Deformed Graphene as a Valley Polarizer and Pressure Sensor

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Elastic deformations in graphene give rise to strong pseudo-magnetic fields, which act with opposite signs on the electrons in the two different valleys [1]. This suggests the construction of a valley polarizer based on that effect [2,3,4], see Figure 1.

Quantitative studies of the current flow in deformed graphene by means of the non-equilibrium Green's function (NEGF) method confirm this idea and show that completely polarized current beams can be generated, see Figure 2. In our approach [4], a wide spatial separation of the valley polarized currents is achieved and a large part of the initially un-polarized current, injected by the source *S*, is transmitted to the contacts 1 and 2 placed at the corners.

Local elastic deformations in graphene can be created by the tip of a tunnelling microscope [5] or by the pressure of an external gas. Therefore, the described current deflection mechanism can be used to build a graphene-based pressure sensor.

References

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[3] S.P. Milovanović et al, Appl. Phys. Lett. 109 (2016) 203108
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Figures

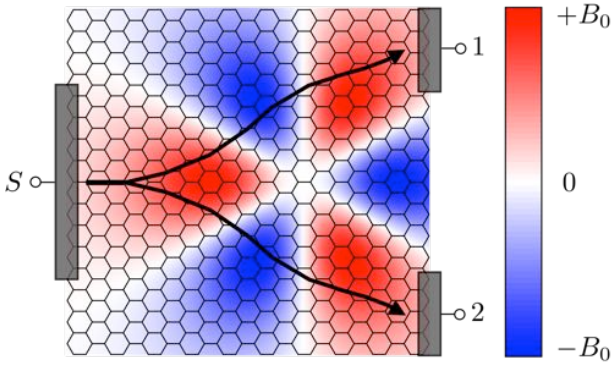

Figure 1: Pseudo-magnetic field in a deformed graphene nano-ribbon, which acts with opposite sign in the two valleys. Hence, the current, which is injected at the source contact *S* and sketched by the black arrows, is split up in two valley-polarized beams, which are collected by the contacts 1 and 2.

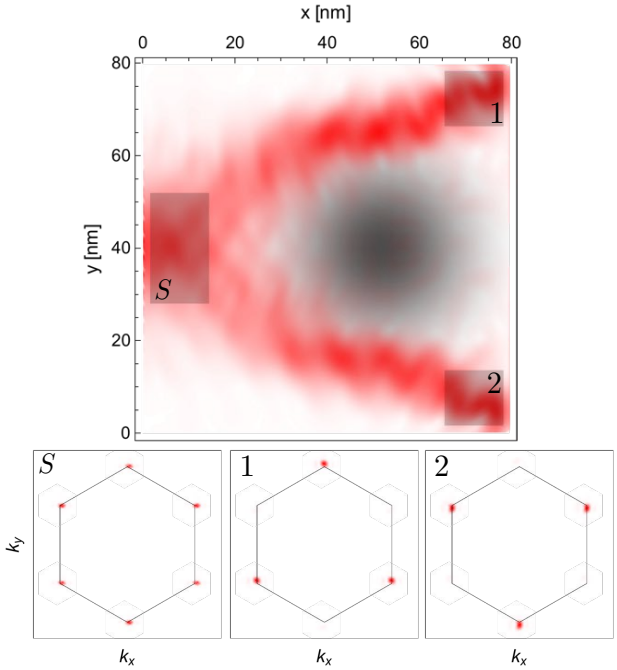

Figure 2: Current flow in a deformed graphene nanoribbon. The current density, which is indicated by the red colour shading, is deflected by the deformation (grey colour shading). The valley polarization, which is measured in the three rectangular regions, shows that the current is injected un-polarized, while the upper and lower beams are completely valley polarized.