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Electron-phonon bound states in graphene JUSTIN ZHU, SAMVEL M. BADALYAN, FRANCOIS PEETERS, Department of Physics, University of Antwerp, Groenenborgerlaan 171, B-2020 Antwerpen, Belgium — We investigate the fine structure of the energy spectrum in graphene induced by electron-optical phonon coupling. Despite the small electron-phonon coupling, perturbation theory is inapplicable in the part of spectrum near the optical phonon emission threshold. In zero magnetic field [1] we derive new dispersion equation, which in the immediate neighborhood below the threshold describes an electron-phonon bound state. We find that the singular vertex corrections beyond perturbation theory strongly inhance the electron-phonon binding energy scale. In quantizing magnetic fields [2], our findings beyond perturbation theory show that the true spectrum near the phonon emission threshold is completely governed by new branches of the spectrum, corresponding to bound states of an electron and an optical phonon with a binding energy of the order of $\alpha\omega_0$ where α is the electron-phonon coupling and ω_0 the phonon energy.

[1] S. M. Badalyan and F. M. Peeters, Phys. Rev. B **85**, 205453 (2012).
[2] J. Zhu, S. M. Badalyan and F. M. Peeters, arXiv:**1206.5107**.

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