

Non-identical moiré twins in bilayer graphene

R. Ribeiro-Palau¹, Y. Hong¹, L. Farrar¹, E. Arrighi¹, V-H. Nguyen², M. DiLuca¹, G. Maffione¹, T. Taniguchi³, K. Watanabe³, D. Maily¹, J.-C. Charlier²

¹Université Paris-Saclay, CNRS, Centre de Nanosciences et de Nanotechnologies (C2N), 91120 Palaiseau, France

²Institute of Condensed Matter and Nanosciences, Université catholique de Louvain (UCLouvain), 1348 Louvain-la-Neuve, Belgium

³National Institute for Materials Science, 1-1 Namiki, Tsukuba 305-0044, Japan
Rebeca.ribeiro@uiversite-paris-saclay.fr

The relative angular alignment between 2D layers of a van der Waals (vdW) heterostructure can dramatically alter its fundamental properties [1]. A striking example is the recent observation of strongly correlated states and intrinsic superconductivity in twisted bilayer graphene [2]. Another remarkable effect of angular layer alignment, predicted for certain vdW heterostructures, is the emergence of phases of matter with non-trivial topological properties, where charge carriers flow without dissipation, being protected against perturbations. In graphene aligned with boron nitride (BN), such a phase has been predicted, with topological protection linked not to the spin, as commonly observed, but rather to the valley degree of freedom.

The experimental observations of these topological valley currents [3] has been largely put in question by theorist, results of numerical simulation [4] and recent scanning SQUID results [5]. In these, the observed non-local signal has been attributed mostly to localized states on the edge of graphene. In this talk, we will show how these two pictures are not incompatible and can be re-conciliated if we take the angular layer alignment into account.

References

- [1] Ribeiro-Palau et al., Science 361, 690 (2018)
- [2] Cao et al., Nature 556, 43 (2018).
- [3] Gorbachev et al., Science 436 (2014), Komatsu et al., Science Adv. 4, eaaq0194 (2018)
- [4] J M Marmolejo-Tejada et al., J. Phys. Mater. 1, 015006 (2018)
- [5] A. Aharon-Steinberg et al., Nature 593, 528 (2021)

Figures

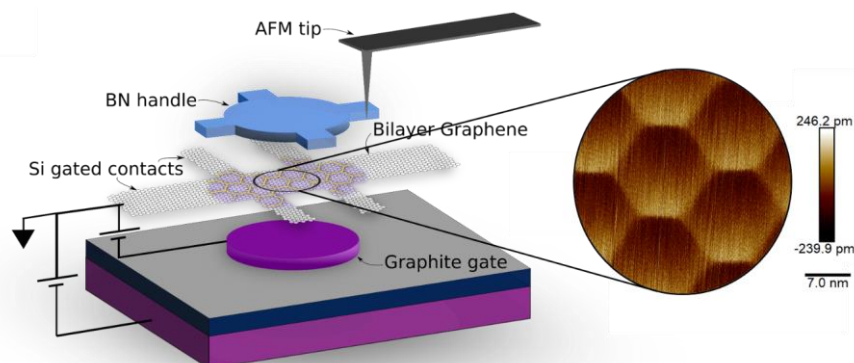


Figure: Schematics of our rotatable van der Waals heterostructure and AFM image of a bilayer graphene/BN moiré superlattice.