Astrobiology is the study of life in the Universe, and a major objective is to understand the past, present, and future biologic potential of Mars. The current Mars Exploration Program encompasses a series of missions for reconnaissance and in-situ analyses to define in time and space the degree of habitability on Mars. Determining whether life ever existed on Mars is a more demanding question as evidenced by controversies concerning the biogenicity of features in the Mars meteorite ALH84001 and in the earliest rocks on Earth. Insitu studies may find samples of extreme interest but resolution of the life question most probably would require a sample returned to Earth. A selected sample from Mars has the many advantages: State-of-the-art instruments, precision sample handling and processing, scrutiny by different investigators employing different techniques, and adaptation of approach to any surprises It is with a returned sample from Mars that Astrobiology has the most to gain in determining whether life did, does, or could exist on Mars.

P51A-11 1120h

Sample Collection for Investigation of Mars (SCIM): Mars Sample Return Within This Decade

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The Sample Collection for Investigation of Mars (SCIM) mission is designed to (1) make a 40 km altitude pass through the Martian atmosphere, (2) collect dust and atmospheric gas, and (3) return the samples to Earth for analysis. This Mars Scout mission concept is compelling because it will return a Martian sample to Earth within this decade without assuming the substantial risk, complexity, and cost of landing on and launching from the surface. Calculations indicate that an equatorial atmospheric pass at 40 km altitude near summer solstice, (Ls 270 ± 40) will allow a significant amount of dust to be collected. Mission calculations "flying" a 100 cm2 collector through a model martian atmosphere shows that 11 million particles $>2\mu m$ in diameter would be encountered. The size distribution of these particles is skewed towards the smallest sizes, but thousands of particles with diameters $=10\mu m$ should be encountered. Calculations show that the particles should reach the SCIM dust collector (an aerogel design broadly similar to Stardust) intact, and with relatively little heating. Unlike the Stardust encounter, the SCIM aeropass will impart significant heating on the spacecraft and sample collector, requiring special attention to its design. Detailed thermal modeling and testing of collector materials under realistic thermal loads suggest the collector can be engineered to survive the aeropass intact. The SCIM flight system is capable of launch in the 2007 opportunity. The atmospheric pass would take place in mid-2009, and the samples returned to Earth in 2010.

URL: http://scim.asu.edu

P52A WCC: Hall D Friday 1330h

Planetary Sciences Posters

Presiding: **H Hiesinger,** Brown University

P52A-01 1330h POSTER

Revolutionizing Remote Exploration with ANTS

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We are developing the Autonomous Nano-Technology Swarm (ANTS) architecture based on an insect colony analogue for the cost-effective, efficient, systematic survey of remote or inaccessible areas with multiple object targets, including planetary surface, marine, airborne, and space environments. The mission context is the exploration in the 2020s of the most compelling remaining targets in the solar system: main belt asteroids. Main belt asteroids harbor important clues to Solar System origins and evolution which are central to NASA's goals in Space Science. Asteroids are smaller than planets, but their number is far greater, and their combined surface area likely dwarfs the Earth's. An asteroid survey will dramatically increase our understanding of the local resources available for the Human Exploration and Development of Space. During the mission composition, shape, gravity, and orbit parameters could be returned to Earth for perhaps several thousand asteroids. A survey of this area will rival the great explorations that encircled this globe, opened up the New World, and laid the groundwork for the progress and challenges of the last centuries. The ANTS architecture for a main belt survey consists of a swarm of as many as a thousand or more highly specialized pico-spacecraft that form teams to survey as many as one hundred asteroids a month. Multi-level autonomy is critical for ANTS and the objective of the proposed study is to work through the implications and constraints this entails. ANTS couples biologically inspired autonomic control for basic functions to higher level artificial intelligence that together enable individual spacecraft to operate as specialized, cooperative, social agents. This revolutionary approach postulates highly advanced, but familiar, components integrated and operated in a way that uniquely transcends any evolutionary extrapolation of existing trends and enables thousand-spacecraft missions.

P52A-02 1330h POSTER

Annual Nighttime Surface Temperature Variation of Phoenix from ASTER Data

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Nighttime thermal infrared multispectral data has been collected over Phoenix and the surrounding area by the Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER) for over a year, providing an excellent dataset for analysis of the seasonal temperature variation of natural desert and urban surfaces. Unlike airborne instruments, which can be flown over a site twice in the same day to produce diurnal pair images, ASTER collects data that typically has days to weeks between day/night observations, making small spatial or temporal-scale weather or anthropogenic processes a potentially dominant effect in a diurnal apparent thermal inertia image. The abundance of nighttime observations of the southern Phoenix area allowed a simple affirmation that the temperatures of many surfaces in the scenes varied from what would be assumed from an annual temperature model, and that weather can have a significant effect on individual nighttime thermal images. The analysis described here was devised in order to check the usefulness of any single acquired image to use in a diurnal pair to determine the apparent thermal inertia. Additional information to result from this endeavor is the amplitiude of seasonal temperature change (annual thermal inertia) and an annual analysis of nighttime temperatures of urban and natural surfaces. A dataset was assembled consisting of five cloud-free nighttime scenes in different seasons, starting in November of 2000 and ending in December of 2001. Southern Phoenix was chosen for analysis due to the abundance of data and the presense of urban, agricultural, and natural desert surfaces in a single scene. A temperature correction and normalization method was devised and employed to spatially map the surface temperature variation without the use of a seasonal temperature model. This analysis may have a significant impact on our understanding of the thermal properties of human-constructed surfaces, the effect of water on large scale surface temperatures, and the usefulness and validity of diurnal thermal inertia images.

P52A-03 1330h POSTER

New Thickness Estimates of Lunar Basalt Flow Units Based on Crater Size-Frequency Distribution Measurements

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Accurate estimates of lava flow unit thicknesses are necessary to constrain estimates of the volcanic flux. In previous studies the thicknesses of individual flow units have been investigated using a variety of techniques, including: (1) shadow measurements in high-resolution images obtained under low-sun conditions, (2) in situ observations of flow units within the walls of Hadley Rille, and (3) studies of the chemical kinetic aspects of lava emplacement and cooling. However, shadow measurements of flow unit thicknesses are made difficult by (1) the limited availability of high-resolution topography and near-terminator images necessary for the recognition of flow fronts, (2) regolith formation processes, which can obliterate flow fronts of up to 15 m, and (3) the composition and the eruption style of lunar lavas which are thought to be responsible for the sparseness of mare flow features. Thus, we developed in more detail an alternative remote sensing technique described by Neukum and Horn [1975] and applied it to numerous mare basalt flow units using recently obtained impact crater size-frequency distribution (CSFD) data. We use the shape of CSFD curves to estimate the thickness of individual lunar mare flow units. A characteristic knee frequently observed in CSFD curves is reasonably interpreted to represent the presence of two lava flow units separated in time. The diameter at which this knee occurs is directly linked to the thickness of the overlying flow unit. We found that this technique expands considerably the ability to assess lava flow unit thicknesses and volumes on the Moon and planets. We examined 58 CSFD curves of basalt flow units in Oceanus Procellarum, Imbrium, Tranquillitatis, Humorum, Cognitum, Nubium, and Insularum that show this characteristic knee. With this technique we were able to identify flow units that have not been detected in low-sun images. We found that the range of flow unit thicknesses is ~20-200 m and the average is ~30-60 m. The volumes range from ~30-7700 km^3. The minimum average volume of all investigated flow units is ~590 km^3 and the maximum average volume is ~940 km^3. We found that the greater abundance of flow fronts and units with evidence of resurfacing in the shallow non-mascon maria and in the younger units in Imbrium. This may be related to two factors. First, because mascon maria tend to undergo subsidence lava units are more likely to pond and have greater thicknesses. Secondly, later flows that are emplaced when topography is smoothed by earlier events theoretically tend to lateral spreading, rather than ponding. Initial analyses also indicate that the range of separation ages between the 26 units analyzed is ~100-2000 m.y. with a mean value of ~700 million years. These values imply that mineralogically similar source regions at depth can be long-lived or repetitively active.

P52A-04 1330h POSTER

Phosphorous- and Potassium-bearing Iron-Nickel Sulfides in Boriskino CM Carbonaceous Chondrite

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Boriskino, a primitive CM carbonaceous chondrite, contains a primary sulfide assemblage of pyrrhotite, Ni-bearing monosulfide solid solution (Mss), pentlandite, and an unusual K- and P-bearing Fe-Ni sulfide. This primary sulfide assemblage shows similarities to magmatic Fe-Ni sulfides, although there is no evidence for silicate-sulfide liquid immiscibility in Boriskino. The assemblage formed in the solar nebula by one of two possible mechanisms: direct condensation of the sulfides or sulfidation of Fe-Ni metal by the reaction FeNi (metal) + H_2S $(Fe,Ni)_{1-x}S + H_2$. The sulfide assemblage equilibrated to temperatures below 610°C, the upper stability limit of pentlandite. The P in solid solution in the metal could have been the source of P in the sulfides. The K and P concentrations in the sulfide range between 0.25 and 1.00 wt.% and 0.7 and 3.4 wt.%, respectively. Experimental investigations (Boctor et al., in progress) of the condensed Fe-P-S system show solubilities of P in FeS much lower than the observed P concentrations in Boriskino sulfides. A positive correlation between Ni and P suggests that the solubility of P in Mss is enhanced by the increase of the Ni content. The presence of K and P in solid solution in the Fe-Ni sulfide in Boriskino suggests that these elements, which are sidrophile or lithophile in other meteorites, show a strong chalcophile tendency under reducing conditions in the solar nebula. The data presented suggest the possibility that during differentiation of an early Earth, both P and K could have been incorporated in a segregating metal-sulfide core.

P52A-05 1330h POSTER

EUV Photosynthesis in Ices Analogus

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Experimental results on the spectral identification of new IR absorption features produced through EUV photon-induced chemical reactions in the cometary-type ices and icy satellites of planetary systems are obtained. We have carried out such measurements on CO2-H2O mixed ices, H2O-CH4 mixed ices, and H2O-C2H2 mixed ices at 10 K. A tunable intense synchrotron radiation light source available at the Synchrotron Radiation Research Center, Hsinchu, Taiwan, was employed to provide the required EUV-VUV photons. In this study the photon wavelengths used to irradiate the icy samples were selected to center at the prominent solar lines, namely, the 121.6 nm, 58.4 nm, and 30.4 nm. New molecular species were produced in the ice samples as a result of EUV photon irradiation. The new molecules identified were mainly H2CO3, H2CO, HCO, C2H6, C3H8, CO2, CO, CH3OH, and C2H5OH. While new molecular species were formed, the original reactants were depleted, as expected. The results obtained are essential to the understanding of chemical evolution and synthesis in ice analogues found, for example, in comets, icy satellites of planetary systems, the interstellar medium, molecular clouds, and protostellar regions. The detailed results of this work will be presented.

P52A-06 1330h POSTER

Saturn: Search for a Missing Water Source

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The discovery of a dense molecular cloud around Saturn radically altered our view of that region. The toroidal cloud presumably consists of water-group neutrals (H2O, OH, O, H, O2, H2), which slowly orbit Saturn until they are dissociated to form plasma ions and electrons. This thick neutral cloud, with peak OH number densities exceding 1000/cm3, indicates the presence of a strong water-vapour source. A significant neutral population above the icy rings of Saturn was hypothesized earlier but never observed. Instead, the large OH population was found further out between the orbits of Enceladus and Dione, raising an intriguing question: are the Main rings the principal source, and if not, where are all these neutrals coming from?

We present a new set of Hubble Space Telescope (HST) measurements; these data are used to model spatial density profiles of the OH cloud and pinpoint the water source. Enhanced OH densities are observed in the E-ring region where a large orbital collision between two ice blocks occured a year prior to HST observations. As we show here, the water source must be significantly larger than current theory predicts to maintain these neutral densities, further exacerbating the problem of a 'missing' water source near Saturn.

Our model includes the effects of plasma chemistry, plasma-neutral, and neutral-neutral collisions to determine the dynamical evolution of the water group neutrals in Saturn's magnetosphere. We show that momentum transfer from these processes results in a rapid net diffusion of the neutral cloud from the source region. Our model indicates that the vast majority of the water produced may originate from a narrow area in the E-ring. This indicates possible presence of a population of small, as of yet unseen bodies concentrated near Enceladus' orbit. The work is supported by NASA Planetary Atmospheres grant to MIT.

P52A-07 1330h POSTER

X-Ray Emission From Comet McNaught-Hartley (C/1999 T1)

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Comet McNaught-Hartley was observed in five one-hour sessions from January 8 to 14 2001 using the advanced CCD imaging spectrometer on board the Chandra X-ray Observatory. The X-ray image of the comet does not show a crescent-like shape. Two brightness maxima are offset from the nucleus between the sunward and comet velocity directions. The comet mean X-ray luminosity is equal to 7.8×10^{15} erg s^{-1} for photon energy E > 150 eV and aperture 1.5×10^5 km where the comet X-ray brightness is 20% of the peak value. Day-to-day variations in X-rays reach a factor of 5. The comet and Earth were seeing different faces of the Sun, and the expected time delay between the solar wind events on the Earth and the comet was 6 days. The best correlation between the X-ray luminosity and the solar wind proton density is for the delay of 5.5 days and may be explained by the higher velocity of heavy ions. Gas production rate was 10^{29} s^{-1} during the observations, and the efficiency of X-ray excitation adjusted to the proton density of 10 cm^{-3} is equal to 5×10^{-14} erg $AU^{3/2}$. The strongest short-term variation was by a factor of 1.75 for 1600 s. This variation may be explained by a sudden (for a few minutes) decrease in the solar wind flux by a factor of 3. Careful background subtraction made it possible to extract the comet spectrum from 150 to 1000 eV. No signal was detected at E > 1000 eV, and an upper limit to any emission with E > 1000 eV is 0.3% of the emission at 150-1000 eV. The best χ^2-fit model to the spectrum consists of 9 narrow emissions. The emission energies and intensities are in good agreement with a charge exchange spectrum calculated by us for the slow solar wind. Using this spectrum, we identify the observed emissions as (Ne^{7+} + Mg^{7+} + Mg^{8+}) 195 eV, (Mg^{8+} + Mg^{9+} + Si^{8+}) 250 eV, C^{5+} 370 and 460 eV, O^{6+} 560 eV, O^{7+} 650, 780, and 840 eV, and Ne^{8+} 940 eV. X-ray spectroscopy of comets may be used to diagnose the solar wind composition and its interaction with comets.

P52A-08 1330h POSTER

Gravitational Anomalies: an attribute of each planetary, satellite, stellar, galactic, galactic grouping and universe body.A natural law.

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The earth has gravitational anomalies of various types, the moon has ringed lunar maria basaltic gravitational anomalies, and Mars has at leat Mt Olympus as a gravitaional anomaly. Therefore, by induction all rocky planets and satellites will have gravitational anomalies. Gasseous planets have different areas of gas called "spots" such as Jupiter's red spot, and the various spots on Saturn, each a concentration of some different gas than its surroundings thereby creating a gravitational anomaly in some cases.The sun has sunspots and solar flares creating temporary gravitational anomalies. The galaxy certainly has gravitational anomalies due to concentrations of stars and so does each galactic group. It is obvious that the universe has many mass concentrations and therefore has gavitational anomalies. By induction, all heavenly bodies will have gravitational anomlies of some kind although possibly of different types and origins. Therefore it is a Natural Law that each heavenly body will have gravitational anomalies and an irregular gravitational field including the universe itself.

P52A-09 1330h POSTER

Each body and mass group, heavenly to subatomic and galactic grouping and universe will have no motion,or rotational, translational, orbital,suborbital,vibrational motion singly and/or in combination as a law of nature.

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Every mass or mass group, heavenly to sub-atomic, will have either no motion,or rotational, vibrational, translational, orbital,and/or suborbital motion singly or in combination as a Law of Nature.Therefore, in computing the value for the mass-energy equation the values to be taken inot account are as follows E = mc^2 + KE(rotational + vibrational + orbital + suborbital + translational) + PE (gravitational + electrostatic+ magnetic + strong +weak)such as when computing the mass-energy conversion in stars such as the sun. Even the Einstein photoelectric effect should be KE(spin,vibrational,translational, orbital, suborbital) = hf(2)-hf(1). The virial equation PE + 2KE = 0 often used in geophysics should be PE(mass + electrostatic + magnetic+ strong + weak)+ 2KE(rotational +orbital + suborbital + translational + vibrational) = 0. All equations in physics and geophysics, and geochemistr and chemistry and astronomy relating to motion should include the vibrational energies,heretorfore not often included now that vibrational data are now available for planets, stars, atoms,nuclei, subatomics and molecules.The galaxy may be vibrating as well as the groupings of galaxies and even the universe.By including these often ignored kinetic energies and Potential energies, reconciliation of theoretical and experimental results can be effected.

P52A-10 1330h POSTER

The Laws of Parallelism, Divergence and Convergence in comination or singly in Space Science: quantitative and qualitative aspects.

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There are many parallelisms, convergences and divergences in combination or singly in planetary and space science. Examples of parallelisms in planetary and space science are volcanoes on Mars, Earth and Io: polar caps on Mars and Earth, riverbeds on Mars and Earth, rings about Jupiter, Saturn,Uranus, rotation of all planets and the sun, black holes and galaxies and galactic groupings:Hadley cells on Venus (ultra-violet photo) and Earth. Examples of convergences are slowing of rotation rate of the earth compared to the rotation rate of the sun: slowing of the moons orbital speed compared with the orbital speed of Earth. Divergences are the increasing distances from the big bang of various galaxies as compared to each other. Examples of convergences in nature are the cone of an umbra, converging to a point beyond the earth itself in a lunar ecalipse, and a cone of divergence occurs with the penumbra. A parallelism can occur with two light rays reflecting back off of a flat icy planetary surface or craters showing parallel ejecta rays.

The elementary mathematical theory of the laws of parallism, convergence and divergesnce are as follows: the amount of parallelism or degree of parallelism is the distance between two parallel lines each describing the phenomena so that if g(earth)=9.8m/s^2 and g(Mars)= 3.4m/s^2, the degree of parallelism = 6.4m/s^2.and if g(Mars)= 3.4m/s^2,and g(earth's moon)= 16m/s^2 the degree of parallelism =1.8m/s^2. Therefore, the greater parallelism or sameness is the lesser distance or value so that the g-parallelism between Mars and Earth's Moon is greater than the g-parallelism bewteen Earth and Mars. The divergence and convergence between two qualtities can be computed by calculating the angle at the vertex of the convergence or divergence by analytic geometry or be instrumentation. A solid angle for a cone of divergence or convergence can be used for quantification. Two parallel lines can constitute the basis for a cylinder of volume and the area of parallelism can also be used to quantify the parallelism say between the parallelisms of the spin rates of Jupiter and Mars.

Many phenomena in nature can be found obeying the law of parallelisms, convergences and divergences from the macroworld to the microworld, from stars to atomic particles, from fields to masses and many can be quantified as stated above.

P52A-11 1330h POSTER

Results of Aplication of Theory "Indirect Influence of the Moon" And/Or "Cycles on Catastrophes" After 1980

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I know that I do not have a merit for the History, but this theory touch diferents themes of meeting without profundity in any. Celestial mechanic and Lagrangian points Earth-Moon system.There are Kordilewski clouds of dust (1961). Solar wind impart moment to dust when these clouds crosses between Sum and Earth (relacioned widh Lunar Fases and Eclipse Epoch).The dust impact over the Earth and produce catastrophes widh Lunar cycles

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