Probing the change of the spin orbit coupling by pressure in graphene WSe_2 based heterostructures with the help of quantum Hall effect

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Graphene is an ideal material as a spin transport channel due to its excellent electrical properties and the small spin orbit coupling (SOC), which leads to a long spin relaxation length [1]. However, the lack of SOC also inhibits the electrical control of spin information. This can be solved by placing the graphene in proximity of a material which has a large SOC,like WSe_2, which enhances the SOC in graphene [2]. Furthermore, the proximitized SOC can be tuned with pressure (making it possible to study properties of the graphene with different SOC) [3,4].

Here, we investigate the evolution of the SOC in bilayer graphene (BLG)/WSe2 heterostructures with pressure. We use Landau level spectroscopy [5] to probe the effect of pressure. We studied devices in two different geometries: a BLG encapsulated with WSe_2 on both sides and only on one side. By tuning the charge density and the electric field and studying Landau level crossings the SOC strength can be obtained, which we found to increase with pressure.

In the WSe_2/BLG/WSe_2 geometry we also investigate the inverted phase, which occurs when the sign of the induced SOC is the opposite for the top and bottom graphene layers [6]. The measurements indicate this phase becomes more stable with pressure.

References

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Figures

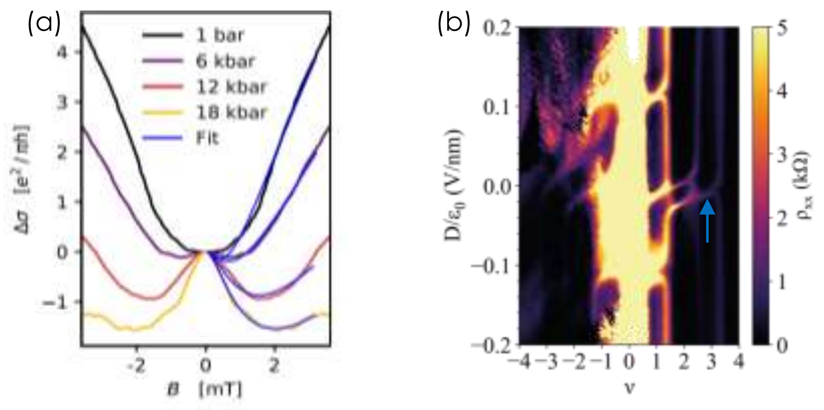

Figure 1: (a) Magnetoconductivity curves at different pressures. The appearance of weak anti-localization by increasing the pressure is a clear signature of the enhancement of the SOC [3]. (b) Resistivity of a BLG/WSe2 device as a function of the electric displacement field and Landau level filling at 14 T and 4.2 K. A crossing point is indicated with the blue arrow.