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Adiabatic expansion cooling of ions in ultracold neutral plasmas[1] PATRICK MCQUILLEN, THOMAS LANGIN, TREVOR STRICKLER, THOMAS KILLIAN, Rice University Department of Physics and Astronomy — 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 Coulomb coupling parameter to approximately two, regardless of initial conditions. This places UNPs just barely into the strongly coupled (non-ideal) regime. It has been predicted that the subsequent expansion of the plasma into the surrounding vacuum results in adiabatic cooling as well as correlation cooling and should result in more strongly coupled ions. Using laser induced fluorescence spectroscopy and taking care to minimize other heating processes like electron-ion thermalization and heating from ion-acoustic-wave excitations, we have measured the ion temperature evolution of UNPs and observed adiabatic cooling of the ions, by up to an order of magnitude. These measurements will be presented along with efforts to model the evolution and the effect on the Coulomb coupling parameter.

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