Geophysical Research Abstracts
Vol. 13, EGU2011-2321, 2011
EGU General Assembly 2011

Electron-Nitrogen Collision Processes Relevant to Planetary Atmospheres

Paul Johnson (1), Charles Malone (1,2), Murtadha Khakoo (2), Jason Young (1), Bahar Ajdari (2), Xianming Liu (1,3), Joseph Ajello (1), and Isik Kanik (1)

(1) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA (Paul.V.Johnson@jpl.nasa.gov), (2) Department of Physics, California State University, Fullerton, CA, USA, (3) Planetary and Space Science Division, Space Environment Technologies, Pasadena, CA, USA

Electron-N_2 collisions play an important role in the nitrogen-rich upper atmospheres of Titan, Triton, and Earth. Modeling these processes requires accurate laboratory data. Despite the recognized importance of such data, there remained a poor degree of consensus among much of the available laboratory collision cross section data well into the present millennium. To address this situation, our group has devoted considerable effort over the past decade to improve the status of low energy electron collision data. In doing so, we have measured direct excitation cross sections for 17 electronic states of neutral N_2 and a variety of key UV emission cross sections. Here we review the results of this effort, highlighting how our picture of electron collision processes has evolved, where consensus has been reached, and where discrepancies still exist. Particular attention will be given to the excitation of the $a^1\Pi_g$ state and the resulting emissions, which comprise the Lyman-Birge-Hopfield (LBH) band system.

LBH emissions are an important signature of excited N_2 in the upper atmosphere of Earth and have been clearly identified in Cassini's Ultraviolet Imaging Spectrograph (UVIS) measurements of Titan's airglow. Hence, the LBH band of emissions, produced primarily from electron impact-induced excitation of the metastable $a^1\Pi_g(v')$ state followed by decay into the ground $X^1\Sigma_g^+(v'')$ state, is an essential input for models of dayglow and auroral processes in nitrogen-rich atmospheres. Here we will highlight recent efforts to enhance our understanding of this important emission process. Specifically, we will present recent measurements showing the total LBH cross section, $a(v',v'')$, calculated in [Ajello and Shemansky, J. Geophys. Res., **90**, 9845, 1985], which was based primarily on a single LBH line, a(3,0), is incorrect. We will present excitation cross sections for both the a(3,0) and a(2,0) vibronic transitions and provide a revised total cross section. These new measurements [Young *et al.*, J. Phys. B., **43**, 135201, 2010] are found to be consistent with recent electron energy-loss measurements [Johnson *et al.*, J. Geophys. Res., **110**, A11311, 2005]. In addition, new electron energy-loss measurements are presented for excitation of the $a^1\Pi_g$ state, with finely-spaced ($<$1eV) impact energy increments in the threshold-to-peak region. These data are unique in that they include measurements at fixed electron scattering angles, differential in impact energy. Also, new near-threshold integral cross sections are provided.

Acknowledgments: This work was performed at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (NASA) and at the California State University, Fullerton. We gratefully acknowledge financial support for this work by NASA's Planetary Atmospheres and Outer Planets Research Programs and the National Science Foundation (Grant No. NSF-PHY-RUI-0096808).