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**Ultracold Plasma Electron Temperature Measurements using Collective Mode Diagnostics** ROBERT FLETCHER, XIANLI ZHANG, STEVEN ROLSTON, University of Maryland — Applying a radio-frequency electric field to an expanding ultracold neutral plasma leads to the observation of Tonks-Dattner resonances, electron sound waves propagating in a finite, inhomogeneous plasma. These TD resonances have strong dependence on the boundary conditions of the plasma; while earlier studies were done using plasmas confined in cylindrical chambers, our freely expanding spherical plasmas have no clear outer turning points for the TD electron waves. Choosing an outer turning point where the local Debye length equals the plasma size, a WKB approximation yields good agreement with the mode frequencies, extracting a temperature consistent with other measurements. We note that the outer turning point used is similar to the location of an ion shock wave predicted in simulations, which may play a role in establishing the boundary conditions for the TD resonances. The determination of a well- defined turning point for the sound waves will allow accurate temperature measurements using TD resonance frequencies.

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