Cascade of superconducting domes and magnetic order in charge neutral and ¼ filled magic angle bilayer graphene

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Superconductivity often occurs close to symmetry broken parent states, in particular when doping magnetically ordered states. Flat bands in Moire lattices in twisted bilayer graphene have emerged as a rich and highly tuneable model platform, where superconducting domes were found close to correlated insulating states at ± ½ band filling, raising speculations of an unconventional pairing mechanism. Here we report on the fabrication of highly twist-angle homogeneous devices, which allow to resolve correlated states at all integer fillings ± ¼, ± ½, ± ¾ of the four-fold spin and valley degenerate Moire band, and a gapped insulating state at charge neutrality. We find an enhanced critical temperature of ~ 3 kelvin of the superconducting dome close to – ½ filling, and strikingly we observe three new superconducting domes at much lower temperatures, when slightly doping the charge neutral point and the ±¼ filled correlated states. Interestingly, the weakly pronounced – ¼ correlated state shows a sharp hysteretic resistance enhancement when a perpendicular magnetic field above 3.6 tesla is applied, consistent with a field stabilized magnetically ordered state. Overall, our study shows that symmetry broken and superconducting states occur not only around half-filling, but are common across the entire Moire band, including charge neutrality. The co-existence of superconductivity and magnetic order in the – ¼ correlated states points to-wards a possible pairing mechanism. (in preparation)

References

[1] Nature 556 (7699), 43 (2019)

Figures

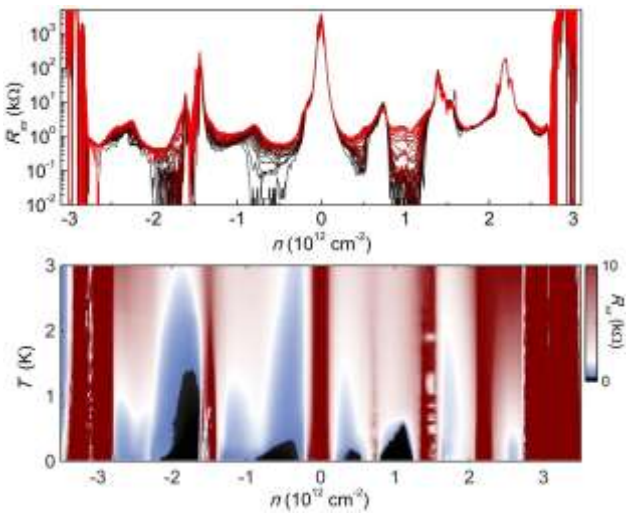

Figure 1: Superconductivity and correlated states in magic angle graphene.