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The Air Force Space Test Program launched the Advanced Research and Global Observations Satellite (ARGOS) on February 23, 1999. ARGOS was in a near-polar sun-synchronous orbit with an ascending node local time of 1430. The instruments on board used remote sensing techniques to measure the composition, density and temperature of the thermosphere and the ionosphere. On board ARGOS was the Low Resolution Airglow and Auroral Spectrograph (LORAAS) instrument, which measured upper atmospheric airglow in the far- and extreme-ultraviolet passband. Every ninety seconds a limb scan, or atmospheric radiance profile, was collected. This study will focus on a statistical validation of a one-dimensional electron density retrieval algorithm for the oxygen emission at 911Å. To do this, we will perform electron density profile retrievals using a one-dimensional algorithm. Our particular interest is in data from limb scans near the terminator. We will then compare these findings with data from ground-based ionosondes. Although ARGOS is no longer operational, this study will be valuable for the Special Sensor Ultraviolet Limb Imager (SSULI) on a recently launched satellite of the Defense Meteorological Satellite Program (DMSP). This first satellite to carry a SSULI instrument was launched October 18, 2003 into an orbit close to the terminator. The SSULI instruments are similar to LORAAS, and therefore we plan to use this analysis to demonstrate the value of using the 911Åemission for the retrieval of electron density profiles near the terminator.

SA23A-11 1330h POSTER

Generation of Metastable Helium and the 10830Å Emission in the Upper Thermosphere

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Models of metastable helium, He(2^3S), production in the upper thermosphere and lower exosphere over Arecibo show that creation by recombination of He^+ can be non-negligible relative to the photoelectron impact on He(1^1S) source. Due to large ground-state He abundance in the winter, and to photoelectrons from an illuminated conjugate thermosphere, the strongest 10830Å intensities (arising from He(2^3S) solar resonance) occur during the winter. The contribution to the 10830Å airglow brightness from He^+ recombination reaches more than 10% in the morning twilight when He^+ peak concentrations are more than ∼30% of the topside composition, and He^+ recombination becomes increasingly dominant for solar zenith angles greater than 100°. Measurements of the topside ionosphere at Arecibo have shown that He^+ layer concentrations in the winter and near the equinoxes are often as high as 50% and significant He^+ concentrations can persist throughout the night. A hot metastable component from recombination renders ambiguous interpretation of the 10830Å spectral profile in terms of exospheric temperature. The presence of such a population may explain reported observations of 10830Å line widths that increase with shadow height, implying twilight temperatures much hotter than those expected of a thermalized neutral population. Modeling of 10830Å line profiles comprised of both thermal and nonthermal He(2^3S) components is investigated to assess the role of He^+ recombination in the generation of metastable He and the implications for the derivation of neutral temperature in the upper thermosphere.

SA23A-12 1330h POSTER

Tracking of Polar Cap Ionospheric Patches

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Ionospheric patches are significant perturbations on F-region electron densities in the polar cap ionosphere. There are many questions related to their formation, transport, and eventual transformation into blobs on the nightside. In an earlier study, we showed that patches observed by ionosondes can be tracked across the polar cap using 2-D convection patterns and a trajectory analysis package. The present study allows for a full three-dimensional convection analysis of the patch fate. Measurements provided by three high-latitude tomography arrays located in Greenland, Alaska and Scandinavia are supplemented by ISR, Ionosonde and DMSP measurements. The data are assimilated into a 3-D global ionosphere model. The background model for the assimilation is the NCAR TIMEGCM, with comprehensive high latitude inputs. We will investigate several patch events and determine whether and under what conditions patches can be routinely tracked, given the instruments and moeling capabilities currently available.

SA23B CC: 519 A Tuesday 1330h

Mars Space Weather and Upper Atmosphere Science I *(joint with A, P, SH, SM)*

Presiding: **K Retherford,** Southwest Research Institute**; W Ward,** University of New Brunswick

SA23B-01 1330h INVITED

First Results of the Analyzer of Space Plasmas and Energetic Neutral Atoms (Aspera-3) Onboard Mars Express

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The scientific objective of the ASPERA-3 experiment is to study the solar wind - atmosphere interaction and characterize the plasma and neutral gas environment in the near-Mars space through energetic neutral atom (ENA) imaging and in-situ ion and electron measurements. The ASPERA-3 instrument comprises four sensors, two ENA sensors and an electron and ion spectrometer. The Neutral Particle Imager (NPI) provides measurements of the integral ENA flux in the energy range 0.1 - 60 keV with no mass and energy resolution but a comparatively high angular resolution of $4.6^\circ \times 11.5^\circ$. The Neutral Particle Detector (NPD) provides measurements of the ENA flux in the energy range 0.1 - 10 keV, resolving velocity and mass (H and O) with a coarse angular resolution of $5^\circ \times 30^\circ$. The ENA detection technique is based on the atom - surface interaction. The Electron Spectrometer (ELS) is a standard top-hat electrostatic analyzer in a very compact design covering the energy range 0.01 - 20 keV with an energy resolution of 8%. Ion mass resolving sensor IMA (Ion Mass Analyzer) provides ion measurements in the energy range 0.01 - 32 keV/q for the main ion components with mass/charge 1, 2, 4, 8, 16, and the molecular ion group (20 - 40) amu/q. The instantaneous field of view is $4.6^\circ \times 360^\circ$. Electrostatic sweeping performs the elevation ($\pm 45^\circ$) coverage. We present and discuss the first ASPERA-3 measurements during the cruise phase and at Mars. The focus will be given to (1) ENA observations in the interplanetary medium, (2) identification of the main plasma domains in the combined ion / electron data, (3) plasma observations inside the obstacle.

SA23B-02 1350h

First Observations from the ASPERA-3 ELS in the Mars Ionosphere

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The Analyzer of Space Plasmas and Energetic Atoms (ASPERA-3) experiment is currently collecting data at Mars. ASPERA-3 determines the electron, ion, and neutral particle components of the plasma using four instruments: Electron Spectrometer (ELS), Ion Mass Analyzer (IMA), Neutral Particle Imager (NPI), and Neutral Particle Detector (NPD). The ELS instrument measures 128 logarithmically spaced samples of the electron spectrum between 1 eV and 20 keV every four seconds. Its 8% energy resolution allows a more detailed investigation of the plasma in the Martian environment than previous electron measurements. This paper presents the first results of ELS measurements in the ionosphere of Mars, including the first high-resolution measurement of the Martian photoelectrons. Spectral peaks are clearly seen where they have been predicted by models.

URL: http://www.aspera-3.org

SA23B-03 1405h

Solar Flux and Solar Wind Dependence of Dayside Photoelectron Fluxes in the Mars Strong Crustal Field Region

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Observed characteristics of photoelectrons in the dayside ionosphere of Mars are examined. During the mapping and extended phases of its mission, the Mars Global Surveyor satellite routinely passes over the region of intense crustal magnetic fields in the southern hemisphere of Mars. When this occurs on the dayside (2 p.m. local time), the magnetometer and electron reflectometer instrument usually measures the planetary magnetic field and electrons produced by photoionization of the upper atmosphere. The electron fluxes respond to the solar flux illumination along the magnetic field line and the solar wind conditions surrounding the planet. Results from a systematic study of the electron flux intensity and pitch angle distribution are presented. The physical processes governing how the photoelectrons vary with solar flux and solar wind conditions are discussed.

SA23B-04 1420h

Effects of the late October 2003 Solar Storms at Mars: Mars Global Surveyor Observations

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The Geoeffective Halo Coronal Mass Ejection (CME) that departed from the Sun on 28 October 2003 also encountered the planet Mars. The Mars Global Surveyor (MGS) magnetometer/electron reflectometer (MAG/ER) instrument package detected the passage of the CME through elevated electron fluxes and an increase in the magnetic field magnitude in the magnetic pileup region over typical values. Unlike terrestrial space weather, global magnetic storms are not expected to occur at Mars because Mars does not have a significant global dipole magnetic field. However, interaction with the small-scale magnetic structures tied to the Martian crust does occur. We investigate space weather effects on the electron environment and magnetic field morphology as seen from the 400 km mapping altitude of MGS during the late October solar storms.

SA23B-05 1435h

Solar Energetic Particles Measured by the Mars Global Surveyor

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We discuss the use of the MGS MAG/ER instrument in the characterization of coronal mass ejections (CMEs) and solar energetic particles (SEPs) at Mars. The Electron Reflectometer (ER) onboard Mars Global Surveyor (MGS) is an imaging electrostatic analyzer designed to measure the energy/angle distributions of 10 eV to 20 keV electrons. During quiet conditions, the ER has a background count rate, integrated over the entire anode, of about 7 counts/sec (c/s). This background is caused by high energy particles that penetrate the 2-mm-thick instrument casing and impact the detector. Since these particles bypass the electrostatic analyzer section, they produce a count rate that is independent of the instrument's energy sweep, typically dominating the signal in the highest 2-3 energy channels. During CME and SEP events, these background count rates increase by several orders of magnitude or more. Using these penetrating particle counts, we show several examples of classical SEP and CME shock arrival profiles at Mars obtained during the MGS mapping orbit, including events from the recent October-November storms in 2003. In many cases the ER data interpretation is supported by magnetic field enhancements, including some examples of the direct measurement of the shock. We also discuss the time variability of these events in orbit around Mars, comparisons to simultaneous measurements by the MARIE instrument and at Earth by the ACE spacecraft, the implications of these results for CME velocity models, and the resulting radiation environment at the surface of Mars.

SA23B-06 1450h

Atmospheric Chemistry on Mars Using the Global Mars Multiscale Model (G3M)

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The chemical stability of the atmosphere of Mars appears to be determined by HOx chemistry which in turn is related to the distributions of water and ozone. Using the G3M (Global Mars Multiscale Model) as a host we have added chemistry and dust modules. The dynamical model is based on a SL/SI dynamical framework employed in the Canadian Meteorological Service of Canada's weather forecast model, GEM (Global Environmental Multiscale) model. The model includes comprehensive physics and has been extended to over 150 km and been run in global uniform (at 1.3^o horizontal resolution) and zoom mode with an interior resolution of 10 km). The version that we will present has a top at 150 km with uniform horizontal resolution. The chemistry added includes photolysis of CO_2 and water vapour and related products and also includes ozone chemistry. Long-lived chemical species are subject to transport by the resolved circulation and by diffusion within the PBL. At present we have not included heterogeneous chemistry. We will present seasonal distributions of CO and ozone and compare with available observations.

SA24A CC: 519 A Tuesday 1530h

Mars Space Weather and Upper Atmosphere Science II *(joint with A, P, SH, SM)*

Presiding: **K Retherford,** Southwest Research Institute**; W Ward,** University of New Brunswick

SA24A-01 1530h INVITED

SPICAM on Mars Express: Vertical profiles of Density, Temperature , Ozone and Dust From Stellar Occultations in the Martian Atmosphere

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SPICAM, a light-weight (4.8 kg) UV-IR dual spectrometer on board Mars Express orbiter, is dedicated primarily to the study of the atmosphere and ionosphere of Mars. The UV imaging spectrometer (118 - 320 nm, resolution 1 nm, intensified CCD) is dedicated to nadir viewing, limb viewing and atmospheric vertical profiling by stellar and solar occultation. We report about the first ever stellar occultations around Mars, and the first measurements of the UV absorption of CO2 in the upper atmosphere of Mars. By orienting Mars Express to a star, the UV spectral transmission of the atmosphere is measured with SPICAM as a function of altitude and wavelength, by comparing the star spectra seen above the atmosphere and through the atmosphere. The main absorbers are CO2 (below 200 nm) and dust (above 200 nm), with some ozone at particular latitudes and seasons. Because of the huge variation of the UV absorption cross-section of CO2, it provides a large dynamic range of slant density measurements. After vertical inversion, the atmospheric pressure and temperature are retrieved from 150 km down to 15-25 km, where dust is usually preventing further measurements. Several occultations have been obtained, and their results will be compared to the LMD General Circulation Model predictions. Collection of future vertical profiles of density and temperature will help in the refinement of meteorological and dynamical Mars atmospheric models. This is essential for future missions that will rely on aerocapture and aerobraking.

SA24A-02 1550h

New Observations of UV Airglow in the Upper Atmosphere of Mars with SPICAM on Mars Express.

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On board Mars Express orbiter, the UV channel of SPICAM is dedicated primarily to the study of the atmosphere and ionosphere of Mars. This UV imaging spectrometer (118 - 320 nm, resolution 1 nm, intensified CCD) is dedicated to nadir viewing, limb viewing and atmospheric vertical profiling by stellar and solar occultation. We report here about the first SPICAM measurements of the Mars UV airglow obtained during limb observations. They were obtained by orienting Mars Express to a predefined inertial pointing direction, and the drift of the spacecraft along its orbit allowed to obtain a vertical profile of the limb emissions. On the day side, above the dust scattering layer, which extends up to 40-50 km, the UV day glow spectrum contains the emissions of CO (Cameron bands produced by dissociation of CO2), the O I line at 297.2 nm, and the (0,0) transition of CO2+at 289 nm. Other emissions are also present. Thanks to observations of calibrated stars, intensity lines are retrieved with an excellent photometric accuracy. Comparisons of absolute intensities and altitude distributions will be compared to model predictions. Future observations of seasonal variations with SPICAM should allow us to much better constrain the mechanisms leading to loss to space through the understanding of the mechanisms driving the formation of this region.

SA24A-03 1605h

An Analysis of the Martian Far-Ultraviolet Dayglow Observed by the Far-Ultraviolet Spectrographic Explorer (FUSE)

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The Far Ultraviolet Spectroscopic Explorer (FUSE) satellite was used to observe Mars on 7/8/2001 for 8031s and on 8/10/2001 for 13241s. During these observations, 6233s and 10988s, respectively, occurred when the satellite was within Earth's shadow and terrestrial airglow contamination was minimized. An earlier observation by *Krasnopolsky and Feldman* (Icarus, *160*, 86–94, 2002) lasted 18340s, of which about half was obtained from within Earth's shadow. The FUSE spectra cover the wavelength range 90-120 nm, at a resolving power of about 5000, and contain a large number of dayglow emission lines of H, He, C, N, O, Ar, N^+, C^+, and Ar^+, as well as bands of N_2 and CO, as described by *Krasnopolsky and Feldman*. Here we present detailed full-disk simulations of several of atomic emission line multiplets, using recent 1-D and 3-D model atmospheres, to place constraints on disk-averaged abundances of the major species of the upper atmosphere.

SA24A-04 1620h INVITED

Model Studies of the Structure of the Martian Ionosphere for Various Solar Fluxes in both the EUV and Soft Xray Regions.

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A two-peaked structure of the Martian ionosphere has been seen in the Mars Global Surveyor Radio Science electron density profiles. Sometimes the lower peak is seen only as a shoulder and sometimes as a distinct peak. The lower peak is produced by absorption of soft xrays, and the upper peak by absorption of the main part of the EUV solar fluxes. We present the results of models of the Martian thermosphere/ionosphere in which we employ different solar EUV and soft xray fluxes. We have found that a distinct lower peak cannot be reproduced by scaling the solar fluxes below 250 Å by a constant factor of 3–6. This is in contrast to models of the terrestrial low altitude ionosphere, where such a scaling has been found to reproduce the electron density profiles measured by incoherent scatter data (Solomon et al., 2001). We have