80 km Puchezh-Katunki crater, and the 250 km Sudbury crater. In order to better constrain the expected lifetimes of these systems and further understand their mechanics, a finite-difference computer simulation is used to evaluate the effects of convective cooling by circulating water and steam. In this work we present modeling results of water and heat transport shortly after the formation of the Sudbury impact crater in present-day Ontario, Canada. Our model predicts that an impact-induced hydrothermal system associated with a Sudbury-sized impact crater can remain active for at least 10^5 - 10^6 years. While the location and volume of the habitable zone within the crater changes as the crater undergoes cooling, it is sufficiently long-lived for an ecosystem to develop. The insight into the mechanics of these systems gained from this model can help locate hydrothermal vents and hydrothermally altered minerals at Martian impact craters.

P52A-0478 1330h POSTER

A Theory of Impact Cratering in Extremely Low Density Solids and Application to Track Shape Formation in Aerogels

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Aerogels are superior in their ability to capture partially (if not completely) intact hypervelocity projectiles. The capture of hypervelocity projectiles of modest velocities ($v \sim 1 - 7$ km s^{-1}) in ultra low-density solids such as aerogels typically results in the formation of carrot-shaped impact craters. Several sample return missions currently in transit (e.g. Stardust) or in planning use aerogel as a capture medium of hypervelocity dust particles. In addition, several aerogel collector arrays have previously been deployed in Low Earth Orbit (LEO) since the early 1990s. These collectors, in addition to recording carrot shaped tracks, have recorded impact events with crater morphologies that do not have laboratory analogs. The origins of these anomalous tracks (and the micrometeorites that created them) are unknown because of the absence of a theoretical understading of impact cratering in aerogels. In this paper, therefore, I propose and develop a general model for impact cratering of a compactile type in a extremely porous media such as aerogels; my model adopts general arguments that derive shock wave attenuation properties in porous solids and apply these to aerogel. The model proposed here details the relationship between the energy loss of a projectile and impact cavity formation. I empirically test this model by self consistently accounting for the energy loss of projectiles in aerogel using a simple drag model together with a component that accounts for the mechanical strength of the aerogel. I show that this model suitably accounts for the slowing of spherical glass beads shot into aerogels of various densities and at various velocities. I find that the range of 20 μm sized glass beads fired into 14 mg cm^{-3} and 50 mg cm^{-3} aerogels at hypervelocities is substantially shorter than what one would expect based on previous work with 106 μm glass beads. An examination of captured projectiles reveals that aerogel aggregation by the projectile is a significant contributor to the anomalous slowing and is responsible for the observation that the range of projectiles captured into aerogel is not a single valued function of the velocity. Together with a simple energy loss model I generated theoretical track shapes and compared these with actual track shapes in 14 mg cm^{-3} and 50 mg cm^{-3} aerogels. The agreement between actual impact craters in aerogel and my model is remarkable given the simplicity of the model. I conclude by discussing implications that these results may have for the Stardust mission and impact cratering on porous asteroids such as Mathilde.

P52A-0479 1330h POSTER

Geochemistry of K/T-boundary Chicxulub ejecta of NE-Mexico

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Many K/T sections all over the world contain impact spherules supposed related to the Chicxulub event. This study focus on ejecta layers in NE-Mexican profiles. We carried out systematic XRF and synchrotron radiation measurements on such spherules at the HASYLAB and ANKA facilities as well as microprobe analyses (CAMECA SX50). Area scans on tektite-like material of the Bochil section reveal a pronounced zonation in the inner part, dominated by Ba and Sr whereas secondary CaCO3 dominates in the altered margin. The composition of the spherules from the Mesa-Juan Perez section differ significantly from the Beloc (Haiti) and Bochil tektite glasses. At Mesa-Juan Perez, spherules are either extremely rich in Fe and Ca or consist of smectite, some of those carry carbonate inclusions. Yttrium, La and Ce are zoned within the smectite with concentrations below the detection limit and up to 20 g/g The Ca-rich inclusions are enriched in Y (up to 35 g/g) and La (18 g/g) and, compared to the surrounding smectite, also in Ce (up to 34 g/g). The Ce enrichment in spherules from the Mesa-Juan Perez section indicates impact-melted carbonates of the Yucatan carbonate platform as possible precursor rocks. Recent investigations focus on the chemistry of melt rock samples from the PEMEX wells Yucatan-6 and Chicxulub-1: Their average composition (mean of 250 data points in wt-percent) is 61.6 for SiO2, 0.16 for TiO2, 18.07 for Al2O3, 0.01 for Cr2O3, 1.98 for Na2O, 1.5 for FeO, 0.05 for MnO, 0.01 for NiO, 0.31 for MgO, 9.14 for K2O, 3.44 for CaO, and 0.01 for SO2. These results are in some cases comparable to the geochemistry of ejecta glasses, e.g. from Beloc (Haiti).

URL: http://www.uni-karlsruhe.de/~img/seite_489.html

P52A-0480 1330h POSTER

Hugoniot measurements using 15 J laser-propelled flyer sheets

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Flyer acceleration facilities with a high intensity laser, "laser gun", have been developed for the past two decades mainly in the field of high-pressure physics. Also in planetary science, laser guns should have some advantages, comparing to conventional guns such as powder guns and two-stage light-gas guns. First, the experiments with laser guns can be carried out under cleaner conditions because there is no gas from explosives. Second, the experiments can be carried out with a short time interval (every 30 minutes); a dozen of shots can be easily done within a day. Third, a high-intensity laser gun can achieve flyer-velocities higher than the escape velocity of Earth, 11.2 km/s, which is not achieved using powder or two-stage light-gas guns. We develop a flyer acceleration facility using a glass laser of University of Tokyo with an maximum energy of 15 J, a pulse width of 15 ns, a spot diameter of 700 μm, and an intensity of about 100 GW/cm2. Aluminum (Al) sheets with a thickness of 50 μm, which are attached to a glass base by adhesive, are irradiated. Vapor of Al and adhesive pushes the Al sheets to high velocities. At present, the flyer velocity is up to about 3 km/s due to the small intensity. Using this gun, we perform measurements of the Hugoniot equation of state. Flyer velocity and shock speed in a sample are measured simultaneously with a high-speed camera, and pressure and particle velocity in the sample are estimated by the impedance matching method. Here, as a sample, we use a meteorite (an ordinary chondrite, ALH769) and Hugoniot data are obtained. It should be noted that this measurement system can be used when a laser is upgraded and flyer velocity achieves more than 10 km/s.

P52A-0481 1330h POSTER

Impact Flashes in Saturn's Rings

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Over the past decade, impact flashes have been observed on the moon and in the laboratory in both the IR and visible parts of the spectrum. These phenomena have been used to constrain impact parameters, such as impact velocity and composition. With the arrival of the Cassini spacecraft at Saturn in July 2004, we embark on a study of impact flashes in Saturn's rings. We begin by modeling high energy, hypervelocity impact events using CTH, a shock physics hydrodynamics code developed at Sandia National Laboratories. The simulated impacts involve two centimeter- to meter-sized icy bodies impacting each other at velocities over 30 km/s. Each body is composed of pure water ice and incorporated into the code using an ANEOS equation of state. The resulting impact-induced vapor plume is post-processed to consider its radiative evolution. The results of this study will be used as an aid to planning observational time on Cassini's Ultraviolet Imaging Spectrograph (UVIS).

P52B MCC: 2000 Friday 1340h

Planetary Ionospheres and Magnetospheres II *(joint with SH, SM)*

Presiding: **C Paranicas,** Applied Physics Laboratory, Johns Hopkins University**; D H Crider,** Catholic University of America

P52B-01 1340h

Evidence of ionospheric Holes in the Venus Nigthtside Ionosphere as Crossings of the Pioneer Venus Orbiter (PVO) Through Plasma Channels Near the Magnetic Polar Regions

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Data obtained from the PVO orbiter electron temperature probe (OETP) and magnetic field observations conducted in the Venus nightside ionosphere reveal that the ionospheric holes detected in that region represent crossings of the PVO through plasma channels that extend downstream from the magnetic polar regions. The electron density profile and the magnetic field signature measured across the nightside ionosphere in orbit 85 show that the spacecraft moved through plasma channels (in an ionosheath-plasma channel-ionosphere transit) in which the magnetic field magnitude and its orientation are similar to those encountered within the ionospheric holes. The enhanced (30 nT) magnetic field intensity measured within the channels, which accounts for that present within the holes, results from the accumulation of the magnetic field that is forced by the solar wind thermal pressure on the polar upper ionosphere in a manner similar to what occurs near the subsolar region where the solar wind kinetic energy density is replaced by the accumulation of magnetic field fluxes around the ionosphere. The large [10(exp-7) ergs cm-3] kinetic energy density that the solar wind maintained in orbit 85 suggest wide and deep plasma channels extending downstream from the magnetic polar regions of the Venus ionosphere and that resulted from the extensive local erosion produced by the solar wind. The fact that an intense [10(exp 5) cm-3] peak electron density was measured deep in the umbra by the midnight plane near the trajectory periapsis (200 km) during that orbit indicates that the nightside ionosphere did not disappear despite the large value of the solar wind dynamic pressure. A geometry of the ionopause traced across the magnetic polar regions is suggested to account for the maintenance of large ionospheric electron densities near the midnight plane and the absence of such densities far away from that plane when there are large solar wind dynamic pressures.

P52B-02 1355h

Simulation of Energetic Neutral Atom Images at Venus

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We present simulated images of energetic neutral atoms (ENAs) produced in charge exchange collisions between solar wind protons and neutral atoms in the

exosphere of Venus. The plasma flow around Venus is modelled by a semi-analytical MHD simulation that includes mass-loading (*Biernat et al.,* J. Geophys. Res., vol. 104, 12617–12626, 1999; *Biernat,et al.,* Adv. Space Res., **28**, 2001). These results are compared with the results that are obtained when the Spreiter-Stahara flow model (*Spreiter and Stahara,* Adv Space Res., **14**, 5–19, 1994) is used. The ENA images are calculated by combining the proton bulk flow and temperature results of the MHD model with a model of the neutral atmosphere using the energy dependent cross sections for the charge exchange collisions. The ENA production rate is integrated along lines of sight to a virtual instrument, thus simulating what could be measured by a space-craft-carried ENA instrument. The images are found to be dominated by two local maxima. One produced by charge exchange collisions in the solar wind, upstream of the bow shock, and the other close to the dayside ionopause. The main contribution to the ENA flux observed in the ENA images stems from a region of space between the ionopause and the bow shock on the dayside of the planet. The simulated ENA fluxes at Venus are lower than those obtained in similar simulations of ENA images at Mars (*Holmström et al.,* J. Geophys. Res., **107**, 1277, doi: 10.1029/2001JA000325, 2002). The reason for the lower ENA flux at Venus is thought to be the smaller extent of Venus' exosphere. The steeper falloff of the neutral gas density with altitude in the exosphere of Venus is caused by Venus' mass, which is 7.5 times greater than the mass of Mars. The dependence of the ENA flux on the altitude of the ionopause is studied numerically, and it is found that the ENA flux decreases as the ionopause altitude is increased.

URL: http://www.irf.se/~herbert/venus/

P52B-03 1410h

High Altitude Ionospheric Clouds at Mars

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As Mars Global Surveyor orbits Mars, it crosses into different plasma regimes, as is evident by the electron spectra obtained by the Electron Reflectometer (ER). Below about 380 km, the electron spectra are dominated by locally produced photoelectrons. The solar wind electrons are no longer visible. This paper investigates the appearance of this electron signature at altitudes above the nominal photoelectron boundary height. These may be detached high altitude ionospheric clouds, analogous to those observed at Venus by the Pioneer Venus Orbiter. We discuss the statistical analysis of their occurrence and possible interpretations.

P52B-04 1425h

The Solar Wind Interaction with Ionosphere/Atmosphere in the Northern Hemisphere of Mars

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In the Northern hemisphere, the crustal fields are rather weak and usually do not prevent direct interaction between the Solar Wind (SW) and the Martian ionosphere/atmosphere. Exceptions occur in the isolated mini-magnetospheres formed by the crustal anomalies. Electron density profiles of the ionosphere of Mars derived from radio occultation data obtained by the Radio Science Mars Global Surveyor (MGS) experiment have been compared with the crustal magnetic fields measured by the MGS Magmetometer/Electron Reflectometer (MAG/ER) experiment. A study of 523 electron density profiles obtained at latitudes from $+67^{\circ}$ to $+77^{\circ}$ has been conducted. The effective scale-height of the electron density for two altitude ranges, 145-165 km and 165-185 km, and the effective scale-height of the neutral atmosphere density in the vicinity of the ionization peak have been derived for each of the profiles studied. The thermal pressure of the ionospheric plasma at 160 km has been estimated. The solar wind interaction with the ionosphere of Mars and the origin of the sharp drop of the electron density at 200-210 km is discussed. For three SZA intervals, the longitudinal variations of the effective scale-height of the neutral atmosphere density in the vicinity of the ionization peak (135 km) have been analyzed. The longitudinal variations disappear where the solar zenith angles are minimal and where the crustal magnetic field at 140-150 km is approximately vertical. Presumably, the compression of the mini-magnetosphere formed by the isolated crustal anomalies and the "cusps" do not allow the crustal magnetic fields to protect the atmosphere from the precipitating energetic particles.

P52B-05 1440h

Measuring Mars' Atmospheric Neutral Density from 160 to 320km altitude with the MGS Electron Reflectometer

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The Magnetometer/Electron Reflectometer (MAG/ER) experiment aboard Mars Global Surveyor (MGS) samples the local electron population's distribution in energy and pitch angle (angle between electron velocity and local magneticfield direction) at the mapping orbit altitude of 400km. We develop a single-particle model of the electrons' interaction with the neutral atmosphere and motion along open field-lines connecting the solar wind to remnant crustal magnetization. Electron reflection from magnetic gradients and absorption due to inelastic collisons with atmospheric neutrals results in characteristic pitch angle (PA) distributions for open field lines. By assuming the validity of spherical harmonic expansions (Cain, Arkani-hamed) in the strongest field regions of Mars (such as Terra Sirenum), we trace the electron paths and fit these PA distributions to our model to constrain the scale height and base density of the neutral atmosphere in the interaction region, which is between 160 and 320km altitude. We analyse 2 martian years of MGS mapping Orbit Data and present the first measurements of Mars' exospheric neutral density. We track density variations over season, latitude and solar cycle and compare with predictions from Mars Thermosphere Global Circulation Model (MTGCM) simulations and with MGS accelerometer data. Our results will help to constrain the upper boundaries of GCMs and assist orbital decay calculations for low-orbiting spacecraft, such as the 2005 Mars Reconnaissance Orbiter.

P52B-06 1455h

Energetic neutral atom images of Jupiter's magnetosphere: composition and time variability

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During the Cassini flyby of Jupiter in late 2000/early 2001, the first ever images of Jupiter's magnetosphere in energetic neutral atom (ENA) flux were obtained. ENAs are typically created when singly-charged energetic ions undergo charge exchange with ambient neutral gas. Since little energy is lost in these collisions, neutrals leave the system along high speed, straight-line trajectories. The Cassini Magnetospheric Imaging Instrument's (MIMI) Ion and Neutral Camera (INCA) detected the fluxes of several to several hundred keV/nucleon ENAs for months leading up to closest approach on December 30, 2000 and for a few days past (after which the viewing geometry was unfavorable). The primary source of Jovian ENAs is the interaction of mirroring ions with the planet's exosphere, in a thin layer just above the denser atmosphere. A significant secondary contribution comes from the tori of neutral gas collocated with the orbits of Io and Europa (see, Mauk et al 2003). We will present the flux of ENAs detected as a function of composition and energy. Furthermore, we have calculated the ENA flux, in several energy bands, for spacecraft distances between about 150 to1000 Jovian radii. We have determined that to lowest order the emission signal is fairly constant, however there is evidence of time variability in the data. We will discuss the implications of composition and time variation for magnetospheric processes. Mauk, B. H., D. G. Mitchell, S. M. Krimigis, E. C. Roelof, and C. P. Paranicas, Energetic neutral atoms from a trans-Europa gas torus at Jupiter, Nature, 421, 920, 2003.

P52B-07 1510h

The Plasma Environments of Jupiter's Galilean Satellites - Galileo Radio Science Results

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The Galileo spacecraft has been orbiting Jupiter since 1995. During that time it has provided several opportunities for the study of the plasma environments of the Galilean satellites Io,Europa, Ganymede, and Callisto by means of radio occultation of its S-band (13.5 cm. wavelength) signal. There have been five occultations each by Io, Europa, Ganymede, and Callisto, however, one of the Ganymede and one of the Callisto occultations occurred near superior conjunction, and did not provide useful data. When observed, the maximum electron densities range from about 5 to about $20x10^3$ cm^{-3} . The apparent vertical structure of these plasma layers range from classical ionospheric profiles observed at Callisto on two occasions to multi-peaked structures observed at Europa. On several occasions no discernible plasma was observed. These observations could be explained by a process in which a tenuous neutral atmosphere (about 10^{10} cm^{-3} is created on the trailing hemisphere by sputtering from the icy surface by energetic particles of the Jovian magnetosphere. If the trailing hemisphere is also illuminated by the Sun, plasma is produced by photoionization and is observed by radio occultation. The configuration of this plasma is, however, determined by its interaction with the corotating Jovian magnetospheric plasma, which under certain geometries would lead to the observation of multipeaked structures.

P52B-08 1525h

Electrical Charging of the Aerosols in Titan's Atmosphere

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We have used recent data on graphitic cloud particles in the atmosphere or Titan to compute the electrical charging of the particles (radii ranging from 0.01 microns to 0.26 microns. The charging on the nightside was rather similar to that obtained earlier (Borucki et al, Icarus, 72, 604-622, 1987) except that charge distributions on the particles are now computed and recently obtained cloud particle sizes and density distributions were employed. The negative charge on particles of 0.26 microns peaked at 9 at 150 km altitude. The computations were repeated for the dayside with the addition of photoelectron emission by the particles as a result of the absorption of solar UV radiation. Particles (except the very smallest) now became positively charged with particles of radius 0.26 microns being charged up to +47. Next, very small particles (radii 0.0003 microns) of polycyclic aromatic hydrocarbons (PAHs) were introduced and treated as sources of negative ions since they could be either neutral or carry one negative charge. Moreover, they are mobile so that they had to be treated like molecular size negative ions although much more massive. They had the effect of substantially reducing the electron densities in the altitude range 190 to 310 km to values less than the negative PAH densities and increasing the peak electron charge on the larger particles. Particles of radius 0.26 microns bore peak charges of +47 at altitudes of 250 km. The simulated effect of PAHs on the nightside proved to be much less pronounced; at the peak negative PAH density, it was less than the electron density. The physics governing these results are discussed.

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