Space Physics Seminar

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Ion loss from Mars atmosphere and the controlling factors

Modern Mars atmosphere is thin, cold and dry. However, there is considerable evidence that Mars' climate has changed greatly during the planet's history. Solar wind induced atmospheric erosion is one candidate for causing the long-term variations of the Mars atmosphere. Mars has only localized crustal magnetic fields, so the solar wind plasma flow interacts directly with the Mars atmosphere/ionosphere system. Such an interaction generates induced current in the ionosphere, modifies the magnetic field environment around Mars and more importantly, causes the erosion of the Mars atmosphere. Here we use a 3D time-dependent multi-species single-fluid MHD model to study the plasma environment of Mars and quantify the ion loss rate. The effects of the crustal magnetic fields are discussed based on model results and their comparison with MGS (Mars Global Surveyor) magnetometer observations. Two event studies of MAVEN (Mars Atmosphere and Volatile Evolution) mission are also presented, one for quiet solar wind condition and the other for a strong ICME impact in March 2015. The ongoing MAVEN mission was designed to study the upper atmosphere, ionosphere, and magnetosphere of Mars, the response to solar and solar-wind input, and the ability of atmospheric molecules and atoms to escape to space. Through detailed comparisons between the model results and the relevant plasma observations from MAVEN, we find that the time-dependent global MHD model is able to reproduce the main features of the plasma environment around Mars for both quiet and disturbed solar wind conditions. Model results suggest that the total ion escape rate was enhanced by an order of magnitude during the ICME event. Given the likely prevalence of ICME-like conditions earlier in the solar system history, ion loss during solar events in ancient times could have contributed significantly to the long-term evolution of the Mars atmosphere.

4:00pm in CAS 502. *Refreshments served at 3:45pm in CAS 500.*

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Next Week
Thanksgiving Recess