Electric backaction on moiré mechanics

Héctor Ochoa
Department of Physics, Columbia University, New York, NY 10027, USA
ho2273@columbia.edu

Abstract

Layered van der Waals materials are formed by assembly of crystalline membranes that combine properties of both *hard* and *soft* condensed matter. Twisted devices are no exception: They form incommensurate structures plagued by soft vibrational modes that change locally the stacking arrangement. In this talk I will discuss the physics of these modes [1,2], how they impact the electronics of the devices [2,3] and, furthermore, how these *moiré phonons* can be manipulated by electric means. Specifically, I will show that lateral electric fields produce layer-shear mechanical forces [4]. In its simplest version the effect has a topological interpretation in terms of sliding Chern numbers defined on the mixed space of momenta and stacking configurations. Out-of-plane electric fields have an even more dramatic effect in moiré patterns of transition-metal dichalcogenides owing to the formation of local ferroelectric domains in these systems. The coupling to these domains enables the electric manipulation of the moiré phonon spectra [5]. In particular, we find a tendency of electric fields to soften the longitudinal *phason* mode of the moiré pattern which, in turn, has also a topological interpretation.

References

[1] HO, Phys. Rev. B **100**, 155426 (2019)
[2] HO and Rafael M. Fernandes, Phys. Rev. Lett. **128**, 065901 (2022)
[3] HO and Rafael M. Fernandes, Phys. Rev. B **108**, 075168 (2023)
[4] HO, Phys. Rev. B **107**, 165417 (2023)
[5] In preparation