Anomalous integer quantum Hall effect in AA-stacked bilayer graphene

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The peculiar quantum Hall effects of chiral Dirac fermions in monolayer [1] and AB-stacked bilayer graphene[2] have been investigated widely both in theoretical and experimental works and greatly intrigued physicists in recent years. We notice that although AB stacking is predicted to be energetically favored over AA stacking in ab initio density-functional theory (DFT) calculation, AA-stacked bilayer graphene (BLG) has been successfully fabricated in experiments [3]. Furthermore, we find that the band structure of AA-stacked bilayer graphene is distinct from monolayer and AB-stacked bilayer graphene through tight-binding calculations and therefore expect that the quantum Hall effect (QHE) in the AA-stacked could be quite different from that in the latter two systems. In this work, we calculate the quantized Hall conductivity σ_{xy} within linear response theory by using Kubo formula [4]. Interestingly, we find that QHE in AA-stacked BLG indeed possesses three unique characteristics: the filling factor $\nu = 0$ plateau, the periodic 8e2/h-steps, and the strong dependence on magnetic field and chemical potential.

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