Exotic chiral topological phases at the quantum phase transitions

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Abstract :
A new phase of matter usually emerges when a given symmetry breaks spontaneously, which can involve charge, spin, valley, and layer degree of freedom. Twisting graphene multilayer to form a moiré superlattice leads to moiré flat bands where various correlated states are developed. Twisted double bilayer graphene (TDBG) is an electrical displacement field (D) tunable moiré system. Here, I will focus on the high-quality ABBA-stacked TDBG device and present the experimental observations of the field-tunable exotic phases, such as spin/valley/layer polarized phases, where interplays among correlation, isospin polarization, topology, layer polarization, and Landau quantization are important. In particular, I will discuss the emergence of novel chiral topological phases and giant magnetoresistance at the quantum phase transitions.

References

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[2] Y. Yuan, et al., Interplay of Landau quantization and interminivalley scatterings in a weakly coupled moiré superlattice, Nano Letters 24, 6722 (2024).
[3] J. Zhu, et al., Probing band topology in ABAB and ABBA stacked twisted double bilayer graphene, arXiv:2409.11023 (2024).

Figures

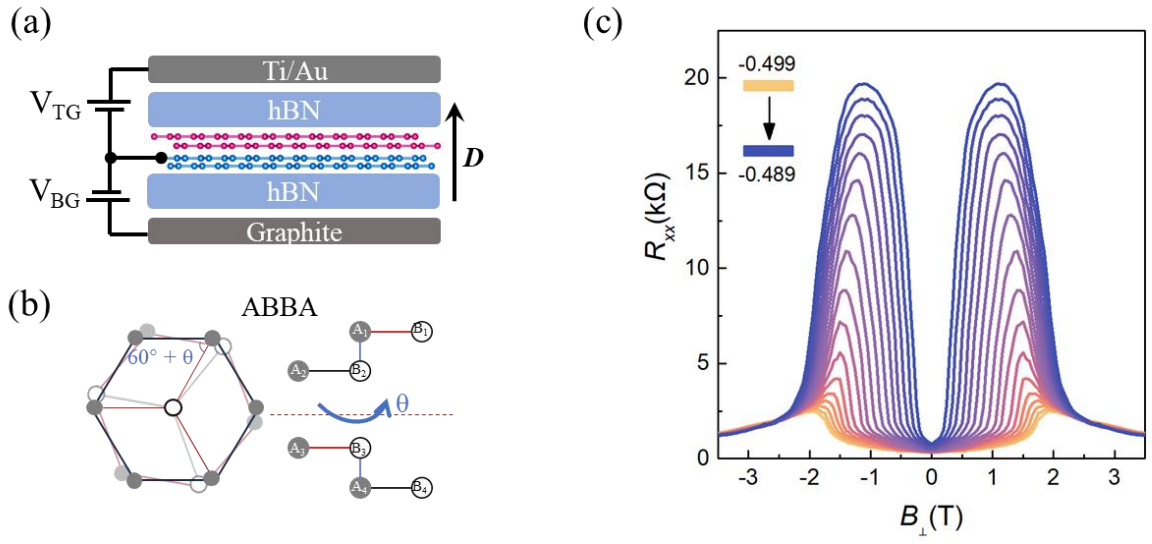

Figure 1: Schematics of ABBA-stacked TDBG Device (**a-b**) and giant magnetoresistance at the quantum phase transitions (**c**).