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**Valley-symmetric quasi-1D transport in ballistic graphene**[1]

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We present our recent studies on gate-defined valley-symmetric one-dimensional (1D) carrier guiding in ballistic monolayer graphene [1] and valley-symmetry-protected topological 1D transport in ballistic bilayer graphene [2]. Successful carrier guiding was realized in ballistic monolayer graphene even in the absence of a band gap by inducing a high distinction (˜more than two orders of magnitude) in the carrier density between the region of a quasi-1D channel and the rest of the top-gated regions. Conductance of a channel shows quantized values in units of $4e^2/h$, suggesting that the valley symmetry is preserved. For the latter, the topological 1D conduction was realized between two closely arranged insulating regions with inverted band gaps, induced under a pair of split dual gating with polarities opposite to each other. The maximum conductance along the boundary channel showed $4e^2/h$, again with the preserved valley symmetry. The 1D topological carrier guiding demonstrated in this study affords a promising route to robust valleytronic applications and sophisticated valley-associated functionalities based on 2D materials. [1]. M. Kim, J.-H. Choi, S.-H. Lee, K. Watanabe, T. Taniguchi, S.-H. Jhi, and H.-J. Lee, Nature Physics **12**, 1022 (2016). [2]. J. Lee, K. Watanabe, T. Taniguchi, and H.-J. Lee, submitted.

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