Abstract Submitted
for the DAMOP14 Meeting of
The American Physical Society

Buffer gas cooling of large polyatomic molecules JULIA PISKORSKI, DAVID PATTERSON, Harvard University, SANDRA EIBENBERGER, University of Vienna, JOHN M. DOYLE, Harvard University — Cryogenic helium buffer gases have cooled a diversity of molecules to temperatures near 1 K. Motivated by collisional studies as well as mixture and chiral analysis, we are now cooling larger (often biological) molecules. A detailed understanding of helium-molecule sticking is currently unknown, as is any possible molecular size limit of buffer gas cooling. We report on experiments with polyatomic molecules that explore He-molecule collisions at energies well below their binding energy, in which the pair would form a dimer (or a larger cluster) under equilibrium conditions. Molecules from an oven source (300-500 K) flow into a cold (5 K) cell, where they undergo a few hundred collisions with He at a density of $\sim 10^{14}$ cm^{-3}. We observe translational and internal cooling of both trans-stilbene and the significantly larger molecule Nile Red. Narrow spectral lines in both molecules indicate the gas-phase monomer. In Nile Red, we also see broad spectral features suggestive of molecule-molecule dimer formation. We see no evidence of high He-molecule dimer formation rates and conclude that for these molecules (and smaller molecules[1]) the lifetime of possible helium-molecule dimers is below $\sim$1 microsecond.

[1]Patterson, *Molecular Physics* (110), 1757, 2012

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Date submitted: 31 Jan 2014 Electronic form version 1.4