Magnetophonon Resonance in Graphene

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Abstract. In contrast to other 2D materials, electron-phonon coupling is particularly strong in graphene – a one-atom thick sheet of graphite. This leads to a renormalisation of the phonon frequency due to interband electronic excitations [1], which is measurable in Raman experiments [2]. Electron-phonon coupling yields particularly rich physics when the graphene sheet is exposed to a strong perpendicular magnetic field. In this case the phonon frequency may coincide with the energy of magnetoexcitons, electronic excitations coupling relativistic Landau levels with neighbouring quantum number, $|n| \rightarrow |n \pm 1|$, as shown in the figure. Apart from the renormalisation of the phonon frequency ω, resonant coupling manifests itself in splitting of the phonon mode, which we expect to be observable in Raman measurements [3]. The fine-structure of this magnetophonon depends on the magnetic field, the filling factor, and the polarisation of the phonon. Most saliently, it allows one to distinguish between phonon modes with different circular polarisation. document.

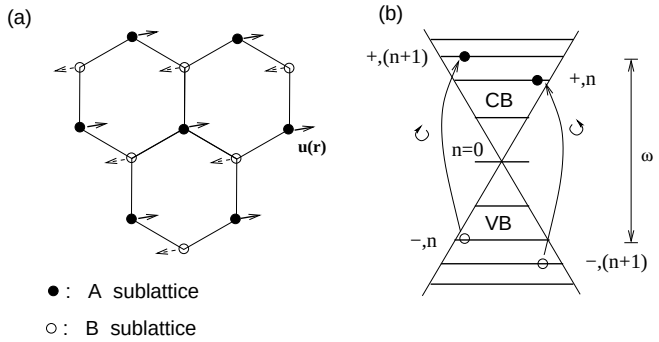

FIGURE 1. *(a)* Optical phonons are lattice vibrations $\mathbf{u}(\mathbf{r})$ with an out-off-phase oscillation of the two sublattices, *A* and *B*. *(b)* Interband (VB: valence band, CB: conduction band) electron-hole excitations coupling to phonon modes with different circular polarization.

REFERENCES

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