Coulomb screening of superconductivity in magic-angle graphene

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Abstract

The origin of superconductivity in magic-angle twisted bilayer graphene has been a subject of intense debate. While some experimental evidence indicated an unconventional pairing mechanism which should be sensitive to Coulomb screening, experimental attempts to tune the critical temperature by screening Coulomb interactions so far have remained unsuccessful, possibly indicating a conventional phonon-mediated pairing. Here we study a double-layer electronic system consisting of two twisted graphene bilayers in immediate proximity of each other but remaining electronically decoupled. By increasing the carrier density in one bilayer, we completely suppressed both the superconductivity and the correlated-insulator state in the adjacent magic-angle graphene. The observation of such an effect from screening offers strong support for an unconventional mechanism of Cooper pairing in magic-angle twisted bilayer graphene, shedding new light on the underlying physics governing their properties.

References

[1] Julien Barrier, Liangtao Peng, Shuigang Xu, V. I. Fal'ko, K. Watantbe, T. Taniguchi, A. K. Geim, S. Adam, Alexey I. Berdyugin, arXiv:2412.01577 (2024)