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Problem of the small Fermi-polaron system in one-dimensional harmonic trap

Abstract

In the thesis, I analyze a system of several fermions interacting via contact interactions with a single finite-mass impurity in a one-dimensional harmonic potential. The studies are motivated by state-of-the-art experiments with ultracold atoms in which such systems were created for the mass-balanced case. I focus on systems with heavy impurity in a regime of strong repulsive interactions. As part of the analysis, I determine energies and density profiles for the system in the many-body ground state and low-excited states. The most important result of my thesis is the derivation of the canonical transformation (the generalized Lee-Low-Pine transformation), which significantly simplifies the analyzed model. It allows not only to improve the efficiency of numerical calculations but also leads to a better understanding of the analyzed problem.

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