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Experimental realization of gate controlled topological conducting channels in bilayer graphene J. LI, K. J. MCFAUL, Z. ZERN, J. ZHU, Department of Physics, Penn State University, University Park, USA, K. WANG, Y. F. REN, Z. H. QIAO, ICQD, USTC, Hefei, China, K. WATANABE, T. TANIGUCHI, National Institute for Material Science, 1-1 Namiki, Tsukuba, Japan — Manipulating the valley degree of freedom in two-dimensional honeycomb lattices can potentially lead to a new type of electronics called valleytronics. In electrically gapped bilayer graphene, the broken inversion symmetry leads to non-zero and asymmetric Berry curvature Ω in the K and K$'$ valleys of the Brillouin zone. Reversing the sign of Ω at the internal line junction of two oppositely gated bilayer graphene is predicted to yield counter-propagating edge modes, the so-called kink states, with quantized conductance of $4e^2/h$ in the absence of valley mixing. We have overcome fabrication challenges to implement high-quality hBN encapsulated, dual-split-gates structures necessary to observe the kink states. Here I present experimental evidences of the kink states. In the absence of a magnetic field, the kink states have a mean free path of a few hundred nm. Ballistic conductance of $4e^2/h$ is achieved in a perpendicular magnetic field. We discuss the potential valley-mixing mechanisms and the role of the magnetic field. Experimental results are supported by numerical studies. We will also discuss ongoing efforts in realizing valley-controlled transmission and guiding of the kink states, which is a significant step towards the development of valleytronics.

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