Single-layer graphene on h-BN in tilted magnetic fields

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We have measured the Landau level structure of high-mobility graphene positioned on h-BN by means of magneto-transport experiments in magnetic fields up to 30 T. For the best quality sample (sample B) we observe a full splitting of the four-fold Landau level degeneracy in agreement with recent results by the Kim group [1].

We performed our experiments on two single-layer graphene devices placed directly on h-BN on top of an *n*-Si/SiO_2 wafer, acting as a back gate. In particular, using tilted magnetic fields, we investigated the spin polarization of individual quantum-Hall states and, more specifically, the competition between a bare Zeeman splitting [2,3] due to the total magnetic field and an exchange-driven splitting dependent on the perpendicular field component.

Already in sample A filling factors ν= -1 and ν= -4 appear. Keeping the perpendicular component constant while increasing the total magnetic field, the resistance minima become more pronounced for both filling factors indicating a (partial) spin polarization of these quantum-Hall states. Using temperature dependent experiments, we extract the gaps for ν= -1 (in perpendicular magnetic field 30 T) and ν= -4 (at θ = 66.4 °, B_{TOT} = 30 T): Δ_{-1}= 93±2 K and Δ_{-4}= 32±2 K. The size of Δ_{-4} is in agreement with the Zeeman energy at 30 T whereas Δ_{-1} is considerably larger pointing towards an interaction-driven enhancement [4].

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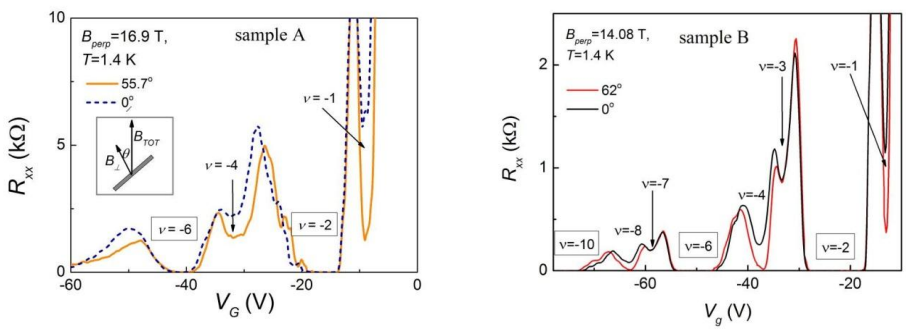

Fig. 1: Splitting of the three lowest hole Landau levels in (tilted) magnetic fields. The perpendicular component of the magnetic field i is $B_\perp$ =16.90 T for sample A and $B_\perp$ =14.08 T for sample B.
The well-pronounced filling factors ν = -2, -6 and -10 separate the four-fold degenerate Landau levels, which become partly split in sample A and fully split in sample B.
The inset in (A) sketches the tilt configuration.