Generation and control of non-local chiral currents in graphene superlattices by orbital Hall effect

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In this study, we present electrical measurements on single-layer graphene Hall-bars that are encapsulated within hexagonal boron nitride thin films and have a controlled twisting angle between the layers. The samples were fabricated using a cryo-etching method [1], which allowed us to achieve unprecedented control over the roughness of the edges. The entire structure was placed onto a thin graphite back gate to prevent dopants or trapped charges that can arise from standard semiconductor substrates [2].

We conducted a comprehensive study of the magnetotransport reponse of the structure at different temperatures, applying an in to-out-of-plane external field and paying special attention to the possible effects arising due to the Moiré pattern.

We present local and non-local signals and report a striking chiral behavior of the nonlocal currents at low magnetic fields resulting from a charge carrier-valley coupling. This behavior is in stark contrast to previous results of similar structures at different twisting angles [3]. The presented chiral response is found to be caused by the orbital valley Hall effect [4,5], with thorough theoretical calculations supporting our experimental results [6].

References

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