Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Early Time, Fast Collisional Dynamics of Equilibriating Ions in a Strongly Coupled Ultracold Neutral Plasma[1] TREVOR STRICKLER, PATRICK MCQUILLEN, THOMAS LANGIN, THOMAS KILLIAN, Rice University, GEORG BANNASCH, THOMAS POHL, Max Planck Institute For the Physics Of Complex Systems — Collision rates in weakly-coupled plasmas are well-described by the Landau-Spitzer formula. In the regime of strong coupling, however, the formula breaks down. This has motivated much theoretical and experimental work to study collision rates in strongly-coupled plasmas. In previous work, we have demonstrated direct measurements of thermalization rates in strongly-coupled ultracold neutral plasmas (UCNPs) created by photoionizing strontium atoms in magneto-optical trap. Our technique used optical pumping to create spin "tagged" subpopulations of ions having skewed velocity distributions. With LIF imaging, we measured the equilibration of the skewed velocity profiles to extract ion collision rates. We are now using these techniques to explore the early time dynamics of these skewed ion velocity distributions in the first 100ns after optical pumping. Molecular dynamics simulations of strongly coupled plasmas predict deviations from the exponential decay of average skewed velocity that is expected for weakly coupled plasmas. We use probe laser pulses on the order of 30ns to measure the relaxation of the skewed velocity profiles to test the theoretical predictions.

[1]This work was supported by the United States National Science Foun- dation and Department of Energy Partnership in Basic Plasma Science and Engineering (PHY-1102516) and the Air Force Office of Scientific Research (FA9550- 12-1-0267).

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Date submitted: 01 Feb 2014 Electronic form version 1.4