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2D Holstein polarons in the presence of spin-orbit interactions
LUCIAN COVACI, MONA BERCIU, University of British Columbia, Vancouver, Canada — The electron-phonon interaction in the presence of spin-orbit interactions (of either Rashba or Dresselhaus type) must be taken in account for GaAs quantum dots or for spintronic devices. The possibility of tuning the electron-phonon interaction by coupling to a substrate (e.g. in organic transistors) requires an accurate treatment of this problem in all coupling regimes. We apply a recently developed approximation (the Momentum Average Approximation) to this specific theoretical question. We have shown that this method is exact in various asymptotic regimes while being accurate for all coupling strengths. We calculate the self-energy at the MA(2) level of the approximation. From ground state properties (energy and effective mass) we conclude that in the presence of spin-orbit interactions, the polaron is harder to trap – the crossover from large to small polarons is shifted to higher couplings. From the spectral function, we show that there are two distinct regimes, depending on relation between the phonon frequency and the strength of the spin-orbit interaction. When the latter is larger we find that the polaron character is dominated by only one band (the '-' band). We also show that the off-diagonal part of the self-energy plays an essential role in obtaining the polaron + one phonon continuum correctly.

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