Heavy fermion physics in the thermoelectric transport of the MATBG flat bands

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In the flat bands of magic angle twisted bilayer graphene (MATBG), a myriad of low-temperature, many-body ground states emerge due to strong electronic interactions [1]. These varied ground states (including superconductivity. or the Pomeranchuk effect). suggested the coexistence of itinerating carriers and localized moments within the flat bands. Thermodynamic studies also evidenced strong electron-hole asymmetry in MATBG[2].
Here, we study the thermoelectric transport in the flat bands, governed by the Seebeck coefficient. We leverage the extreme sensitivity of the Seebeck coefficient to electron-hole asymmetry to investigate the electronic spectrum of correlated states in MATBG. Our devices are optically excited *pn* junctions on high-quality MATBG samples. Our findings reveal strong asymmetry of the low energy bands at the correlated states which can be naturally attributed to the existence of incoherent heavy fermion bands [3]. We model our findings via the Topological Heavy Fermion model [4].

Figures

a)

b)

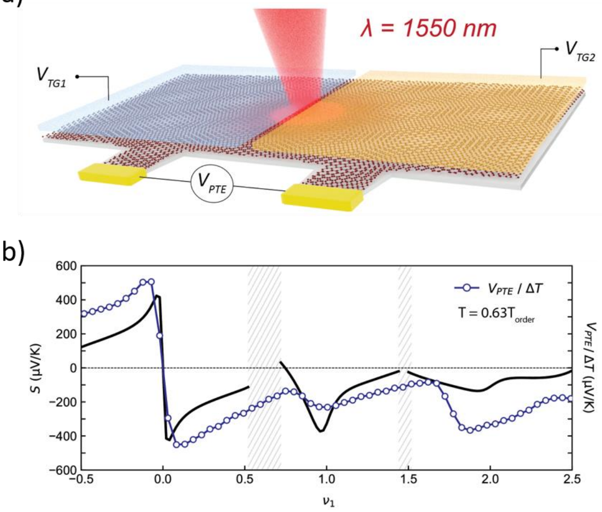

Figure 1: a) Schematic representation of the (photo-)thermoelectronic study of magic-angle twisted bilayer graphene *pn* junctions. b) Sign-preserving thermoelectricity at T = 10 K across the correlated states (blue circles). The black lines correspondsto the Seebeck coefficient of the KIVC ground states within the THF model.

References

[1] Balents L. *et* al, Nat. Phys. **16** (2020)
[2] Zondiner, U. *et al*, Nature **582** (2020)
[3] Luque Merino, R. *et al*, arXiv:2402.11749 (2024)
[4] Calugaru, D. *et al*, arXiv:2402.14057 (2024)