Data Needs For Simulations Of Electron-driven Processes In Planetary And Cometary Atmospheres

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Abstract. Sunlight causes photoionization of atoms and molecules in planetary and cometary atmospheres, producing photoelectrons. These cause further ionization, yielding secondary electrons. Electrons in the solar wind, often accelerated by magnetospheric processes, also produce ionization and secondary electrons. In each case the secondary electrons lose energy in further interactions, including dissociation and electronic and vibrational excitation. Radiative decay of the excited species produces light emissions, such as dayglow, nightglow and aurora. Excitation energy can also be lost in collisions between excited molecules and neutral species, sometimes initiating chemical reactions. Thus electron-driven processes are important in determining both the energy balance and composition of planetary and cometary atmospheres.

Simulation of these processes requires accurate atomic and molecular data, such as electron impact cross sections for ionization and excitation, radiative transition probabilities and collisional reaction rates. This will be illustrated by several examples of our recent work in which updated measurements [1-4] or theoretical calculations [5] of atomic and molecular data were applied to simulations of electron cooling by CO_2 at Mars [6], the abundance of CO in comet Hale-Bopp [7], electron heating rates in the atmosphere of Titan [8], infrared emission rates from CO in the atmospheres of Mars and Venus [9], and 630.0-nm emissions in the atmosphere of Europa [10]. Finally, ongoing simulations of emissions from hydrogen in the atmosphere of Jupiter will be described.

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