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Quantum Point Contacts in Monolayer WSe_2

Abstract

Quantum point contacts (QPCs) have been realized in III-IV semiconductor heterostructures, and more recently in bilayer graphene and trilayer WSe_2 [1, 2]. These QPCs are fabricated in these two-dimensional systems using electrostatic gates, and require ballistic transport from source to drain contact to observe conductance quantization. In this work, we show that it is possible to achieve high-quality QPCs on monolayer WSe_2 due to improvements in materials synthesis and contact quality. Measurements down to millikelvin temperatures show clear conductance quantization over micron-sized source-drain length scales. In WSe_2, at zero field, a two-fold degeneracy is expected at the top of the valence band due to the presence of strong spin-orbit interactions. Surprisingly, we find that the observed conductance plateaus are quantized in units of e^2/h, indicating that the spin-valley degeneracy is lifted even without the application of magnetic fields. Further, the first plateau has a systematic dependence on charge carrier density and on applied magnetic field, in a manner similar to the "0.7-anomaly" reported in previous experiments on III-V semiconductors [3]. We will discuss the nature of the anomaly seen here and the relevance of spin-orbit coupling to transport through this system.

References

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[3] A P Micolich. *J. Phys.: Condens. Matter* (2011). **23** 443201.

Figures

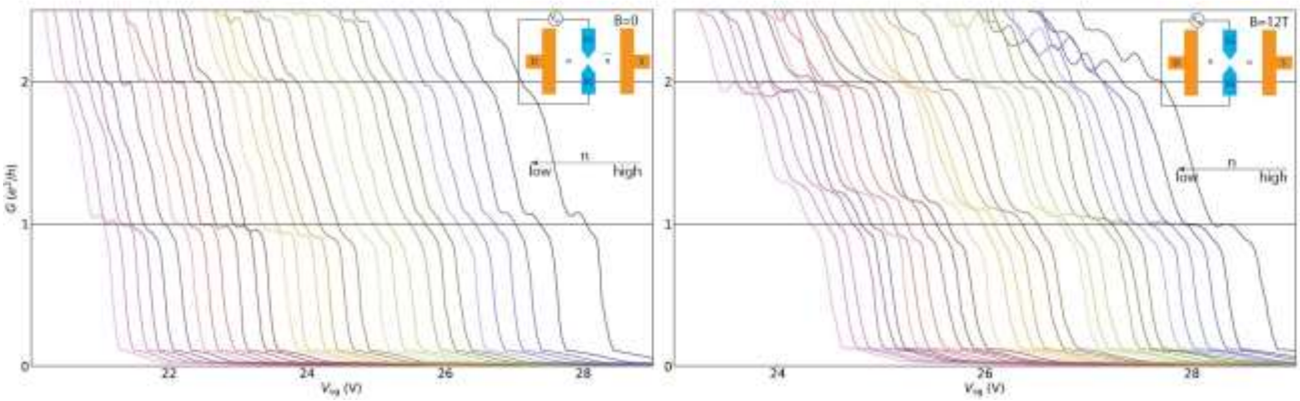

Figure 1: Conductance as a function of the split-gate voltage at zero magnetic field (left) and B=12T (right). The rightmost (leftmost) curves correspond to the highest (lowest) carrier density outside the QPC channel. Measurements are performed at 10mK.