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Interplay between electronic excitations and flexural phonons in graphene JOSE GONZALEZ, PABLO SAN-JOSE, Instituto de Estructura de la Materia (CSIC), Madrid, SPAIN — We investigate the mutual influence of electronic excitations and flexural phonons in graphene by analyzing the many-body corrections that they induce on each other. Thus we show that the interaction with the electron-hole excitations leads to a drastic softening of the acoustic branch of out-of-plane phonons, which become unstable for wavelengths longer than a critical value. In terms of the effective potential of flexural phonons, this is interpreted as the onset of spontaneous symmetry breaking, with the development of a nonvanishing expectation value for the field of vertical displacement in the graphene sheet. Conversely, we show that the flexural phonons induce an effective density-density interaction that is logarithmically divergent in the infrared, potentially balancing the repulsive Coulomb interaction as this is renormalized away by the logarithmic divergence of the Fermi velocity in the low-energy regime.

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