**Probing the potential landscape of a graphene bilayer in the quantum Hall regime**

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Owing to their high mobility and electric field tuneable bandgap, micron-sized sheets of bilayer graphene are emerging as a serious alternative to nanoscale ribbons as the channel material of a graphene field-effect device [1]. While the performance of such bilayer devices potentially competes with that of conventional semiconductors, the "on/off" conductance ratio currently falls short of expectations, probably due to large fluctuations in the local electrostatic potential created by charged impurites [2]. To determine the precise nature of these potential fluctuations, we use the charged tip of a scanning probe microscope to locally perturb the potential landscape in an exfoliated bilayer while measuring its bulk conductance. In a magnetic field we observe a rich texture of ≈ 100 nm "hotspots" where the response to the tip is particularly pronounced. We analyse the evolution of these hotspots as a function of magnetic field, back-gate, and tip voltage, and discuss their origin in terms of tip-enhanced back- and forward-scattering from saddle points in the potential landscape [3].

**References**

[1] B. N. Szafranek *et al.*, APL, **96** (2010) 3364139.
[2] K. Zou and J. Zhu, PRB, **82** (2010) 081407.
[3] A. Baumgartner *et al.*, PRB **76** (2007)**,** 085316.

**Figures**

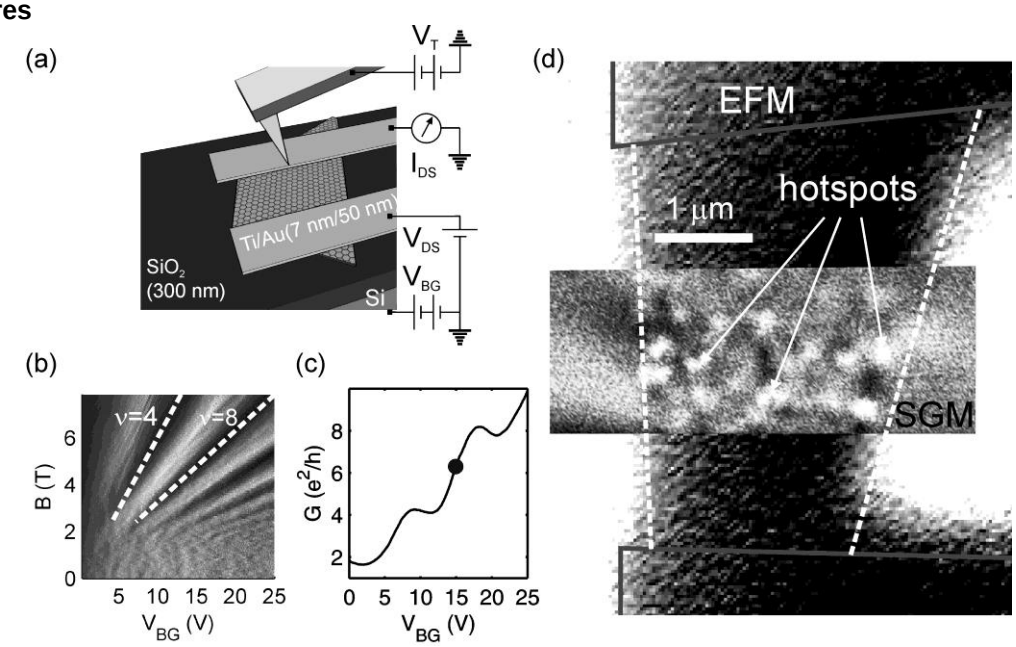


***Fig.1.*** *(a) Schematic of scanning gate microscopy on a graphene flake. The current $I_{DS}$ is recorded as a function of tip position. (b Differential conductance surface of a graphene bilayer as a function of magnetic field and back-gate voltage. Landau levels appearing at filling factors of 4 and 8 confirm that the flake is bilayer. (c) Conductance as a function of magnetic field at B = 6 T. Black circle indicates the back-gate where the SGM image in (d) was captured. (d) Electrostatic force and scanning gate micrograph of a bilayer flake. Dashed outlines indicate the edge of the flake while solid outlines indicate the edge of the contacts.*