Strong Electron-Phonon coupling in Graphene (TIFX04-17-34)

Background: Experimental evidence for exceptionally strong electron-phonon coupling is found in recent ARPES measurements (F.~Mazzola et al. Phys. Rev. Lett. 111, 216806 (2013). The interpretation from the data indicates a strength of the electron phonon coupling nearly an order of magnitude greater than what is found in the π-bands near the Dirac point. The challenge is to understand why and to find a way to utilize this to make graphene superconducting.

Problem description: An international team, experiment and theory, is presently working on understanding the electron-phonon coupling (EPC) in the σ-band of graphene. To complement the advanced Density function density (DFT) based calculations I have developed a flexible tight-binding model (TBM) based code. So far no analysis of inter-band π-σ scattering has been reported in the literature. Our DFT and TBM calculations indicate that the scattering is crucial.

Activities: You should continue last year successful bachelor thesis project that was based on a simple model study of the electron-phonon matrix elements (Chem. Phys. Lett. 660, 233 (2016), H. Toren, L. Samuelsson and B. Hellsing). With the TBM code you will calculate and analyze the spectral function which is measured in the ARPES experiment. The aim is to resolve the spectral function in terms of contributions from interband and intraband scattering and to make clear which phonon modes are in operation in the two cases.

Target audience: GU-Fysik och Teknisk fysik (F). Knowledge in quantum mechanics and some elementary Solid State course is preferred.

Group size: 3 or more students

Handledare
Bo Hellsing, room 3008, third floor in Soliden, E-mail: hellsing@physics.gu.se Department of Physics, GU