Superconducting Properties of the Spin-Polarized Attractive Hubbard Model

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9.7 cm

Spin-polarized superfluidity in the context of the cold atomic Fermi gases and unconventional superconductivity with a nontrivial Cooper pairing have recently been investigated both theoretically and experimentally. In the presence of a magnetic field, the numbers of particles with spin down and spin up are different. This makes the formation of Cooper pairs across the spin-split Fermi surface with non-zero total momentum ($\vec{k}\uparrow$, $-\vec{k}+\vec{q}\downarrow$) (Fulde and Ferrell, and Larkin and Ovchinnikov state) possible.

In this work the influence of a pure Zeeman effect on the superfluid characteristics has been investigated within the spin-polarized attractive Hubbard model. The ground state and temperature phase diagrams have been obtained both for a fixed number of particles and a fixed chemical potential. For sufficiently high magnetic fields the finite temperature transition between the superconducting and the normal state changes from the second to the first order. Two critical magnetic fields have been found for a fixed number of particles. The two critical fields define the phase separation region between the superfluid phase with the particle density n_s and the normal state with the density of particles n_n. Moreover, the behaviour of the order parameter and the spin polarization has been investigated at $T = 0$ as well as at finite temperature. Finally, the BCS-BEC crossover with increasing attraction in the ground state has been discussed.

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