

Path integral description of Cooper pairing in imbalanced gases

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Abstract

Cooper pairing is usually investigated in systems having an equal number of both pairing partners. When there is a population imbalance between the pairing species, this will lead to frustration for the pairing and for the resulting superfluid or superconducting properties. Imbalanced fermi gases have been of interest in nuclear physics for a long time, but only recently came under experimental control in ultracold gases. In the ultracold atomic systems, both the dimensionality and the interaction strength are adaptable, which allows to probe the effect of imbalance also in the BEC/BCS crossover regime. We apply path integral techniques to derive properties of the imbalanced gases. For the case of a (quasi)-2D fermi gas, analytical results for the gap and the chemical potential as a function of the population imbalance are derived. We investigate the possibility to obtain Sarma phases. Also the impact of imbalance on the superflow flow through the lattice is investigated. The results obtained through functional integration are in agreement with recent experiments, and can shed light on the question of demixing in the trapped superfluid.