THE IMPORTANCE OF THE ELECTRON TEMPERATURE FOR THE UPPER ATMPSPHERE OF MARS. M. Mooroka[1], L. Andersson[1], T. McEnulty[1], and R. R Ergun[1] [1]Laboratory for Atmosperic and Space Physics at University of Colorado (michiko.morooka@lasp.colorado.edu).

abstract: Understanding the Mars photochemistry is critical for explaining the upper atmosphere and the atmospheric loss to space. The system is complex and therefore often simulated. Most models are either focusing on the neutral atmosphere or the ionosphere. Over the years this has result in a large number of models. More recent models covers processes all the way down to the exobase from the solar wind, however, not all the processes cannot be covered due to the comprexity and some parameters are still under the assumption.

An important parameter for modeling Mars ionosphere is the electron temperature. It can affect to both ionospheric chemistry and dynamics. For instance, the ion recombination rate increases in a colder plasma, afecting the production and loss in the photochemically dominated region of the ionosphere. The plasma scale height has also a function of the electron temperature. Therefore, understanding the characteristics of the electron temperature is clucial to the modeling of Mars.

However, the current understanding of the electron structure of Mars is very poor. The only observation of the electron temperature comes from the two Viking landers (VL1 and VL2) in 1976. The retarding potential analyzers of each landers measured one altitude profile of plasma density and the temperature [1]. Besids, Viking 2 profile is usually attributed to a disturb situation [2] and therefore is rarely used.

The upcoming Mars mission MAVEN has a set of Langmuir probe (LPW) onboard and can measure the density and the temperature of the electrons in a cold plasma. A similar Langmuir probe measurement was onboard the Cassini spacecraft obtained the characteristics of the electrons at Titan's atmosphere. The results clearly show the electron density and temperature dependence in altitudes and moon's local time (figure) [3]. As the electron densities of Mars' atmosphere are affecte by the photo-chemical model [e.g., Morgan et al., 2008] as well as the solar wind pressure [Edberg et al., 2010], it is also likely that the electron temperature reflects such large variations in location and time. The electron temperature impacts clearly the ion production rates, and the fraction of different ions spices can depend on the electron temeperature. With different masses, the ions has different escape rates from the atmosphere. The implication of these facts is that different ion spices ratio of the ion outflow in a different location.

This presentation will demonstrate the current understanding of the upper atmosphere of Mars that are mainly based on a single altitude profiling of the electron temperature. We will also demonstlate using an ionospheric model that the different electron temperature profiles can impact to the ion compositions both in altitude profile and the outflow. The electron observations by MAVEN/LPW can provide better understanding of the electron temperature pofile, and therefore urge the different modelers to start evaluate the impact of a variable electron temperature in their models.

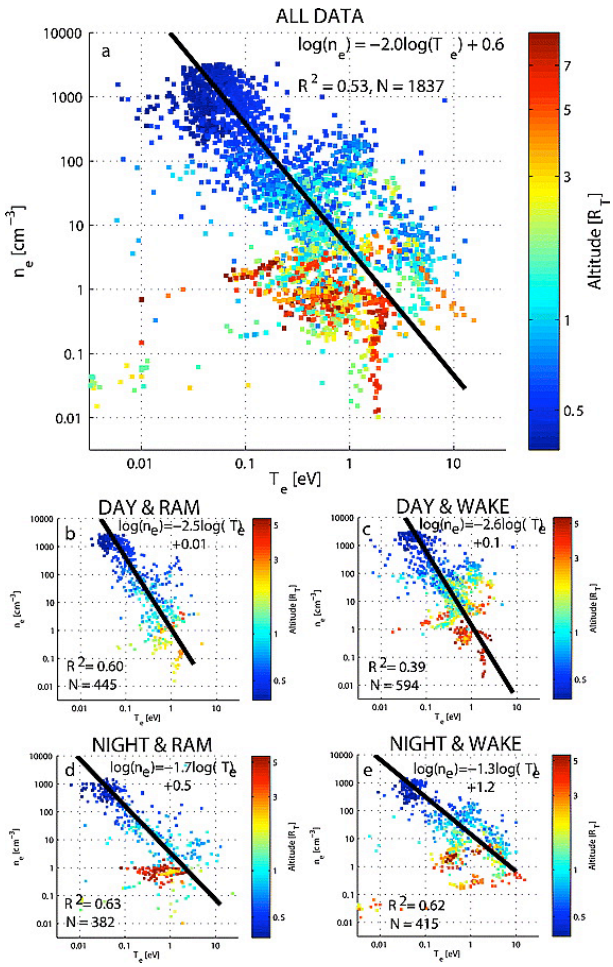

Figure: Langmuir probe electron observations from Cassini/RPWS showing the density and temperature characteristics of Titan's ionosphere that are different in moon's local time and sun illumination [3].

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