Transport through quantum spin Hall insulator/metal junctions in graphene ribbons

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Quantum spin Hall insulator/metal interfaces are naturally formed in graphene ribbons with intrinsic spin-orbit coupling by selectively doping two regions creating a potential step. For a clean graphene ribbon, the transmission of the topological edge states through a n-n or p-p junction is perfect irrespective of the ribbon termination, ribbon width and potential step parameters due to the orthogonality of incoming and outgoing edge channels. This is shown numerically for an arbitrary crystallographic orientation of the ribbon and proven analytically for zigzag and armchair boundary conditions. Perfect transmission is also present in n-p junctions for armchair and antizigzag terminations. In disordered ribbons, the orthogonality between left- and right-movers is in general destroyed and backscattering sets in. However, perfect transmission is restored by increasing the ribbon's width, even in the presence of strong edge roughness.

References

[1] G. Metalidis and E. Prada, arXiV:cond-mat/1012-4345.