SFB/TRR 21 - Seminar

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Hydrodynamics and superfluidity of a strongly interacting Fermi gas

Ultracold atomic gases, with unprecedented possibilities to control interactions and external confinement, offer an excellent playground for testing and understanding strongly interacting matter. Here we present a number of experiments on the ultracold degenerate gas of fermionic 6Li atoms with unitarity-limited interactions. Firstly, we extend the method of collective oscillations to study the hydrodynamics of a trapped Fermi gas at finite temperatures [1]. We show that density profiles and frequencies of the so-called higher-nodal collective modes strongly depend on temperature of the system, in contrast to collective oscillations studied earlier. This allows us to distinguish between superfluid and normal hydrodynamic behavior and test the finite-temperature equation of state of a unitary Fermi gas with a good precision [2]. Secondly, we study the phenomenon of "second sound" in a unitary Fermi gas [3]. Differently from the situation in superfluid helium, this special temperature wave is accompanied by a significant density perturbation. We measure the speed of second sound and obtain a superfluid fraction in the system - the quantity of fundamental importance for strongly interacting superfluids.

[1] E. R. Sánchez Guajardo, et al., PRA 87, 063601 (2013) [2] M. K. Tey, et al., PRL 110, 055303 (2013) [3] L. A. Sidorenkov, et al., Nature 498, 78 (2013)

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