Quantum interference assisted spin filtering in graphene nanoflakes

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We present a theoretical investigation the electronic and transport properties through magnetic graphene nanoflakes with zigzag edges. [1,2]
In the ballistic tranposrt regime, we identify transmission antiresonances as the clear fingerprint of destructive quantum interference (QI), analogous to those observed in molecular junctions. The QI features survives to interactions and are remarkably robust increasing the system size. The existence of destructive QI can be rationalized in terms of symmetries, revealing the generality of the phenomenon and providing a powerful tool to understand and predict destructive QI in a wide class of nanostructures. [2]
In the presence of short-range spin ordering wchi arises due to the properties of the zigzag edges, [1] the interplay between QI and magnetism results in spin-resolved QI features separated in energy and in a nearly-perfect QI-assisted spin-filtering effect. We also devise a protocol to achieve electrostatic control over the efficiency of the spin filter upon deposition of graphene on a suitable substrate, e.g., h-BN which breaks the graphene inversion symmetry. Such a device benefits of the extraordinary conduction properties of graphene, and operates without any external magnetic field, paving the path toward QI-assisted spintronics. [2]

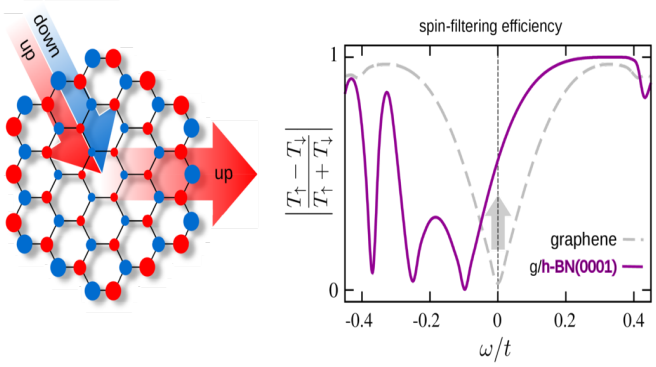

Figure. [Left] Antiferromagnetic graphene nanoflake spin filter. [Right] Spin-filtering efficiency for graphene and graphene deposited on a h-BN substrate.

References

[1] A. Valli, A. Amaricci, A. Toschi, T. Saha-Dasgupta, K. Held, and M. Capone, Phys. Rev. B **94**, 245146 (2016).
[2] A. Valli, A. Amaricci, V. Brosco, and M. Capone, in preparation (2018).