Anomalously strong confinement in strained graphene systems

Kang-Hun Ahn[1], Sul-Ah Park[1], Young-Woo Son[2], Kyung-Joong Kim[1], and Ya. M. Blanter[3]

[1]Department of Physics, Chungnam National University, Daejeon 305-764, Republic of Korea
ahnkh@cnu.ac.kr
[2]Korea Institute for Advanced Study, Seoul 130-722, Republic of Korea
[3]Kavli Institute of Nanosciences, Delft University of Technology, Lorentzweg 1, 2628 CJ Delft, The Netherlands

Abstract

The quasi-particles near charge neutral point in graphene are described by massless Dirac Fermions. When mechanical strain is applied to graphene, it is now well known that the strain plays a role of pseudo-magnetic field, which can be so strong to confined quasi-particles in pseudo-Landau levels. The strain engineering of graphene attracts great interest nowadays because of the huge pseudo-magnetic field which is unrealistically strong if it was real magnetic field.

We investigate electronic properties of mechanically deformed graphene systems not only near Dirac points but also other points in Brillouin zones. We introduce various phenomena which cannot be described in perturbation method.

Rotationally symmetric strain causes inhomogeneous pseudo magnetic field causing quasi-particle confinement near Dirac points. At certain energies, the quasi-particle can escape out through transport channel which can be described by 'snake orbit'. We show that depending on the symmetries of the confined states, the system shows paramagnetic or diamagnetic response of real magnetic field[1].

We find that the electron transport of uni-directionally strained graphene is extremely sensitive to small deformation at certain momentum states. We show that the sensitivity is not originated from geometry of contacts or chaotic scattering at boundaries. We find and discuss anomalously strong confinement in this system using analytical and numerical analysis and suggest possible experiments to observe the phenomenon[2].

References

[1] Kyung-Joong Kim, Ya. M. Blanter, Kang-Hun Ahn, Phys. Rev. B, **84** (2011) 081401(R).
[2] Sul-Ah Park, Young-Woo Son, Kang-Hun Ahn, preprint.

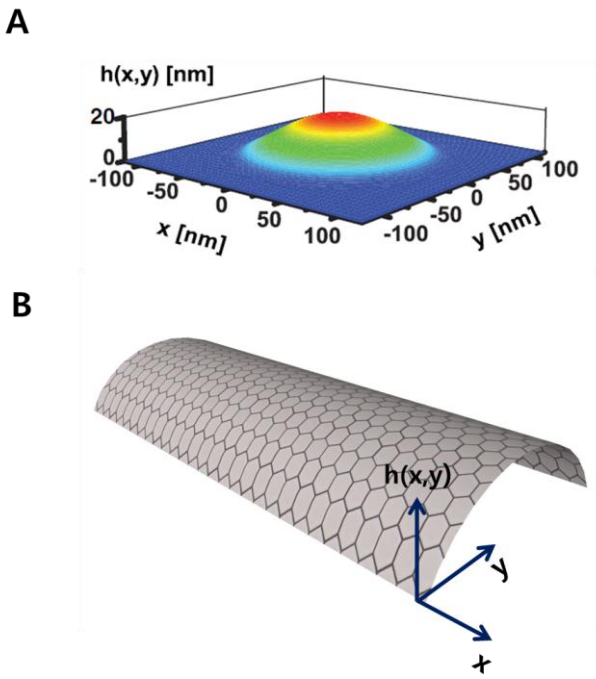

Figure 1 The graphene systems we consider. The graphene with rotationally symmetric strain (A) and uni-directionally deformed graphene (B).