Straining the carbon flatland

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Abstract:

In the past decade there has been exciting new developments in the field of condensed matter physics, in particular with the theoretical prediction and experimental realization of 'Dirac materials'. This new class of matter comes with intriguing physical properties such as that of a linear spectrum of chiral low-energy excitations which can be mapped on to relativistic Dirac equation. Among others the leading material is graphene which is a two dimensional sheet of carbon atoms arranged in a honeycomb pattern. It has drawn a lot of interest due to its remarkable physical properties [1,2]. In low dimensional systems, for instance graphene, it is also known that the electron correlation effects are often enhanced and play an important role not only in the study of many-electron physics but also are useful in designing new materials for various applications.

In this talk, we shall discuss some of our work related to the change in the physical properties of graphene with the application of uni-axial strain. We shall present a theoretical study on the effects of electron-electron interactions and anisotropy due to strain in graphene.

The mutual interplay of interactions and strain can provide a route towards understanding the role of correlations in graphene, which so far have been quite elusive in the un-deformed case. Moreover in the past few years, the research has quickly moved on from single to bi-, double- and multi-layer graphene as they display plethora of interesting properties.

In particular the electronically decoupled multi-layer systems, which are in fact coupled only via the long-range Coulomb interaction, are very fascinating as they exhibit variety of phenomenon like van der Waals (vdW) interactions. We shall also present some of our recent results related to change in the van der Waals interaction in double layer graphene upon deformation due to strain.

[1] A. H. Castro Neto, F. Guinea, N. M. R. Peres, K. S. Novoselov, and A. K. Geim, Rev. Mod. Phys. 81, 109 (2009) and references therein

[2] V. N. Kotov, B. Uchoa, V. M. Pereira, F. Guinea, and A. H. Castro Neto, Rev. Mod. Phys. 84, 1067 (2012) and references therein.