An impurity in a Fermi sea on a narrow Feshbach resonance: A variational study of the polaronic and dimeronic branches

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Abstract

In [1] we study the problem of a single impurity of mass M immersed in a Fermi sea of particles of mass m. The impurity and the fermions interact through an s-wave narrow Feshbach resonance, so that the Feshbach length R_* naturally appears in the system. We use simple variational ansatz, limited to at most one pair of particle-hole excitations of the Fermi sea and we determine for the polaronic and dimeronic branches the phase diagram between absolute ground state, local minimum, thermodynamically unstable regions (with negative effective mass), and regions of complex energies (with negative imaginary part). We also determine the closed channel population which is experimentally accessible. Finally we identify a non-trivial weakly attractive limit where analytical results can be obtained, in particular for the crossing point between the polaronic and dimeronic energy branches.

References

[1] Christian Trefzger, Yvan Castin, Phys. Rev. A **85**, 053612 (2012).