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Observation of First and Second Sound in a Homogeneous Bose Gas TIMON HILKER, CHRISTOPH EIGEN, LENA BARTHA, JAKE GLIDDEN, University of Cambridge, ROBERT SMITH, University of Oxford, ZORAN HADZIBABIC, University of Cambridge — The existence of two distinct sound velocities is one of the hallmarks of superfluids. We present the first observation of both sound modes in a moderately interacting ultracold Bose gas. Using a magnetic field gradient, we excite center-of-mass oscillations of a homogeneous K-39 Bose gas in a three-dimensional box trap, revealing distinct oscillations of both the condensed and the thermal component. As predicted by the two-fluid model, we find that the slower mode (second sound) is predominantly associated with the BEC component, while the faster mode (first sound) is linked to the thermal component. We study the speed and damping of both modes for various interaction strengths and temperatures, including temperatures above T_c for the first sound.

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