# Robust Interlayer-Coherent Quantum Hall States in Twisted Bilayer Graphene

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We introduce a novel two-dimensional electronic system with ultrastrong interlayer interactions, namely twisted bilayer graphene with a large twist angle, as an ideal ground for realizing interlayer-coherent excitonic condensates. In these systems, subnanometer atomic separation between the layers allows significant interlayer interactions, while interlayer electron tunneling is geometrically suppressed due to the large twist angle [1]. By fully exploiting these two features we demonstrate that a sequence of odd-integer quantum Hall states with inter-layer coherence appears at the second Landau level (N = 1). Notably the energy gaps for these states are of order 1 K, which is several orders of magnitude greater than those in GaAs. Furthermore, a variety of quantum Hall phase transitions are observed experimentally. All the experimental observations are largely consistent with our phenomenological model calculations. Hence, we establish that a large twist angle system is an excellent platform for high-temperature excitonic condensation.

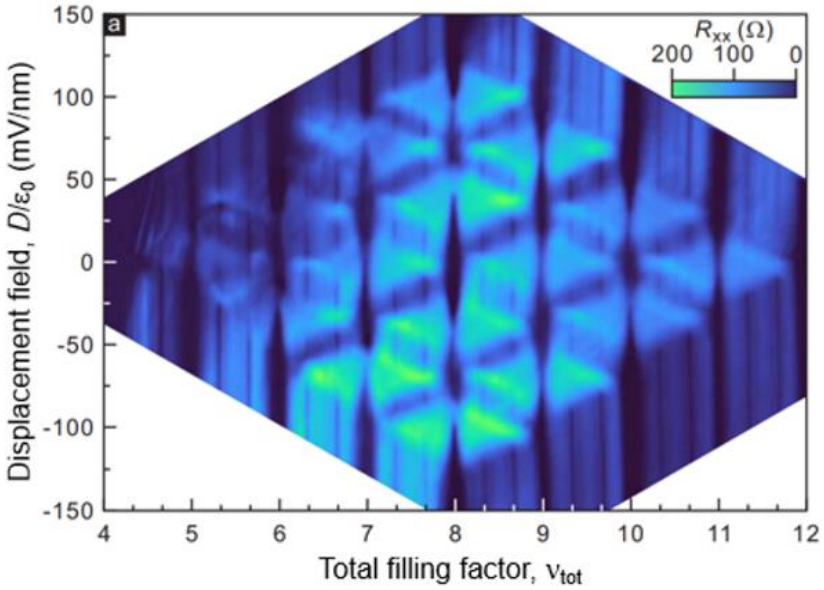


Fig. 1. Cascade of quantum Hall states in the N = 1 LL of twisted bilayer graphene.

References

[1] Y. Kim et al., Phys. Rev. Lett. **110** 096602 (2013).