Abstract Submitted
for the DAMOP17 Meeting of
The American Physical Society

Control of Rotational Energy and Angular Momentum Orientation with an Optical Centrifuge[1] HANNAH M. OGDEN, MATTHEW J. MURRAY, AMY S. MULLIN, University of Maryland, College Park — We use an optical centrifuge to trap and spin molecules to an angular frequency of 30 THz with oriented angular momenta and extremely high rotational energy and then investigate their subsequent collision dynamics with transient high resolution IR spectroscopy. The optical centrifuge is formed by combining oppositely-chirped pulses of 800 nm light, and overlapping them spatially and temporally. Polarization-sensitive Doppler-broadened line profiles characterize the anisotropic kinetic energy release of the super rotor molecules, showing that they behave like molecular gyroscopes. Studies are reported for collisions of CO_2 super rotors with CO_2, He and Ar. These studies reveal how mass, velocity and rotational adiabaticity impact the angular momentum relaxation and reorientation. Quantum scattering calculations provide insight into the J-specific collision cross sections that control the relaxation.

[1]NSF-CHE 105 8721

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Date submitted: 27 Jan 2017 Electronic form version 1.4