Layertronics – the layer localization control of topological states in bilayer graphene with a gate voltage

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Experiments in gated bilayer graphene with stacking domain walls show a couple of topological gapless states protected by no-valley mixing. We investigate these states under gate voltages [1,2]. We find that the layer localization of the two states switches non-trivially between layers depending on the applied gate voltage magnitude. The control of the carriers localization in distinct layers along domain walls opens the possibility for the design of layertronic devices, which could be exploited in addition to other degrees of freedom, like valley, spin and charge, in graphene-based electronics. The localization analysis is performed using atomistic models, which allow us to elucidate the origin of topological gapless states, i.e., to indicate the bands of single-layer graphene they arise from. Based on this analysis we provide a model Hamiltonian with analytical solutions, which explains the layer localization as a function of the ratio between the applied potential and interlayer hopping.

References

[1] W. Jaskólski, M. Pelc, L. Chico and A. Ayuela, Nanoscale, 2016,8, 6079-6084.
[2] W. Jaskólski, M. Pelc, G. W. Bryant, L. Chico, A. Ayuela, 2D Materials. 2018 xxx, xxxx.

Figures

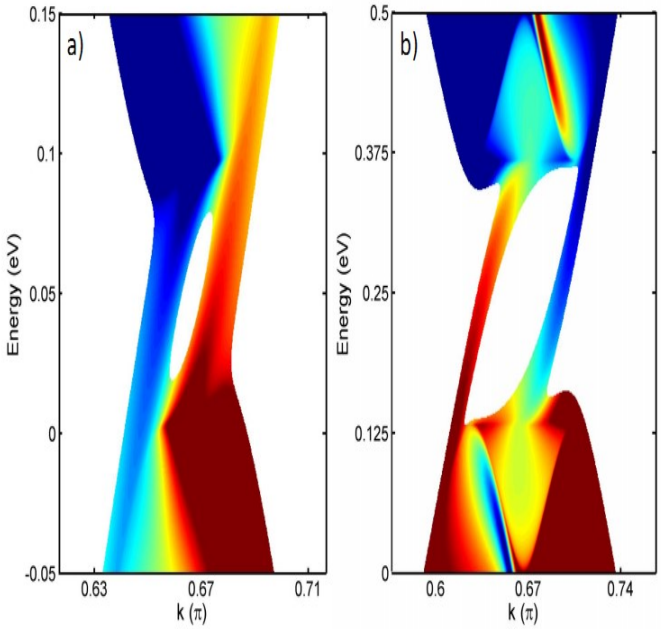

Figure 1: Topological gapless modes of bilayer graphene with stacking domain wall for two values of the gate voltage, V=0.1 eV (a) and V=0.5 eV (b). Color reflects the localization in top (blue) or bottom (red) layer.