Imaging moiré mini bands in 2D materials by nano-ARPES

Felix Baumberger[1,2], Gianmarco Gatti[1], Julia Issing, Simone Lisi[1], Xiaobo Lu[3], Anna Tamai[1], Alberto Morpurgo[1], Louk Rademaker[1], Sense Jan van der Molen[4], Dmitri K. Efetov[3]

[1] *DQMP, University of Geneva, 24 Quai Ernest-Ansermet, 1211 Geneva 4, Switzerland*
[2] *Swiss Light Source, Paul Scherrer Institute, CH-5232 Villigen PSI, Switzerland*
[3] *ICFO, The Barcelona Institute of Science and Technology, Castelldefels, Barcelona, Spain*
[4] *Huygens Huygens-Kamerlingh Onnes Laboratory, Leiden Institute of Physics, Leiden University, Niels Bohrweg 2, 2333 CA Leiden, The Netherlands*

Felix.baumberger@unige.ch

Van der Waals bilayers stacked with a small twist-angle between the layers form lateral moiré superlattices. This profoundly affects the transport and optical properties of the materials, as exemplified by the recent discoveries of superconductivity in magic angle bilayer graphene [1] and of correlated insulating phases at integer and fractional filling in twisted transition metal dichalcogenides [2]. It is generally believed that these remarkable manifestations of many-body physics arise from flat minibands forming in the moiré superlattice.

Recent advances in sample fabrication and photoemission instrumentation now allow for direct electronic structure measurements of moiré systems fabricated with the top-down methods developed for transport and optical studies. In this talk, I will address the specific challenges of device fabrication for electron spectroscopy and discuss first nano-ARPES data on twisted bilayer graphene and transition metal dichalcogenide moirés [3,4].

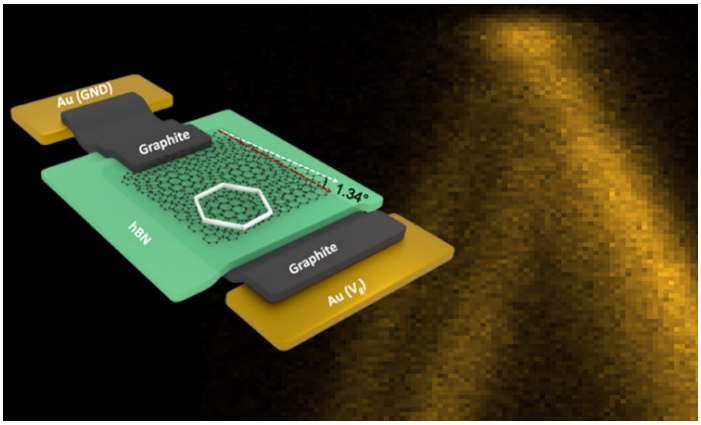

Fig. 1. Flat band in twisted bilayer graphene imaged by nano-ARPES [3].

[1] Y. Cao et al., *Unconventional superconductivity in magic-angle graphene superlattices*, Nature **556**, 80 (2018)
[2] K. F. Mak and J. Shan, *Semiconductor moiré materials*, Nature Nanotechnology **17**, 686 (2022)
[3] S. Lisi et al., *Observation of flat bands in twisted bilayer graphene*, Nature Physics **17**, 189 (2021)
[4] G. Gatti et al., *Observation of flat G moiré bands in twisted bilayer WSe_2*, arXiv:2211.01192 (2022)