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Electron-molecule processes relevant to planetary atmospheres[1]

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Electron-molecule collisions play an important role in the nitrogen-rich upper atmospheres of Titan, Triton, and Earth. Modeling these processes requires accurate laboratory data. To this end, measurements and analyses of recent electron impact excitation experiments with molecular nitrogen are presented. Absolute excitation cross sections for transitions from the $X\,^1\Sigma_g^+(v''{=}0)$ to the $C\,^3\Pi_u$, $E\,^3\Sigma_g^+$, $a''\,^1\Sigma_g^+$, $b\,^1\Pi_u$, $c_3\,^1\Pi_u$, $o_3\,^1\Pi_u$, $b'\,^1\Sigma_u^+$, $c_4'\,^1\Sigma_u^+$, $G\,^3\Pi_u$ and $F\,^3\Pi_u$ states are determined from electron energy loss measurements, integrated over a broad range of scattering angles, with incident electron energies ranging from 13 eV to 100 eV. Vibrationally resolved excitation of the $C\,^3\Pi_u(v')$ state for the $v'{=}0$, 1, 2, 3, and 4 levels will also be discussed, which indicates non-Franck-Condon behavior below roughly 30 eV. Results from rotationally resolved electron-impact induced VUV emission measurements will also be discussed. Of particular interest is the predicted variation of predissociation yield with increasing rotational quantum number. This is expected to introduce additional temperature dependencies to atmospheric models. Preliminary results of vibrationally resolved excitation functions for electron impact induced emissions of the Lyman-Birge-Hopfield (LBH) band system will be presented. Finally, we will discuss an investigation into $e-H_2$ processes related to the Jovian and Saturnian aurora as well as the recently identified atomic hydrogen plume on Saturn.

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