Population and mass-imbalanced two-component Fermi gases in one dimension

Fabian Heidrich-Meisner
(LMU Munich)

Abstract:

In this talk I will discuss pairing correlations in one-dimensional Fermi gases with attractive interactions, loaded into an optical lattice (see [1] for a review). Using the density matrix renormalization group method I'll argue that the ground state of the partially polarized phase of the negative-U Hubbard model is of the Fulde-Ferrell-Larkin-Ovchinnikov (FFLO) type, i.e., pairing correlations oscillate in real-space, with the wave-vector set by the difference of the Fermi wave-vectors of the majority and minority species. Second, I'll discuss the density profiles of such a system in a harmonic trap, which have been measured in a recent experiment at Rice [2]. Third, within the so-called Bose-Fermi resonance model that incorporates the coupling of fermions to a molecular channel, we demonstrate that the FFLO phase competes with a Bose-Fermi mixture, where the former is the ground state on the BCS side. An interesting open question concerns the fate of the FFLO state in two dimensions. We show that on a ladder geometry, the partially polarized phase still exhibits FFLO correlations yet the density profiles already bear qualitative similarities with higher dimensional systems. Finally, I will discuss mass-imbalanced systems putting a particular focus on the emergent shell structures in a harmonic trap [3]. Compared to the purely population-imbalanced case, the behavior is much richer, with the emergence of a trimer fluid phase and a revival of the fully paired fluid at equal density.

[1] Feiguin, HM, Orso, Zwerger, Lect. Not. Phys. 836, 503 (2011)
[2] Liao et al., Nature 467, 567 (2010)
[3] Dalmonte, Dieckmann, Roscilde, Hartl, Feiguin, Schollwoeck, HM, arXiv:1203.5999