Toward Spin-Orbit-Coupled Superlattices in Ballistic Graphene Devices

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Quantum transport simulations based on the real-space Green's function formalism have shown their exceptional reliability in understanding and predicting transport properties of two-dimensional materials (2DMs). Graphene, the first truly 2DM discovered nearly two decades ago, is particularly suitable for combined studies of transport experiments and simulations. Here, two latest works on transport simulations for graphene devices are briefly shown: Magneto-transport in gate-controlled graphene superlattice [1] and spin-dependent transverse magnetic focusing in graphene on WSe2 [2]. Whereas previous studies [3] have shown rather good agreement between experiment and simulation for graphene superlattice devices, the purely theoretical work [1] can be regarded as a guide for further experimental magneto-transport studies. See Figure 1 below for the high-field simulation. The combined experimental and theoretical work [2], reports, to our knowledge, the first quantum transport simulation for realistic devices of graphene with strong spin-orbit coupling, successfully reproducing the transport features experimentally observed. As a natural combination of [1] and [2], we point out the way toward spin-orbit-coupled superlattices in ballistic graphene devices for future challenges.

References

[1] A. Mrenca-Kolasinska, S.-C. Chen, M.-H. Liu, arXiv:2304.07478.
[2] Q. Rao et al., arXiv:2303.01018.
[3] R. Huber et al., Nano Lett. **21**, 8046 (2020); R. Kraft et al., Phys. Rev. Lett. **125**, 217701 (2020).

Figures

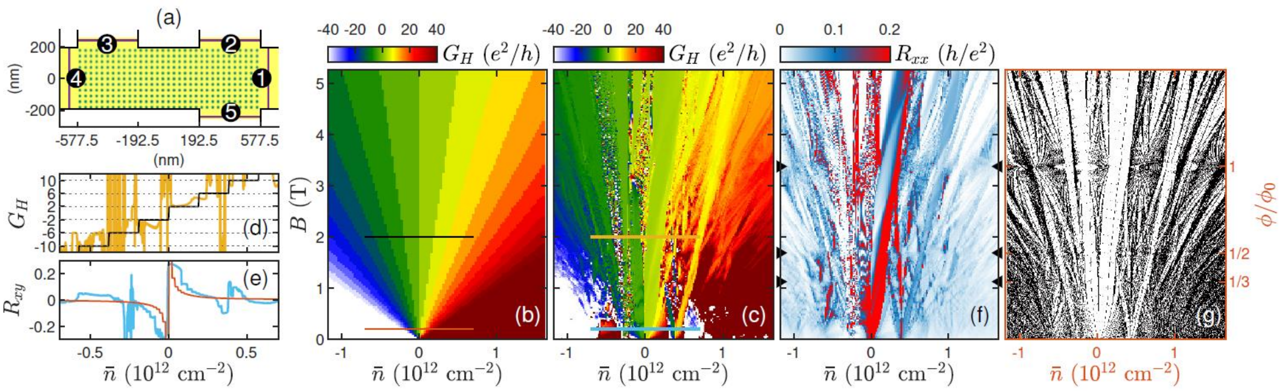

Figure 1: High-field magneto-transport simulation for a gate-controlled graphene superlattice device from [1], where detailed descriptions can be found.