Chiral nonlocal currents in single layer graphene from orbital valley Hall effects

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In this work we report on electrical measurements on single layer graphene Hall-bars encapsulated within hexagonal boron nitride thin films with controlled twisting angle between the layers. The samples have been fabricated by means of a cryo-etching method [1], permitting an unprecedented control of the roughness of the edges. The whole structure was placed onto a thin graphite back gate, preventing dopants or trapped charges arising from the standard semiconductor substrates [2].

We have carried out an exhaustive study of the electrical response at different temperatures when an in-to-out-of-plane external magnetic field has been exerted with special attention to the possible effects arising due to the Moiré pattern. Local and non-local signals are presented and a striking chiral behaviour at low magnetic fields of the nonlocal currents resulting from a charge carrier-valley coupling is found, in stark contrast with previous results of similar structures at different twisting angles [3]. Orbital valley Hall effect [4,5] has been found responsible for the presented chiral response with thorough theoretical calculations supporting the experimental results [6].

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