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Non-Markovian Collisional Dynamics in a Strongly Coupled Ultracold Neutral Plasma[1] TREVOR STRICKLER, THOMAS LANGIN, PATRICK MCQUILLEN, Rice University, GEORG BANNASCH, THOMAS POHL, Max Planck Institute For the Physics of Complex Systems, THOMAS KILLIAN, Rice University — Collision rates in weakly coupled plasmas are well-described by the Landau-Spitzer formula; however, the formula breaks down for plasmas in the strongly coupled regime where collisions may be governed by non-Markovian dynamics. In this work, we present experimental results concerning non-Markovian processes in a strongly coupled ultracold neutral plasma (UCNP) created by photoionizing strontium atoms in a magneto-optical trap. Our diagnostic uses optical pumping to create spin "tagged" subpopulations of ions having skewed velocity distributions that then relax back to equilibrium. In previous work, we used this technique with LIF imaging to extract ion-ion collision rates of strongly coupled UCNPs. With newly improved time resolution (down to 30 ns), we have now explored the very early time dynamics of these skewed ion distributions within a few 100 ns after the optical pumping, where molecular dynamics simulations predict non-Markovian deviations from the exponential velocity damping expected for weakly coupled systems. We observe evidence of non-exponential damping and compare results across a range of plasma parameters.

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