Symmetry broken Chern insulator in magic angle twisted bilayer graphene

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Flat bands in magic-angle twisted bilayer graphene (MATBG) have recently emerged as a rich platform to explore strong correlations [1], superconductivity [2–5] and magnetism [3,6,7]. However, the phases of MATBG in a magnetic field and what they reveal about the zero-field phase diagram remain relatively uncharted. Here we report a rich sequence of wedge-like regions of quantized Hall conductance with Chern numbers C=±1, ±2, ±3 and ±4, which nucleate from integer fillings of the moiré unit cell ν=±3, ±2, ±1 and 0, respectively. We interpret these phases as spin- and valley-polarized many-body Chern insulators. The exact sequence and correspondence of the Chern numbers and filling factors suggest that these states are directly driven by electronic interactions, which specifically break the time-reversal symmetry in the system. We further study the yet unexplored higher-energy dispersive bands with a Rashba-like dispersion. The analysis of Landau-level crossings enables a parameter-free comparison to a newly derived 'magic series' of level crossings in a magnetic field and provides constraints on the parameters of the Bistritzer–MacDonald MATBG Hamiltonian. Overall, our data provide direct insights into the complex nature of symmetry breaking in MATBG and allow for the quantitative tests of the proposed microscopic scenarios for its electronic phases.

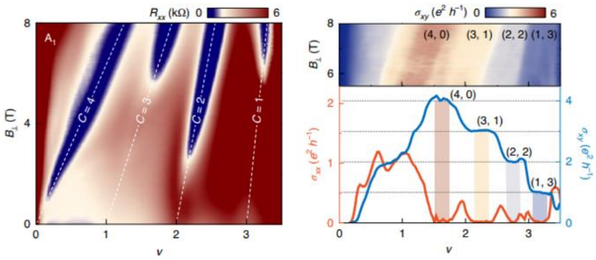

Figure1: **Emergent CCIs in MATBG.** Colour plot of R_{xx} versus ν and $B_\perp$, measured at T= 1.5 K. The white lines indicate the trajectories of four different topologically non-trivial Chern gaps with (C, ν) indices of (4, 0), (3, 1), (2, 2) and (1, 3). Corresponding Hall conductance σ_{xy} versus ν and B⊥ (top) and line cuts showing quantized σ_{xy} and vanishing longitudinal conductance of the Chern insulators at B⊥ = 8 T (bottom).

References:

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