N_2 and SO_2 VUV Oscillator Strengths for Planetary Atmosphere Studies

Glenn Stark
Physics Department, Wellesley College, Wellesley, MA 02181

Peter L. Smith
Harvard-Smithsonian Center for Astrophysics, Cambridge, MA 02138

Juliet C. Pickering, Geoff Cox & James Rufus
Blackett Laboratory, Imperial College, London, U.K.

Analyses of Voyager EUV occultation measurements of the N_2-rich atmospheres of Titan and Triton have been hampered by the lack of fundamental spectroscopic data for N_2 — in particular, by the lack of reliable *f*-values and linewidths for electronic bands of N_2 in the 800 to 1000 Å wavelength region. In order to address this shortfall, we have studied the photoabsorption spectrum of N_2 with a resolving power $(\lambda/\delta\lambda)$ of 90,000 to 170,000. New band-integrated photoabsorption cross sections (*i.e., f*-values) for the region 900 and 950 Å will be presented. Data for linewidths — which, in the case of the EUV bands of N_2, are often determined by predissociation lifetimes rather than by Doppler effects — are as essential as *f*-values in calculations of the transmission of radiation through the high column densities of N_2 ($nl \simeq 10^{19}$ cm^{-2}) observed by the Voyager spacecraft at Titan and Triton. We will present preliminary linewidth results for some $b(v')$-X(0) bands of N_2. We will also demonstrate that, for some bands and for high column densities, isotopically rare $^{15}N^{14}N$ may contribute disproportionately to N_2 absorption.

Determination of the chemical composition of the atmosphere of Io from Hubble Space Telescope observations in the 190-220 nm wavelength region requires knowledge of the photoabsorption cross sections of SO_2 at temperatures ranging from 110 to 300 K. We have initiated a laboratory program to measure SO_2 absorption cross sections with very high resolving power ($\lambda/\delta\lambda \simeq 500,000$) and at temperatures appropriate to the Io atmosphere. Previous photoabsorption measurements, with $\lambda/\delta\lambda \leq 100,000$, have been unable to fully resolve the very congested SO_2 spectrum. Our measurements are being undertaken at Imperial College, London, using an ultraviolet Fourier transform spectrometer. We present new room temperature SO_2 photoabsorption cross sections in the 190-220 nm region measured with an instrumental resolution of 0.0004 nm. These high-resolution cross sections are compared to previous, lower-resolution, data.

References:

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