SEMINAR

DEPARTMENT OF PHYSICS

Collective Modes and Collisions in Strongly Coupled Ultracold Plasmas

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ABSTRACT

Ultracold neutral plasmas [1], formed by photoionizing laser-cooled atoms near the ionization threshold, explore a new regime of matter at the intersection of atomic, condensed matter, and plasma physics. Because of the low electron and ion temperatures (Te=1-1000K and Ti=1K), the Coulomb interaction energy per particle can exceed the thermal energy, which makes the system strongly coupled. Strong coupling is of interest in many areas of physics, and it leads to spatial correlations and surprising equilibration dynamics. Ultracold plasmas provide a valuable new window into these phenomena because of the excellent control of initial conditions and diagnostics that are available. I will describe recent measurements of equilibration rates in the strongly coupled regime [2] that are relevant for plasmas produced through short-pulse laser irradiation of solid targets, such as in inertial confinement fusion. I will also describe the excitation of density waves [3] through newly developed techniques for sculpting the initial density distribution of the plasma.This work is supported by the National Science Foundation, Department of Energy, and the Air Force Office of Scientific Research.

[1] "Ultracold Neutral Plasmas," T. C. Killian and S. L Rolston, Phys. Today 63, 46 (2010).

[2] "Velocity relaxation in a strongly coupled plasma," G. Bannasch, J. Castro, P. McQuillen, T. Pohl and T. C. Killian, Phys. Rev. Lett. 109, 185008 (2012).

[3] "Ion Acoustic Waves in Ultracold Neutral Plasmas," J. Castro, P. McQuillen, and T. C. Killian, Phys. Rev. Lett. 105, 065004 (2010).