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Non-Markovian Dynamics and Self-Diffusion in Strongly Coupled Plasmas[1] TREVOR STRICKLER, THOMAS LANGIN, PATRICK MCQUILLEN, Rice University, JEROME DALIGAULT, Los Alamos National Laboratory, NIKOLA MAKSIMOVICH, University of Colorado - Boulder, THOMAS KILLIAN, Rice University — In weakly coupled plasmas, collisions are dominated by long range, small angle scattering, and each collision is an uncorrelated binary event. In contrast, collisions in strongly coupled plasmas (coupling parameter $\Gamma > 1$) are dominated by short range, large angle scattering in which the collisions may be correlated and non-independent in time, *i.e.*, non-Markovian. In this work, we present experimental results indicative of non-Markovian processes in a strongly coupled ultracold neutral plasma (UCNP) created by photoionizing strontium atoms in a magneto-optical trap. We use optical pumping to create spin "tagged" subpopulations of ions having non-zero average velocity $\langle v \rangle$, and use laser induced fluorescence (LIF) imaging to measure the relaxation of $\langle v(t) \rangle$ back to equilibrium. We observe clear non-exponential decay in $\langle v(t) \rangle$, which indicates non-Markovian dynamics. We further demonstrate there is a theoretical basis to consider $\langle v(t) \rangle$ as an approximation to the ion velocity autocorrelation function (VAF). We then calculate diffusion coefficients from our data, demonstrating experimental measurement of self-diffusion coefficients for $0.3 < \Gamma < 3.5$.

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