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Preparation of Vibrationally Excited H_2 in a Coherent Superposition of M-States Using Stark Induced Adiabatic Raman Passage (SARP)[1]

NANDINI MUKHERJEE, WENRUI DONG, WILLIAM PERREAULT, RICHARD ZARE, Stanford Univ — We prepare a large ensemble of rovibrationally excited (v =1, J =2) H_2 molecules in a coherent superposition of M-states using Stark-induced adiabatic Raman passage (SARP) with linearly polarized single mode pump (532 nm) and Stokes (699 nm) laser pulses of duration 6 ns and 4 ns. A biaxial superposition state, $|\psi\rangle = 1/\sqrt{2}\ [\ |v=1,\ J=2,\ M=-2\rangle - |v=1,\ J=2,\ M=+2\rangle]$, is prepared using SARP with a sequence of a pump laser pulse partially overlapping with a cross polarized Stokes laser pulse co-propagating along the quantization z-axis. The degree of phase coherence is measured by recording interference fringes in the ion signal produced using the O(2) line of 2+1 resonance enhanced multiphoton ionization (REMPI) from the rovibrationally excited (v =1,J =2) level as a function of REMPI laser polarization angle. The ion signal is measured using a time-of-flight mass spectrometer. Nearly 60% population transfer from H_2 (v =0,J =0) ground state to the superposition state in H_2 (v =1, J =2) is measured from the depletion of Q(0) REMPI signal of the (v =0,J =0) ground state. The M-state superposition behaves much like a multi-slit interferometer where the number of slits, i.e. the number of M-states, and their separations, i.e. the relative phase, can be varied experimentally.

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