Spin and valley degrees of freedom in a bilayer graphene quantum point contact: Zeeman splitting and interaction effects [1]

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We present a study on the lifting of degeneracy of the size-quantized energy levels in an electrostatically defined quantum point contact in bilayer graphene by the application of in-plane magnetic fields. We observe a Zeeman spin splitting of the first three subbands, characterized by effective Landè g-factors that are enhanced by confinement and interactions. In the gate-voltage dependence of the conductance, a shoulder-like feature below the lowest subband appears, which we identify as a 0.7 anomaly stemming from the interaction-induced lifting of the band degeneracy. We employ a phenomenological model of the 0.7 anomaly to the gate-defined channel in bilayer graphene subject to in-plane magnetic field. Based on the qualitative theoretical predictions for the conductance evolution with increasing magnetic field, we conclude that the assumption of an effective spontaneous spin splitting [2] is capable of describing our observations, while the valley degree of freedom remains degenerate [1].

References

[1] V. Gall, R. Kraft, I. V. Gornyi, R. Danneau, arXiv 2108.10098 (2022)
[2] H. Bruus, V. V. Cheianov, and K. Flensberg, Physica E: Low-dimensional Systems and Nanostructures 10, 97 (2001)

Figures

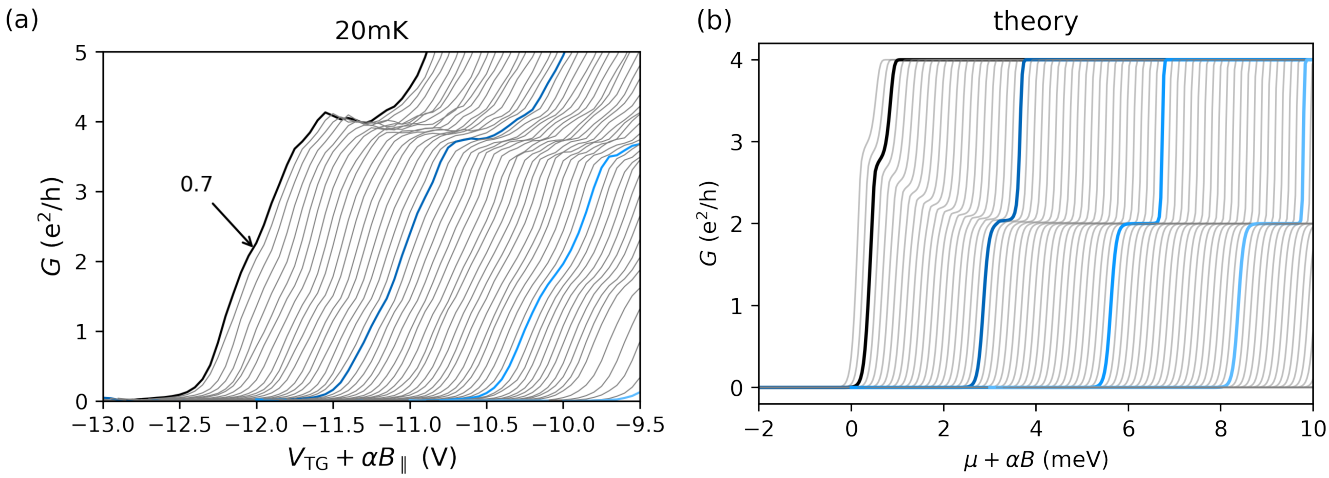

Figure 1: (a) Measured differential conductance G as a function of top-gate voltage V_{TG} for in-plane magnetic fields B between 0.2T (black line) and 6T (light blue line) with horizontal shifts. (b) Differential conductance obtained from the extension of the phenomenological model [2] to four subbands, assuming an effective spontaneous spin splitting. Colored lines correspond to the same magnetic fields as in (a). Figures taken from [1].