

FREQUENCY-COMB REFERENCED SPECTROSCOPY OF  $\nu_4$  AND  $\nu_5$  HOT BANDS IN THE  $\nu_1+\nu_3$  COMBINATION BAND OF  $C_2H_2$ 

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Doppler-free transition frequencies for  $\nu_4$  and  $\nu_5$  hot bands in the band of  $C_2H_2$  have been measured using saturation dip spectroscopy with an extended cavity diode laser referenced to a frequency comb. The frequency accuracy of the measured transitions, as judged from line shape model fits and the spectrometer stability, is better than 30 kHz. This is some 2-3 orders of magnitude improvement on the accuracy and precision of previous measurements of the line positions derived from the analysis of high-resolution Fourier transform infrared absorption spectra. The data were analyzed by determining the upper state energies, using known lower state level positions, and fitting them to a  $J(J+1)$  polynomial expansion to identify perturbations. The results reveal that the upper rotational energy level structure is mostly regular but suffers  $J$ -localized perturbations causing level shifts between one and several hundred MHz. These perturbations are due to accidental near degeneracies with energy levels of the same  $J$  and larger bending vibrational excitation.

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