An electronic beam splitter realized with crossed graphene nanoribbons

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Graphene nanoribbons (GNRs) are promising components in future nanoelectronics. We have explored a prototype 4-terminal semiconducting device formed by two crossed armchair GNRs (AGNRs) using state-of-the-art first-principles transport methods. 2 We analyze in detail the roles of intersection angle, stacking order, inter-GNR separation, and finite voltages on the transport characteristics. Interestingly, when the AGNRs intersect at $\theta = 60^{\circ}$, electrons injected from one terminal can be split into two outgoing waves with a tunable ratio around 50% and with almost negligible back-reflection. The splitted electron wave is found to propagate partly straight across the intersection region in one ribbon and partly in one direction of the other ribbon, i.e., in analogy of an optical beam splitter. Our simulations further identify realistic conditions for which this semiconducting device can act as a mechanically controllable electronic beam splitter with possible applications in carbon-based quantum electronic circuits and electron optics.

References

[1] P. Brandimarte et al., arXiv:1611.03337