武汉物数所理论交叉学术交流系列报告 （第一九六期）

Non-equilibrium dynamics in strongly interacting Fermi gases

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About the speaker:

Dr. Kuiyi Gao received his BS from Wuhan University and Ph.D from Institute of Physics, Chinese Academy of Sciences (2014). He has been working as a postdoc fellow in Prof. Micheal Koehl's group, Physikalisches Institut, University of Bonn, Germany. His current research is focusing on ultra-cold 3D/2D Fermi gases experiment, especially on excitations and non-equilibrium dynamics of strongly interacting Fermionic superfluid under external driving.

Abstract:

Ultra-cold Fermi gases with tunable interactions have been widely used to investigate the BEC-BCS crossover in the last decade and superfluidity of Fermi gases with strong interaction have shown a variety of rich physics. Excitations and non-equilibrium dynamics related to pairing in strongly interacting atomic Fermi gases was proposed for studying excitations and pairing dynamics in superconductivity, however, experimental realization has been hindered by the difficulty of performing fast enough perturbations to the system.

In this talk, I will show three experiments in exploring Higgs/amplitude mode and non-equilibrium dynamics of strongly interacting Fermi gases of ^{6}Li atoms. With a periodic modulation of the amplitude of the superconducting order parameter Δ in superfluid Fermi gas with RF field, we observe an excitation resonance around frequency $2\Delta/h$, which gradually vanishes due to the broken particle-hole symmetry from BCS side to BEC side. With a fast population transfer, the interaction in the Fermi gas is rapidly quenched, which induces non-equilibrium dynamics beyond prediction of collisionless BCS theory. From strong to weak quench, quasi-particle relaxation and following collective modes in harmonic trap are observed. However, from weak to strong quench, stronger interaction after quench always leads to unexpected longer pairing/thermalization time.

Reference:
A. Behrle, T. Harrison, J. Kombe, K. Gao*, M. Link, J.-S. Bernier, C. Kollath & M. Koehl*, "Higgs mode in a strongly interacting fermionic superfluid", Nature Physics 14, 781 (2018)

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