Electron energetics in the Martian dayside ionosphere: Model comparisons with MAVEN data

Shotaro Sakai[1]; Laila Andersson[2]; Thomas E. Cravens[1]; David L. Mitchell[3]; Christian Mazelle[4]; Ali Rahmati[3]; Christopher M. Fowler[2]; Stephen W. Bougher[5]; Edward M. B. Thiemann[2]; Francis G. Eparvier[2]; Juan M. Fontenla[6]; Paul R. Mahaffy[7]; John E. P. Connerney[7]; Bruce M. Jakosky[2]
[1] U. Kansas; [2] LASP, CU Boulder; [3] SSL, UC Berkeley; [4] CNRS,IRAP; [5] U. Michigan; [6] NWRA; [7] NASA GSFC

The goal of the Mars Atmosphere and Volatile EvolutioN (MAVEN) mission is to characterize the loss of atmospheric gas to space and how this has affected the Martian climate through. Atomic oxygen is a key species in atmospheric loss at Mars and the current key path for photochemical loss of neutral oxygen is the dissociative recombination of ionospheric O_2^+, which is associated with the electron temperature in the ionosphere. We present a study of the energetics of the dayside ionosphere of Mars using models and data from several instruments onboard the MAVEN spacecraft. In particular, calculated photoelectron fluxes are compared with suprathermal electron fluxes measured by the Solar Wind Electron Analyzer (SWEA), and calculated electron temperatures are compared with temperatures measured by the Langmuir Probe and Waves (LPW) experiment. The major heat source for the thermal electrons is Coulomb heating from the suprathermal electron population, and cooling due to collisional rotational and vibrational CO_2 dominates the energy loss. The models used in this study were largely able to reproduce the observed high topside ionosphere electron temperatures (e.g., 3000 K at 300 km altitude) without using a topside heat flux when magnetic field topologies consistent with the measured magnetic field were adopted. Magnetic topology affects both suprathermal electron transport and thermal electron heat conduction. The electron temperature is shown to affect the O_2^+ dissociative recombination rate coefficient, which in turn affects photochemical escape of oxygen from Mars.