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Superconductivity in Bilayer Graphene/hBN Superlattices II – More on Experiments and Possible Scenarios –

Based on 'Superconductivity in Bilayer Graphene/hBN Superlattices I -Main Results-', we continue to discuss the superconductivity (SC) in the bilayer-graphene/hBN superlattices [1]. The key points are (I) Origin/Pairing Symmetry of the SC (II) Universality Class of the SC transition and the 'quantum-limited' SC (III) Possible 'hidden order' and its critical fluctuations (IV) Vortex State (V) Normal State (VI) Routes to 'high-Tc SC' built-in transistors. Note that SC has been realized in our devices without fine tuning to the point with the vanishing velocity/flat band i.e. 'without magic' [2].

(I) A possible role of the van Hove singularity (vHs) is discussed through the estimation of the low-field Hall effect. Some hints for the SC pairing symmetry are identified.
(II) The SC transition is identified with the BKT(Berezinskii-Kosteritz-Thouless) universality class. A large SC fluctuation is observed in the 'quantum limit'.
(III) Possible 'hidden orders' are discussed, which can be related to a scenario for the Cooper pairing (combined with phonon).
(IV) Preliminary results for the vortex state are shown. In a genuine 2D SC, a large thermal/quantum fluctuation is expected with an enhanced Pauli paramagnetism. Furthermore, the quantum Hall states reside nearby.
(V) Also in the normal state, scattering mechanism of the quasiparticles is non-trivial. Roles of e.g. phonon/Coulomb interaction(Umklapp process)/critical fluctuation/disorder are discussed.
(VI) Routes to 'high-Tc SC' built-in transistors are proposed.

References

[1] S. Moriyama, Y. Morita, K. Komatsu, K. Endo, T. Iwasaki, S. Nakaharai, Y. Noguchi, Y. Wakayama, E. Watanabe, D. Tsuya, K. Watanabe, T. Taniguchi, arXiv:1901.09356.
[2] Y. Cao, V. Fatemi, S. Fang, K. Watanabe, T. Taniguchi, E. Kaxiras, P. Jarillo-Herrero, Nature 556 (2018) 43.

Figures

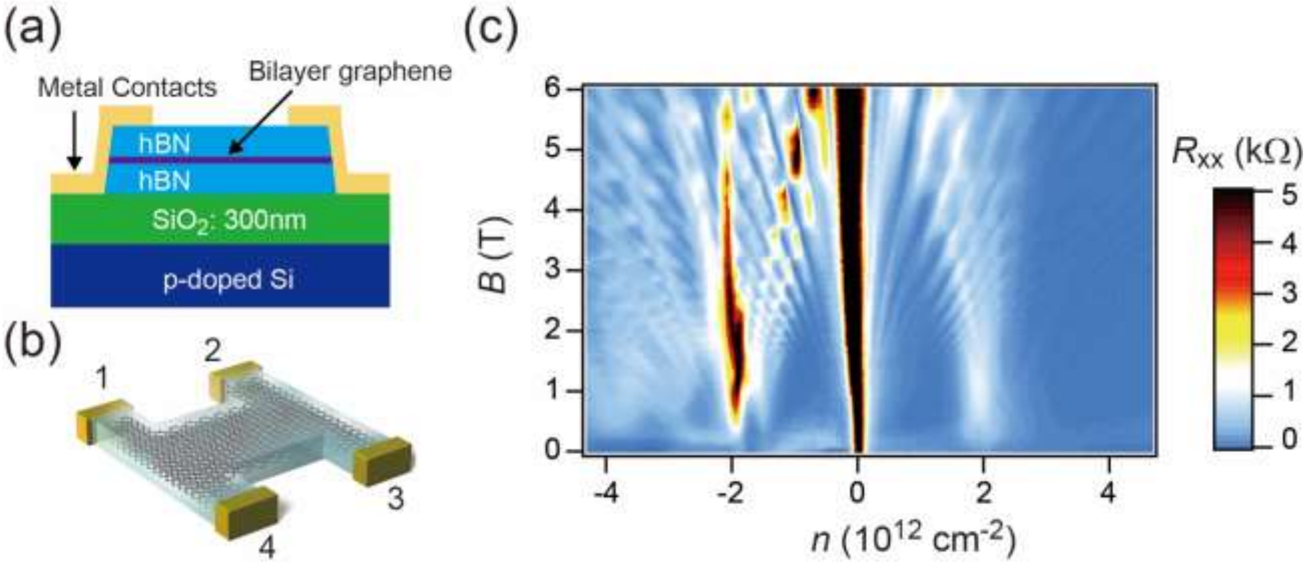

Figure 1: (a,b) Schematics of our devices. (c) Intensity map of the longitudinal resistance as a function of the gate voltage V_g and the magnetic field B (applied perpendicular to the substrate) at 6 K for our device.