Valley currents via ballistic edge modes in graphene superlattice near the main Dirac point

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In carefully stacked two-dimensional materials, topological bands generate Hall like conductivity and topologically protected edge states in zero magnetic field. By placing single layer graphene (SLG) on hexagonal boron nitride (h-BN), it might be possible to transform SLG into a topological phase by varying their crystallographic alignment. Recent measurements of nonlocal resistances (Rnl)[1] in a narrow energy range focusing with the secondary Dirac point (SDP) [2] in SLG/h-BN superlattice Hall bars have been interpreted as arising due to the valley Hall effect and quantum valley Hall state. Here we report h-BN/SLG/h-BN Hall bars which have a negligible Rnl of SDPs, but at the main DP Rnl is reaching quantum-limit at 9 K. We investigate valley currents near the main Dirac point [3] and also demonstrate nonlocal measurements over a distance of 15 μm indicating ballistic behaviour in good agreement with recent theoretical works [4] that are trying to shed some light into these intriguing experiments.

REFERENCES

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FIGURES

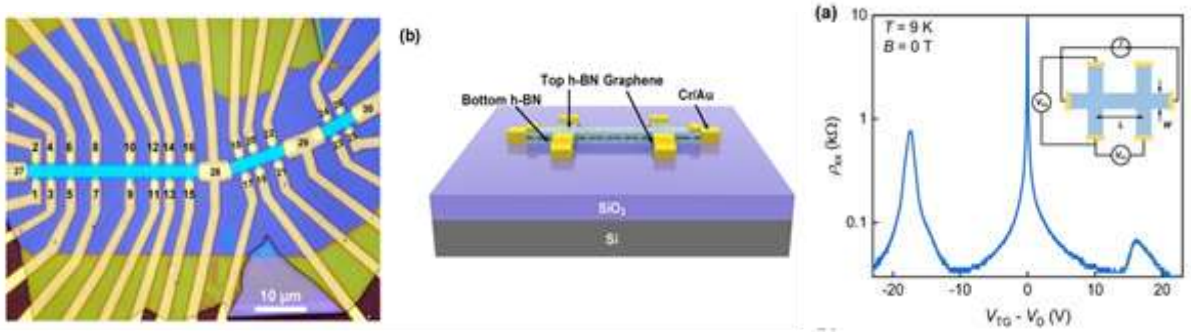

Figure 1: From left to right, h-BN/SLG/h-BN device structure via optical micrograph, schematic illustration of a typical device, Longitudinal resistivity (ρ_{xx}) vs gate voltage ($V_{TG} - V_D$) in zero magnetic field at 9 K. Inset shows schematic illustrations of the local measurement setup, where L is the distance between the current path and voltage probes, and W is the device width.