LINE MIXING AND BROADENING IN THE RAMAN Q-BRANCH OF HD

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Using a high-resolution (2 MHz) and shot-noise-limited stimulated Raman gain spectrometer, measurements were made of the Raman Q branch lines of pure HD over a density range of 1 to 7 Amagat at 304.6 K. Line mixing and broadening coefficients were determined by fitting the mixing parameters and line widths as a function of gas density. The broadening coefficients agree with previous measurements, and are an order of magnitude more precise. The Q(0) line mixing coefficient is in agreement with a previous measurement. The Q(1) through Q(3) mixing coefficients have not been measured previously.

The HD broadening coefficients were fitted to a variety of empirical energy gap laws. A modification of the exponential gap law (EGL) and the modified exponential gap (MEG) law, was necessary to successfully model both the broadening and the mixing coefficients. Using the parameters of the successful gap law fit, the relaxation matrix of HD at room temperature was calculated. With the relaxation matrix, the Q branch spectrum was simulated at densities between 49.1 and 490 Amagat for comparison with early high-density measurements. The simulated spectra and measurements were found to agree within about 5 percent of the peak of the spectra at all densities.