FINE AND HYPERFINE STRUCTURE IN SUB-DOPPLER, INFRARED, CH-STRETCHING SPECTRA OF MONODEUTERATED METHYL RADICAL

MELANIE A. ROBERTS, CHANDRA SAVAGE, FENG DONG, DAVID J. NESBITT, JILA, National Institute of Standards and Technology and University of Colorado, and Department of Chemistry and Biochemistry, University of Colorado, Boulder, Colorado 80309.

High resolution direct absorption spectroscopy in the CH-stretching region is used to observe fully resolved rovibrational structure and partially resolved fine and hyperfine structure of monodeuterated methyl radical (CH$_3$D). CH$_3$D is readily made by passing a mixture of CH$_2$DI and Ne/He through the orifice of a slit nozzle and striking a discharge, which supersonically expands to permit spectroscopic study of radicals with a rotational temperature of approximately 15 K and slit-narrowed IR line widths of 0.002 cm$^{-1}$. We obtained and analyzed rovibrational transitions in both the symmetric and antisymmetric CH-stretch regions. We also observed fine and hyperfine structure, arising from interactions between electron spin with molecular rotation and with H/D nuclear spins, respectively. This structure results in complex lineshapes under sub-Doppler resolution. Simultaneous least squares fitting of the set of spectral profiles is used to extract rotational, spin-rotation and Fermi contact information in the ground and vibrationally excited states.