Precise electronic and valleytronic nanodevices based on strain engineering in graphene

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Abstract

Graphene based nanodevices can be made so small that quantum transport phenomena play a crucial role in their functionality. We will present several such systems and discuss the theoretical and numerical models which are helpful in the understanding and efficient prediction of their electronic properties.

As examples, planar graphene with out-of-plane deformations and bent carbon nanotubes will be discussed as deformation/pressure nano-sensors and valley filters/polarizers. Precise combination of the curvature, magnetic and the pseudo-magnetic fields enables to control the quantum transport in these systems and gives rise to phenomena such as directing and focusing of currents depending on the deformation, placement of contacts and valley polarization. They can be applied in new types of graphene based electronic and valleytronic nanodevices.

References

[1] T. Stegmann and N. Szpak, New J. Phys, 18 (2016) 053016

Figures

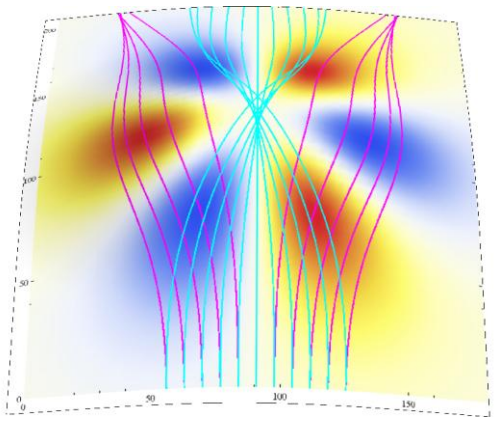

Figure 1: Theoretical model of current lensing and valley filtering based on classical trajectories

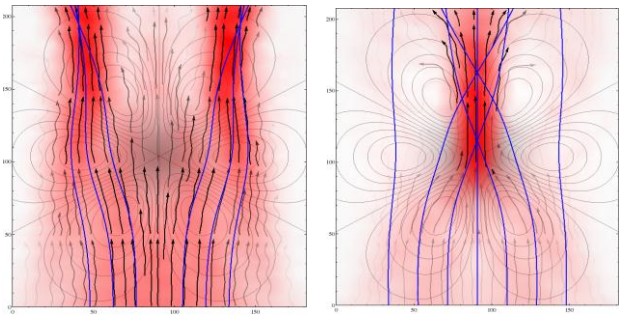

Figure 2: Numerical model of current lensing and valley filtering based on quantum transport calculations

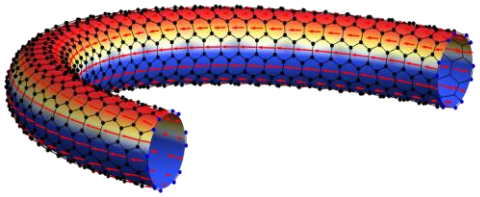

Figure 3: Artificial gauge fields due to strain in deformed carbon nanotubes also influence their current flow profiles and valley polarization