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Ion Temperature Evolution in an Ultracold Neutral Plasma
PATRICK MCQUILLEN, TREVOR STRICKLER, THOMAS LANGIN, Rice University Department of Physics and Astronomy & Rice Quantum Instititue — Ultracold neutral plasmas (UNPs), created by photoionizing laser-cooled atoms have ions which inherit very low temperatures. However, a process known as disorder induced heating (correlation heating) quickly heats the ions, limiting the equilibrium shielded ion Coulomb coupling parameter to approximately two, regardless of initial conditions. This places UNPs just within the strongly coupled (non-ideal) regime. Subsequently, competing cooling and heating mechanisms have been predicted to determine the ion temperature evolution. Using laser induced fluorescence spectroscopy and taking care to minimize extraneous heating processes like heating from ion-acoustic-wave excitations; we have measured the ion temperature evolution of UNPs, observing both adiabatic cooling of the ions, by up to an order of magnitude and collisional heating by the electrons. These measurements will be presented along with efforts to model the ion temperature evolution as well as discussion of the Coulomb coupling parameter. We gratefully acknowledge support from the Department of Energy and National Science Foundation (PHY-0714603) and the Air Force Office of Scientific Research (FA9550-12-1-0267).

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