Comparing fermionic superfluids in two and three dimensions

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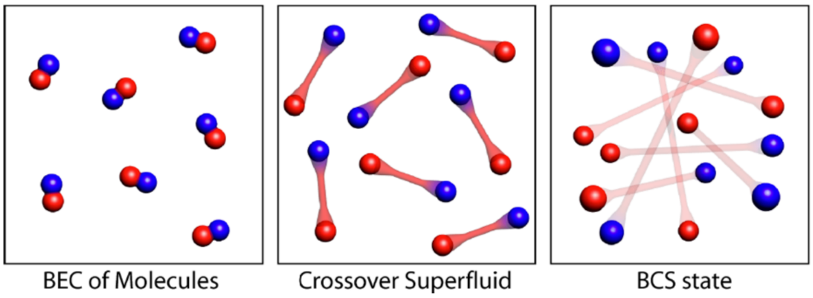
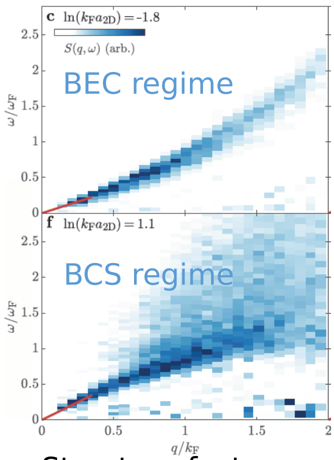
Understanding the origins of unconventional superconductivity has been a major focus of condensed matter physics and experiments have found the highest critical temperatures in layered 2D materials. However, to what extent their remarkable stability is affected by their reduced dimensionality is still an open question. Here, I will discuss influence of dimensionality on the stability of strongly interacting fermionic superfluids.

I will introduce fermionic superfluidity in ultracold atoms, where Cooper pairs form. Their pair size can be continuously tuned from the Bardeen-Cooper-Schrieffer (BCS) regime of loosely bound pairs to the BEC regime of very tightly bound pairs [1]. I will introduce the critical velocity v_c and the pairing gap Δ and review milestone experiments performed on superfluid 3D Fermi gases [2]. After explaining how to determine v_c and Δ using Bragg spectroscopy I will discuss our recent intriguing results comparing superfluidity in 2D and 3D [3-5]. We find that the superfluid gap follows the same universal function of the interaction strength regardless of dimensionality, which suggests that there is no inherent difference in the stability of 2D and 3D.





Structure factor

References

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