower than those from graphene on SiO2. In high magnetic fields, we observe the electronic structure of graphene devices is significantly altered by the electron-electron interactions and the formation of large interaction energy gaps. We will discuss the spatial, orbital quantum number, and magnetic field dependence of the observed interaction gaps.

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Date submitted: 16 Nov 2011 Electronic form version 1.4