

Superfluidity in unbalanced two-component fermionic mixtures

Abstract:

We discuss the properties of two-component fermionic mixtures when the "balance" between the two species is broken. The unbalance can be realized by either different masses or different populations between the two flavours.

We mainly focus on lattice systems with short-ranged attractive interactions, exploring the effect of unbalance on superfluidity and other properties using static and dynamical mean-field methods.

In the case of population unbalance, we find that in intermediate and strong coupling a uniform polarized superfluid with anomalous properties can be stabilized at low temperature, in contrast with the weak-coupling regime, where the system undergoes phase separation between a balanced superfluid and a polarized metal.

In the case of mass unbalance, the physics is characterized by the competition between superfluidity and spatial ordering (density-wave). For the balanced system, if the number of fermions is different from the number of lattice sites, the system is always a superfluid. When the mass difference exceeds a critical value, we find instead a phase separation between a commensurate density-wave and a superfluid. We also investigate the normal-state properties and the correlation-driven metal-insulator transition.