Summary of Research

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High Resolution Infrared Spectroscopy of Molecules of Terrestrial and Planetary Interest

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Abstract

High Resolution Infrared Spectroscopy of Molecules of Terrestrial and Planetary Interest

In collaboration with the laboratory spectroscopy group of the Ames Atmospheric Physics Research Branch (SGP), high resolution infrared spectra of molecules that are of importance for the dynamics of the earth's and other planets' atmospheres were acquired using the SGP high resolution Fourier transform spectrometer and gas handling apparatus. That data, along with data acquired using similar instrumentation at the Kitt Peak National Observatory was analyzed to determine the spectral parameters for each of the rotationally resolved transitions for each molecule. Those parameters were incorporated into existing international databases (e.g. HITRANS and GEISA) so that field measurements could be converted into quantitative information regarding the physical and chemical structures of earth and planetary atmospheres.

Accomplishments

The laboratory spectroscopy group of the Ames Atmospheric Physics Research Branch (SGP) acquires high resolution infrared spectra of molecules that are of importance for the dynamics of the earth's and other planets' atmospheres using their own high resolution Fourier transform spectrometer and gas handling apparatus and similar instrumentation at the Kitt Peak National Observatory. Spectra of these molecules are needed over a range of temperatures, gas pressures of the molecules themselves, and pressures of other gases prevalent in the planets' atmospheres.

The data was analyzed using computer algorithms developed by our principal investigators to model the spectra. Such analysis determined the spectral parameters for each of the rotationally resolved transitions for each molecule, including the line position, line intensity, self-broadening coefficient, foreign gas broadening coefficient, foreign gas frequency shift coefficient and line mixing coefficient. Those parameters were incorporated into existing international databases (e.g. HITRANS and GEISA) so that field measurements could be converted into quantitative information regarding the physical and chemical structures of earth and planetary atmospheres.

The results of this work are available in the following publications:

The Nitric Oxide Fundamental Band: Frequency and Shape Parameters for Rovibrational Lines, M. N. Spencer, C. Chackerian, L. P. Giver, L. R. Brown, *Journal of Molecular Spectroscopy*, Vol. **165**, No. 2, Jun 1994, pp. 506-524

The Rovibrational Intensities of the $(40^01)\leftarrow(00^00)$ Pentad Absorption Bands of $^{12}C^{16}O_2$between 7284 and 7921 cm^{-1}, L. P. Giver, C. Chackerian, Jr., M. N. Spencer, L. R. Brown, R. B. Wattson, *Journal of Molecular Spectroscopy,* Vol. **175**, No. 1, Jan 1996, pp. 104-111

Temperature Dependence of Nitrogen Broadening of the NO Fundamental Vibrational Band, M. N. Spencer, C. Chackerian Jr., L. P. Giver, L. R. Brown, *Journal of Molecular Spectroscopy*, Vol. **181**, No. 2, Feb 1997, pp. 307-315

Zeeman Tuning Rates for *Q*-Branch Transitions in the ν_3 Band of NO_2, Christopher R. Mahon, Charles Chackerian Jr., *Journal of Molecular Spectroscopy,* Vol. **189**, No. 2, Jun 1998, pp. 276-282

The NO Vibrational Fundamental Band: O_2-Broadening Coefficients, C. Chackerian Jr., R. S. Freedman, L. P. Giver, L. R. Brown, *Journal of Molecular Spectroscopy*, Vol. **192**, No. 1, Nov 1998, pp. 215-219

Absolute Rovibrational Intensities for the $X^1\Sigma^+$ (ν=3) $\leftarrow$ (ν=0) Band of Carbon Monoxide: A Near-IR Intensity Standard, Charles Chackerian, Jr., R. Freedman, and L. P. Giver, *Journal of Molecular Spectroscopy*, accepted for publication.