Interaction induced terahertz photocurrents in twisted bilayer graphene

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Magic-angle twisted bilayer graphene hosts a highly interacting electron system that exhibits phenomena bridging topology and strong correlations [1]. Polarization resolved photocurrent measurements offer a direct access to the geometry of electron wave functions including berry curvature and the quantum metric [2],[3]. In this talk we will present terahertz photocurrent measurements in twisted bilayer graphene close to the magic-angle. Our measurements reveal several fragile states not detectable by quantum transport that originate from hidden symmetries intrinsic to twisted bilayer graphene. Amongst them, we observe signatures of a gapped state at charge neutrality and Hartree interaction induced band renormalizations manifesting in the photoresponse. Our measurements demonstrate how terahertz photocurrent is a powerful tool for probing interacting electrons and their quantum geometry in flat band systems.

References

[1] E. Y. Andrei & A. H. MacDonald "Graphene Bilayers with a Twist" *Nature Materials* **19**, 265–1275 (2020)

[2] D. Kaplan *et al* "Shift current response as a probe of quantum geometry and electron-electron interactions in twisted bilayer graphene" Phys. Rev. Research 4, 013164 (2022)

[3] D. Kaplan *et al* "Twisted photovoltaics at terahertz frequencies" Phys. Rev. Research 4, 013209 (2022)

Figures

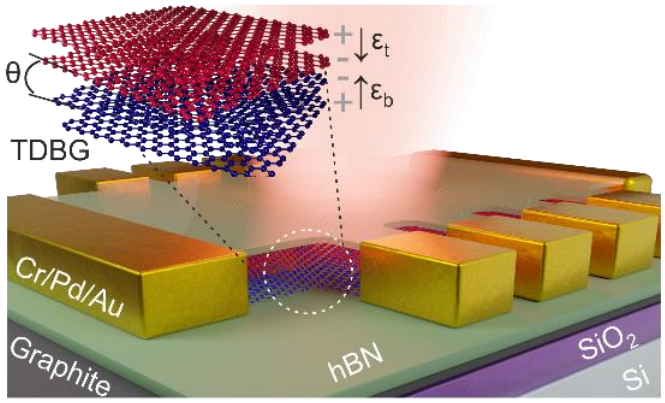

Figure 1: Schematic of photocurrent experiments in twisted graphene heterostructures