On the Ro -Vibrational Study of "Hot" Transitions in C_2H_4:

The $\nu_7 + \nu_{10} - \nu_{10}$ and $\nu_{10} + \nu_{12} - \nu_{10}$ Bands

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The main goal of the present study is to analyze rotational structure of two excited vibrational states, ($\nu_7 = \nu_{10} = 1$, B_{3g}) and ($\nu_{10} = \nu_{12} = 1$, B_{1g}). The bands $\nu_7 + \nu_{10}$ and $\nu_{10} + \nu_{12}$ are totally forbidden by symmetry and cannot be appeared in absorption spectra, in principle. The only way for study of rotational structure of the states ($\nu_7 = \nu_{10}=1$, B_{3g}) and ($\nu_{10} =\nu_{12}=1$, B_{1g}) by the methods of high resolution absorption spectroscopy is the analysis of "hot" bands, such, *e.g.*, as $\nu_7 + \nu_{10} - \nu_{10}$ and $\nu_{10} + \nu_{12} - \nu_{10}$.

In the present study the experimental spectrum of C_2H_4 was recorded with the Fourier transform interferometer 120 HR in University of Oulu (Finland). Both of these bands are located in the region of considerably stronger bands, ν_7 and ν_{12}. On that reason, as the first step of analysis, we made assignments of transitions belonging to these strong bands. After "cleaning" the experimental spectrum from transitions belonging to strong bands, assignments of remaining weak transitions was made on the base of calculation scheme discussed in [1]. As the result, 556 transitions with $J^{max.} = 35$ and $K_a{}^{max.} = 15$ were assigned to the band $\nu_7 + \nu_{10}$, and 228 transitions with $J^{max.} = 21$ and $K_a{}^{max.} = 11$ were assigned to the band $\nu_{10} + \nu_{12}$. On that base, the rotational energies of the vibrational states ($\nu_7 = \nu_{10} = 1$) and ($\nu_{10} = \nu_{12} = 1$) were determined, and then they were used as an input data in the fit procedure.

The obtained from the fit set of parameters reproduced the experimental data with an accuracy close to experimental uncertainties.

[1]. O. N. Ulenikov, E. S. Bekhtereva, O. V. Gromova, S. Alanko, V.-M. Horneman, and C. Leroy, *Molec. Phys.*, 108(10), (2010).