DAMOP10-2010-020103

Abstract for an Invited Paper
for the DAMOP10 Meeting of
the American Physical Society

A Quantum Gas of Polar Molecules

KANG-KUEN NI, California Institute of Technology

I will present our experimental realization of a near quantum degenerate gas of absolute ground-state polar molecules. This result represents more than 10 orders of magnitude improvement in phase-space density (PSD) compared to previous results for polar molecules and is only a factor of 15 in PSD away from quantum degeneracy. I will also present initial ultracold collisional studies in our KRb molecule system. Our high phase-space-density gas of polar molecules is created using two coherent steps. First, atoms in an ultracold gas mixture are converted into extremely weakly bound molecules near a Fano-Feshbach resonance. Second, the weakly bound molecules are transferred to the ro-vibronic ground state using a coherent two-photon Raman technique with an efficiency as high as 90%. We confirmed that these ground-state molecules are polar with a spectroscopic measurement of their permanent electric dipole moment. Additionally, we demonstrate manipulation of the molecular hyperfine state, where we can produce ultracold polar molecules all in a *single* internal quantum state, and in particular, in their *lowest* energy state. With this gas of molecules, we have studied ultracold collisions, including ultracold chemical reactions and collisions controlled by electric dipole-dipole interactions.

This work was performed at the University of Colorado, Boulder under the direction of Dr. Deborah Jin.