

Cascade of superconducting domes and magnetic order in charge neutral and $\frac{1}{4}$ 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 Moiré 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 $\pm \frac{1}{2}$ 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 $\pm \frac{1}{4}$, $\pm \frac{1}{2}$, $\pm \frac{3}{4}$ of the four-fold spin and valley degenerate Moiré band, and a gapped insulating state at charge neutrality. We find an enhanced critical temperature of ~ 3 kelvin of the superconducting dome close to $-\frac{1}{2}$ filling, and strikingly we observe three new superconducting domes at much lower temperatures, when slightly doping the charge neutral point and the $\pm \frac{1}{4}$ filled correlated states. Interestingly, the weakly pronounced $-\frac{1}{4}$ 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 Moiré band, including charge neutrality. The co-existence of superconductivity and magnetic order in the $-\frac{1}{4}$ correlated states points to towards a possible pairing mechanism. (in preparation)

References

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

Figures

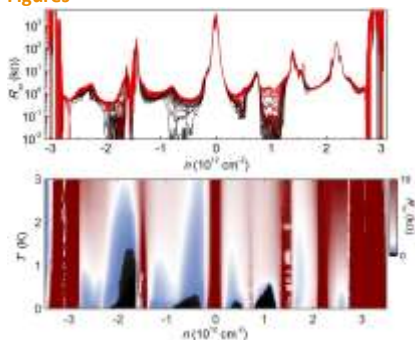


Figure 1: Superconductivity and correlated states in magic angle graphene.