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Tunable zero-line modes via magnetic field in bilayer graphene

KE WANG, ZHENHUA QIAO, Univ of Sci & Tech of China — Zero-line modes appear in bilayer graphene at the internal boundary between two opposite vertical electrostatic confinements. These one-dimensional modes are metallic along the boundary and exhibit quantized conductance in the absence of inter-valley scattering. However, experimental results show that the conductance is around 0.5 e^2/h rather than quantized. This observation can be explained from our numerical results, which suggest that the scattering between zero-line mode and bound states and the presence of atomic scale disorders that provide inter-valley scattering can effectively reduce the conductance to about 0.5 e^2/h. We further find that out-of-plane magnetic field can strongly suppress these scattering mechanisms and gives rise to nearly quantized conductance. On one hand, the presence of magnetic field makes bound states become Landau levels, which reduces the scattering between zero-line mode and bound states. On the other hand, the wave function distributions of oppositely propagating zero-line modes at different valleys are spatially separated, which can strongly suppress the inter-valley scattering. Specifically speaking, the conductance can be increased to 3.2 e^2/h at 8 T even when the atomic Anderson type disorders are considered.

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