Infrared absorption spectroscopy of the $^{14}\text{N}_2^+$ Meinel system 2-1 band

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Introduction
The $^3\Pi_u - ^3\Sigma_g^+$ system of $\text{N}_2^+$ was first observed in auroral emissions by Meinel in 1950. Although the $\text{N}_2^+$ band system has been reinvestigated since this first spectral study, no laboratory spectrum of the 2-1 vibronic band has been obtained. We have observed the 2-1 band of $\text{N}_2^+$ in a positive column discharge cell with continuous-wave cavity ringdown spectroscopy (cw-CRDS).

Experiment
We use continuous-wave cavity ringdown spectroscopy to investigate the vibronic spectra of molecular ions. The output of a cw external cavity tunable diode laser is coupled into a high finesse cavity formed from two highly reflective mirrors. A piezo changes the length of the cavity, and the light couples to the cavity when in resonance. The light is diverted with an acousto-optical modulator (AOM) when resonance is achieved, and the intensity exponentially decays with a rate proportional to the cavity absorption.

In this experiment, the $\text{N}_2^+$ ions were produced in a DC positive column discharge cell. Argon purge gas (300 mTorr) protected the ringdown mirrors.

Discharge Parameters
Total pressure = 500; 3000 mTorr
Discharge voltage = 3100 V
Discharge current = 70 mA

Spectra and Results
Relative frequency calibration was achieved using a spectrum analyzer, and a picometer resolution wavemeter was used for mode hop correction. A Herriott cell was used to record a water spectrum for absolute frequency calibration. $\text{N}_2^+$ spectral parameters were determined through a least-squares analysis.

Ongoing Work
More than 20 additional $\text{N}_2^+$ lines involving higher N states are assigned and require further analysis of the centrifugal distortion constants. As many as 460 lines of $\text{N}_2^+$ have also been tentatively assigned, but these assignments are based on the predicted frequencies with no intensity information. We will calculate the intensities for these lines and finalize the assignments for both $\text{N}_2^+$ and $\text{N}_2^*$.

References

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