

# Second sound with ultracold atoms

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We briefly review the research on second sound in ultracold atomic physics, with emphasis on strongly interacting unitary Fermi gases with infinitely large s-wave scattering length [1]. Second sound is a smoking-gun feature of superfluidity in any quantum superfluids. The observation and characterization of second sound in ultracold quantum gases has been a long-standing challenge, and in recent years there are rapid developments due to the experimental realization of a uniform box-trap potential.

Here, we present a brief historical account of the key research activities on second sound over the past two decades. We summarize the initial theoretical works that reveal the characteristics of second sound in a unitary Fermi gas [2,3], and introduce its first observation in a highly elongated harmonic trap. We then discuss the most recent measurement on second sound attenuation in a uniform setup [4], which may open a new era to understand quantum transport near quantum criticality in the strongly interacting regime. The observation of second sound in homogeneous weakly interacting Bose condensates are also briefly introduced.

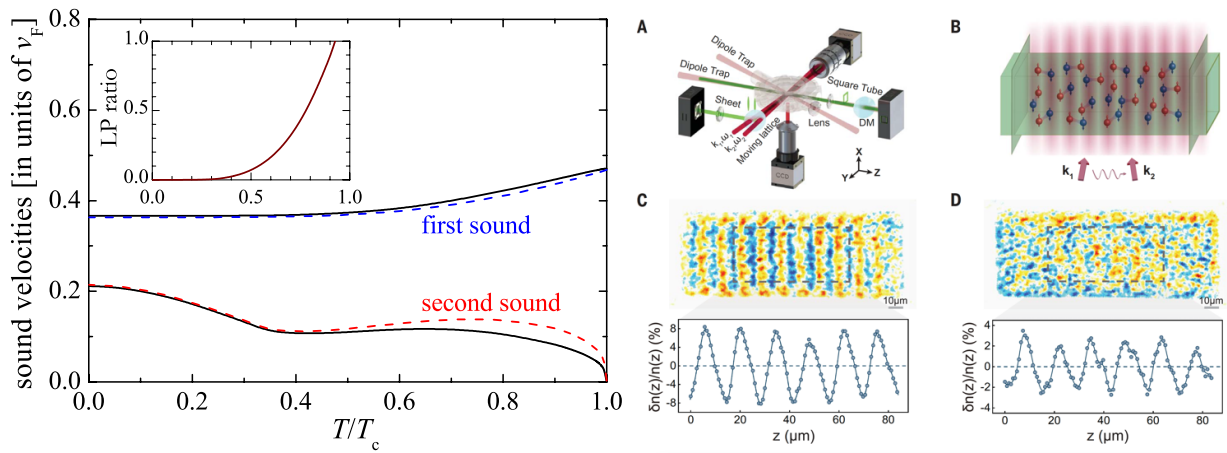


Fig.1 Left: First and second sound velocities of a homogeneous unitary Fermi gas [2]. Right: The observation of first and second sound propagation and attenuation at University of Science and Technology of China [4].

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