An Overview of the BCS-BEC Crossover in a Gas of Fermi Atoms with a Feshbach Resonance

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The BCS-BEC crossover phenomenon observed in superfluid Fermi gases (^{40}K and ^{6}Li) is one of the most exciting topics in the current research of cold atom physics. In a two-component Fermi gas, the strength of a pairing interaction can be tuned by adjusting the threshold energy of a Feshbach resonance. Using this tunable interaction, one can continuously change the character of superfluidity from the weak coupling BCS-type to the Bose-Einstein condensation (BEC) of tightly bound Cooper pairs (that have been already formed far above the superfluid phase transition temperature T_c). This interesting crossover phenomenon thus enables us to study fermion superfluidity (such as metallic superconductivity and superfluid ^{3}He) and boson superfluidity (such as superfluid ^{4}He) in a unified manner. Since T_c in the strong coupling BEC regime reaches about $0.2T_F$ (where T_F is the Fermi temperature), this research field would be also useful for the study of high- T_c superconductivity.

In this talk, I will give a brief review on the recent progress of the BCS-BEC crossover physics in cold Fermi gases. I will also present my research plan on a strongly correlated atomic gas in an optical lattice.