Edge state crossing in a multi-band tight-binding model of graphene

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The description of Dirac electrons in graphene is performed using a multi-band tight binding model [1]. When considering a finite graphene sample, edge states cross the band gap and connect the Dirac cones at the K and K' point. The chirality is the essence of the topological character of graphene [2], causing these gap crossings.
In this work, we include electron-electron interactions via a self-consistent mean-field approach and different magnetic phases of the edge states are examined. Various types of spin-orbit coupling modify the topological character of the edge states [2,3]. We discuss the influence of intrinsic, Bychkov-Rashba-type and strain-induced spin-orbit coupling on the crossing. We evaluate different observables, such as chirality and magnetization, and discuss the influence of spin-orbit coupling on the topological nature of graphene.

References

[1] Konschuh, S., Gmitra, M. and Fabian, J. Phys. Rev. B 82 (2010) 245412
[2] Kane, C. L . and Mele, E. J., Phys. Rev. Lett. 95 (2005) 226801
[3] van Gelderen, R. and Morais Smith, C. Phys. Rev. B 81 (2010) 125435

Figures

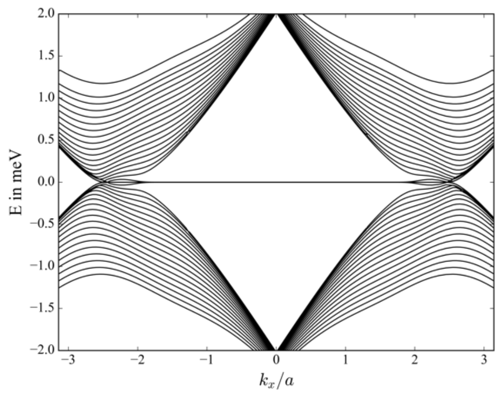

Figure 1: The band structure of a semi-infinite sample of graphene with periodic boundary conditions along x and open boundary conditions along y. The Bychkov-Rashba-type spin orbit coupling modifies the dispersion relation at the K and K' points and thus the crossing of the band gap.

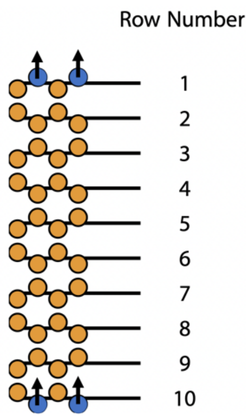

Figure 2: The magnetisation of electrons located at the edges as a time-reversal invariant self-consistent solution to the mean-field interacting system.