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Creation and Observation of second sound in Homogenous Unitary Fermi gases ZHENJIE YAN, PARTH PATEL, BISWAROOP MUKHERJEE, AIRLIA SHAFFER-MOAG, CEDRIC WILSON, RICHARD FLETCHER, MARTIN ZWIERLEIN, Massachusetts Institute of Technology — Second sound is a distinct excitation mode which exists in superfluids. In contrast to the first sound which is a density wave, the second sound mode is a temperature wave caused by the out-of-phase oscillation between the normal and superfluid components. Using a resonant oscillating gradient potential, we create stable standing waves of second sound in a uniform trap. In order to observe these temperature waves, we apply an off-resonant rf pulse, which is sensitive to the pair-breaking excitations, as a local temperature probe. Using the aforementioned methods, we measure the speed and decay rate of the second sound at various temperatures. Using the properties of second sound, we obtain the superfluid fraction, thermal diffusivity and heat capacity ratio of a unitary Fermi superfluid.

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