SELF-BROADENING COEFFICIENTS AND LINE INTENSITIES IN THE $\nu_6$ BAND OF METHYL CHLORIDE IN THE 10 $\mu$m REGION

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The halocarbons derivatives of methane contribute to the destruction of the ozone layer and the greenhouse effect$^1$. The most abundant of these halocarbons is methyl chloride (CH$_3$Cl) with an estimated lifetime in the stratosphere of about 1 to 3 years$^2$. This molecule is the main source of natural chlorine in the atmosphere and was included in the global stratospheric chlorine budget$^3$.

High-resolution spectroscopy studies are necessary to achieve accurate concentration of this gas. The results of such studies is of great interest to atmospheric scientists to enrich databases$^4$.

We performed the first systematic measurements of pressure broadening coefficients and line intensities of ro-vibrational absorption transitions of the $\nu_6$ perpendicular band of $^{12}$CH$_3$ $^{35}$Cl and $^{12}$CH$_3$ $^{37}$Cl isotopes. The spectra were recorded in the spectral region between 920 and 1130 cm$^{-1}$ with a high-resolution Fourier transform spectrometer.

A multi-pressure fitting technique was used to fit a series of seven spectra at pressures of CH$_3$Cl ranging from 1.02 to 10.24 mbar to retrieve line intensities of about 2000 transitions with $3 \leq J \leq 55$ and $0 \leq K \leq 12$. The rotational dependencies of the self-broadening coefficients have been clearly observed and modeled using a second-order empirical polynomial. The average accuracies have been estimated to be about 4 and 5% for line intensities and self-broadening respectively.

The rotational dependencies of line intensities were analyzed and used to derive the transition dipole moments squared for each line. The analysis of these moments using the theoretical model of Tarrago et al.$^5$ allows us to derive a consistent set of line

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$^2$Brown AT, Volk CM, Schoeberl MR, Boone CD., Bernath PF. Stratospheric lifetimes of CFC-12, CCl$_4$, CH$_4$, CH$_3$Cl and N$_2$O from measurements made by the Atmospheric Chemistry Experiment-Fourier Transform Spectrometer (ACE-FTS), Atmos. Chem. Phys., 13, 6921-50 (2013).


intensity parameters such as vibrational transition moments, band intensities as well as Herman-Wallis coefficients. The results were compared with previous works and with HITRAN databases.