Miuko Tanaka[1]
Yuya Shimazaki[2], Ivan Borzenets[1], Takashi Taniguchi[3], Kenji Watanabe[3], Michihisa Yamamoto[1] and Seigo Tarucha[1]
[1]Depertment of Applied Physics, University of Tokyo, Tokyo, Japan
[2]Institute of Quantum Electronics, ETH Zurich, Zurich, Switzerland
[3]Advanced Materials Laboratory, National Institute for Material Science, Tsukuba, Japan
tanaka@meso.t.u-tokyo.ac.jp

Non-local transport in symmetry broken state of bilayer graphene under magnetic field

It was theoretically established that a gapped state appears near the charge neutrality point of bilayer or ABC-stacked few layer graphene owing to the electron-electron interaction [1-3]. Subsequent experimental works employing suspended few layer graphene revealed the layer anti-ferromagnetic nature of the gapped state [4-7]. Since time reversal symmetry is broken, non-zero spin and valley contrasting Berry curvature leads to anomalous transport near the gap, where the valley current flows opposite direction between layers hosting opposite spin [8].

In this work, we aim to detect experimentally such anomalous transport. We fabricated dual-gated bilayer graphene encapsulated by hexagonal-Boron Nitride in a Hall bar geometry and performed non-local resistance measurement (Fig.1). We observe large non-local resistance near the charge neutrality point close to zero perpendicular electric field under a perpendicular magnetic field larger than a few tesla (Fig.2). The observed non-local resistance is several orders of magnitude larger than the value expected from the classical current diffusion or van der Pauw formula, thus implying existence of the anomalous transport. Detailed mechanism of the anomalous transport will be presented in the poster.

References

[1] H. Min *et al.*, Phys. Rev. B 77 (2008) 041407(R)
[2] F. Zhang *et al.*, Phys. Rev. B 81 (2010) 041402(R)
[3] S. Raghu *et al.*, Phys. Rev. Lett. 100 (2008) 156401
[4] J. Martin *et al.*, Phys. Rev. Lett. 105 (2010) 256806
[5] R. T. Weitz *et al.*, Science 330 (2010) 812
[6] J. Velasco Jr *et al.*, Nat. Nanotechnol. 7 (2012) 156
[7] Y. Lee *et al.*, Nat. Comm. 5 (2014) 5656
[8] F. Zhang *et al.*, Phys. Rev. Lett. 106 (2011) 156801

Figures

Fig. 1

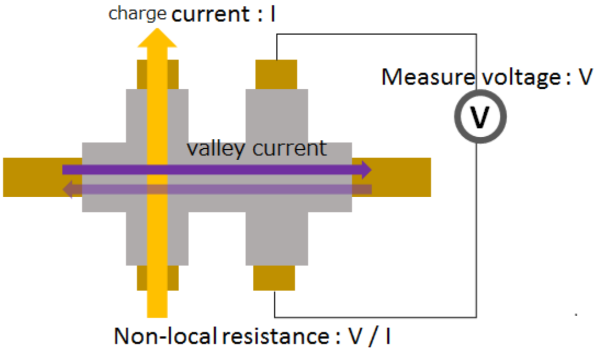

Fig. 2

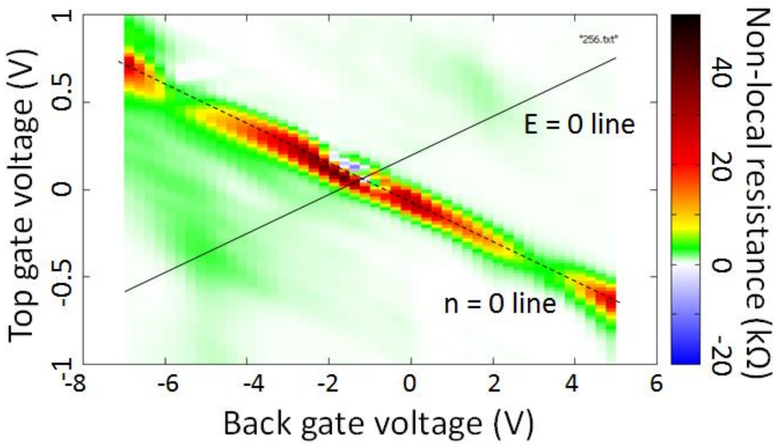

Figure 1 : Schematic of the non-local measurement setup. When charge current is applied, valley current is induced perpendicular to it due to non-zero berry curvature. In LAF, direction of valley current is opposite for opposite spin (deep purple and light purple arrow) because sign of berry curvature depend not only on valley but also on spin.

Figure 2 : Non-local resistance measured at 3K under the magnetic field of 5T. Using dual-gate, we can control the electric field perpendicular to graphene plane and carrier density independently. Solid line indicate electric field zero, and dotted line indicate carrier density zero line. We can see enhance of non-local resistance near the E=0, n=0 point.