Resonant states and valley current polarization in gated MoS_2 nanoribbons

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Single layers of MoS_2 constitute a new class of two-dimensional semiconductors with promising applications in novel electronics that exploits spin and valley properties of charge carriers [1]. By the means of tight-binding [2] transport calculation we investigate the valley properties of a single-layer nanoribbon. We characterize the dispersion relation of the ribbon and point out the presence of bands corresponding to the edge modes, modes with distinct K and K' polarization, and higher-energy bands corresponding to Q valleys. We show that current flowing through a locally gated metallic-zigzag ribbon, can be suppressed due to opposite localization of the edge modes in the regime of the inverted band gap and explain appearance of energy-equidistant resonant states due to quasi-bound edge states. Finally, we present that due to band mixing in a side-gated ribbon valley polarization of the current can be achieved, important in the context of electrical measurements of valley hall effect [3].

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