The $\nu_7 + \nu_9 - \nu_9$ Hot Band in Ethane

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Applying an IRIR double resonance technique in a seeded molecular jet, a rotationally cooled hot band spectrum of ethane has been recorded in the region of the C–H stretching fundamental ν_7 near 3000 cm^{-1}. A mixture of C_2H_6 and SF_6 in Ar is expanded through a slit nozzle. A 10 Watts cw CO_2 laser excites a single rotational level in the ν_3 manifold of SF_6. Collisional relaxation redistributes the excited state population over many rovibrational levels of C_2H_6. A continuously tunable F-center laser (FCL) then probes the changes in C_2H_6 population induced by the CO_2 laser.
No evidence has been found for hot bands starting from excited torsional states indicating that these levels are quickly deactivated by V-T transfer to the ground state in the collisional environment of the jet. Significant population of high rotational levels in the ground state demonstrate rapid conversion of internal rotation into end-over-end rotation of the molecule. The ν_9 state collects substantial population suggesting that this state is collisionally rather stable.
The observed hot bands are assigned to the two perpendicular components of the $\nu_7+\nu_9(A_{1g}\oplus A_{2g}\oplus E_g) \leftarrow \nu_9(E_u)$ band. The spectrum appears to be heavily perturbed by dark state interactions in the upper level forcing us to analyse each K-stack separately. Rotational levels in the $\nu_7 + \nu_9$ state up to $J = 15$ and $K = 5$ have been least squares fitted to standard symmetric rotor expressions with an average standard deviation of 0.0014 cm^{-1}.