STUDY OF STATE DENSITY EFFECTS BY IMPULSIVE COLLISIONS OF HIGHLY VIBRATIONALLY EXCITED MOLECULES AND H_2O

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We investigated how donor molecules' state density affect impulsive collisions by studing collisional energy transfer of vibrationally excited pyridine-d_5 (donor) and H_2O (bath), and the result was compared with experiments of pyridine:H_2O, picoline:H_2O and lutidine:H_2O. Vibrationally excited pyridine-d_5 was prepared by absorbing pulsed 266nm UV light from forth harmonic generator of a Nd:YAG laser. A tunable F-center laser with 0.0003 cm^{-1} resolution was used to probe individual H_2O (000 to 001) rotational states. The population of each H_2O rotational state was measured by time dependent transient IR absorption and the rate of single collision between pyridine-d_5 and H_2O was determined afterwards. The translational energy gain in H_2O was obtained by Doppler-broadened linewidths for each rotational state and the rotational energy gain was measured by a population distribution of H_2O rotational states with E_{rot} between 1000 and 2000 cm^{-1}. The probability distributions for the large energy transfer of pyridine-d_5 and H_2O was calculated and the result was compared with other donors and H_2O.