EXTENSIVE INVESTIGATION OF ROOM-TEMPERATURE $CH_3C^{14}N$-N_2 PRESSURE-BROADENING PARAMETERS IN THE 180–1400 GHz RANGE

F. ROHART*, A. DUDARYONOK, L. ZOU*,***, L. MARGULES*, N. LAVRENTIEVA**, J. BULDYREVA******, *Laboratoire PhLAM - Physique des Lasers, Atomes et Molécules, UMR CNRS 8523, Université Lille, F-59000 Lille (*); Laboratory of Molecular Spectroscopy, V.E. Zuev Institute of Atmospheric Optics SB RAS, 1 Akademician Zuev sq., 634055 Tomsk, Russia (**); Université du Littoral Côte d'Opale, UR 4493, Laboratoire de Physico-Chimie de l'Atmosphère, F-59140, Dunkerque (***); Institut UTINAM, UMR CNRS 6213, Université de Franche-Comté, 16 Route de Gray, F-25030 Besançon cedex (****)*

Acetonitrile CH_3CN is a molecule of atmospheric interest, now included in the HITRAN database [1]. However, except for some experimental studies of line intensities, positions, broadening and shifting parameters [2,3], its line broadening by many atmospheric gases remains incomplete. The case of N_2-broadening is the most important since nitrogen is the main perturbing gas in the atmospheres of Earth and Titan. In the present work we address N_2-broadening coefficients of $CH_3C^{14}N$ rotational transitions for a wide range of rotational quantum numbers J and K.

Experiments were performed with a frequency-modulated spectrometer operating in the 180–1400 GHz range and consisting of a 10–20 GHz frequency synthesizer followed by a frequency multiplier chain based on solid-state devices, a 1.1 meter long absorption inox cell and a bolometric detection. Measurements were done at room temperature, with the active-gas pressure equal to 2–5 mTorr and the buffer-gas pressure 50–600 mTorr. Rotational lines with J = 9, 12, 15, 21, 27, 33, 42, 48, 63, 69, 75 and $K \leq 15$, located in the region 184–1390 GHz, have been studied in detail. All recorded lines exhibit clear departures from the usual Voigt profile and have been analyzed using the more realistic Speed-Dependent Voigt profile. The Voigt profile has been also employed because of its continuing use in atmospheric applications.

Measured values are compared to theoretical estimates obtained by the semi-empirical method [4] successfully applied previously to other symmetric tops CH_3X [5] and well appropriate for the CH_3CN-N_2 case because of strong electrostatic interactions due to the large dipole moment of the absorbing molecule. Being fitted on experimental J- and K-dependent values of pressure-broadening coefficients, the theoretical model parameters enable computations of line-shape parameters for enlarged ranges of rotational quantum numbers.

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