Strange metal behavior of the Hall angle in twisted bilayer graphene

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Twisted bilayer graphene (tBLG) with interlayer twist angles near the magic angle ~1.08° hosts flat bands and exhibits correlated states including Mott-like insulators, superconductivity and magnetism. We will discuss our recent measurements on a tBLG device with a twist angle of 0.93°, below the magic angle. We find in addition to Mott-like insulator and superconducting states near half filling, evidence for a novel correlated state at five electrons/moiré unit cell. Our results reveal that the magic range of tBLG is in fact larger than what is previously expected, and provide a wealth of new information to help decipher the strongly correlated phenomena observed in tBLG. Moreover, we will discuss combined temperature-dependent transport measurements of the longitudinal and Hall resistivities in close to magic-angle tBLG. While the observed longitudinal resistivity follows linear temperature *T* dependence consistent with previous reports, the Hall resistance shows an anomalous *T* dependence with the cotangent of the Hall angle ~ T^2. Boltzmann theory for quasiparticle transport predicts that both the resistivity and the Hall angle cotangent should have the same *T* dependence, contradicting the observed behavior. This failure of quasiparticle-based theories is reminiscent of other correlated strange metals such as cuprates.

References

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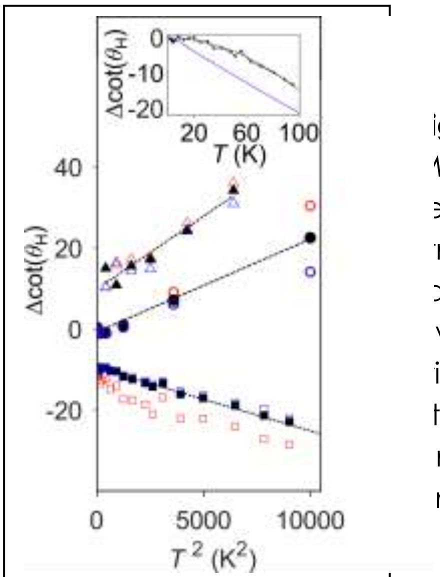
Figures



igure 1: Hall angle cotangent temperature dependence. 1ain panel: Hall angle cotangent change from its low emperature value versus T^2, for three different samples riangles, squares, and circles). Filled symbols indicate data aken near half-filling, while open symbols indicate data taken way from half-filling. Data represented by squares and iangles are vertically offset for clarity. Dashed lines show linear ts to the half-filling data. Inset: measured change in the Hall ngle cotangent vs. *T* near half-filling for one sample (squares) n a linear scale. Blue line: theory.