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Pairing and pseudogap for ultracold fermions in two dimensions[1]

J. TEMPERE[2], S.N. KLIMIN, J.T. DEVREESE, Theorie van Quantum en Complexe Systemen (TQC), Universiteit Antwerpen, Belgium — The T-matrix approach, straightforwardly applied to cold fermions in two dimensions, leads to a divergent fermion density for any finite temperature. We have shown that the Gaussian pair fluctuation theory, which is an improvement of the Nozières – Schmitt-Rink approach, provides a convergent density in the paired fermion state. In our work, special attention is paid to the pseudogap state above the BKT transition temperature. In the pseudogap state, the modulus of the order parameter is finite, while phase coherence is absent. The pairing crossover temperature in 2D has been determined. Owing to the fluctuations, this pairing temperature is considerably lower than the mean-field critical temperature. With increasing coupling strength, the pairing temperature behaves non-monotonically reaching a maximum before decreasing to a finite value. For an imbalanced Fermi gas, the fluctuations lower the critical value of the imbalance at which the superfluid or non-coherent paired state is formed. This effect exists even at zero temperature, where only the quantum fluctuations survive. The obtained pairing temperatures and spectral functions are in fair agreement with recent experimental results on pairing of fermionic atoms in strongly anisotropic optical lattices.

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