Planar tunneling in twisted moiré heterostructures

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Experiments showing extraordinary quantum mechanical phenomena such as quantum tunneling are now possible in low-dimensional systems due to the ability to exfoliate 2D materials from the bulk, such as graphene and hexagonal boron nitride (hBN). In some of the earlier works, a few atomic layers of hBN were used as the tunnel barrier to demonstrate electron tunnelling from metal into a graphene/graphite sheet [1-3]. Experiments have revealed signs of strong correlations in response to theoretical predictions of graphene layers being strongly coupled near the so-called "magic" angles, where the low energy bands become incredibly flat [4-7]. In this work, we probe correlations in twisted moiré heterostructures using electron tunneling as a novel tool. We fabricated vertical tunneling transistors of twisted bilayer graphene, with tungsten diselenide (WSe_2) as the tunnel barrier. A schematic of the device is shown in Figure 1a. Figure 1b shows 2-probe resistance as a function of carrier density at T = 2 K with an optical image of the device shown in the inset. Tunneling conductance (dI/dV) is shown in Figure 1c as a function of bias voltage (V_{DC}) and gate voltage (V_{TG}). In this talk, I'll further detail how we have used tunneling as a sensitive probe to investigate correlations in the moiré bands at low temperatures and high magnetic fields.

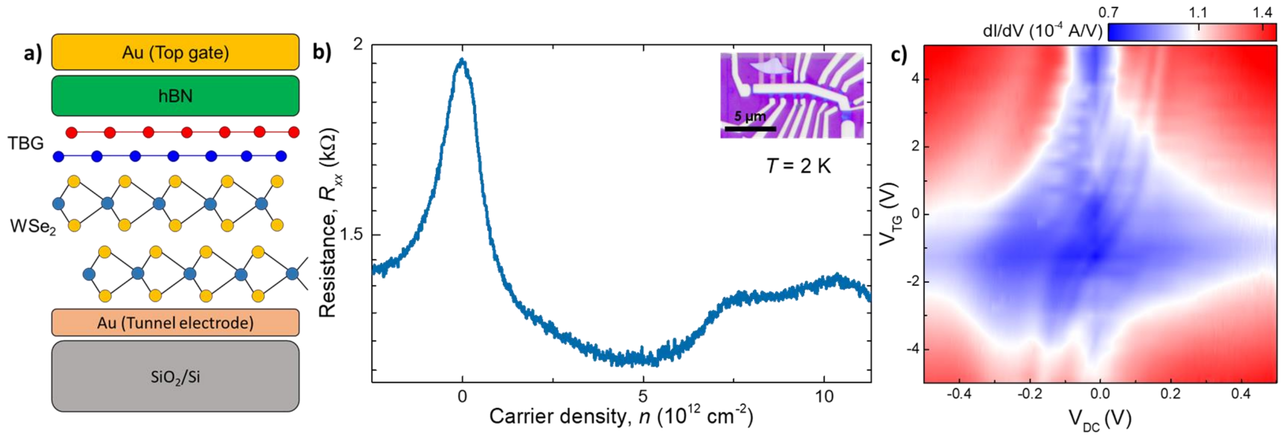

Figure 1 a. Schematic of the device **b.** 2-probe resistance as a function of carrier density, *optical image in inset* **c.** Tunneling conductance *(dI/dV)* as a function of bias voltage (V_{DC}) and gate voltage (V_{TG})

[1] Liam Britnell et al., *Nano Lett.*, 12, (2012), 1707–1710

[2] U.Chandni et al., Nano Lett., 15, (2015), 7329-7333

[3] U.Chandni et al., Nano Lett., 16, (2016), 7982-7987

[4] R.Bistritzer et al., PNAS, 108, (2010), 12233-12237

[5] Y.Cao et al., Nature, 556, (2018), 80-84

[6] Y.Cao et al., Nature, 556, (2018), 43–50

[7] Sharpe et al., Science, 365, (2019) ,605-608