Correlated Topological States in Graphene Nanoribbon Heterostructures

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Finite graphene nanoribbon (GNR) heterostructures host intriguing topological in-gap states [1]. These states may be localized either at the bulk edges or at the ends of the structure. Here we show that correlation effects play a key role in these systems: they result in increased magnetic moments at the ribbon edges accompanied by a significant energy renormalization of the topological end states, even in the presence of a metallic substrate [2].
We present simulations of 7-9-armchair-GNRs based on a Green functions method with GW self-energy applied to an effective Hubbard model. Our computed results for the differential conductance are in excellent agreement with experimental observations [3]. Furthermore, we discover a striking, novel mechanism that causes an energy splitting of the nonzero-energy topological end states for a weakly screened system. We predict that similar effects should be observable in other GNR heterostructures as well.

References

[1] T. Cao et al., Phys. Rev. Lett., 119 (2017) 076401
[2] J.-P. Joost, A.-P. Jauho, M. Bonitz, Nano Letters, 19 (2019) 9045-9050
[3] D. J. Rizzo et al., Nature, 560 (2018) 204-208

Figures

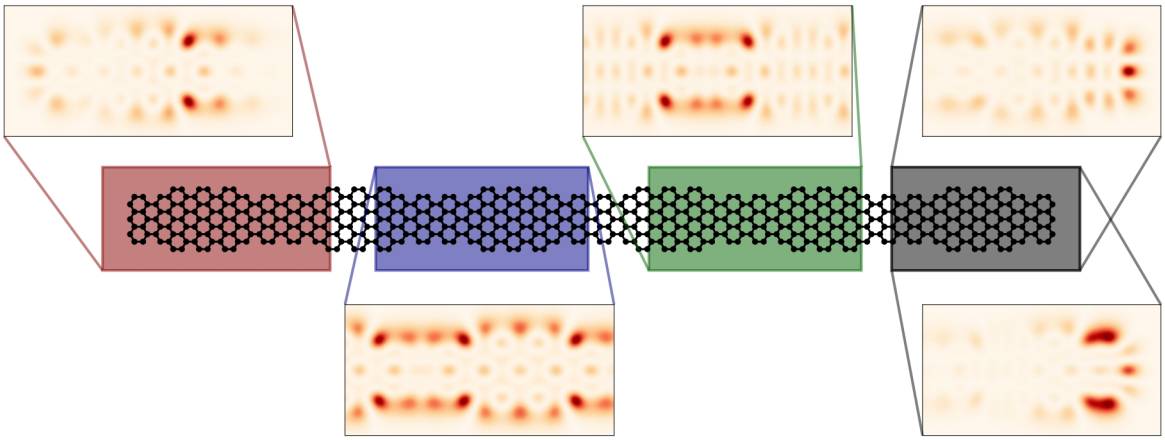

Figure 1: The GNR heterostructure (center) exhibits localized topological states depending on its shape and width. The local electron distribution corresponding to these topological states is visualized by the dark red areas in the boxes.