Higher-order Bragg gaps in the electronic band structure of bilayer graphene renormalized by recursive super moiré potential.

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Abstract
Heterostructures of graphene encapsulated between two thin, rotationally misaligned hBN flakes form a stimulating platform for probing topological phases of matter [1]. The difference in the lattice constants of hBN and graphene and the angular misalignment between the layers generate two distinct long-wavelength moiré superlattices at the top and bottom interfaces of graphene with hBN [2]. In this work We present our findings on the recursive band gap engineering of chiral fermions in bilayer graphene doubly aligned with hBN. By utilizing two interfering moire potentials, we generate a super moiré pattern which renormalizes the electronic bands of the pristine bilayer graphene, resulting in higher-order fractal gaps even at very low energies. These Bragg gaps can be mapped using a unique linear combination of periodic areas within the system. To validate our findings, we used electronic transport measurements to identify the position of these gaps as functions of the carrier density and establish their agreement with the predicted carrier densities and corresponding quantum numbers obtained using the continuum model as shown in fig1. Our work provides direct experimental evidence of the quantization of the area of quasi-Brillouin zones in super moiré systems [3]. It fills essential gaps in understanding the band structure engineering of Dirac fermions by a recursive doubly periodic superlattice potential.

References

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Figures

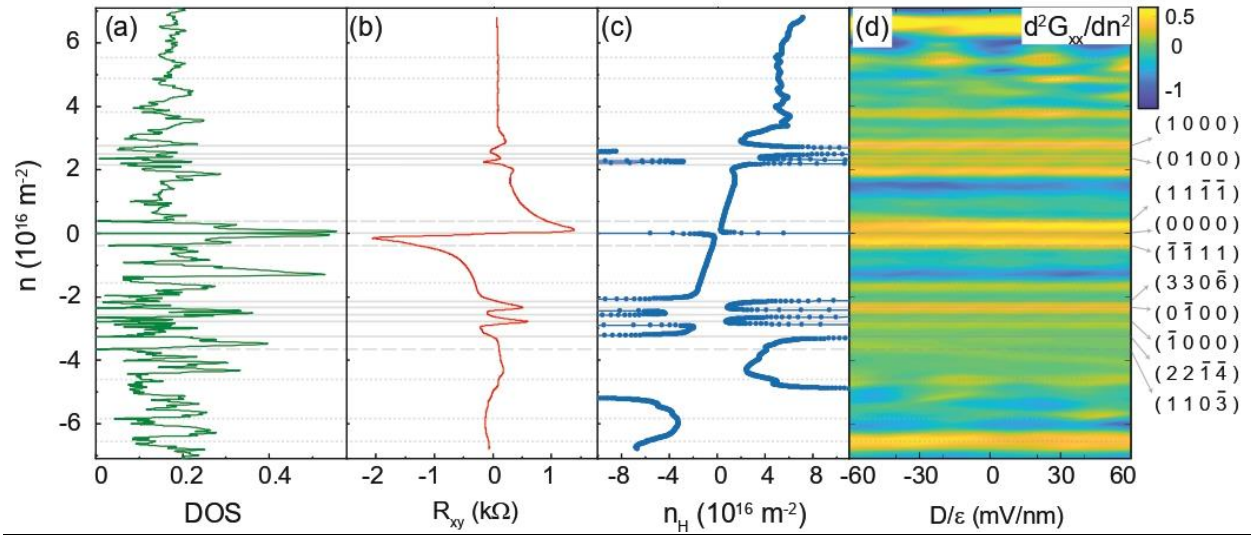

Figure 1: Experimentally obtained and theoretically calculated Bragg gaps. (a) Plot of the calculated density of states (DOS) for $\theta_b = 0.026°$ and $\theta_t = 0.44°$. Horizontal lines represent prominent dips in the DOS. (b) Plot of transverse resistance R_{xy} versus n measured at B = 0.7 T and T = 2 K. (c) Plot of hall carrier density n_H versus n. (d) Map of the normalized d^2G_{xx} (B = 0)/dn^2 in the n − D plane; the data have been plotted on a logarithmic scale. The quantum numbers of the Bragg gaps expected at these values of n are marked on the right.