Correlated electrons in twisted bilayer graphene: superconductivity to strange metal behavior

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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 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 dependence consistent with previous reports, the Hall resistance shows an anomalous temperature dependence with the cotangent of the Hall angle scaling quadratically in temperature. Boltzmann theory for quasiparticle transport predicts that both the resistivity and the Hall angle cotangent should have the same temperature dependence, contradicting the observed behavior. This failure of quasiparticle-based theories is reminiscent of other correlated strange metals such as cuprates. Moreover, we will discuss our recent work in which we study tBLG with an extremely low Fermi velocity, which enables us to find evidence of a quantum geometric contribution to the superfluid stiffness, and tune the electrons well into the Bose-Einstein condensate regime.