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Energy, decay rate, and effective masses for a moving polaron in a Fermi sea: Explicit results in the weakly attractive limit[1] TREFZGER CHRISTIAN, CASTIN YVAN, CNRS-Laboratoire Kastler Brossel — We study the properties of an impurity of mass M moving through a spatially homogeneous three-dimensional fully polarized Fermi gas of particles of mass m. In the weakly attractive limit, where the effective coupling constant $g \to 0^-$ and perturbation theory can be used, both for a broad and a narrow Feshbach resonance, we obtain an explicit analytical expression for the complex energy $\Delta E(\mathbf{K})$ of the moving impurity up to order two included in g. This also gives access to its longitudinal and transverse effective masses $m^*_\parallel(\mathbf{K})$, $m^*_\perp(\mathbf{K})$, as functions of the impurity wave vector $\mathbf{K}$. Depending on the modulus of $\mathbf{K}$ and on the impurity-to-fermion mass ratio M/m we identify four regions separated by singularities in derivatives with respect to $\mathbf{K}$ of the second-order term of $\Delta E(\mathbf{K})$, and we discuss the physical origin of these regions. Remarkably, the second-order term of $m^*_\parallel(\mathbf{K})$ presents points of non-differentiability, replaced by a logarithmic divergence for $M = m$, when $\mathbf{K}$ is on the Fermi surface of the fermions. We also discuss the third-order contribution and relevance for cold atom experiments.

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