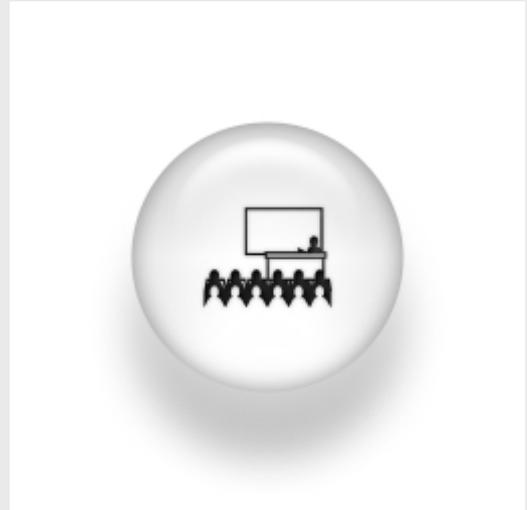


Fano interference and infrared phonon activity in bilayer graphene

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ABSTRACT:

The detection and analysis of the spectral properties of optical phonon in single-layer and multilayer graphene provides a powerful tool not only for a careful characterization of the systems but also for investigating the role of the underlying electron-phonon interaction.

Recent experiments in gated bilayer graphene revealed a clear phonon resonance at 1590 cm^{-1} with several interesting features, as for instance a giant enhancement of the phonon intensity as a function of the gate voltage as well as a pronounced Fano lineshape asymmetry.

In this talk I will discuss how these features can be analyzed and predicted on a microscopic quantitative level using a charge-phonon theory applied to the specific case of graphene systems.

We show in particular how the phonon intensity and the Fano asymmetry are strictly related, stemming out from the quantum interference between the electronic and phononic degrees of freedom.

Within this context we are also able to elucidate the relative role of the E_u and E_g phonon modes in regards to the infrared activity and the Fano asymmetry of the observed phonon peaks.

We present thus a complete phase diagram for the strength of the phonon modes and their Fano properties as functions of the chemical potential and of the gated-induced electronic gap, showing that a switching mechanism between the dominance of the E_u or E_g mode can be controlled by the external gate voltage.

Our work permits thus reconciling within a unique theoretical approach the phonon-peak features observed by different experimental groups, and it provides an analytical tool for predicting and controlling on a quantitative level the spectral properties of the phonon resonances in the infrared spectra of graphenes.