Tnano 2020

International Workshop on Nanotechnology (Tnano20)
October 5 – 8, 2020, in Tbilisi, Georgia

BERRY PHASES IN THE MOIRÉ PATTERNS OF TWISTED TMD BILAYERS WITH UNIFORM AND NON-UNIFORM STRAINS

Wang YAO[1,2]

[1] Department of Physics, The University of Hong Kong
[2] HKU-UCAS Joint Institute of Theoretical and Computational Physics at Hong Kong, China
wangyao@hku.hk

Long wavelength moiré pattern in van der Waals stacked 2D materials has provided a powerful tool towards designer quantum materials that can extend the exotic properties of the building blocks. For band edge carriers located at the Brillouin zone corners (valleys), the interlayer coupling features sensitive dependence on the atomic registry between the constituting layers. In twisted TMDs homobilayers, such coupling in the moiré pattern manifests itself as a location-dependent Zeeman field acting on the active layer pseudospin, which exhibits a spatial texture that gives rise to non-Abelian Berry connections. We show that Abelian Berry phase in the adiabatic limit and geometric scalar correction together realizes fluxed superlattices tunable by twist angle, strain and interlayer bias, underlying the quantum spin Hall effect discovered in low energy mini-bands [1,2]. We will also discuss carrier dynamics in moiré patterns distorted by non-uniform strains, and show how the interplay of moiré interlayer coupling and strain together leads to non-Abelian Berry phase effects [3].

The work was supported by Research Grant Council of HKSAR (17302617, 17312916, C7036-17W).

References

[1] Hongyi Yu, Mingxing Chen, Wang Yao, *Giant magnetic field from moiré induced Berry phase in homobilayer semiconductors,* Natl. Sci. Rev. **7**, 12 (2020) .
[2] Dawei Zhai and Wang Yao, *Theory of tunable flux lattices in the homobilayer moiré of twisted and uniformly strained transition metal dichalcogenides,* https://arxiv.org/abs/2006.02306, Phys. Rev. Materials, in press.
[3] Dawei Zhai and Wang Yao, in preparation.