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Kinetic Energy Oscillations during Disorder Induced Heating in an Ultracold Plasma[1] THOMAS LANGIN, PATRICK MCQUILLEN, TREVOR STRICKLER, Rice University, THOMAS POHL, Max Planck Institute for the Physics of Complex Systems, THOMAS KILLIAN, Rice University — Ultracold neutral plasmas of strontium are generated by photoionizing laser-cooled atoms at temperature $T_{MOT} \approx 10\,\mathrm{mK}$ and density $n \approx 10^{16}\mathrm{m}^{-3}$ in a magneto-optical trap (MOT). After photoionization, the ions heat to $\sim 1\,\mathrm{K}$ by a mechanism known as Disorder Induced Heating (DIH). During DIH kinetic energy oscillations (KEO) occur at a frequency $\sim 2\omega_{pi}$, where ω_{pi} is the plasma frequency, indicating coupling to collective modes of the plasma. Electron screening also comes into play by changing the interaction from a Coulomb to a Yukawa interaction. Although DIH has been previously studied, improved measurements combined with molecular dynamics (MD) simulations allow us to probe new aspects. We demonstrate a measurement of the damping of the KEO due to electron screening which agrees with the MD simulations. We show that the MD simulations can be used to fit experimental DIH curves for plasma density n, resulting in very accurate density measurements. Finally, we discuss how ion temperature measurements are affected by the non-thermal distribution of the ions during the early stages of DIH.

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