Engineering of instabilities in graphene

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Abstract:

Recent progress in doping of graphene with various types of non-carbon atoms has opened a new field to study two-dimensional materials with adjustable physical parameters. We investigate instabilities due to an electromagnetic field, localized spin textures and thermally distributed phonons in these materials.
While the coupling to an electromagnetic field results in the formation of plasmons, a spin texture can open a gap and break the valley symmetry. Phonons can lead to phase transitions for sufficiently strong electron-phonon coupling. We calculate the plasmon spectrum, the critical point of the phonon instabilities, the renormalization of the phonon frequency and the effect of a random gap on transport properties.