Laboratory for **A**tmospheric and **S**pace **P**hysics

Activity Report
2001
University of Colorado at Boulder

Cover. The LASP Space Technology Building, formally dedicated on September 5, 1991. This facility is located off-campus in the Research Park at 1234 Innovation Drive, Boulder, Colorado.

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Introduction

This report describes activities of the members of the Laboratory for Atmospheric and Space Physics (LASP) from January 2001 through December 2001. LASP is an institute of the Graduate School of the University of Colorado. LASP conducts basic theoretical and experimental research in planetary, atmospheric, magnetospheric, and solar physics. LASP also conducts research to explore the potential uses and development of space operations and information systems. Through LASP's research programs, University faculty, staff members, and students are able to participate in national and international space programs. In particular, students from the Department of Astrophysical and Planetary Sciences, the Department of Atmospheric and Oceanic Sciences, the Department of Physics, the Department of Geological Sciences, and the College of Engineering pursue research interests under the auspices of the Laboratory. A coordinated, multi-purpose research program has evolved that uses remote sensing spectroscopic and in situ techniques.

LASP has taken part in many major space exploration missions. This work has demonstrated LASP's ability to conceive, design, fabricate, test, and operate space vehicles and instruments and to exploit the data from space experiments. Research and development programs at LASP provide new techniques for data manipulation and image processing, as well as new instruments and sensors for space applications. Members of LASP examine basic concepts for space operations and information systems and develop tools and approaches to evaluate and support these concepts. In response to the increasingly complex needs of operating spacecraft and handling data, LASP is developing prototype operations systems for the Space Station, EOS, and for other future missions. The OASIS system (Operations and Science Instrument Support) is evolving into a multi-purpose operating system that will be used on NASA's Space Station testbed, by many NASA centers, by the European Space Agency, and by several aerospace companies as well.

A number of the research associates at LASP hold joint appointments in the Department of Astrophysical and Planetary Sciences, in the Department of Atmospheric and Oceanic Sciences, in the Department of Physics, in the Department of Aerospace Engineering Sciences, and in the Department of Geological Sciences. The large scientific community at the University and throughout Boulder provides opportunities for members of LASP to enjoy substantial collaboration and communication with experts in related fields. LASP has also actively conducted experimental and theoretical work in cooperation with other universities in the United States and abroad. In recent years joint programs have been carried out with institutions in Belgium, Canada, Finland, France, Germany, Japan and Russia.

Please visit LASP's Website for the latest developments: **http://lasp.colorado.edu**

A Message from the Director

In 1946-47, a handful of American universities joined with the military and with industry to initiate the era of space exploration. The University of Colorado was one of those pioneering universities. The first experiments to be performed in space were lofted by sub-orbital rockets. A key obstacle to these first rocket flights was providing a stabilized platform for cameras and other experiments. With support from the Naval Research Center and the Air Force Cambridge Research Laboratory (now the Air Force Research Laboratory), the University of Colorado formed a research group called the Upper Air Laboratory (UAL) to solve this problem. Their solution — called the biaxial pointing platform — cleared the way for some of the first major scientific discoveries made in space. Researchers and engineers from the UAL flew experiments into space on over 50 rocket flights before Sputnik. By 1965, the UAL had grown substantially. Along with this growth came a new building on campus and a new name: the Laboratory for Atmospheric and Space Physics (LASP).

This past year has seen the successful launch of the TIMED mission and major progress on the Solar Radiation and Climate Experiment (SORCE). The continuing successes of SNOE, QuickScat, and other active programs are also quite gratifying. We are actively pursuing new opportunities in the NASA SMEX, MIDEX, and Discovery programs. Recent accomplishments in the MESSENGER project (with Johns Hopkins Applied Physics Laboratory) under the Discovery program auspices, whets our appetite for new experimental challenges.

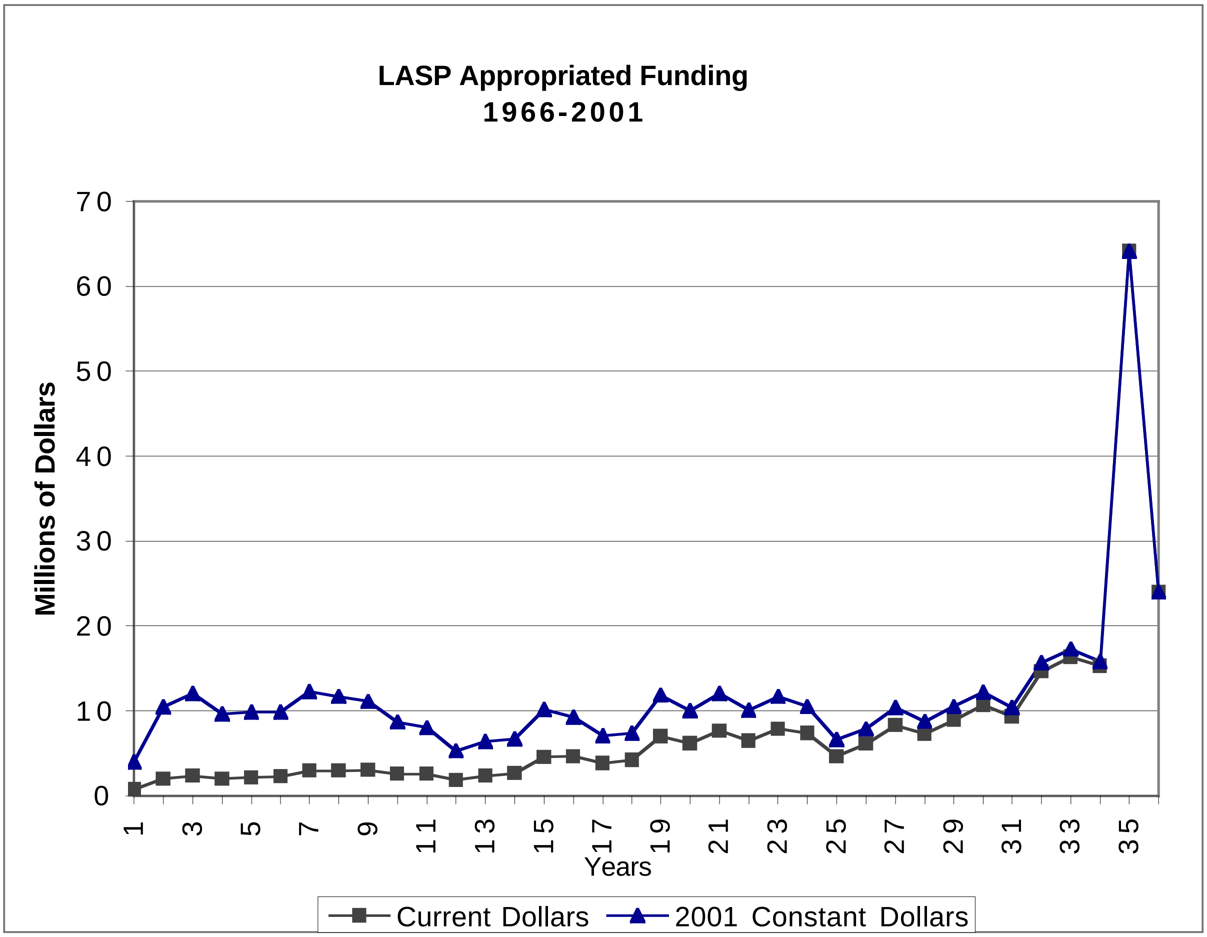
New mission activity accompanies the excitement and importance of science data coming back from such ongoing missions as Galileo, Cassini, UARS, ISTP/POLAR, SAMPEX, FAST, CLUSTER, and other programs. Also, laboratory developments in dust detection systems, results from Space Shuttle missions (COLLIDE and MGM) and new research in the Astrobiology program have made the past year exciting and interesting. The theoretical and modeling efforts that develop hand-in-hand with the hardware, data analysis, and operations work makes for an exceptionally complete program in LASP.

We at LASP express our appreciation to the University, to the local Boulder community, and to the national agencies for the continuing support that we receive. We look forward to working actively with the broad space research community in many new endeavors. Thanks also to the students, staff, and faculty of LASP for all their hard work. Special thanks to Ann Alfaro for her tireless efforts in preparing this report.

Daniel N. Baker

LASP Appropriated Funding

During the period 1/1/2001 to 12/31/2001 LASP appropriated funding totaled $24,002,108 for support of 152 grants and contracts.



CURRENT PROGRAMS

Solar Radiation and Climate Experiment (SORCE)

The SOlar Radiation and Climate Experiment (SORCE) is a free-flying satellite carrying four instruments to measure the solar radiation incident at the top of the Earth's atmosphere. This NASA mission is one element of the Earth Observing System (EOS) and is scheduled for launch in November 2002. It will continue the precise measurements of total solar irradiance (TSI) that began with the ERB instrument in 1978 and have continued to the present with the ERBS, ACRIM, and VIRGO measurements, and will also provide measurements of the solar spectral irradiance from 1 to 2000 nm. SORCE instruments include the Total Irradiance Monitor (TIM), the Spectral Irradiance Monitor (SIM), two Solar Stellar Irradiance Comparison Experiments (SOLSTICE), and the XUV Photometer System (XPS).

Science Rationale

Solar radiation, the Earth's average albedo, and long wave infrared emission determine the Earth's global average equilibrium temperature. Measurements obtained during the past 22 years show that TSI varies ~0.1% over the solar cycle with larger short-term variations. The variations occur over time scales from a day up to and exceeding the 11-year solar cycle. Climate models including a realistic sensitivity to solar forcing indicate corresponding global surface temperature changes on the order of 0.2°C for recorded solar variations. However, global energy balance considerations may not provide the entire story, and how TSI variations are distributed in wavelength is critically important in understanding the Earth's response to solar variations.

Because of selective absorption and scattering processes in the atmosphere, different regions of the solar spectrum affect Earth's climate in distinct ways. Approximately 20-25% of the TSI is absorbed by atmospheric water vapor, clouds, and ozone, impacting convection, cloud formation, and latent heating via processes that are strongly wavelength dependent. Wavelengths below 300 nm are completely absorbed by the Earth's atmosphere and contribute the dominant energy source in the stratosphere and thermosphere, establishing the upper atmosphere's temperature, structure, composition, and dynamics. Variations in the Sun's radiation at these short wavelengths can be factors of two or greater and lead to significant changes in atmospheric chemistry. The solar ultraviolet influences stratospheric chemistry and dynamics, which in turn controls the ultraviolet radiation leaking through to the surface. Radiation at visible and infrared wavelengths, containing the bulk of the solar energy, penetrates into the lower atmosphere. The non-reflected portion of this radiation is absorbed in the troposphere or by the Earth's surface, becoming a dominant term in the global energy balance and an essential determinant of atmospheric stability and convection. To understand the effects solar variability has on Earth's climate, it is important to accurately monitor both the TSI and its spectral dependence.

SORCE Science Objectives

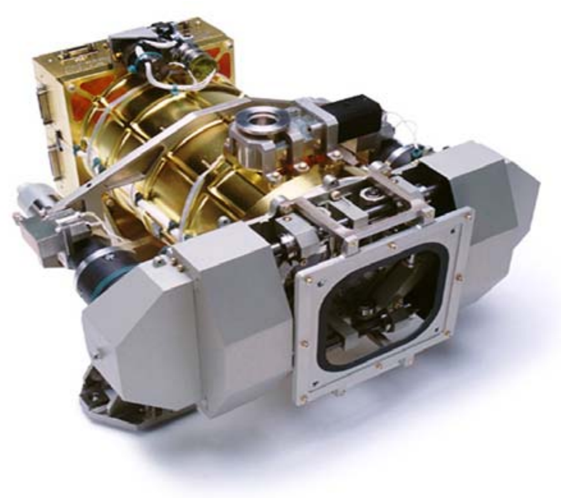
- SORCE will make precise and accurate measurements of the TSI. Connect these observations to previous TSI measurements to form a long-term record of solar influences on the Earth. Provide TSI with an absolute accuracy of 0.01% and with a long-term relative accuracy of 0.001% per year.
- SORCE will make precise measurements of the visible and near infrared solar spectral irradiance suitable for future climate studies. Obtain daily measurements of the solar spectral irradiance from 300 to 2000 nm with a spectral resolution ($\Delta\lambda/\lambda$) of <1/30, an absolute accuracy of 0.03%, and a precision and relative accuracy of better than 0.01% per year.
- SORCE will make daily measurements of the solar ultraviolet irradiance from 120 to 300 nm with a spectral resolution of 1 nm. Achieve this measurement with an absolute accuracy of better than 5% and with a long-term relative accuracy of 0.5% per year. Use solar/stellar comparisons to relate the solar spectral irradiance to the ensemble average flux from a number of bright, early-type stars.
- The SORCE observations will improve our understanding of how and why solar variability occurs and how it affects our atmosphere and climate. Use this knowledge to estimate past and future solar behavior and climate response.

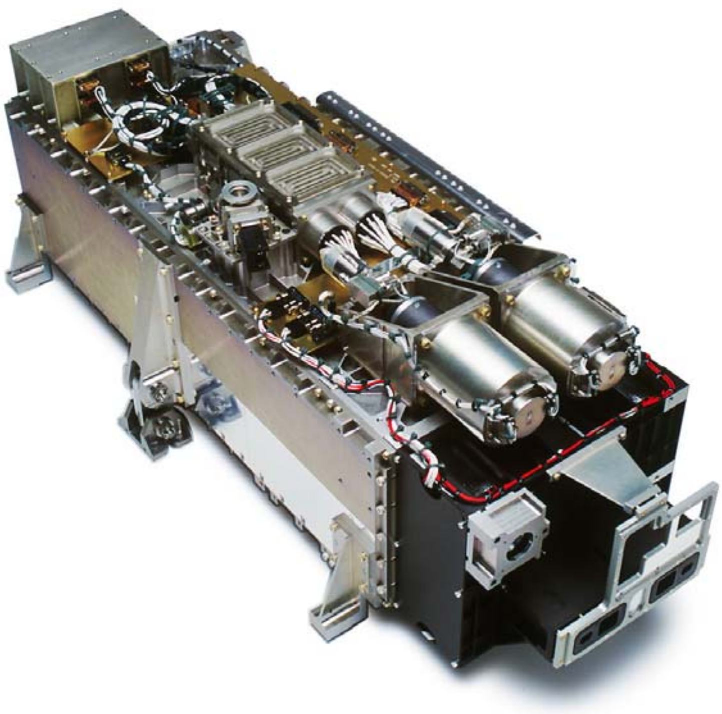
SORCE Mission Description

LASP has full programmatic responsibility for the SORCE mission, which is under the direction of Principal Investigator Gary Rottman. LASP has developed, calibrated, and tested the four science instruments, and is integrating them onto a spacecraft provided by Orbital Sciences Corporation. After launch, science and mission operations will be conducted from LASP's Mission Operations Center. LASP has responsibility for the acquisition, management, processing, analysis, validation, and distribution of the SORCE mission data.

SORCE Instruments

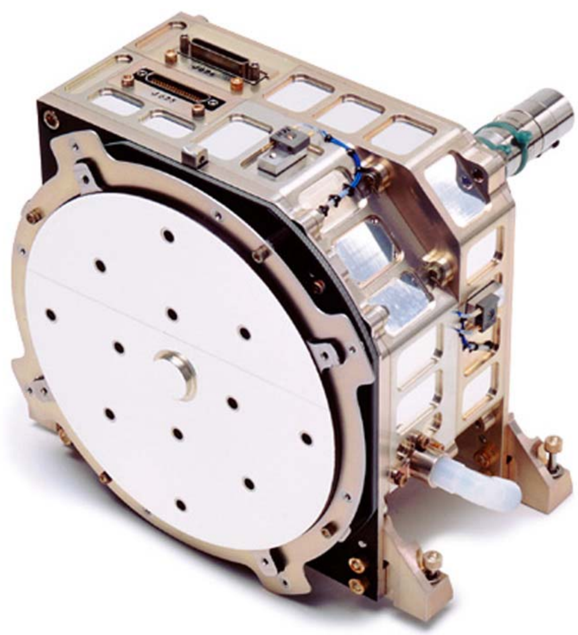
TIM (Total Irradiance Monitor) will provide a measurement of TSI directly traceable to SI units with an absolute accuracy of 0.01% and relative accuracy of 0.001% per year. The instrument incorporates Electrical Substitution Radio-meters (ESR's) with modern, state-of-the-art electronics, processing methods, and materials. Four absorptive cavities provide redundancy and duty cycling capability. The TIM will monitor the Sun every spacecraft orbit, reporting 4 TSI measurements per day.





The SIM (Solar Irradiance Monitor) will measure spectral irradiance from 200 to 2000 nm with a resolution varying from 0.2 to 33 nm, an absolute accuracy of 0.03%, and a relative accuracy of 0.01% per year. This prism spectrometer has only a single optical element and is a variant of the optical design first described by Féry in 1910. The prism has a concave front surface and a convex, aluminized back surface such that it is self-focusing. The instrument contains two completely independent and identical (mirror-image) spectrometers, providing the redundancy, self-calibration capability, and duty cycling needed to meet the scientific objectives.

SOLSTICE (Solar Stellar Irradiance Comparison Experiment) is a second generation of the UARS SOLSTICE also built and operated by LASP. This grating spectrometer will measure spectral irradiance from 115 to 320 nm with a resolution of 0.1 nm, an absolute accuracy of better than 5%, and a relative accuracy of better than 0.5%. The instrument observes the Sun and bright, early-type stars using the very same optics and detectors. The stellar targets establish essential long-term corrections to the instrument sensitivity. The ensemble average flux from these 20 stars should remain absolutely constant (intrinsic variability of less than one part in ten thousand over thousands of years). This in-flight calibration technique establishes the instrument response as a function of time throughout the SORCE mission, yielding solar data that are fully corrected for instrumental effects to an accuracy of about 1%. Moreover, the SOLSTICE technique provides a method of directly comparing solar irradiance measurements made during the SORCE mission with previous (e.g. UARS SOLSTICE) and future observations. The same set of stable stars selected by UARS, based on repeated observations throughout the 10-year mission (1991 to present), will be used for the SORCE mission.

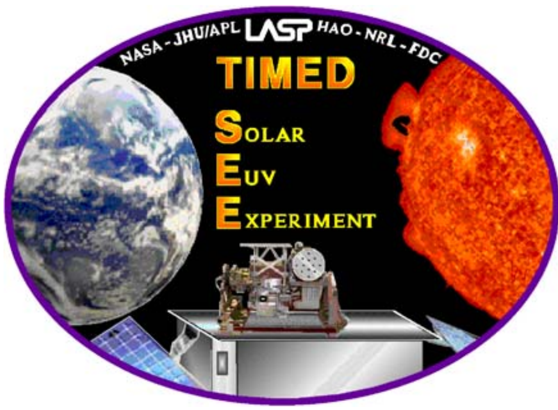


The XPS (XUV Photometer System) will measure six broadband samples of the solar XUV irradiance from 1 to 31 nm and at Lyman-alpha (121.6 nm) with an absolute accuracy of 12% and a relative accuracy of 2%. This instrument includes twelve silicon photodiodes, each with a filter to provide ~5 nm spectral bandpass. The photometers are packaged together with a common filter wheel mechanism, which can rotate a closed aperture, a fused silica window, or an open aperture in front of each photometer. The closed and window positions permit accurate subtraction of any background signal from visible and near UV light.

SORCE Mission Operations and Data Analysis

LASP is preparing to operate and obtain data from the SORCE spacecraft for a period of 5 years (6 year goal), and to process and analyze all engineering data to insure the health and safety of the spacecraft and instruments. Within 48 hours of data capture, all science data with the associated instrument and spacecraft engineering data will be processed to derive Level 3 science data products in standard geophysical units (W/m^2 or $W/m^2/nm$). The Level 3 data are 6-hr averages, with higher time resolution data available to meet secondary science objectives such as studying the passage of faculae and sunspots across the solar disk. Within 3 months of data acquisition, the final release of all science data will include corrections for changes in instrument performance. Validated data will be provided to the scientific community, and collaboration with users will ensure that these data are used in an appropriate manner. The SORCE data will be validated against other simultaneous space observations (when available), against previous spectral irradiance observations, and against the best known models of solar radiation.

TIMED Solar EUV Experiment (SEE)



The Solar EUV Experiment (SEE) is one of the four scientific instruments on the NASA Thermosphere-Ionosphere-Mesosphere-Energetics-Dynamics (TIMED) spacecraft. The TIMED spacecraft along with the JASON spacecraft were launched on a Delta-II on December 7, 2001 from the Vandenberg Air Force Base (VAFB). After initial activation of the instruments, the TIMED mission began normal operations on January 22, 2002. The SEE instrument, which was built at LASP, measures the irradiance of the highly variable, solar extreme ultraviolet (EUV) radiation, one of the major energy sources for the upper atmosphere. The SEE measurements span from 0.1 nm to 195 nm and are fundamental for the TIMED mission's investigation of the energetics in the tenuous, but highly variable, layers of the atmosphere above 60 km. Solar radiation below 200 nm is completely absorbed in the Earth's mesosphere and thermosphere. Changes in the amount of solar radiation, which range from 20% at the longer wavelengths to factors as much as 100 at the shorter wavelengths, result in corresponding changes in the photochemistry, dynamics, and energy balance of the upper atmosphere. A detailed quantitative understanding of atmospheric radiative processes, including changes in the solar ultraviolet irradiance arising from flares, solar rotation (27 day), or the 11 year solar cycle, is fundamental to the TIMED investigations. The primary science objectives for SEE are to accurately and precisely determine the solar VUV absolute irradiance and variability during the TIMED mission, to study the solar-terrestrial relationships utilizing atmospheric models, and to improve proxy models of the solar VUV irradiance. The LASP scientists analyzing the TIMED SEE data are Tom Woods (PI), Frank Eparvier, Gary Rottman, and Don Woodraska.

International Solar Terrestrial Physics (ISTP) Program

The International Solar-Terrestrial Physics (ISTP) program is comprised of several spacecraft measuring the hot, high-speed plasmas flowing past the Earth from the expanding solar corona. There is a large armada of spacecraft within the Earth's magnetosphere examining many aspects of the plasmas that change as the sun disturbs the geospace environment. There is also an international web of ground stations that is recording the magnetospheric and ionospheric signatures of the interaction of the variable sun with the terrestrial environment. ISTP has greatly expanded our knowledge of Sun-Earth Connections and continues to reveal the nature of the sun, the interplanetary medium, and the magnetosphere-ionosphere system. Daniel N. Baker, William Peterson, Shri Kanekal and Xinlin Li are actively working on data from the ISTP program.

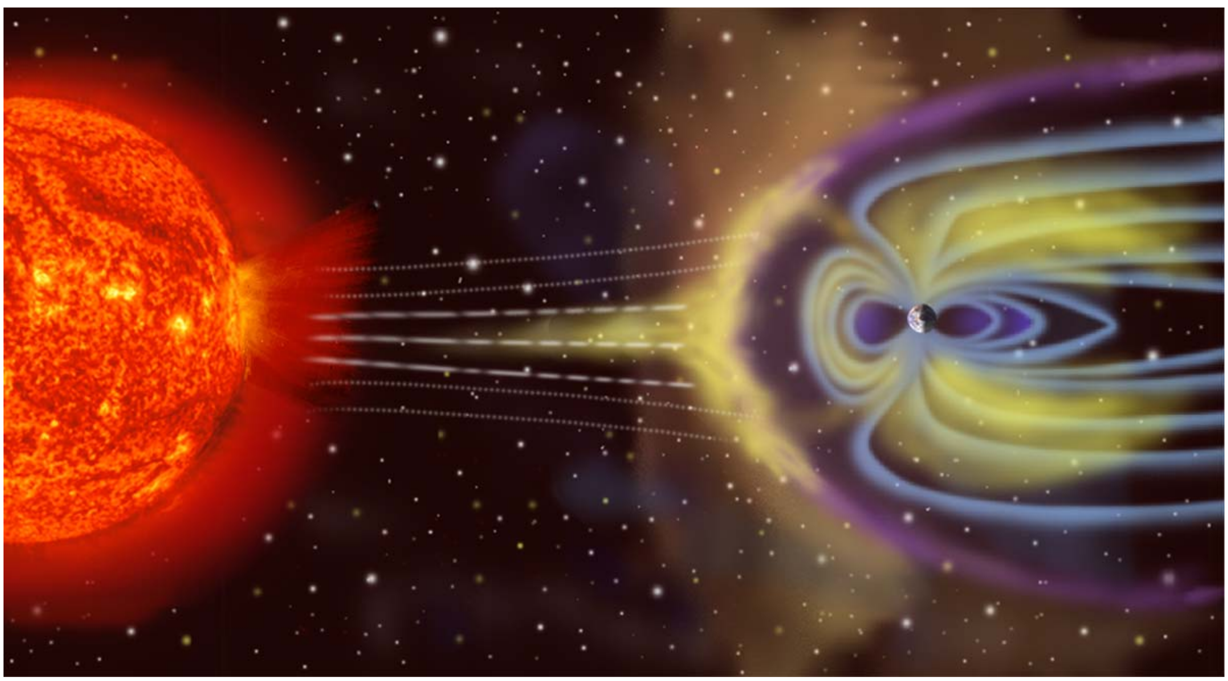
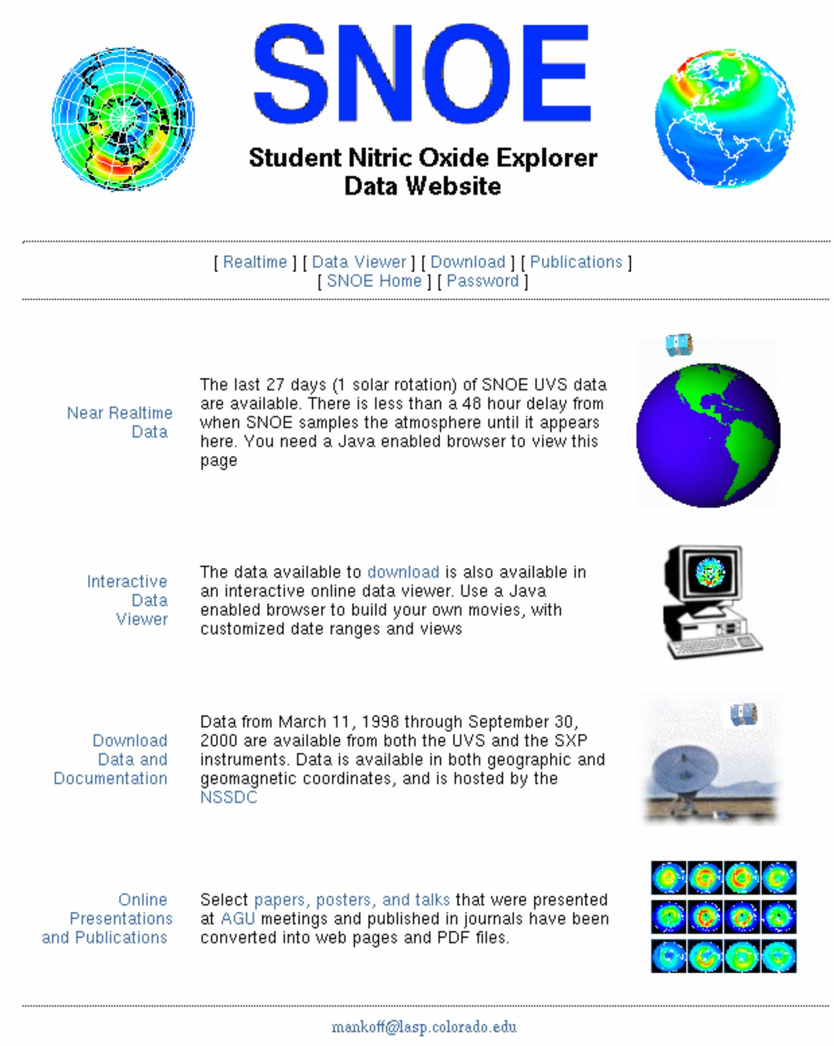


Figure: The connected Sun-Earth system continues to be studied by the ISTP program.

Student Nitric Oxide Explorer (SNOE)

SNOE ("snowy") is a small scientific satellite that is measuring the effects of energy from the sun and from the magnetosphere on the density of nitric oxide in the Earth's upper atmosphere. The spacecraft and its instruments were designed and built at LASP, the Laboratory for Atmospheric and Space Physics of the University of Colorado. SNOE was launched on February 27, 1998, and has entered its fifth year of successful operations. It is being operated from the mission operations center at the

LASP Space Technology Research building. The SNOE Data Website http://lasp.colorado.edu/snoe/ contains a description of the SNOE mission, spacecraft drawings and images, and provides access to the scientific data and publications. Flight engineering data are updated daily. An archive of launch activities and development personnel has been retained.



Measurements of Halogen Oxides in the Troposphere

Ozone depletion events occur not only in the stratosphere (the Antarctic "ozone hole"), but also near the Earth's surface, particularly at high latitudes in springtime. Although the mechanism for these boundary layer ozone losses is not completely understood, it is believed that they are caused by gas-phase bromine compounds, which may originate from sea-salt. Linnea Avallone participated in the Alert 2000 Polar Sunrise Experiment in Alert, Nunavut, Canada during April-May 2000 to study the causes of the sudden ozone loss phenomenon. The radical species chlorine oxide and bromine oxide (ClO, BrO) were measured using vacuum ultraviolet resonance fluorescence techniques that have been employed previously for stratospheric observations of the same molecules. The results from this study indicate that snow-covered surfaces near the Arctic Ocean are indeed sources of atmospheric bromine. Boundary layer ozone losses are also known to occur along the Antarctic coast, but they appear to be less frequent than those in the Arctic. Members of Avallone's research group will travel to Antarctica in August-October 2002 to study halogen chemistry in a remote, unpolluted location.

There is mounting evidence that halogens have an effect on the abundances of ozone and hydrocarbons in regions of the atmosphere other than the high-latitude boundary layer. To investigate this possibility, Linnea Avallone's research group is planning a series of measurements in regions likely to be affected by halogen chemistry. For example, the Great Salt Lake, as well as several chemical plants on its shores, are thought to be large sources of atmospheric chlorine. Observations of bursts of tiny particles along the coast of Ireland have led to the speculation that iodine compounds, created by oceanic plants, may promote nucleation of particles. The group will participate in on-going field studies at Mace Head, Ireland to elucidate the role of iodine oxide (IO) in particle formation.

CRYSTAL-FACE

Linnea Avallone's research group will participate in CRYSTAL-FACE, making measurements of particulate water on the NASA WB-57F and of carbon dioxide on the CIRPAS Twin Otter. A closed-path tunable diode laser hygrometer will be coupled to a heated, anisokinetic inlet to measure the amount of water condensed in particles with diameters larger than about 1 micron. Although smaller particles are also sampled, the instrument's sensitivity to them is low. These measurements will be used, along with observations of water vapor made by a similar instrument operated by the Jet Propulsion Laboratory, to understand the fraction of water present in the condensed phase in a variety of cirrus cloud types. Accurate knowledge of ice water content (IWC) and ice water path (IWP) are important for retrieving cloud parameters from space-borne instruments and for modeling the radiative properties of clouds. The in situ observations made by Avallone's group will help to constrain and validate IWC and IWP.

Carbon dioxide concentrations will be measured using a non-dispersive infrared absorption technique, based on the LiCor 6251 CO2 analyzer. The optical system from a commercial instrument has been modified for structural stability and packaged with aggressive pressure control electronics to enable measurements of CO2 precise to better than 0.1 ppmv (the ambient concentration of CO2 is about 375 ppmv). Observations of CO2 will be taken in the neighborhood of convective systems from both the CIRPAS Twin Otter, flying at low altitudes (less than 12000 ft) and the NASA WB-57F (by a group from Harvard), flying at high altitudes (greater than 50000 ft). Comparisons of these two data sets will yield information about the amount of low-altitude air entrained into convective systems. This information is important to understanding how much water vapor is transported to the upper troposphere by convection, and also to modeling the impact of convection on the trace gas budget of the troposphere.

Experimental Studies of Impacts in Space

Three experimental programs are underway at LASP to study the physics of low energy collisions in space. Planetary ring systems, protoplanetary disks, the asteroid belt, and the Kuiper belt are all collisionally evolved systems. Dust released in these collisions is an important observable tracer of the dynamics of the larger particles. However, little is known about the dissipation of energy, production of ejecta, and accretion in the low speed collisions that occur between objects with low surface gravity, such as planetary ring particles. Experimental studies at LASP are underway to understand these low energy collisions.

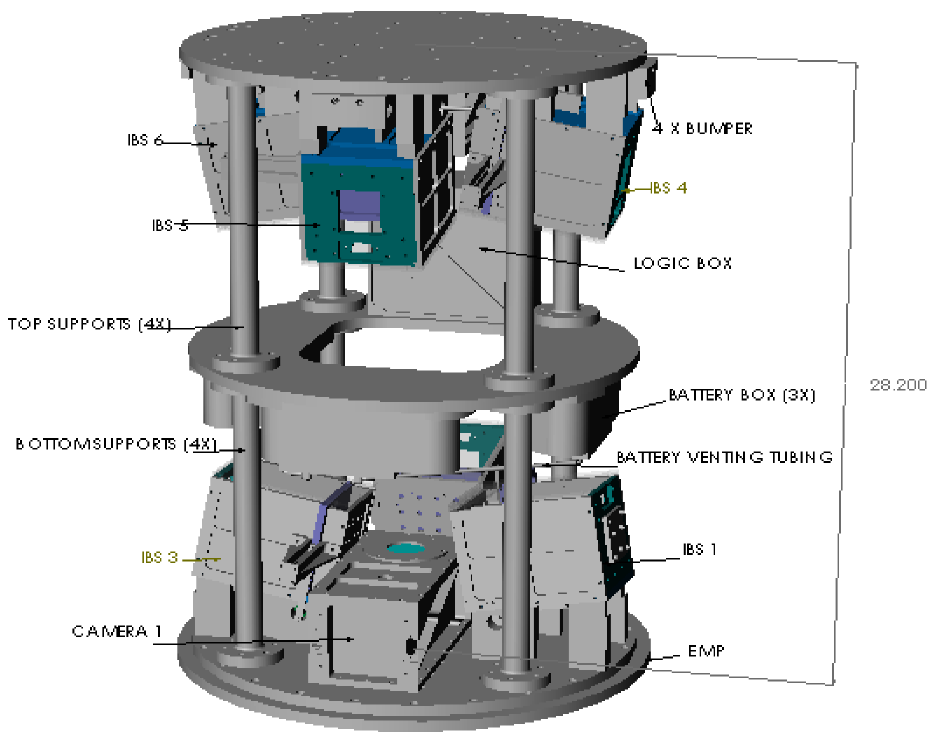


Figure: COLLIDE-2, showing the major experiment components, including the six IBS containers where low-velocity microgravity impact experiments take place.

A ground-based program focuses on impacts into various types of simulated planetary regolith, or dust, at speeds from 1 to 10 m/s. This program provides a point of comparison for other experiments performed in reduced gravity environments, and also provides a valuable database on the behaviors of different types of regolith in low energy impacts. Michael Mellon and Josh Colwell conduct these experiments in LASP's Planetary Soils Laboratory.

The Collisions Into Dust Experiment-2 (COLLIDE-2) flew on Space Shuttle mission STS-108 in December 2001, performing 6 impact experiments into simulated regolith at speeds between 1 and 100 cm/s. Video data of these impacts shows the amount of energy dissipated in the collision and the speed and amount of dust ejecta produced. The figure below shows one video frame shortly after an impact at 100 cm/s and the ejecta produced by the impact. Josh Colwell is the Principal Investigator; Larry Esposito and Mihaly Horanyi are co-investigators.

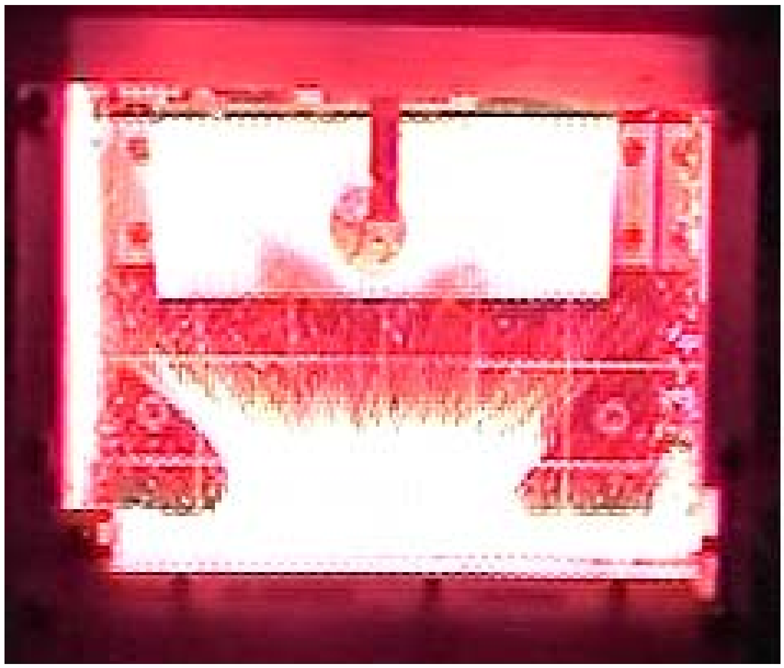


Figure: Image from COLLIDE-2 low energy impact experiment into sand, looking edge-on at the target surface. The impactor hit the surface at 1 m/s, and the resulting ejecta can be seen moving away from the impact site. Far more ejecta is produced in this microgravity experiment than in similar experiments performed on the ground at the same impact speed and energy.

The Physics of Regolith Impacts in Microgravity Experiment (PRIME) will study the same process as COLLIDE with impact experiments in NASA's KC-135 reduced gravity airplane. These experiments will be at speeds from 10 cm/s to 10 m/s and help bridge the gap between the ground-based experiments and the space-based experiments. PRIME will generate more data than COLLIDE, but in a different reduced gravity environment and at generally higher energies. Work on PRIME began in 2000. Josh Colwell is the Principal Investigator with Co-Investigator Stein Sture.

The combined results and insights gained from these experimental programs, together with numerical and theoretical analyses will help us understand the origin and evolution of planetary ring systems and the early stages of planet accretion.

MESSENGER (MErcury: Surface, Space ENvironment, GEochemistry, and Ranging): A Mercury Orbiter Mission

The Mariner-10 flybys of the planet Mercury in 1974 and 1975 found a strong magnetic field and an active magnetosphere similar in many ways to that of Earth. Given the small size of the planet, Mercury's interior was expected to have cooled and solidified long ago. The presence of an intrinsic magnetic field, however, implied an internal dynamo in a fluid core, posing numerous, unresolved questions concerning the origin, composition, and thermal history of Mercury. The Mariner-10 spacecraft also detected intense particle bursts and magnetic field disturbances, indicating that magnetospheric substorms occur at Mercury.

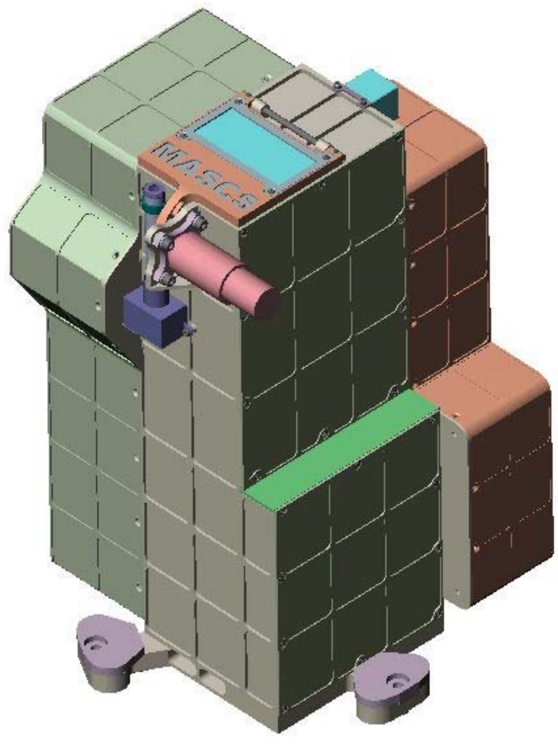


Figure: The MASCS detector package that is being prepared for MESSENGER by LASP researchers.

The MESSENGER mission is under development in the NASA Discovery program. This mission to Mercury will provide unique measurements that are not possible at other planets due to the constraints of orbital mechanics and the large dimensions of other magnetospheres relative to their planetary bodies. The MESSENGER mission will provide the essential data necessary to formulate the next generation of theories and models for terrestrial-type planetary structure and dynamics. The mission will also return critical measurements necessary for the understanding of not just the surface history and internal structure of Mercury but the formation and chemical differentiation of the Solar System as a whole.

MESSENGER is a large collaboration of 11 different institutions. It is led by Sean Solomon from the Carnegie Institution in Washington, DC and managed by the Applied Physics Laboratory at the Johns Hopkins University. It will study the planet's surface morphology and composition, interior structure and magnetic field, and atmospheric and magnetospheric composition. Included in this suite is the Mercury Atmospheric and Surface Composition Spectrometer (MASCS), which will be designed, built, and operated by the Laboratory for Atmospheric and Space Physics. William McClintock and Daniel Baker are both Co-Investigators on the MESSENGER science team.

The Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) Mission

SAMPEX carries a payload of four scientific instruments which study solar particles, anomalous cosmic rays, and magnetospheric electrons and ions. It has been operating in low-Earth orbit since July 1992. The SAMPEX instruments have sensitivities >100 times greater than previous spacecraft, and these have led to new discoveries such as a new radiation belt of interstellar material and rare hydrogen and helium isotopes trapped in the radiation belts. SAMPEX provides unique global maps of magnetosphere energetic particles, and has given new insights into the processes by which radiation levels through the entire magnetosphere can become greatly enhanced.

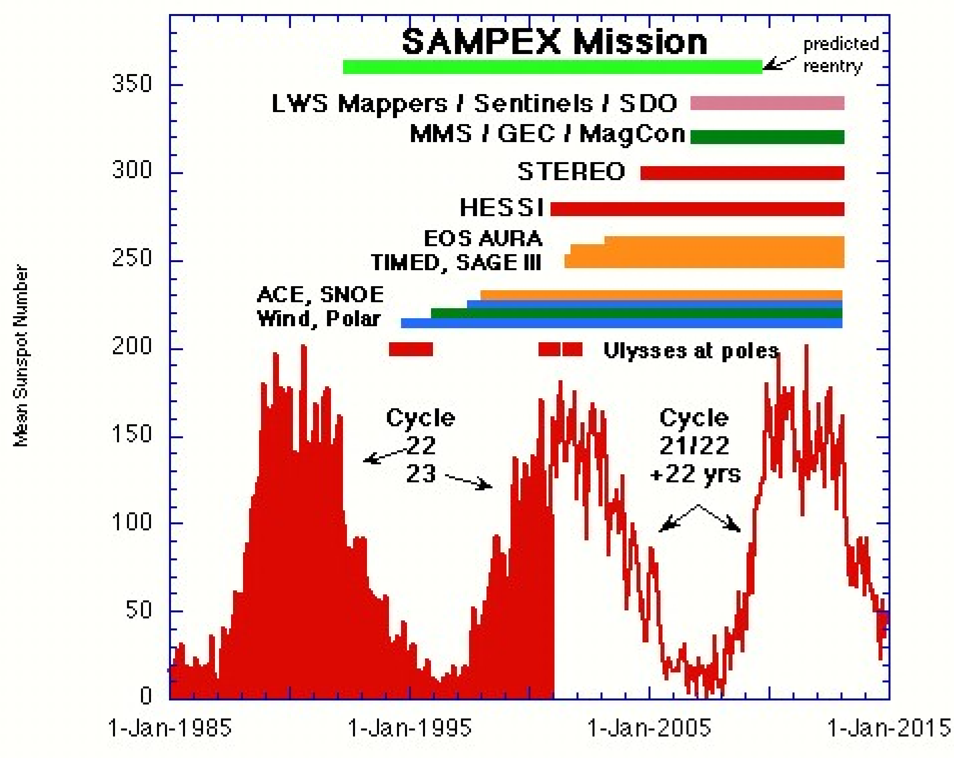


Figure: The SAMPEX mission life compared to the sunspot activity cycle and compared to the other presently active (or planned) space physics missions.

The figure above shows the SAMPEX mission lifetime in comparison to the solar sunspot cycle. Also shown are other active space physics missions. It is likely that

SAMPEX can continue to operate for several more years until it re-enters the Earth's atmosphere.

LASP scientists Daniel N. Baker, Xinlin Li, and Shri Kanekal are working on magnetospheric data from SAMPEX. New results have been obtained by comparing relatively low-energy (E>25keV) electrons measured by SAMPEX with SNOE measurements of nitric oxide in Earth's upper and middle atmosphere. This collaborative work is being carried out with Charles Barth and Ken Mankoff.

Center for Astrobiology

The CU Center for Astrobiology is run through LASP as a part of the NASA Astrobiology Institute. It brings together faculty from across the campus to study the origin and evolution of life on Earth, the potential and actual distribution of life in the solar system, and the potential for life to exist beyond our own solar system. In addition to the physical and biological sciences, faculty participate from the humanities, bringing together a wide variety of contributions to a single intellectual theme.

The astrobiology program includes contributions in research, teaching, and outreach. Research activities involve faculty, students, and post-docs in planetary science, geology, astrophysics, atmospheric science, molecular biology, evolutionary biology, biochemistry, and philosophy. Teaching is done at both the graduate and undergraduate levels, and include courses on life elsewhere and the history and philosophy of astrobiology. A new graduate-level certificate program has been initiated as a way of providing training across the breadth in astrobiology that adds to the in-depth training in a student's own discipline.

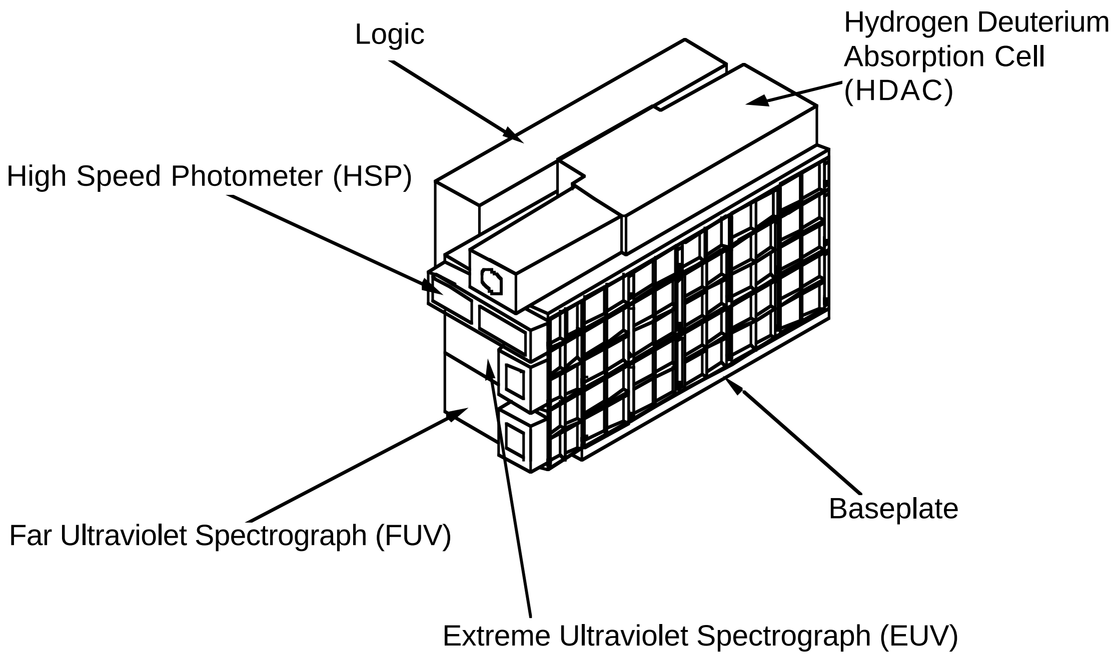
Our ongoing research includes a wide variety of areas including the earliest history of the Earth and of life on Earth, the origin of planets, the nature of climate on Earth-like planets and its ability to support life, the nature of life in extreme environments on the Earth, the origin of the genetic code and the earliest RNA world on Earth, major events in the history of life on Earth, the origin of different mechanisms of metabolism, the potential for life on Mars, and the "philosophy of science" of astrobiology.

Outreach is done on a small scale, involving public talks and writing by individual participants, and on a larger scale, with our annual public symposium. This past year, our public symposium was on the topic of "What is life?", brought in nationally known experts on the history of life on Earth, the biochemical origin of life, and the public perspective, and was attended by about 400 people.

Cassini UVIS

LASP built the UltraViolet Imaging Spectrograph for the Cassini orbiter spacecraft, part of the NASA-ESA mission to Saturn. It was launched in October 1997 and will arrive at Saturn in June 2004. The instrument is working well and on the way to Saturn. We are analyzing observations of stars, Venus, and the Earth's Moon from 1999, and from Jupiter in 2000.

The LASP UVIS was built with the participation of the Max Planck Institute of Lindau, Germany. It measures the composition of the atmospheres of Saturn and Titan, their clouds, thermospheres, and heavy hydrogen abundances. Dynamical waves and wakes in the rings of Saturn and the upper atmospheric structure will be measured by observing stellar and solar occultations.



The Cassini spacecraft (2,500 kilograms of hardware and 3,000 kilograms of propellant) will deliver the European-built Huygens probe to Saturn's moon Titan and then tour the Saturnian system for nearly four years. Approximately 1,300 academic and industrial partners in 16 European countries are participating in the Cassini mission. In addition, there are more than 3,000 participants in 32 different states in the US. The mission is managed for NASA by the Jet Propulsion Laboratory in Pasadena, California, and for ESA by the European Space Technology and Research Center in Noordwijk, the Netherlands. The Italian Space Agency contributed the orbiter's 4-meter-diameter high-gain antenna for communications and portions of other orbiter science experiments. The United States supplied batteries and two science instruments for Huygens.

In 2000, Cassini observed Jupiter, its atmosphere, moons, and glowing Io torus. These observations complement and extend those from the LASP Galileo UVS. In 2001, we continued analysis of the Venus and Jupiter data, and began planning for UVIS observations in the four-year Saturn tour, which begins in 2004.

The LASP UVIS Science team includes Principal Investigator Larry Esposito, Co-Investigators George Lawrence, Bill McClintock, Charles Barth, Joshua Colwell, and Ian Stewart. Alain Jouchoux is the Operations Team Leader, assisted by Michelle Kelley and Darren Osborne.

Cassini Jupiter Flyby

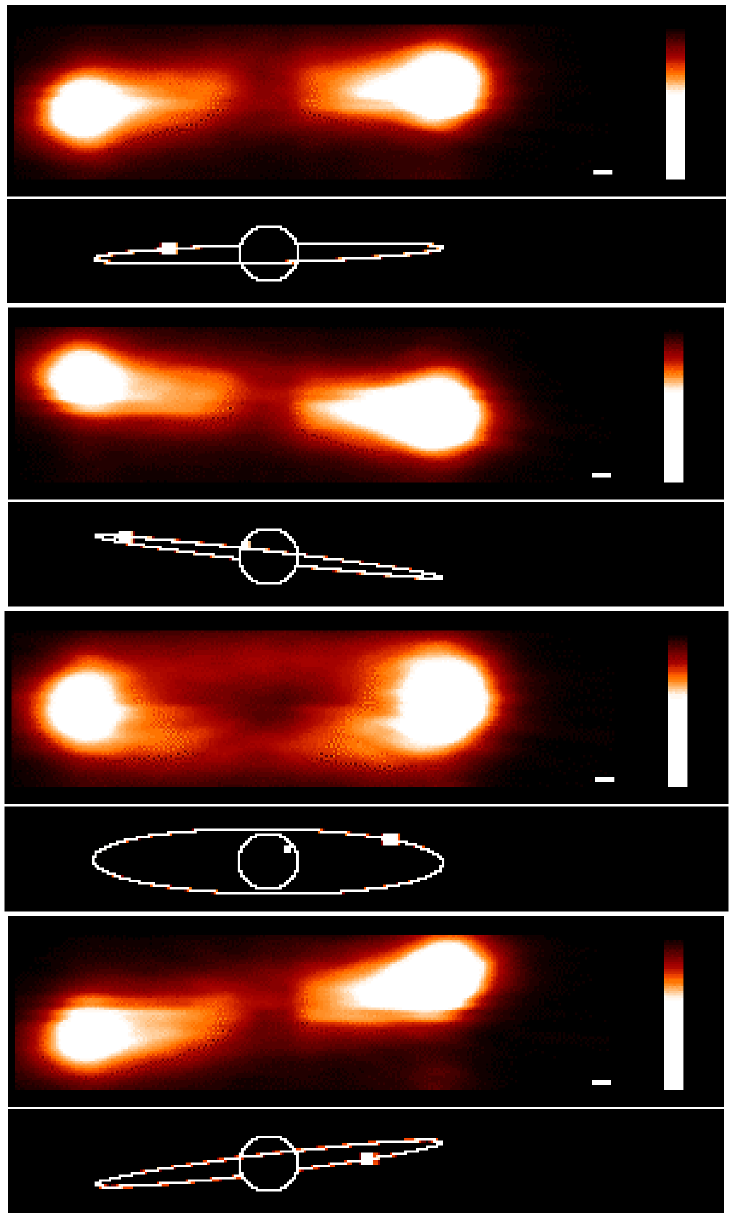


Figure: Four ultraviolet observations of the Io torus spanning 1 October to 14 November, 2000, during the Cassini Jupiter flyby. The torus is a donut of glowing gas orbiting Jupiter, composed mostly of sulfur and oxygen gases from Io's volcanic eruptions. Because the atoms giving off the light are trapped by Jupiter's tilted magnetic field, the torus wobbles back and forth during the course of a Jupiter day.

Mars Odyssey THEMIS

Faculty and students in LASP are participants in the THermal EMission Imaging System experiment on the Mars Odyssey spacecraft mission, currently orbiting Mars. The instrument is designed to measure surface composition and physical properties at very high spatial resolution. Surface composition is important for understanding the origin of the martian crust and its relationship to the interior and for finding locations that contain minerals indicative of the past presence of liquid water; places that contained liquid water have the potential to have had life. Surface physical properties allow understanding of the geological processes that have acted and also allow us to identify and understand sites that might be of interest as landing sites for future Mars missions.

Bruce Jakosky is leading the CU effort, which also involves LASP Research Associates Sara Martinez-Alonso and Mike Mellon and graduate students Shannon Pelkey and Stacy Varnes. They are participating in both aspects of the mission, and are currently working with the rest of the THEMIS team to understand how to interpret this new type of data. The spacecraft has been orbiting only for a short period, and results should begin to come out in the very near future.

Mars Global Surveyor

In March of 1999 the Mars Global Surveyor spacecraft began mapping the planet Mars with a suite of geologic remote sensing instruments. In early 2001 the primary mapping mission ended and an extended mission phase began, marking one full martian year of mapping the red planet

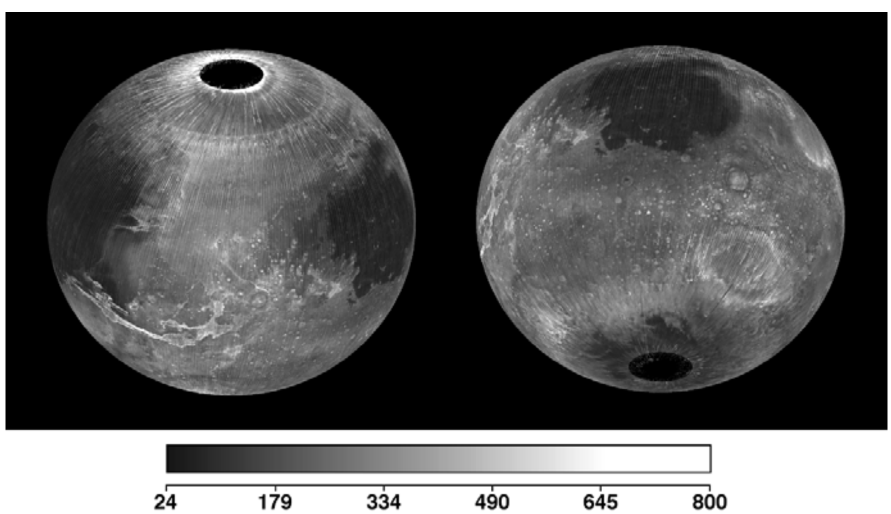


Figure: The global distribution of thermal inertia of the martian surface determined from Thermal Emission Spectrometer data from mapping orbits 1583 to 9382 (acquired during April 1999 through November 2000). Thermal inertia units are J/m2 K s1/2.

Researchers at LASP are participating in the data analysis from this mission. Michael Mellon's Mars Data Analysis investigation (with graduate student Than Putzig) is focusing on deriving and mapping the thermal inertia of the martian surface at high (3 km) spatial resolution using remotely measured surface temperatures and other data from the Thermal Emission Spectrometer. Thermal inertia is a measure of a planet's surface-temperature response to changes in solar heating throughout the day. Low values of thermal inertia are typical of fine grained, loosely packed, soils like dust and fine sand which indicates windblown deposits. High values are typical of expanses of exposed bedrock or heavily cemented (lithified) rock units. Intermediate values of thermal inertia would indicate a coarse sandy or rocky surface. Through mapping of the thermal inertia, the physical character of the surface can be estimated and, in comparison with images and geologic unit maps, a more complete view of the geologic history can be attained.

Through Bruce Jakosky's Interdisciplinary Scientist investigation, ongoing research includes surface-atmosphere interactions that include seasonal cycles and their effects on the atmosphere, the implications of MGS mission results for past life on Mars, and planning for future Mars landings. Specific analysis (with graduate student Shannon Pelkey) includes examination of the thermal inertia, spectral, and other properties of potential 2003 Mars Exploration Rover landing sites, as well as examination of the properties of future landing sites of exobiological interest.

Permafrost of Earth and Mars

One of the long-standing questions of the martian climate involves the history of water. Current martian surface conditions allow water to be stable only in a frozen state at the polar surface or as subsurface ground ice within the regolith at mid and high latitudes. Water in the equatorial regions of Mars would rapidly freeze, then sublimate (evaporate) into the dry atmosphere. Research is being carried out by Michael Mellon to investigate the behavior of ground ice and the relationship between subsurface ice, subsurface water, and small-scale geologic features.

Of particular interest are features now being observed in high resolution Mars Global Surveyor images, namely small polygonal networks and young, apparently water-carved, gullies. Polygonal networks of fractures that are ubiquitous in terrestrial ice-rich permafrost and are now observed on Mars in relative abundance. Fractures form in ice rich soils when seasonal cooling causes contraction. The presence of these features on Mars indicates the presence of subsurface ice, which previously has been only theoretically predicted to be there.

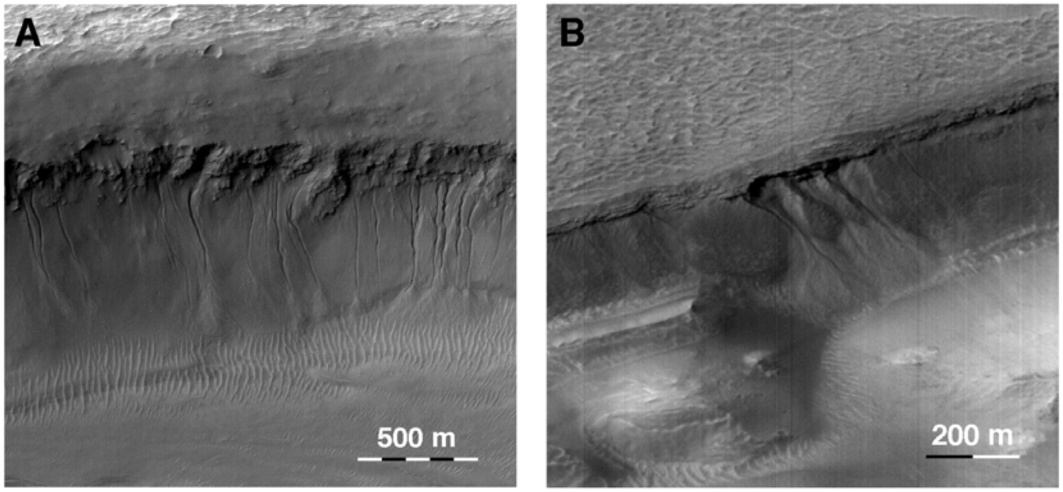


Figure. Gullies on Mars. These small scale features are thought to be carved by liquid water based on morphological evidence and Earth analogs. Yet they occur in regions on Mars where the ground temperatures are continuously well below freezing. Researchers at LASP are investigating the origin of these features.

Small geologically young gullies have also been discovered, that indicate surface water erosion in regions of Mars where surface water is unstable, and should rapidly freeze. These feature raise questions about where liquid water could originate in the current martian climate. In collaboration with Roger Phillips (visiting form the Washington University), Michael Mellon has developed a possible solution to this paradox. Shallow aquifers may exist as a result of global average geothermal heating and thermal insulation from unusually dry loose surface soil.

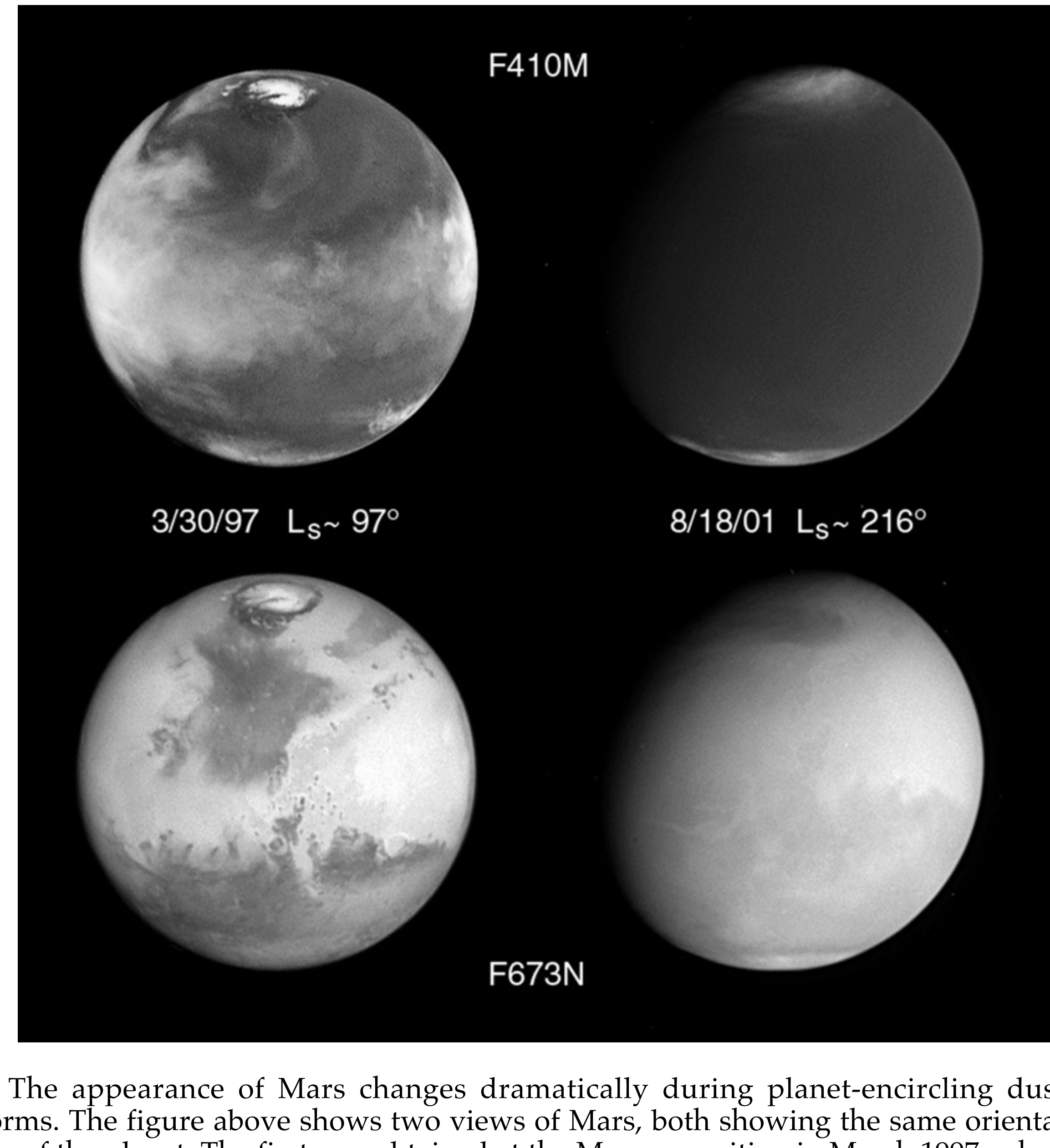
Additional research includes the study of analogous geologic features in the Antarctic Dry Valleys these valleys are among the coldest and driest places on Earth and are therefore similar in condition to the martian climate. The study of these terrestrial geologic features, may help us to better understand the processes that possibly form similar structures on Mars. A combination of field work in the Antarctic Dry Valleys, laboratory analysis of permafrost samples, and theoretical study of ice stability and polygon formation are being employed.

Hubble Space Telescope Observations of Mars

In late-1990, the Hubble Space Telescope began a long-term program of observations to monitor seasonal and inter-annual changes which occur on the surface and in the atmosphere of the planet Mars. The science team undertaking this program is composed of planetary scientists Steve Lee (LASP, University of Colorado), Philip James (University of Toledo), Todd Clancy and Mike Wolff (Space Science Institute), and Jim Bell (Cornell University).

During the most recent observing cycle, our HST observations of Mars resumed in late-2000 and continued through late-2001. Several sets of observations were scheduled in the several months before and after the Mars opposition in June 2001. At opposition, Mars was about 68 million km from Earth; from this distance, HST could resolve features as small as 16 km across.

In late-June 2001, the orbiting Mars Global Surveyor observed the initiation of a global dust storm. Within a week, clouds of suspended dust encircled the entire planet. The dust did not begin to settle until October 2001. During this time, the surface of the planet was obscured by the optically thick dust clouds.



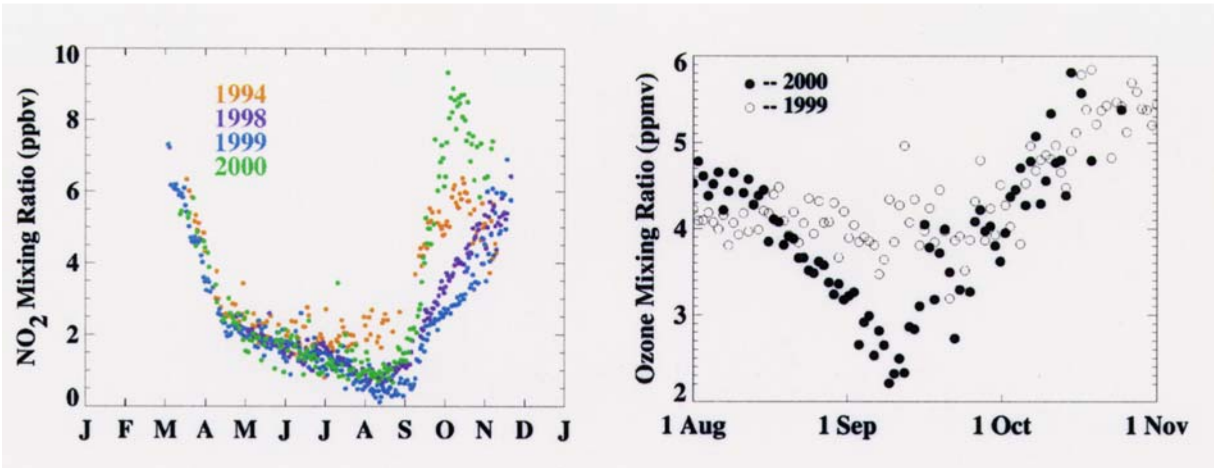
The appearance of Mars changes dramatically during planet-encircling dust storms. The figure above shows two views of Mars, both showing the same orientation of the planet. The first was obtained at the Mars opposition in March 1997, when the atmosphere was cold and water-ice clouds were pervasive. The second was obtained in August 2001, when the atmosphere was warm and dusty. The F673N (red filter) images enhance the appearance of surface features; the obscuration of the surface during the global dust storm is dramatic. The F410M (violet filter) images enhance the appearance of water-ice clouds in the atmosphere; in March 1999, the aphelion cloud belt is very obvious, while in August 2001 the high dust loading has warmed the atmosphere so that water-ice clouds cannot form. These images are good evidence of the two climate states of Mars – the cold, cloudy aphelion state (March 1999), and the warm, dusty perihelion state.

Our observations will resume in January 2003. We will be making use of the newly installed Advanced Camera for Surveys (ACS). ACS will provide twice the spatial resolution of our earlier HST images. That, combined with the proximity of Mars at opposition in 2003, will improve the images' spatial resolution to about 5 km per pixel.

Polar Ozone and Aerosol Measurement (POAM II and III) Scientific Investigations

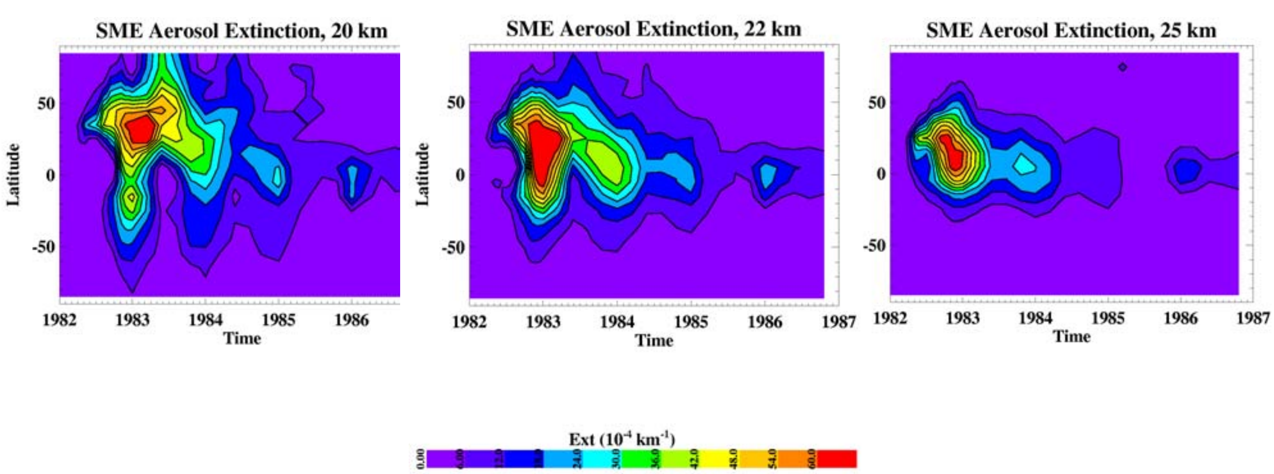
The Polar Ozone and Aerosol Measurement (POAM II and III) instruments are Department of Defense satellite instruments designed to measure profiles of water vapor, ozone and nitrogen dioxide (NO_2) densities, aerosol extinction and temperature in the polar stratosphere. LASP research associates Cora Randall and Dave Rusch are POAM team members, and are involved in all aspects of the data analysis, from validation to scientific investigations. POAM II operated from 1993 to 1996; POAM III, an improved version of POAM II, was launched in 1998 and is currently operational. Ongoing investigations include validation of the data as well as comparison of the POAM II and III measurements of ozone and NO_2 to output from two-dimensional chemistry-transport models. We are also studying the impact of interannual variations in vortex dynamics on the polar distribution of ozone and NO_2. As part of the SOLVE campaign (see below) we are working to quantify ozone loss in the Arctic lower stratosphere. Finally, because of high solar activity, 2000 was an exceptional year in terms of particle impacts on the upper atmosphere. We have used POAM III and Halogen Occultation Experiment (HALOE) data to show that NO_x (NO and NO_2) produced after solar proton impacts in the mesosphere descended to the stratosphere in record amounts during the 2000 Austral winter, causing significant loss of middle stratospheric ozone.

The left panel of the following figure shows the temporal variation in NO_2 measured by POAM III inside the southern hemisphere polar vortex in 1998, 1999 and 2000, at an altitude of about 30 km. NO_2 in 2000 reached levels that were higher by more than a factor of two compared to the previous two years. Also plotted are POAM II NO_2 mixing ratios from 1994, which had the highest NO_2 enhancements of any year measured by POAM II or III prior to 2000. The ozone mixing ratios in 2000 and 1999 are plotted in the right panel of the figure, and show the dramatic decrease that occurred in September of 2000 as the NO_2 mixing ratios steeply increased.



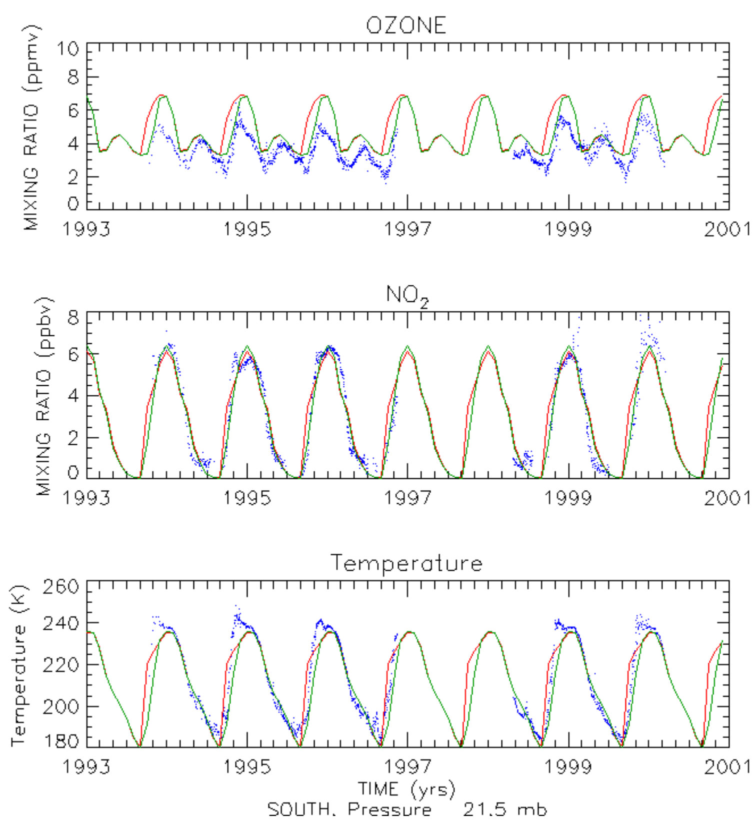
Global Aerosol Climatology Project (GACP)

As part of NASA's Global Aerosol Climatology Project (GACP), LASP investigators Cora Randall, Dave Rusch, Frank Eparvier and Mike Callan are "resurrecting" data from the Solar Mesosphere Explorer (SME) satellite. The goal is to provide the climate modeling community with information regarding stratospheric aerosol forcing after the eruption of El Chichón in 1982. The SME data are the only global satellite measurements of stratospheric aerosol profiles during the 2.5 years immediately following El Chichón. The database provided by this work will enable climate modelers to derive the radiative effects of aerosols in the visible, near infrared and thermal infrared spectral regions. SME radiance data from the 440-nm, 1.27 µm, 1.87 µm and 6.8 µm channels are being used to derive extinction, mass and size distribution information pertaining to aerosols in the lower stratosphere. The figure here shows the variations in aerosol extinction at 1.27 µm derived from SME data at several different altitudes, after the eruption of El Chichón.



Solar Influences on Global Change

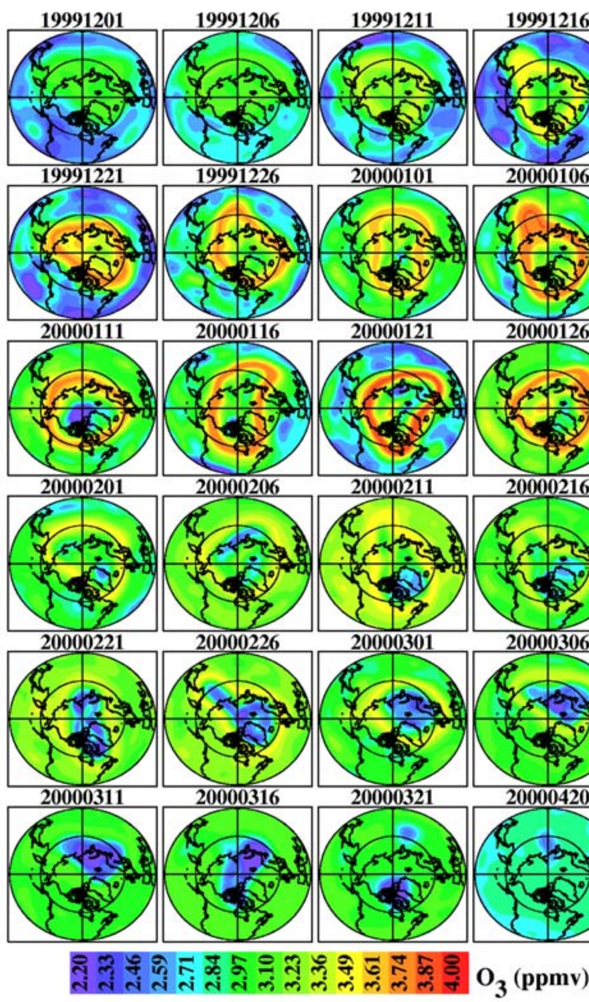
LASP scientists Dave Rusch, Cora Randall and Dan Baker are participating in NASA's program focused on solar influences on global change. As part of this program, they are investigating the effects of particle ionization on the earth's middle atmosphere and its role in global change. Specifically, the coupling between the upper and middle atmosphere by the production and transport of nitric oxide, its subsequent reaction with stratospheric ozone, and the ensuing impact on climate are being studied. The program utilizes data from several satellite missions and ground-based instruments, as well as 2- and 3-dimensional models to study the long-term consequences of solar particle effects on the global odd nitrogen content of the middle atmosphere. It involves collaboration with scientists from the Naval Research Laboratory. The work addresses the significance of solar-generated particle impacts affecting the atmospheric densities of odd nitrogen and ozone, a key question in separating the effects of solar and anthropogenic forcing of the Earth's climate. The results pertaining to particle impacts will be compared to the expected climate forcings from other natural and anthropogenic processes to assess the significance of the solar energetic particle input on the global system.



The figure above shows the results of the NRL 2D model run for ozone, NO_2 and temperature compared to data from the POAM (Polar Ozone and Aerosol Measurement) II and III instruments in the southern hemisphere at 21.5 mbar. The POAM instrument measures atmospheric parameters only at latitudes near the Earth's poles. The two models (solid lines) differ in the amount of drag introduced into the calculated atmospheric winds. In this preliminary comparison, the model results compare favorably with the measurement. This comparison is one of the first between a model and a long term high latitude data set.

SAGE III Ozone Loss and Validation Experiment (SOLVE) Campaign

SOLVE is a large measurement campaign dedicated to studying ozone loss in the Arctic region, and to validating the Stratosphere Aerosol and Gas Experiment (SAGE) III satellite instrument. A number of LASP scientists are involved in the campaign, which took place in Kiruna, Sweden between October of 1999 and March of 2000.



Unfortunately, due to launch delays, the SAGE III instrument was not launched in time for the campaign. However, the Polar Ozone and Aerosol Measurement (POAM III) satellite instrument is very similar in concept to SAGE III, so some of the measurements made during the campaign are being used to validate POAM III. POAM III will then be used to help validate SAGE III once it is launched. LASP research associate Cora Randall participated as part of the POAM team in the SOLVE field campaign. The POAM measurements are also being used to calculate ozone loss in the Arctic region. The goal here is to use the large volume of aircraft, balloon and ground-based measurements to improve the validity of deriving ozone loss information from satellite data such as POAM and SAGE in years when campaigns are not feasible.

One of the other main roles of POAM in the SOLVE campaign is to provide a more global picture of the Arctic region than is available from field campaign measurements. Using a technique which takes advantage of the fact that ozone can often trace the structure of the polar vortex, we have generated semi-global ozone fields from the POAM measurements. These fields are being used by theoreticians to improve calculations of photochemistry along the aircraft flight paths, and to initialize global models. The figure on the previous page depicts the evolution of 20-km ozone over the course of the 1999-2000 winter, as derived from POAM. The areas of blue in the February and March plots signify chemical ozone loss, similar to that which occurs in the Antarctic ozone hole every September and October.

PROGRAMS IN DEVELOPMENT

Aeronomy of Ice in the Mesosphere (AIM)

The AIM team has completed the phase A report. The final site selections will be announced in July of 2002 and, if selected, we will begin Phase B activities in the fall of 2002.

The overall goal of the Aeronomy of Ice in the Mesosphere (AIM) experiment is to resolve why polar mesospheric clouds (PMCs) form and why they vary. By measuring PMCs and the thermal, chemical and dynamical environment in which they form, we will quantify the connection between these clouds and the meteorology of the polar mesosphere. In the end, this will provide the basis for study of long-term variability in the mesospheric climate and its relationship to global change. The results of AIM will be a rigorous validation of predictive models that can reliably use past PMC changes and present trends as indicators of global change. This goal will be achieved by measuring PMC abundances, spatial distribution, particle size distributions, gravity wave activity, dust influx to the atmosphere and precise, vertical profile measurements of temperature H_2O, OH, CH_4, O_3, CO_2, NO, and aerosols. These data can only be obtained by a complement of instruments on an orbiting spacecraft (S/C).

Over the last 30 years ground based observations from NW Europe of the number of noctilucent clouds (NLCs) show dramatic increases. These clouds, known more recently to satellite observers as Polar Mesospheric Clouds (PMCs), are believed to respond dramatically to even small changes in their environment. Since cooling of the upper atmosphere (PMCs occur near 85 km) is expected to accompany the possible warming of the lower atmosphere due to an increased greenhouse effect, an increase in mesospheric cloudiness could be one consequence of mesospheric climate change.

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Mark C. Lewis, Ph.D., Astrophysical and Planetary Sciences Department
May 2001

"Dynamics of Strongly Perturbed Planetary Rings"
Thesis Advisor: Glen R. Stewart

Ana Lia Quijano, Ph.D., Program for Atmospheric and Oceanic Sciences
August 2001

"Investigation of radiative impacts of mineral dust; Implications for climate change and remote sensing"
Thesis Advisor: Irina Sokolik

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Aaron Watson
Joshua Wells
Angela Williams
Seth Wilson
Ann Windnagel
William Wood
Sean Yarborough
Torsten Zorn

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Linnea Avallone

Experimental and theoretical studies of tropospheric and stratospheric chemistry, particularly of halogens and related species. Analyzing measurements of chemical species to understand dynamical processes in the stratosphere and troposphere. Development of instrumentation for autonomous in situ measurements of trace species related to understanding the lifetimes of anthropogenic pollutants.

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Magnetic fields and plasma environments of solar system objects – mainly Jupiter and the Sun, but more recently, other planets, comets and asteroids.

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Research in space instrument design and calibration, space physics data analysis, and magnetospheric modeling. Study of plasma physical and energetic particle phenomena in the magnetospheres of Jupiter and Mercury, along with the plasma sheet and magnetopause boundary regions of the Earth's magnetosphere. Analysis of large data sets from spacecraft; involvement in missions to Earth's deep magnetotail and comets; the study of solar wind-magnetospheric energy coupling; theoretical modeling of magnetotail instabilities. Study of magnetosphere-atmosphere coupling; applying space plasma physics to study of astrophysical systems. Research to understand magnetospheric substorms and geomagnetic storms. Teaching of space physics and public policy, as well as public outreach to space technology community and general public.

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Research interests include the aeronomy of the upper atmosphere, the effects of solar irradiance and particle flux variability on the upper atmosphere, and the sources of that solar variability. Approaches include rocket and satellite measurements of the solar outputs and of the atmosphere, and data analysis and theoretical modeling. Currently Co-Investigator on the Thermosphere- Ionosphere-Mesosphere Energetics and Dynamics (TIMED) satellite Solar EUV Experiment (SEE).

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Xinlin Li

Space physics, data analysis and modeling. Especially interested in understanding the dynamics of relativistic electrons in the magnetosphere: the source, loss, and transportation of these MeV electrons; also interested in charged particle injections into inner magnetosphere during magnetic storms and substorms, and magnetosphere-atmosphere coupling due to energetic particle precipitations.
lix@kotron.colorado.edu (303) 492-3514

William E. McClintock

Observational Astrophysics - Ultraviolet observations of the outer atmospheres of cool stars and the very local (d<20pc) interstellar medium. Ultraviolet Observations of Planetary Atmospheres. Development of state-of-the-art instrumentation for high resolution spectroscopy for the 900-2500/ wavelength range.

bill.mcclintock@lasp.colorado.edu (303) 492-8407

Michael Mellon

The history of water on Mars, the martian permafrost, surface-atmosphere interactions and the martian climate. Periglacial geology and geophysics on Earth and Mars. Use of ice-related geomorphic features as an indicating of the distribution of subsurface ice. Antarctic analogs to martian geomorphology. Laboratory research in transport processes in frozen soils, including gas diffusion and solute migration and the effects of water vapor, ice, and adsorbate on transport physics. Remote sensing and thermophysical properties of planetary regoliths, with specific emphasis on martian surface material. Planetary surface temperature behavior and geothermal heat flow.

mellon@argyre.colorado.edu (303) 492-1711

Michael Mills

Research has focused on stratospheric sulfate aerosol. The current research tool is a 2D microphysical model of the troposphere, stratosphere, and mesosphere. A primary goal has been to assess the sources of the nonvolcanic stratospheric sulfate layer, and understand anthropogenic contributions. Because of the role of aerosol in stratospheric chemistry and radiative balance, this knowledge of its sources is critical to understanding global change. Recent efforts have attempted to understand discrepancies between observed and calculated aerosol mass at the top of the layer. Other work has examined the causes of observed particle nucleation in polar winter, the implications for aerosol of recently measured photolysis rates for H_2SO_4 and SO_3, and volcanic aerosol as a potential source for polar mesospheric clouds.

mills@colorado.edu (303) 492-7767

Keiji Ohtsuki

Theoretical studies of planet formation; origin and dynamical evolution of ring-satellite systems.

ohtsuki@lasp.colorado.edu (303) 492-0260

Robert T. Pappalardo

Processes that have shaped the surfaces of the planets and satellites, especially the icy outer planet satellites. The nature, origin, and evolution of bright grooved terrain on Ganymede, and implications for the satellite's geological history. Solid-state convection within Europa, investigation of the satellite's surface geology, and implications for lithospheric properties and geological history. Evidence for a subsurface liquid water ocean within Europa, and the nature and thickness of the satellite's ice shell.

Robert.Pappalardo@lasp.colorado.edu (303) 492-6423
http://www.icymoons.com

William K. Peterson

Obtaining and using observations from ground and space based instruments to characterize the Earth's plasma environment to test models and theories attempting to describe it. Primary work has been with energetic ion mass spectrometers in the Earth's Magnetosphere on the NASA ISEE, DE, AMPTE, FAST, and ISTP/Polar projects. Currently Principal Investigator on the Toroidal Imagining Mass Angle Spectrograph (TIMAS) Instrument on the Polar Satellite. A graphic illustrating some of the results of that project is at:
ftp://willow.colorado.edu/pub/timas/timas_oveveriew_image.ps
bill.peterson@lasp.colorado.edu (303) 492-2686

Wayne R. Pryor

Planetary ultraviolet spectroscopy; outer planet auroras, gases, and aerosols; and interplanetary hydrogen and helium. Projects involve use of Galileo, Cassini, Hubble Space Telescope, Pioneer Venus, Voyager, McDonald Observatory, UARS, and Ulysses data.
wayne.pryor@lasp.colorado.edu (303) 492-1259

Cora E. Randall

Primary interests include atmospheric chemistry and dynamics, mainly of the stratosphere, and secondarily of the mesosphere and troposphere. Work is experimental in nature, relying on data from remote sensing satellites. The emphasis is on ozone, NO2, and aerosol data from the Polar Ozone and Aerosol Measurement (POAM) instrument as well as from the Stratosphere Aerosol and Gas Experiment (SAGE). Measurements from instruments on the Upper Atmosphere Research Satellite (UARS) and the Solar Mesosphere Explorer (SME) are also used. Other interests include the spectroscopy of comets and laboratory polarization measurements.
cora.randall@lasp.colorado.edu (303) 492-8208

Gary J. Rottman

Accurately measure the solar spectral irradiance (Principal Investigator on sounding rockets, UARS, EOS, and TSIM and Co-Investigator on SME and TIMED). Special emphasis is given to solar variability on all time scales and to comparisons of the solar irradiance with the output of other late type stars. Past work has concentrated on the ultraviolet (λ<300 nm) irradiance, but emphasis has now extended to the visible and near-infrared. Application of ultraviolet spectroscopy and the development of new instrumentation for remote sensing.
gary.rottman@lasp.colorado.edu (303) 492-8324

David W. Rusch

The general fields of spectroscopy and aeronomy, emphasizing the measurements of minor constituents and aerosols in planetary atmospheres such as nitric oxide and ozone and the physical and chemical phenomena which determine their densities and temporal variations. Research in the atmospheric sciences including stratospheric, mesospheric, and thermospheric data analysis and modeling. Application of

the principles of molecular and atomic spectroscopy in the measurement of ultraviolet, visible, and near-infrared emission and absorption features to obtain understanding of atmospheric phenomena. Current research involves the determination of atmospheric processes affecting ozone and the reevaluation of ozone trends from long-term satellite measurements.
rusch@sertan.colorado.edu (303) 492-8627
http://lasp.colorado.edu/~rusch/dwr.html

Nicholas M. Schneider

The physics of planetary magnetospheres, particularly the interactions between planetary plasmas and the satellites of the outer planets. Extensive groundbased observations of the Jupiter/Io system, especially imaging and spectroscopy of the Io atmosphere and plasma torus. Program has been expanded to include Hubble Space Telescope observations. Designing and building of a spacecraft to study the Jupiter/Io system.
nick.schneider@lasp.colorado.edu (303) 492-7672
http://ganesh.colorado.edu/nick

Martin Snow

Current research interests involve ultraviolet spectroscopy and comets. Results from the Goddard High Resolution Spectrograph have provided information about a variety of astronomical objects, including cool star chromospheres, quasars, and hot star winds. Cometary research has been on the large-scale phenomena in plasma tails. Observations from the Ulysses Comet Watch involving amateur astronomers from around the world have greatly aided this research.
marty.snow@lasp.colorado.edu (303) 492-3744

A. Ian F. Stewart

The investigation by ultraviolet emissions of the aeronomy of planetary and satellite atmospheres, cometary comae, and Io's plasma torus.
stewart@viralf.colorado.edu (303) 492-4630

Glen R. Stewart

Origin and evolution of the solar system, with an emphasis on modeling the solid-body accretion of the terrestrial planets and the solid cores of the giant planets. Accretion of the Moon after a giant impact on the Earth. Modeling of satellite wakes and spiral density waves in planetary rings. Nonlinear dynamics of the three-body problem as applied to problems in solar system dynamics.
glen.stewart@lasp.colorado.edu (303) 492-3737

Gary E. Thomas

Research concerning the middle atmosphere of Earth, in particular the mesosphere (50-100 km). Of interest are noctilucent clouds that occur in the high-latitude summertime mesopause region, around 83 km. These clouds were observed for five years by a CU LASP ultraviolet experiment onboard the LASP SME satellite, and

more recently by instruments onboard the POAM II and UARS (Upper Atmosphere Research Satellite) spacecraft. In the last decade, interest involves global change in this region, possibly caused by anthropogenic emissions and by climate changes in the troposphere. Critical parameters studied are solar UV flux, water vapor, temperature and ozone which are being monitored by instruments onboard the UARS.
gary.thomas@lasp.colorado.edu (303) 492-7022
http://lasp.colorado.edu/noctilucent_clouds

O. Brian Toon

Theoretical studies of stratospheric aerosols; investigations of volcanic aerosols and studies of polar stratospheric clouds; theoretical studies of tropospheric clouds, aerosols and radiative transfer; experimental investigations of stratospheric and tropospheric phenomena; theoretical investigations of planetary atmospheres.
btoon@lasp.colorado.edu (303) 492-1534

Thomas N. Woods

Observational studies of the solar ultraviolet (UV) radiation, its variability, and its interaction with Earth's atmosphere. Principal investigator of NASA suborbital program to study the solar irradiance and thermospheric airglow. Principal investigator of the Solar EUV Experiment (SEE) on the TIMED mission. Co-investigator of the Solar Stellar Irradiance Comparison (SOLSTICE) experiment currently making solar UV irradiance measurements on the Upper Atmosphere Research Satellite (UARS) and planned for the Earth Observing System (EOS) missions.
tom.woods@lasp.colorado.edu (303) 492-4224

FACULTY ACTIVITIES

Linnea M. Avallone

Appeared on Charles Osgood Files Radio program, CBS Radio Network, discussing use of commercial aircraft for atmospheric sampling, 14 August 2001
Associate editor for Journal of Geophysical Research - Atmospheres
Chair for the PAOS Distinguished Lecture committee, Fall 2001
Created new course, ATOC 7500, "Designing, Making, and Interpreting Atmospheric Measurements
Evaluated course for transfer credit for Arts and Sciences Dean's Office
Helped with preparations for the CIRES Teacher Enrichment program's summer workshop "Earthworks"
Independent study (ATOC 4900) for William Wood and Jessica Howell, chemistry undergraduates; both students made measurements of ozone and nitrogen oxides in the Boulder area to study local air quality
Invited lecture on atmospheric measurements in ASEN 2519, "Gateway to Space", 14 Feb. 2001

Invited lecture on meteorological measurements in ARSC/GEOL 2110, "Physical Science of the Earth System", 4 Sept 2001
Invited lectures in ATOC 3500, "Air Chemistry and Pollution"; presented on 9 Oct. 2001 and 29 Nov 2001
Led a bi-weekly research seminar and journal club (discussion of journal articles) for my research group during Spring 2001
Major Revision of Existing Course (ARSC 5020), Policy Responses to Global Environmental Change (capstone course for Environmental Policy Certificate), 17 students, Spring 2001
Member of 2001 Spring Meeting Program Committee, American Geophysical Union
Member of Atmospheric Chemistry Technical Committee, American Geophysical Union, Atmospheric Sciences Section
Member of Gannet Hallar's Comps II exam committee
Member of Honors thesis committee for Andrew Luxen, Political Science major
Member of PAOS Curriculum Committee
Member of the LASP Education and Public Outreach Committee
Member, American Geophysical Union Spring 2002 Meeting Program committee
Participated in field study - Made measurements of NO and NO2 from the South Dakota School of Mines and Technology T-28 aircraft, in collaboration with Prof. Andrew Detwiler
Participated in field study - Made measurements of ozone and nitrogen oxides at local Boulder sites and at CU's Mountain Research Station to assess local air quality (collaboration with Dr. Andrew Turnipseed)
Participated in field study - NASA TRACE-P mission; made NO and NO2 measurements from NASA DC-8 to study boundary layer radical chemistry, in collaboration with Prof. William Brune of Pennsylvania State University
Principal Dissertation/Thesis Advisor for Graduate Students Anna Gannet Hallar, ATOC and Amelia Gates, ATOC
Reviewed Manuscripts for Journal of Geophysical Research
Reviewed Proposals for National Science Foundation, Atmospheric Sciences Division
Section Secretary (elected office), American Geophysical Union
Served as a science fair judge for grades 6,7, and 8 at St. Louis School, Louisville, 7 Feb. 2001
Session chairperson for the American Geophysical Union Fall meeting, Dec. 2001
Subject of wire article written by American Communications Foundation (ACF NewsSource),
Supervised Gannet Hallar in graduate level independent study project, ATOC 5900
Supervised summer research activities of Jessica Howell, chemistry undergraduate
Supervised summer research activities of William Wood, chemistry undergraduate
Taught ATOC 4800, Policy Implications of Climate Controversies (critical thinking), 23 students, Spring 2001
Taught ATOC 6020 - group meeting -, 3 students registered, 6 attending; Fall 2001

Frances Bagenal

Advisor to ~12 APS minors
Advisor to ~10 APS majors
Associate Chair (spring)
Associate Editor of Reviews of Geophysics
Chair, APS Library, AV & Slide collection
Decadal Survey for Solar and Space Physics for the NRC/NAS Space Studies Board
Designed electronic tutorials for the Cosmic Perspectives introductory astronomy textbook
Guest special section editor, *Journal of Geophysical Research/Space Physics*
Member, A&S Curriculum Committee
Member, APS Course Scheduling committee (spring)
Member, APS Undergrad Curriculum Committee
Member, Committee on International Space Programs, Space Studies Board, National Academy of Sciences/National Research Council (spring)
Member, Committee on IT and Information Literacy
Member, Core Curriculum Task Force (spring)
Member, Dissertation/Thesis Committee for Beau Bierhaus Aero Eng PhD; Shawn Brooks APS PhD; and Matt Burger APS PhD.
Member, Executive Committee (spring)
Member, LASP faculty search committee
Member, NSF Planetary Astronomy review panel Jan 24-26, 2001
Member, Prize Committee of the AAS Div. of Planetary Sciences
Member, Program review/self-study committee
Member, SBO/Fiske Director Search Committee
Member, Space Studies Board Exploration for the National Research Council / National Academy of Sciences (spring)
Member, UG curriculum committee for the new APS Major
Organized the purchase of a collection of 36 posters on Women in Science, an exhibition in Fiske Planetarium and their distribution to 9 departments
Principal Dissertation/Thesis Advisor for Graduate Students Andrew Steffl APS graduate student, and David Brain APS PhD student.
Reviewed 7 manuscripts or proposals
Supervisor of Peter Delamere, Post-Doctoral Research Associate, LASP (from fall)
Taught ASTR 3750 - Planets, Moons & Rings
Taught ASTR 5835 - Planetary Graduate Seminar on Pluto

Daniel N. Baker

Advisor, Sun-Earth Connections (NASA) Roadmap committee
Articles in: "Equinox" magazine, "Inventing Tomorrow", several newspapers
Chair, Air Force Technical Applications Center (AFTAC) Advisory Committee, continuing
Chair, Directors Group

Chair, Space Studies Board Task Group on "Assessment of Mission Size Trade-offs"
Chair, STEP Results, Applications, and Modeling Phase (S-RAMP),continuing
Chair, USRA Strategic Planning Steering Committee
Co-Chair, SCOSTEP 10th Quadrennial Meeting Committee National Academy of Sciences/Space Studies Board Decadal Survey
Commendation from NAS/Space Studies Board
Consultant, SAIC, Inc., Ball Aerospace Corporation, and USRA Astrophysics and Space Physics Council, Washington, DC
Convenor, SCOSTEP Symposium (10th Quadrennial)
Convenor, Special session at American Geophysical Union Fall Meeting
Deputy Director, Center for Limb Atmospheric Sounding
Director, LASP/Chair of Executive Committee
Invited lecture, Pachyderms of Pueblo, CO, Sept 2001
Major press reports: Science magazine, New York Times, Rocky Mountain News, Daily Camera, Space News, Denver Post, San Francisco Chronicle, Associated Press, ABC News/Associated Press, LA Times and San Francisco Examiner, French Press Agency, Gannett News Service, Sapporo (Japan) News.
Member of Dissertation/Thesis Committee for: Eric Roden (ASEN); Jeremy Richardson (PHYS); Corinne Krauss (APS); and Amanda Sickafoose (APS)
Member, Chancellor's Federal Relations Advisory Committee
Member, Conference on Space Weather Organizing Committee
Member, External Advisory Board, Aerospace Engineering Department
Member, Graduate School/Institute Directors Group
Member, MESSENGER/Mercury Orbiter Science Working Team
Member, NASA Magnetospheric Multiscale Mission, Study Team
Member, National Academy of Sciences/Space Studies Board Atmosphere-Ionosphere-Magnetosphere Panel
Member, Nominations Committee, American Geophysical Union
Member, Polar Science Working Team, continuing
Member, SAMPEX Science Working Team, continuing
Member, Space Station Advisory Panel, American Geophysical Union
Member, University Space Research Association (USRA) Council of Institutes Representative, continuing
Member, USRA Astrophysics and Space Physics Council, continuing
Organizing Committee, Chapman Conference on Storm-Substorm Relations, Lonavala, India
Organizing Committee, Workshop on Radiation Belts, Queensland, New Zealand
Oversaw LASP strategic planning process
President-Elect, American Geophysical Union
Principal Dissertation/Thesis Advisor for Graduate Students Joshua Rigler and Lin Li
Produced Sun-Earth Connections video
Public Lecture, New views of the Sun and Planets, Dawson School, Boulder, CO, April 2001
Public Lecture, The Sun and the Planets
Regional Editor of Journal of Atmospheric and Solar Terrestrial Physics

Served on LASP Business Committee
Supervised three (3) undergraduate students
U.S. Representative, International Association for Geomagnetism and Aeronomy, continuing
U.S. Representative, International Union of Geophysics and Geodesy, continuing

Joshua E. Colwell

Journal Referee: *Journal of Geophysical Research, Icarus, and Science*
Member, American Geophysical Union, American Astronomical Society, Division of Planetary Science
Member, Cassini Rings Working Group
Member, Cassini UVIS Team
Member, LASP Computer Systems Advisory Committee (CSAC)
Member, Planetary Atmospheres Review Panel
Outreach lectures at Monarch K-8 science class
Principal Investigator, COLLIDE-2
Principal Investigator, Dynamics of Dusty Plasmas Near Surfaces in Space
Principal Investigator, PRIME
Proposal Reviewer: NASA
Textbook Reviewer: Addison-Wesley
Thesis advisor for Amanda Sickafoose

Larry W. Esposito

Cassini UVIS Jupiter Io Torus: Movie production, press releases, press conferences, JPL Cassini "Friends and Family" presentation, JPL "Brown Bag" lunch presentation, Cassini outreach webcast, NASA "Select TV" broadcast, various radio and TV interviews.
Chair, Bally Promotion Committee
Chair, National Academy of Sciences Task Group on the Forward Contamination
Chair, Planetary Sciences Search Committee
Deputy scientific organizer, COSPAR
Manuscript Reviewer for *National Science Foundation, PSS, Icarus, J. Geophys. Res.*
Member, AAU Space Science Working Group
Member, APS Chair Nominating Committee
Member, Arts and Sciences Reinvestment Advisory Committee
Member, Dissertation/Thesis for Amanda Sickafoose, David Brain, Mark Lewis, and Erika Barth.
Member, LASP Executive Committee
Member, LASP Merit Evaluation Committee
Member, LASP Self Study Committee
Member, NASA Discovery Mission Science Panel
Principal Dissertation/Thesis Advisor for Graduate Students Jeremy Richardson and Shawn Brooks

Proposal Reviewer, NASA
Supervisor, Rings Group
Taught ASTR/GEOL 3300 Extraterrestrial Life

Mihaly Horanyi

Associate editor, *JGR-Space Physics*
Chair, Physics Department: Comps. Committee
Member of Dissertation/Thesis Committee for Amanda Sickafoose, APS; Olga Kalashnikova, PAOS; and Shawn Brooks, APS
Member, LASP Library Comm.
Member, LASP Search Comm. Planetary Origins position
Member, LASP/ASEN Collaboration Committee
Member, NASA Decadal Survey: Planetary Rings Panel
Member, NASA Micro-Gravity Fluids Science Review Panel, 2001
Principal Dissertation/Thesis Advisor for Graduate Students Colin Mitchell, Physics; Corrine Krauss, APS; L. Jeremy Richardson, Physics; Craig Agnor, Physics; and Byron Smiley, Physics.
Reviewer of manuscripts for JGR-Space, Geophys. Res. Lett., Physics of Plasmas (1)
Reviewer of proposals for DOE, NSF, and NASA
Taught PHYS-3070 Energy in a technical society
Taught PHYS-3210 Mechanics

Bruce M. Jakosky

Editorial Board, Astrobiology
Editorial Board, Geobiology
External reviewer and referee for manuscripts submitted to the journals *Science, Nature, Geophys. Res. Lett., Astrobiology.*
External reviewer for proposals submitted to NASA Cosmochemistry and Planetary Geology and Geophysics programs
External reviewer for report to National Academy of Sciences Committee on Planetary and Lunar Exploration
External reviewer, Los Alamos National Laboratory LDRD research program, 9 May 01
Independent Study/Research Study Group Supervised for Sara Michelle Brokering, 3 units, ASTR2840, field investigation of sites pertinent to planetary geology
Member, Advisory Panel, New York Hall of Science, Extraterrestrial Life Exhibit.
Member, LASP Executive Committee
Member, LASP Planetary faculty search committee
Member, NASA Exobiology Peer Review Panel
Member, NASA Mars Exploration Program Analysis Group
Member, NASA Mars Landing Site Steering Group
Member, NASA Solar System Exploration Subcommittee
Member, NASA/JPL Europa Orbiter Study Team

NASA Astrobiology Institute, Executive Council member
NASA/Ames Mars Quest science advisor, providing answers to "questions to a scientist" regarding Mars, space exploration, life in the universe.
Participated in approximately thirty media interviews dealing with the Mars exploration program, Mars science, life in the solar system and in the universe, and astrobiology in general. Interviews were with local and national newspapers, radio, video for programming, and magazines.
Principal Dissertation/Thesis Advisor for Graduate Students Sarah Earley (M.S., GEOL); Shannon Pelkey (Ph.D., APS); and E. Stacy Varnes (Ph.D., GEOL)
Taught GEOL 5700, Special topics--Remote sensing of planetary surfaces
Taught GEOL/ASTR 3300, Extraterrestrial life
Taught GEOL/ASTR/ATOC 5830, Astrobiology

Greg Kopp

Coordinator, LASP Science Seminar series
Director at Large, Rocky Mountain Section of the Optical Society of America
Member, American Astronomical Society, Solar Physics Division
Member, American Geophysical Union
Member, International Astronomical Union
Team member, Terrestrial Planet Finder

Steven W. Lee

Peer reviewer for NASA Planetary Geology, Planetary Atmospheres, and Mars Data Analysis Programs
Public Lectures on Mars: Presentations to meetings of Rotary Clubs and Optimist's Clubs in Colorado and Montana; presentation to Denver Area Science Fiction Association; presentation at MileHiCon science fiction convention (Denver, CO); presentation for "CU in Residence" Program (Grand Junction, CO); presentations at Orlando Science Center during opening of MarsQuest exhibit (Orlando, FL);) participated in SERCH/SSE Regional Space Science Workshop [gave several talks on Mars science and exploration to fifty educators selected to represent the Eastern US (held in Orlando, FL)].
Referee for *Journal of Geophysical Research, Icarus*
Science Content Coordinator for the MarsQuest museum exhibition

William McClintock

Member, LASP Executive Committee
Member, American Geophysical Union, Astronomical Society of the Pacific, Society of Photo-Optical Instrumentation Engineers
Member, Cassini UVIS Science Team
Member, SORCE Science Team
Member, MESSENGER Science Team

Principal Investigator, Mercury Atmosphere and Surface Composition Spectrometer for the MESSENGER mission to Mercury

Michael T. Mellon

Chair - Planetary Journal Club Seminar Series
Co-Convener – *Exploring Mars with TES: A Data User's Workshop*, Phoenix, 13-15 Nov.
Committee Member – Jennifer Heldmann's Geology Preliminary and Comprehensive Exams
Journal Club talk - Ice Shelves and Antarctic Climate History
Panel Member – Ball Aerospace, Mars Sample Return Study, Science Advisory Panel
Participating Scientist - Mars Team On Line, education and outreach program, NASA Ames
Principal Dissertation/Thesis advisor for Than Putzig (Ph.D., GEOL)
Reviewer - Manuscripts for *Journal of Geophysical Research-planets, Geophysical Research Letters, Nature, Icarus*
Reviewer - Proposals for NASA Mars Global Surveyor Data Analysis, Planetary Geology and Geophysics and Mars Data Analysis Programs

Robert T. Pappalardo

Advisor, NPR radio program "The DNA Files" (advisor for radio program on the search for extraterrestrial life in the solar system)
APS Dept. Representative to CU Geophysics Ph.D. Program, Fall 2001
Arizona State University, Geosciences Alumni Scholarship (member of selection committee for alumni-sponsored student scholarship program)
Co-Chair of APS Dept. Colloquium series, Fall 2001
Committee on Planetary and Lunar Exploration (COMPLEX) of the Space Studies Board, National Academy of Sciences (member of committee advising the NAS Space Studies Board on planetary studies that can be conducted from space, and supporting ground-based activities).
Division for Planetary Sciences of the American Astronomical Society (member, Scientific Program Committee, annual meeting).
Interview for NPR radio program "The DNA Files" (radio program on the search for extraterrestrial life in the solar system)
Invited Colloquium, MIT Dept. Ocean Engineering, Cambridge MA, April 2001: Geology of Europa from Galileo Imaging: Implications for Current Activity.
Jupiter Conference, Boulder CO, June 2001 (member, Scientific and Local Organizing Committees).
National Academy of Sciences Solar System Exploration Strategy Committee (Vice-chair of Large Satellites Panel and
National Academy of Sciences, Task Group to Assess Mars Science and Mission Priorities (member of National
Outstanding Paper in a Classified or Unclassified Publication, Applied Physics Laboratory of Johns Hopkins University, for the article entitled "Folds on Europa: Im-

plications for Crustal Cycling and Accommodation of Extension," which appeared in the journal Science
Principal Dissertation advisor for Amy Barr, Ph.D. candidate in Geophysics
Public Talk on "The hidden ocean of Europa," Jupiter Conference, Boulder, CO, June 2001
Research Council committee to asses NASA's Mars Exploration Program goals and priorities).
Review of 2 proposals to the NASA Planetary Geology and Geophysics Program
Review of manuscript for *Journal of Geophysical Research--Planets* and *Science*
Review of U.S. Geological Survey map of Jupiter's moon Ganymede.
Sciences on goals and priorities for planetary exploration for the decade 2003-2013).
Steering Group Member of committee advising NASA and the Space Studies Board of the National Academy of
Taught ASTR/GEOL 5800 Planetary Surfaces and Interiors, Fall 2001
UROP Advisor for undergraduate Michelle Stempel
Written popular review of model of Miranda's geological history, authored by Andrew Chaikin of Space.com at:
http://www.space.com/scienceastronomy/solarsystem/miranda_creation_011016-1.html

Cora E. Randall

Advisor, PhD graduate student Cynthia Shaw.
Atmospheric science presentation at LASP retreat, August 2001
Co-Chair: Langley DAAC UWG, since March 1998
Judge, Science Fair, Bear Creek Elementary School, 8 Feb. 2001
Judge, Science Fair, St. Louis Elementary/middle school, 6 Feb. 2001
Member, Aimee Merkel graduate dissertation committee.
Member, EOS-CHEM aerosol working group, since spring, 1999
Member, EOS-CHEM education/outreach working group, since fall, 1998
Member, LASP EPO exploratory group, since spring 2001
Member, LASP executive committee
Member, Space Science Institute Broker Advisory Team
Organized atmospheric science contributions to LASP brochure, Sept. 2001
Presentation to prospective graduate students, 8 March 2001
Reviewer, Australian National Antarctic Research Expeditions (ANARE) proposal
Reviewer, JGR atmospheres
Reviewer, *Journal of Atmospheric and Oceanic Technology*
Reviewer, NASA ACMAP, Jan. 2001
Reviewer, NASA Global Modeling Initiative, Jan. 2001
Reviewer, NASA Living With a Star Targeted Research and Technology
Team member Global Aerosol Climatology Project, since 1998
Team member HIRDLS, since 1997
Team member ILAS II, since 1999
Team member POAM, since 1994
Team member SAGE II, since 1999

Gary J. Rottman

Associate Director of LASP
Attended and presented papers at eleven scientific meetings (three international)
Chair, LASP Projects Steering Committee
Chair, SORCE Science Team
Co-Investigator, TIMED SEE Mission
Member, EOS Investigator's Working Group
Member, UARS Science Team.
Member, LASP Executive Committee
Principal Investigator, EOS SORCE Mission
Principal Investigator, UARS SOLSTICE Mission

Glen R. Stewart

Judged Science Fair at Louisville Elementary School
Manuscript Reviewer, *Icarus, Astrophysical Journal*
Member, American Astronomical Society
Member, LASP education and public outreach committee
Member, Search Committee for CEO of Peakarts
Presented papers at three scientific meetings
Principal thesis advisor for John Weiss and Mark Lewis, APS
Proposal Reviewer, NASA

Tom Woods

Local Meeting Organizer, International *Thermospheric/Ionospheric Geospheric Research (TIGER)* Symposium
Manuscript Reviewer, *Astronomy and Astrophysics, Journal of Geophysical Research, Journal of Atmospheric and Solar-Terrestrial Physics*
Member, American Astronomical Society, Solar Physics
Member, American Geophysical Union
Member, NASA SORCE Science Team
Member, NASA TIMED Science Team
Member, NASA UARS Science Team
Member, SPIE International Society for Optical Engineering
Proposal Reviewer, NASA, NSF

2001 Seminar Series

Greg Kopp, Chair

18-Jan	Larry Esposito (LASP/APS)	Recent Cassini Results
25-Jan	George Lawrence (LASP)	Camera Hand lens Microscope (CHAMP)
08-Feb	Roger Linfield (NASA/JPL)	NASA's StarLight mission - enabling optical space interferometry
15-Feb	Greg Laughlin NASA/ARC	Mining for Planets
22-Feb	Pawel Artymowicz (Stockholm Observ.)	The origin of structure in protoplanetary and replenished dust disks
01-Mar	Tom Ayres (CASA)	Cool stars; hot coronae
08-Mar	Krishan Khurana (UCLA)	Convection in Jupiter's Magnetosphere
12-Mar	Ray Jayawardhana (U. Cal Berkeley)	Probing the origins and diversity of planetary systems
15-Mar	Students' Seminars	
22-Mar	William Kurth (U. of Iowa)	Radio and plasma wave observations at Jupiter with Cassini and Galileo
5-Apr	Yi-Jiun Su (LASP)	Cusp electron and ion structures observed by the FAST satellite
12-Apr	Cora Randall (LASP)	POAM III Results from SOLVE
17 Apr	Robert Ergun (LASP)	The MagCAT Mission
19-Apr	Mike Mills LASP	The Polar Mesopause Sulfate Aerosol Layer
26-Apr	Caspar Ammann (NCAR/U. Mass)	Evaluating the Role of Explosive Volcanism in Climate

03-May	Marty Snow (LASP)	Stellar Observations from the UARS SOLSTICE
10 May	Wayne Pryor	Recent UV Results from Ulysses and Cassini
31 Aug	Peter Delamere AER	Momentum Decoupling in Space Plasmas at Earth and Jupiter
13 Sept	Sara Martinez-Alonso LASP	Mapping of hydrothermal systems using infrared spectroscopy
20 Sept	Daniel Baker LASP	A Telescopic and Microscopic View of the Sun-Earth System: New CLUSTER Observations of the Magnetosphere
27 Sept	Tim Brown HAO/NCAR	Transits by Extrasolar Planets: the Power of the Dark Side
11 Oct	Laila Andersson LASP	Downward Current
18 Oct	Glen Stewart LASP	Did Neptune ever launch waves into the Kuiper Belt?
25 Oct	Gerhard Wurm Univ. of Jena, Germany	From Dust to Planetesimals in Experiments: Collisional Physics and Implications for Observations of Protoplanetary Disks
1 Nov	Rodney Viereck NOAA	NPOESS: The Next Generation of Operational Spacecraft
13Nov	Carl Gelderloos BATC	Power for Outer Solar System Missions
15 Nov	Jeremy Richardson LASP	Infrared Observations of HD209458b during secondary eclipse
28Nov	Peter Pilewskie NASA/Ames	Scattering and Absorption of sunlight by atmospheric aerosols and clouds
4 Dec	John Boynton/John Evanyo LASP/BATC	LASP and Ball Aerospace Mars Sample Return

6 Dec	Tom Woods LASP	Mars Sample Return – Science (Part II)

LASP Technology Colloquium Series

Jerald Harder, Chair

Feb 8	Greg Kopp LASP	Terrestrial planet finder: What can you do with half a photon per square meter per second?
Mar 14	Ben Balsley CIRES	Atmospheric measurements using tethered lifting systems
June 13	Darin Toohey Linnea Avallone LASP	Technology for measurements of atmospheric free radicals by resonance fluorescence
Aug 15	William McClin-tock LASP	The Atmospheric and Surface Composition Spectrometer (ASCS) for the MErcury: Surface, Space
Nov 13	Carl Gelderloos Ball Aero/Tech Corp	Power for Outer Solar System Missions

Planetary Journal Club Seminar Series

Michael T. Mellon, Chair
David Brain, Asst. Chair

5 Feb	Bruce Jakosky	D/H on Mars and the history of water
19 Feb	Mike Mellon	Surface properties of the martian south polar layered deposits and the MPL landing site
26 Feb	Kevin McGouldrick	Precipitating condensation clouds in substellar atmospheres
5 Mar	Jeff Hanna	A stratigraphic study of small volcano clusters on Venus
19 Mar	Sam Jones	How to sustain an electric field in a collisionless magnetosphere
2 Apr	Mihaly Horanyi	Dust Measurements in the Outer Solar System: Why & How
9 Apr	Jen Heldmann	Activity on Chiron: New Results from Old Data
16 Apr	Shawn Brooks	Saturn's E-Ring: Whence the Beef?
23 Apr	Shannon Pelkey	Ganymede…in stereo!
30 Apr	Joshua Colwell	The Yarkovsky effect

24 Sep	Bruce Jakosky	The Role of Astrobiology in Solar System Exploration
1 Oct	Keith Harrison	Martian Magnetics: An Overview
8 Oct	Mike Mellon	Ice Shelves and Antarctic Climate History
15 Oct	Cori Krauss	Theoretical Modeling of Eruption Plumes on Mars Under Current and Past Climates
22 Oct	Erika Barth	The Galactic Habitable Zone
29 Oct	Fran Bagenal	Jets from the Black Bowling Pin: Comet Borelly Observed by Deep Space One
5 Nov	Amanda Sickafoose	Once Upon and Asteroid
12 Nov	Amy Barr	Silicate Volcanism on Io
19 Nov	John Weiss	Family Feuds: The Role of Asteroid Families in Collision Rates

Center for Astrobiology Seminar Series

Bruce J. Jakosky, Chair

21 Feb	James Kasting Penn State Univ.	Did Earth look like Titan during the Late Archean?
21 March	Conway Leovy U. of Washington	The origins of rivers on Mars
25 April	Andy Ackerman Ames Res. Ctr.	With rain comes the blues: Precipitating condensation clouds in substellar atmospheres.
11 Oct	Gerald Joyce Scripps	Minimum Constitutional Requirements for a Catalytic Nucleic Acid

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Baker, D.N., Space Weather – The Industrial Perspective, Center for Integrated Space Weather Modeling Summer School, Invited lecture, Boston University, 8 August 2001.

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Merkel, A.W., G.E. Thomas, and S.M. Bailey, Global Images of Polar Mesospheric Clouds from the SNOE Spacecraft, International Workshop on Layered Phenomena in the Mesopause Region, Monterey, CA, Oct. 10 - 12, 2001.

Merkel, A.W., G.E. Thomas, S.M. Bailey, and C.A. Barth, Global Images of Polar Mesospheric Clouds from the SNOE Spacecraft, AGU, Spring Meeting, Boston, MA, May 28 - June 1, 2001.

Nimmo, F., Pappalardo, R. T., and B. Giese, Elastic thickness and heat flux estimates on Ganymede, Eos, 82, F688, 2001.

Ohtsuki, K., G.R. Stewart, and S. Ida, Semi-analytic formulas for the stirring rates of planetesimals, 32nd DDA meeting, Houston, TX, 2001.

Ohtsuki, K., S. Ida, and L.W. Esposito, Evolution of ring particle size distribution due to accretion in the Roche zone, 33rd DPS meeting, New Orleans, LA, 2001.

Palmroth, M., P. Janhunen, T. I. Pulkkinen, H. Laakso, and W. K. Peterson, Location and motion of the cusp in global MHD simulation, Spring Meeting of the European Geophysical Society, Nice, France, March, 2001.

Pappalardo, R. T., Diapirs on Europa: Terrestrial analogs and astrobiological implications. 1st Europa Focus Group NASA Astrobiology Workshop, Ames Research Center, Mountain View, CA, Feb. 2001.

Pappalardo, R. T., Overview of Europa's geology: Implications for the ice shell and a sub-ice ocean, Jupiter Conference, Boulder, CO, 2001.

Pelkey, S.M., B.M. Jakosky, and M.T. Mellon, Implications of the TES data for surface properties and landing safety, Mars Landing Site Workshop, Pasadena, Oct., 2001.

Peria, W.J., R.M. Winglee, W.K. Peterson, and H. Collin, Toward a Characterization of Ion Outflows in a Geophysically Relevant Coordinate System, Fall AGU meeting, San Francisco, CA Dec., 2001.

Peria, W.J., R.M. Winglee, W.K. Peterson, and H. Collin, Toward a Characterization of Ion Outflows in a Geophysically Relevant Coordinate System, Fall AGU meeting, San Francisco, CA Dec., 2001.

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Peterson, W.K., H.L. Collin, and A.W. Yau, Seasonal Variations in the Partition of Energy Imparted to Escaping Ionospheric Ions, Fall AGU meeting, San Francisco, CA Dec., 2001.

Peterson, W.K., H.L. Collin, and A.W. Yau, Seasonal Variations in the Partition of Energy Imparted to Escaping Ionospheric Ions, Fall AGU meeting, San Francisco, CA Dec., 2001.

Peterson, W.K., H.L. Collin, M. Boehm, A.W. Yau, C. Cully, and G. Lu, Spatial/temporal coherence of ionospheric outflow on January 9-12, 1997, Spring AGU meeting, Boston, May 2001.

Petrinec, S.M., D.L. Chenette, W.L. Imhof, D.N. Baker, C.A. Barth, K.D. Mankoff et al., A Multi-spacecraft Study of the Magnetospheric Influence on Ionospheric Chemistry - a Detailed Examination of Recent Geomagnetically Active Periods, AGU, Fall Meeting, San Francisco, CA, Dec. 10-14, 2001.

Phillips, R. J., M. T. Mellon, B. M. Jakosky, M. A. Bullock, B. M. Hynek, Water on Mars: Recent revisions in our understanding of the history and timing, Geological Society of America Annual Meeting, Denver, CO, 2001.

Phillips, R.J., M.T. Mellon, M.A. Bullock, and B.M. Jakosky, Geology and climate history on Mars (invited), Geol. Soc. of America, Boston, 2001.

Popp, P.J., R.S. Gao, J.A. Neuman, M.J. Northway, J.C. Holecek, D.W. Fahey, C. Wiedinmyer, C.A. Brock, B.A. Ridley, J.G. Walega, F.E. Grahek, J.C. Wilson, J.M. Reeves, D.W. Toohey, L.M. Avallone, B.F. Thornton, A.M. Gates, M.N. Ross, and P.F. Zittel, The emission and chemistry of reactive nitrogen species in the plume of an Athena II rocket, talk presented at the Fall AGU Meeting, San Francisco, CA, Dec. 2001.

Randall, C.E., AIM science requirements for microphysics objective, AIM science team meeting, 1 Feb. 2001.

Randall, C.E., Comparison of SAGE II and HALOE O_3, NO_2 and H_2O, SAGE science team meeting, May 4, 2001.

Randall, C.E., POAM III results from SOLVE, LASP seminar, 12 April 2001.

Randall, C.E., POAM III results from SOLVE, Third Annual Distinguished DAAC UWG lecture, NASA Langley Research Center, 19 April 2001.

Randall, C.E., PV as a predictor of aerosol (& other) distributions, HIRDLS science team meeting, August 24, 2001.

Randall, C.E., PV/O_3 mapping with POAM, NOGAPS team meeting, Naval Research Laboratory, 13 March 2001.

Rigler, E.J., and D.N. Baker, Linear prediction filter analysis of solar wind/magnetosphere coupling: Studies at non-geosynchronous altitudes and high time resolution, Fall AGU Meeting, San Francisco, CA, Dec. 13, 2001.

Rigler, E.J., D.N. Baker, T.G. Onsager, and R.L. McPherron, Characterizing outer-belt electron flux variability in both the frequency and time domains, Spring AGU Meeting, Boston, MA, May 2001.

Robertson, S., Z. Sternovsky and M. Horanyi, Ion currents on droplets in plasma, Ninth Workshop on the Physics of Dusty Plasmas, Iowa City, May 21-23, 2001.

Rottman, G., T. Woods, M. Snow, B. Knapp, and J. London, An Improved Understanding of Solar Variability Derived from UARS SOLSTCE Observations, UARS Science Team Meeting, Sept. 2001.

Rottman, G.J., A New Understanding of Solar Variability Derived from UARS Observations, Fall AGU Meeting, San Francisco, CA, Dec. 2001.

Rottman, G.J., Measurement of Solar Irradiance During The Past Two Solar Cycles, presented at IAGA, Hanoi, Vietnam, August 2001.

Rottman, G.J., Solar Radiation and its Variation, Presented at The Evolving Sun And Its Influence On Planetary Environments, Granada, Spain, June 2001.

Rottman, G.J., The Solar Radiation and Climate Experiment — SORCE, CERES Science Team Meeting, Hampton, VA, May 2001.

Rottman, G.J., The Solar Radiation and Climate Experiment — SORCE, Presented at The Evolving Sun And Its Influence On Planetary Environments, Granada, Spain, June 2001.

Rottman, G.J., The Solar Radiation and Climate Experiment, EOS Investigator's Working Group Meeting, San Antonio, TX, Oct. 2001.

Rusch, D.W., D.E. Siskind, and C.E. Randall, A time-dependent investigation of the effect of particle ionization on the earth's middle atmosphere using a two-dimensional model, Spring AGU meeting, Boston, MA, 2001..
Schenk, P. M. and R. T. Pappalardo, Wavy gravy and the topography of chaos on Europa, Jupiter Conference, Boulder, CO, 2001.
Sickafoose, A. A., J. E. Colwell, M. Horanyi and S. Robertson, Dust levitation near surfaces in space, Division of Planetary Science, New Orleans, Nov. 2001.
Sickafoose, A.A., J. Colwell, M. Horanyi and S. Robertson, Experimental dust levitation near surfaces, Ninth Workshop on the Physics of Dusty Plasmas, Iowa City, May 21-23, 2001.
Sickafoose, A.A., J. Colwell, M. Horanyi and S. Robertson, Particle levitation in a sheath above a surface, the Division of Plasma Physics of the American Physical Society, Long Beach, CA. Bull. Am. Phys. Soc. 46, 119 2001.
Smiley, B., M. Horanyi and S. Robertson, Charge aerosol collection in the mesosphere during MIDAS/SOLSTICE 2001, presented at the Oct. 2001 meeting of the Division of Plasma Physics of the American Physical Society, Long Beach, CA. Bull. Am. Phys. Soc. 46, 119 2001.
Solomon, S.C., et al. (including B.M. Jakosky, invited paper), What happened when on Mars?, Spring AGU meeting, Boston, 2001.
Spaun, N. A.,, J. W. Head, and R. T. Pappalardo, Chaos and Lenticulae on Europa: Morphology, Distribution, and Stratigraphy. 1st Europa Focus Group NASA Astrobiology Workshop, Ames Research Center, Mountain View, CA, Feb. 2001.
Steffl, Stewart, Bagenal, Schneider, Radial structure of the Io Plasma Torus from Cassini UVS data, Jupiter Meeting, Boulder, June, 2001.
Steffl, Stewart, Bagenal, Schneider, Radial structure of the Io plasma torus from Cassini UVIS, Division of Planetary Sciences, American Astronomical Society, New Orleans, LA, Nov., 2001.
Sternovsky, Z., M. Horanyi and S. Robertson, Charging of dust particles on surfaces, Ninth Workshop on the Physics of Dusty Plasmas, Iowa City, May 21-23, 2001.
Sternovsky, Z., M. Horanyi and S. Robertson, Dust charging on surfaces, presented Division of Plasma Physics of the American Physical Society, Long Beach, CA. Bull. Phys. Soc. 46, 120 2001.
Stewart, G.R. and K. Ohtsuki, Rapid instabilities in narrow self-gravitating rings, Houston, DDA meeting, April 2001.
Stewart, G.R., Landau damping of apsidal spiral density waves in the Kuiper Belt, New Orleans, DPS meeting, Nov., 2001.
Stewart, G.R., Resonant planet-disk interactions in the solar system, invited talk at the Institute for Mathematics and its Applications, Univ. of Minnesota, Oct., 2001.
Su, Ergun, Bagenal, Parallel electric fields in Io-related Jovian aurora, Jupiter Meeting, Boulder, June, 2001.
Su, Yi-Jiun, Robert E. Ergun, W.K. Peterson, Terry G. Onsager, Robert Pfaff, and Charles W. Carlson, FAST observations of cusp particle precipitation, Spring AGU meeting, Boston, May 2001.
Tobiska, W. K., K. Schatten, W. Pryor, D. Bouwer, T. Detman, T. Woods, C. Pankratz, F. Eparvier, R. Viereck, and L. Puga, Forecast solar variability on multiple time scales, Fall AGU Meeting, San Francisco, CA, Dec. 2001.

Toohey, D., L. Avallone, A. Gates, B. Thornton, E. Richard, and K. Kelly, Insights into stratospheric chemistry and transport from ultra-fast measurements in rocket plumes, talk presented at the Fall AGU Meeting, San Francisco, CA, Dec. 2001.

Toohey, D.W., B.F. Thornton, L.M. Avallone, M.N. Ross, E. Richard, and K. Kelly, Measurements of Cl, ClO, and CO2 in the exhaust plume of the space shuttle, talk presented at the Spring AGU Meeting, Boston, MA, May 2001.

Trattner, K.J., S.A. Fuselier, W.K. Peterson, M. Boehm and D. Klumpar, On spatial and temporal structures in the cusp, Spring Meeting of the European Geophysical Society, Nice, France, March, 2001.

Varnes, E.S., B.M. Jakosky, and T.M. McCollom, Geochemical energy potentially available to organisms in martian hydrothermal systems, DPS, New Orleans, 2001.

Vassiliadis, D., A.J. Klimas, D.N. Baker, and S. Kanekal, Dynamics of the energetic electron flux: Modeling and space weather predictions, AGU Chapman Conference on Storm-Substorm Relationships, Lonavala, India, March 2001.

Viereck, R., L. Floyd, M. Weber, Tom Woods, G. de Toma, L. Puga, M. Deland, O. R. White, and B. Knapp, The MgII core-to-wing ratio: An update of the multi-satellite composite index, Fall AGU Meeting, San Francisco, CA, Dec. 2001.

Woods, T., S. C. Solomon, and S. M. Bailey, Solar EUV and X-ray irradiance: Recent results and new prospects Fall AGU Meeting, San Francisco, CA, Dec. 2001.

Wygant, J., P Way, A Keiling, C Cattell, R Lysak, M Temerin, F Mozer, S Mende, G Parks, M Brittnacher, C Kletzing, J Scudder, W Peterson, C Russell, J Spann, M Andre, P Toivanen, W Lotko, and A Streltsov, Spacecraft Observations of Intense Electric and Magnetic Field Fluctuations and Associated Earthward Magnetic Field-aligned Poynting Flux Throughout the Plasma Sheet at 4-6 Re Altitudes during Major Geomagnetic Storms, Spring AGU meeting, Boston, May 2001.

CONTRACTS AWARDED

Avallone, Linnea	In Situ measurements of Halogen oxides in the Troposphere
Avallone, Linnea	Measurements of long-lived trace gasses from commercial aircraft platforms
Avallone, Linnea	In situ measurements of carbon dioxide in the upper troposphere and lower stratosphere
Avallone, Linnea	Measurements of "total water" and carbon dioxide from the NASA WB-57 for CRYSTAL-FACE, proposal submitted to the NASA Cloud Cirrus Regional Study of Tropical Anvils and Cirrus Layers
Bagenal, Frances	MHD Simulations of the coupling between Io and Jupiter
Bagenal, Frances	Interdisciplinary study of the Io plasma torus

Bagenal, Frances	Deep Space 1: Analysis of Particles and Fields Observations on a Spacecraft using Electric Propulsion
Bagenal, Frances	Galileo: Interdisciplinary Study of the Io Plasma Torus
Bagenal, Frances	Analysis of MGS magnetometer data and comparisons with models of Mars' magnetic field and solar wind interaction
Bagenal, Frances	Martian surface magnetic field (GSRP- D. Brain)
Baker, Daniel N.	GGS (CEPPAD)
Baker, Daniel N.	Nonlinear modeling of high-latitude electrodynamics
Baker, Daniel N.	Space weather specifying outer belt electrons by data assimilation
Baker, Daniel N.	STC activities
Baker, Daniel N.	MESSENGER mission to orbit Mercury
Baker, Daniel N.	SAMPEX – Data Analysis
Baker, Daniel N.	Boston University CLUSTER Funding
Baker, Daniel N.	Radiation Belt Modeling
Baker, Daniel N.	Nonlinear Dynamics Modeling
Barth, Charles A.	Student Nitric Oxide Explorer
Barth, Charles A.	Aerospace Engineering Program (Program of Excellence)
Boynton, John	Mars sample return study
Colwell, Joshua	Physics of regolith impacts in microgravity experiment (PRIME)
Colwell, Joshua	Collisions into dust
Colwell, Joshua	Dusty plasma dynamics near surfaces in space
Colwell, Joshua	SOA design, testing, and documentation
Davis, Randal	ICESAT mission operations
Davis, Randal	ARGOS/OASIS
Davis, Randal	Mission operations of the NASA Quikscat satellite
Davis, Randal	Development of Mission Analysis tools for Gravity Probe B mission Stanford
Emery, William	Ocean wind and land surface student satellite (OWLS3)
Ergun, Robert	Fast Satellite operations and data analysis

Ergun, Robert	Investigation of radio tomography imaging of the magnetosphere
Ergun, Robert	Characterization and numerical simulation of FAST solitary waves in the auroral ionosphere
Esposito, Larry	Hubble pre-Cassini studies of Titan
Esposito, Larry	UV imaging spectrograph for Cassini
Esposito, Larry	Photometric analysis of the Jovian ring system and modeling of ring origin and evolution
Esposito, Larry	Atmospheric modeling and infrared observations of a transiting extrasolar planet
Esposito, Larry	HST Cycle 9
Grimm, Robert	Lithospheric dynamics of Mars: Water, flow, and failure
Grimm, Robert	Origin of magnetic lineations on Mars
Horanyi, Mihaly	Fundamentals of dusty plasma
Horanyi, Mihaly	Dusty plasma in planetary magnetosphere
Horanyi, Mihaly	Cassini CDA investigations
Horanyi, Mihaly	Electrostatic discharges near the Martian surface
Horanyi, Mihaly	Charged aerosols
Jakosky, Bruce	Center for Astrobiology
Jakosky, Bruce	Physical properties of potential Mars landing site
Jakosky, Bruce	Remote sensing of planetary surfaces
Jakosky, Bruce	Mars Global Surveyor (MGS) interdisciplinary scientist
Jakosky, Bruce	2001 Mars Orbiter Thermal Emission Imaging System (THEMIS)
Lawrence, George	Camera hand lens microscope (CAMP)
Lee, Steven W.	Mars Color Imager (MARCI) Science team
Lee, Steven W.	Multi-decade observations of Martian surface variability and sediment transport: Integrated analyses of Mariner 9 through Mars Global Surveyor data
Lee, Steven W.	Ozone, condensates, and dust in the Martian atmosphere; Hubble Space Telescope General Observer Program (Cycles 10 and 11)
Li, Xinlin	Energetic particle dynamics during geomagnetic storms and magnetospheric substorms
Li, Xinlin	Source of radiation belt electrons

Li, Xinlin	Energization and loss of outer radiation belt electrons
Li, Xinlin	Solar wind fluctuations and their consequences on the magnetosphere
Li, Xinlin	Detailed study of the magnetic storms selected for GEM inner magnetosphere and storms campaign
McClintock, William	MASCS instrument development for the MESSENGER mission
McClintock, William	Science Team Support for MESSENGER mission Phase C/D
McGrath, Michael	Mechanics of Granular Materials Microgravity Experiment
McGrath, Michael	Cosmic origins spectrograph
Mellon, Michael	High-Resolution Thermal Inertia of Mars
Mellon, Michael	Small Scale polygons and the history of ground ice on Mars
Mellon, Michael	The distribution of near-surface ground ice on Mars
Mellon, Michael	High Resolution Imaging Science Experiment (HiRISE) for Mars Reconnaissance Orbiter - 2005
Mellon, Michael	Mars Subsurface Sounding Radar Characterization Experiments
Keiji Ohtsuki	Dynamical evolution of ring-satellite systems
Keiji Ohtsuki	Origin and evolution of irregular satellites
Pappalardo, Robert	Astrobiological and geological implications of diapric transport with Europa and Ganymede
Pappalardo, Robert	Characteristics and Consequences of Faulting on Ganymede and Europa
Peterson, William	Polar TIMAS operations and data analysis
Pryor, Wayne	UV studies of Jupiter's hydrocarbons and aerosols from Galileo
Pryor, Wayne	Planetary atmospheres (Jovian auroral chemistry)
Randall, Cora	Impact of descending polar mesospheric NOx on stratospheric ozone
Randall, Cora	NOGAPS assimilation of ozone data sets
Rottman, Gary	UARS SOLSTICE
Rottman, Gary	SORCE/EOS SOLSTICE
Rottman, Gary	SORCE sciences discovery

Rottman, Gary	Science analysis and data validation of the UARS SOLSTICE
Rottman, Gary	SORCE – Total Solar Irradiance Sensor (TSIS)
Rusch, David	Atmospheric studies using POAM II data
Rusch, David	Aeronomy of Ice in the Mesosphere (AIM)
Schneider, Nicholas	Satellite atmospheres and Io Torus observations
Schneider, Nicholas	Jupiter Magnetospheric Explorer (JMEX)
Schneider, Nicholas	Io Announcement of Opportunity
Simmons, Karen E.	Characterizing the oxidizing properties of Mars' polar regions
Solomon, Stanley	Energy transfer in the thermosphere and mesosphere
Stewart, A. Ian	UV spectrometer investigation – Galileo Orbiter
Stewart, A. Ian	UVS/EUV participation in Galileo Europa mission (GEM) and Galileo prime mission
Stewart, Glen	Late stages of accretion or Uranus and Neptune
Stewart, Glen	Dynamics of planetesimals and the Kuiper comet belt
Stewart, Glen	Dynamical models of solar system formation and evolution
Thomas, Gary	Polar Mesospheric Cloud studies
Toon, Brian	Comparisons of 3-D numerical simulations
Toon, Brian	Contrail persistence and aircraft exhaust impacts of cirrus clouds
Toon, Brian	IR optical constants of particles in lower stratosphere and upper troposphere
Toon, Brian	Theoretical studies of feedbacks between microphysics and dynamics in marine stratocumulus clouds
Toon, Brian	Theoretical studies of stratospheric clouds and aerosols (SOLVE)
Toon, Brian	Comparisons of 3-Dimensional numerical simulations of ambient and volcanic stratospheric aerosols with SAGE II observations
Toon, Brian	Modeling aerosols nucleation in the presence of clouds
Toon, Brian	The properties of clouds in the atmospheres of early Earth, Mars and Titan
Toon, Brian	Cold saline springs in permafrost on Earth and Mars

Toon, Brian	Investigations of desert dust and smoke in the north Atlantic in support of the TOMS instrument
Toon, Brian	Investigations of clouds and aerosols in the stratosphere and upper troposphere
Woods, Thomas N.	TIMED SEE – Phase E: Funding for Mission operations and data analysis

Proposals Submitted

Linnea Avallone	Measurements of CO2 and H2O for CSCAPE
Linnea Avallone	Halogen chemistry of atmospheric mercury: Joint laboratory kinetics and Arctic field studies
Linnea Avallone	In Situ measurements of halogen oxides in the troposphere and enhancement of graduate education in atmospheric sciences
Linnea Avallone	Measurements of "Total Water" and Carbon Dioxide during CRYSTAL-FACE
Frances Bagenal	DS-1 electric propulsion – Augmentation budget
Frances Bagenal	Jupiter Meeting Book Publishing
Frances Bagenal	Jupiter Magnetospheric Explorer Phase B
Frances Bagenal	New Horizons Pluto Mission
Daniel Baker	Solar cycle dynamics of solar magnetospheric and heliospheric particles and long term atmospheric coupling: SAMPEX-Data Analysis
Daniel Baker	Self-organized critical plasma sheet and substorm onset
Daniel Baker	Radiation belt specification and forecasting with data assimilation
Daniel Baker	POLAR/GGS CAMMICE continuation
Daniel Baker	CEPPAD revised funding
Daniel Baker	GGS (CEPPAD)
Daniel Baker	SCOSTEP's 10th Quadrennial solar-terrestrial physics symposium
Daniel Baker	CAMMICE revised funding
Daniel Baker	Characterizing radiation belt climatology and relating radiation belt properties to spacecraft operational anomalies

Daniel Baker	CLUSTER data analysis program
John Boynton	Mars sample return study
Joshua Colwell	Dynamics of charged dust near surfaces in space
Joshua Colwell	Experimental studies of low velocity impacts into regolith
Joshua Colwell	Mechanics of regolith and dust ejecta in low energy collisions in space environments
Randal Davis	ICESAT Launch Slip
Randal Davis	Preparation for No-GPS contingency for QuikSCAT Mission Operations
William Emery	Geostationary advanced imager for new science (GAINS): high spatial resolution based on super-resolution
Robert Ergun	GEM: Self-consistent characterization of parallel electric fields in the lower magnetosphere
Robert Ergun	Boundary layer acceleration snapshot (BLAST)
Robert Ergun	Time history of events and their macroscopic interactions during substorms (THEMIS)
Robert Ergun	Observatory for heteroscale magnetosphere-ionosphere coupling (OHMIC)
Robert Ergun	Modeling of parallel electric fields in the aurora
Robert Ergun	Magnetospheric constellation and tomography (MAGCAT)
Robert Ergun	Theory of the auroral current system
Larry Esposito	Pluto and outer solar system explorer (POSSE)
Larry Esposito	Pluto occultation imaging spectrograph experiment
Mihaly Horanyi	The physics of dusty plasmas
Mihaly Horanyi	Cassini CDA investigations
Mihaly Horanyi	Electrostatic charging of dust on the surface of Mars
Bruce Jakosky	Participation in Mars Odyssey Project Science Group
Bruce Jakosky	Physical properties of potential Mars landing sites
Bruce Jakosky	Thermal imaging system (THEMIS)
Bruce Jakosky	Remote sensing of planetary surfaces
Bruce Jakosky	Remote sensing and geochemistry of planetary surfaces

Bruce Jakosky	Mars Global Surveyor (MGS) interdisciplinary scientist
Bruce Jakosky	Mars Global Surveyor (MGS) augmentation
Shri Kanekal	Proton cutoff systematics during the Solar Maximum Conditions
Shri Kanekal	Dynamics of energetic electron fluxes in the inner magnetosphere
Shri Kanekal	Dynamic inner magnetosphere energetic particle data and model synthesis
Shri Kanekal	GEM: Comprehensive survey of relativistic electron mechanics during geomagnetic storms over a complete solar cycle
Shri Kanekal	Max Planck Institute European Commission Proposal
Steven Lee	Studies of the efficacy of Aeolian sediment transport at high elevations on Mars
Xinlin Li	Study of the Magnetic storms selected for GEM inner Magnetosphere and Substorms Campaign
Xinlin Li	Quantitative forecast of MeV electrons and magnetic activity in the magnetosphere based on solar wind measurements
William McClintock	Instrument for solar/stellar occultations and planetary airglow emission spectroscopy
Michael McGrath	SDRL Documents and analysis
Michael McGrath	MGM safety and health plan
Michael Mellon	Water and ice on Mars: The distribution and characteristics of water-related small-scale geologic features from MGS data
Keiji Ohtsuki	Dynamical evolution of ring-satellite systems
Keiji Ohtsuki	Origin and evolution of planetary rings
Keiji Ohtsuki	Origin and evolution of irregular satellites
Robert Pappalardo	Characteristics and consequences of faulting on Ganymede and Europa
Robert Pappalardo	Astrobiological and geological implications of convective transport in ice outer planet satellites
Robert Pappalardo	Clickworkers: Distributed human volunteer data analysis
William Peterson	Investigation of H+ and O+ outflows from the Earth's ionosphere

William Peterson	Polar TIMAS Operation and Data Analysis
Wayne Pryor	Heliospheric hydrogen and helium from Ulysses, Galileo and Cassini UV data
Wayne Pryor	Models of the carbon monoxide airglow on Venus
Wayne Pryor	Jovian Lyman-Alpha aeronomy
Cora E. Randall	Assimilation of Ozone Data Sets,
Cora E. Randall	Aeronomy of Ice in the Mesosphere, Co-I, Phase A
Gary Rottman	National Polar-Orbiting operational environmental satellite system (NPOESS)
Gary Rottman	Solar Radiation and Climate Experiment (SORCE)
Gary Rottman	Solar Radiation and Climate Experiment (SORCE) MOBY vacuum test chamber
Gary Rottman	Solar Radiation and Climate Experiment (SORCE): Red Team Activities
Gary Rottman	Solar Radiation and Climate Experiment (SORCE): Science
Gary Rottman	Solar Radiation and Climate Experiment (SORCE): Risk Mitigation
David W. Rusch	Aeronomy of ice in the mesosphere (AIM)
David W. Rusch	An investigation of the effect of solar variability and particle ionization on the Earth's middle atmosphere
Nicholas Schneider	JMEX-Phase A Concept Study
Nicholas Schneider	IO Announcement of Opportunity
Glen R. Stewart	Dynamical models of solar system formation and evolution
Glen R. Stewart	Dynamics of planetesimals and planetary accretion
Glen R. Stewart	Evolution of protoplanetary disks near the snowline
Stein Sture	Particulates at low stresses (PALS)
Yi-Jiun Su	CUSP dynamics-Particle acceleration by Alfven waves
Gary Thomas	Solar-induced variations in Polar Mesospheric Clouds: Comparisons with terrestrial influences
Brian Toon	Contrail persistence and aircraft exhaust impacts on cirrus clouds
Brian Toon	Investigations of Desert dust and smoke in the North Atlantic in support of the TOMS instrument

Brian Toon	Influence of nucleation mechanisms on the radioactive properties of deep convective clouds and subvisible cirrus in CRYSTAL/FACE
Thomas N. Woods	TIMED SEE - Revised launch date
Thomas N. Woods	TIMED SEE – Launch delay continuation
Thomas N. Woods	TIMED SEE – Phase E: Mission operations and data analysis