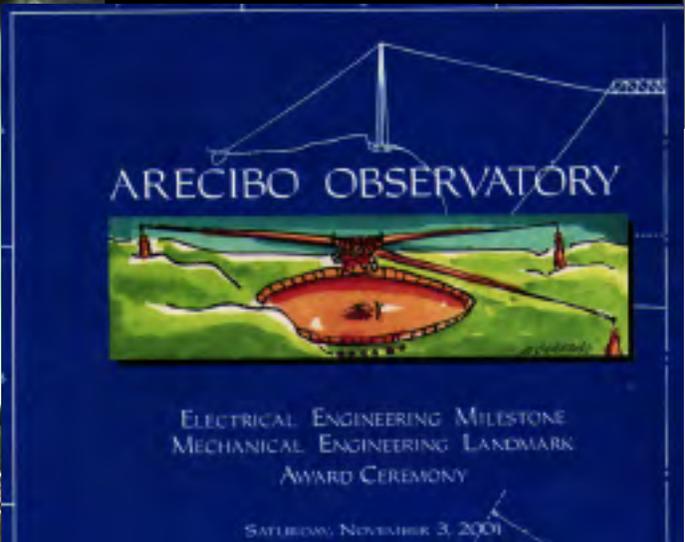
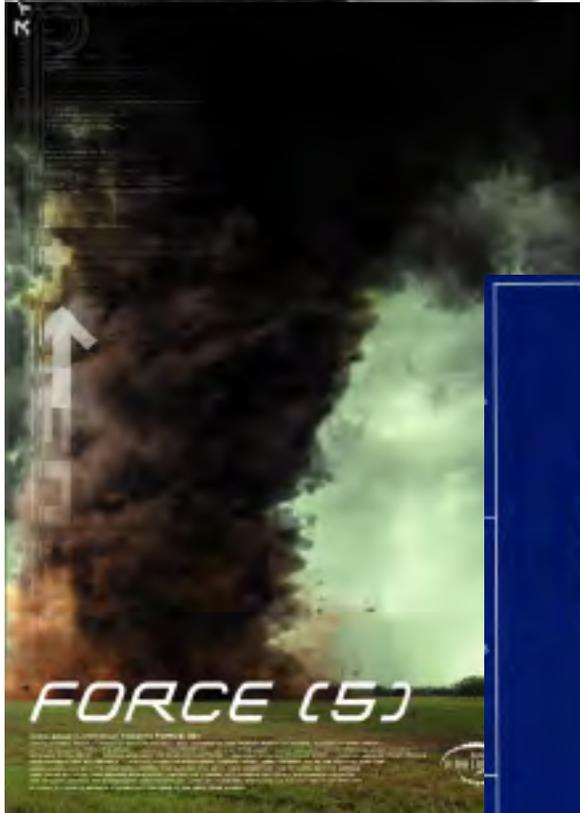




RICE SPACE INSTITUTE ANNUAL REPORT TO THE PRESIDENT 2001



**RICE SPACE INSTITUTE
OFFICE OF THE DIRECTOR**



MEMORANDUM

Date: 23 January 2002

To: Malcolm Gillis, President
Eugene Levy, Provost
Kathy Matthews, Dean of Natural Sciences
Sidney Burrus, Dean of Engineering

From: Patricia H. Reiff

Subject: Institute Annual Report, 1 January - 31 Dec 2001

I am pleased to provide herewith the second Annual Report to the President for The Rice Space Institute, covering the interval 1 January - 31 December 2001. The Rice Space Institute was created to be the focus of space research on the Rice campus, to continue the exciting research and outreach begun under the world's first Space Science Department. The Institute has grown far beyond those goals, though, reaching out to all members of the Rice community, not only in Natural Science and Engineering but to many others across the campus and around the world. Its mission is to "Make the Universe Smaller" by fostering interdisciplinary research and education.

To accomplish these goals, we have active groups in Space Astronomy and Astrophysics, Space Exploration, Space Weather, Space History and Public Policy, Space Education and Public Outreach, and Space Technology. At the end of 2001, the Rice Space Institute has **over 100** self-identified members from 19 Departments and 5 Schools (Natural Science, Engineering, Humanities, Social Science, and Jones Management School). It also has members from Rice University staff, including the Library, the News Office, the Rice Counsel, the Provost's office, the Budget office and Facilities and Engineering. We have opened the RSI to Emeritus Faculty and alumni, and have obtained community and corporate members, for a total of 24 Associate members.

We are anticipating an especially exciting 2002, as we are a host of the second decadal World Space Congress and chief organizer of the world's first Space Policy Summit. This year will bring Rice University again to the forefront of space exploration, research and policy.

A handwritten signature in blue ink that reads "Pat H. Reiff".



Mission

“The mission of the Rice Space Institute is to *"Make the Universe Smaller"* by interdisciplinary research and education at all levels, charting the course for the next generation of peaceful uses of space. ”

Goals

- to foster superior, cutting-edge **research** that commands national and international respect in various space-related Science and Technology disciplines;
- to continue to be a world leader in scholarship in the **history and philosophy of science**;
- to strengthen our leadership in **bringing space science to the public**;
- to become the recognized leader in the area of **space policy**;
- to build on our relationships with industry and government and continue to foster **technology transfer**;
- to continue to **serve the Rice community**.

To accomplish these goals, we have groups within the RSI which focus on the various research areas of the RSI. The groups comprise Space Weather, Space Exploration, Space Astronomy and Astrophysics, Space Technology, Space History and Public Policy, Space Education and Public Outreach, and Space Remote Sensing. (There is also a significant interest in Space Biology and Bioengineering, but that is the purview of the Rice Biomedical Institute). Each group has one or more group leaders. The group leaders and other significant advisors comprise the Council of the Rice Space Institute. The Council guides the governance and structure of the RSI, laying out the major thrusts, and selecting projects for seed funding from the RSI. These goals align well with the goals of the Schools and University we serve. As a non-degree-granting entity, we do not have degree goals, but we work closely with related departments on degree programs and course work, in particular the "Master of Science Teaching" degree which we proposed and which we are administering through the Physics and Astronomy Department.

Research Group Highlights

Space Weather



The Space Weather group comprises research in Magnetospheric Physics and Solar Wind-Magnetosphere-Ionosphere coupling. Led by 2001 group leaders Anthony Chan (theory) and John Freeman (observations), the Space Weather group at Rice is arguably one of the leaders in the world in theory and modeling of the space environment. The new group leaders for 2002 will be Frank Toffoletto and Trevor Garner. Their codes are used by the Air Force and NOAA for real-time understanding of space weather. The group has heavy involvement in the IMAGE spacecraft (whose P.I. James Burch is a Rice alumnus). This groundbreaking spacecraft has "seen the invisible", creating images of invisible cold and hot plasma populations, and has, for the first time, observed the dynamic magnetosphere

much as an astronomical object. In this figure we see the first-ever image of the dynamics of the cold plasma in Earth's neighborhood, by using 30.4 nM scattered sunlight from the ionized Helium in the plasmasphere. IMAGE also includes a radio sounder, and a special imager to view the light from precipitating protons in the aurora. It also can "see" the trapped energetic particles by measuring the fast neutral atoms which result from charge exchange of energetic ions with the Earth's outer atmosphere. These processes depend on laboratory cross-sections, which were first done at Rice with Dr. Stebbings' group, and continue with Dr. Lindsay. Dr. Burch presented the results in the spring 2001 "Marlar Distinguished Lecture" which is available using the Rice webcast server.

Plasmasphere image from IMAGE. The "shoulder" (bulge at the bottom center) is now understood by using Rice theoretical models.

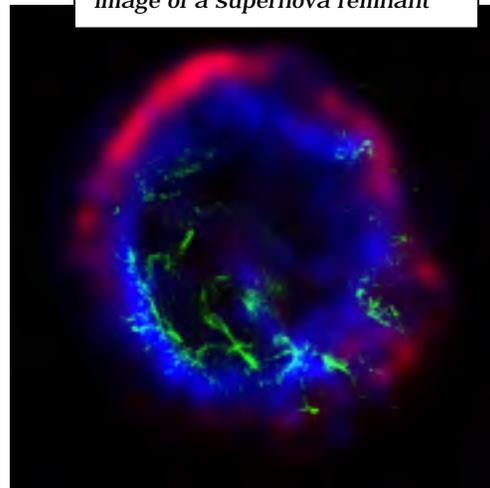


Space Astronomy and Astrophysics



The Astronomy/Astrophysics group comprises theoretical and observational research in both high-energy astrophysics and observational astronomy, particularly in stellar and planetary "origins". Rice University in 2001 gained two new faculty members in astronomy, Christopher Johns-Krull and Uwe Oberlack, as well as a new research faculty member Giovanni Fosatti. The RSI is pleased to have as a member Chandra Fellow Markus Boettcher, who studies the X-ray universe using the Chandra spacecraft. Organized by group leaders Edison Liang (Astrophysics) and Ian Smith (Astronomy), this group has heavy participation outside of the Physics and Astronomy Department, as well as input from several Adjunct Professors. Two RSI members doing astronomy research include

Combined visible and x-ray image of a supernova remnant



Richard Gomer of the Biochemistry Department and Tom Williams of History. One of our major projects for 2001 was designing a possible oncampus observatory for teaching and public outreach; however, this project was postponed to 2002.

Space Exploration



The space exploration group focuses on research in both manned and unmanned exploration of the solar system. Organized by group leaders Adrian Lenardic (unmanned) and Keith Berrier (manned), this group also has attracted much interest from around the campus. Paul Cloutier's Mars magnetic field observations and the Mars surface work in the Earth Science Department are highlights. Rice alumnus and Adjunct Associate Professor Jim Newman will be flying in STS 109 this spring, performing the latest Hubble Space Telescope upgrade. He will be carrying along banners for the Rice Space Institute, for the Baker Institute for Public Policy, and for the World Space Congress. In addition, he will be taking to space our three public outreach CD's "Earth Update", "Space Update" and "Space Weather".



Alumnus Jim Newman spacewalking, reflected in his colleague's helmet.

Space Technology



The technology group focuses on research in space instrumentation and aerospace technology. Organized in 2001 by group leaders Carter Kittrell (instrumentation) and Pol Spanos (technology), this group is interested in space instrumentation, fluid flows and space technology. A new group leader for 2002 is Uwe Oberlack, who is joining the instrumentation group as a new faculty member. He has expertise in high-energy astrophysics instrumentation. The plasma tank instrumentation work and the plasma propulsion research of Adjunct Professor Franklin Chang-Diaz's are highlights. The VASIMR system could cut short the travel time to Mars by months, making a manned trip much safer and less expensive. We hope to expand the technology effort in the coming year.

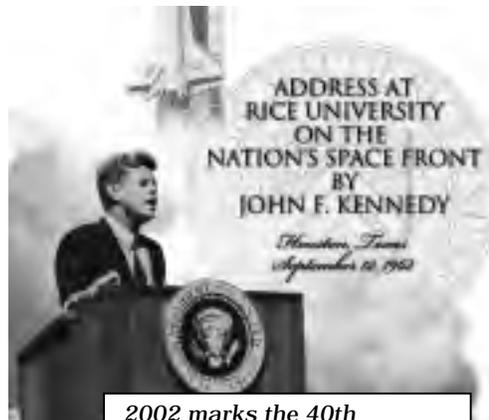


Graduate student Tim Glover works with Astronaut Franklin Chang-Diaz on the VASIMR propulsion system.

Space History and Public Policy



The history group (headed in 2001 by Albert Van Helden) focuses on the history of Astronomy and Astronomers (particularly Galileo). In the philosophy area, co-leader Sherrilyn Roush's research focuses on the anthropic principle and its application to



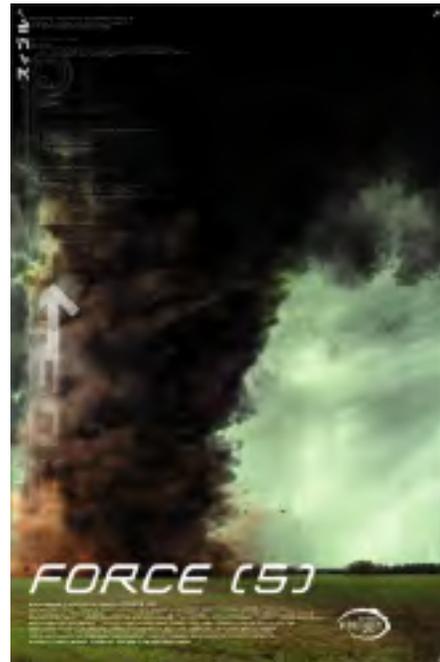
2002 marks the 40th anniversary of the JFK "To the Moon" speech

cosmology. This group has been very active in creating a proposal for NSF support of their research. Roush is the new leader for 2002, joined by coleaders Tom Williamson and Paul Jeffries for 2002. The group is also active in planning for the International Space Summit for the World Space Congress in Houston this year. This summit, which will bring together the heads of the space organizations of the spacefaring nations, will be held in the Baker Institute in October 2002. A preliminary "Critical Space Issues" workshop is being planned for May, 2002, with discussion of crosscutting issues (e.g. technology and education) that will underlie the Summit discussions. We are very pleased that Neal Lane (former NSF director and former Science Advisor to the President) and George Abbey (former director of Johnson Space Center) are spearheading the organization of the preliminary workshop, which will be funded by Boeing. A publication will result, featuring the reports of Rice rapporteurs who will summarize and set the workshop in context. A celebration of the 40th anniversary of the Kennedy "To the Moon" speech is being planned for the Rice Stadium.

Space Education and Public Outreach



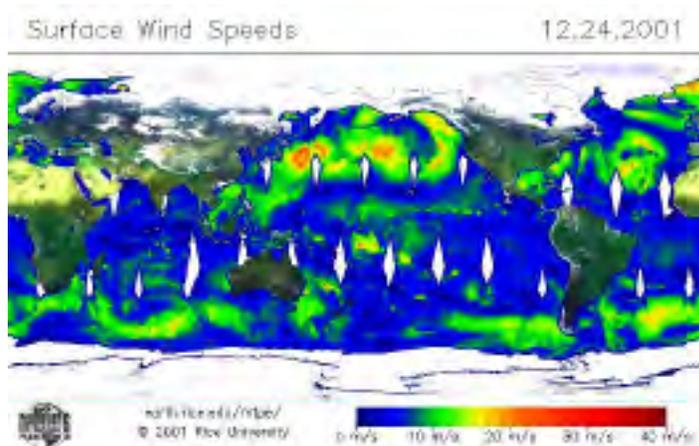
The education and public outreach group builds on significant strength in public outreach. Education co-leader Lissa Heckelman is working with our "Masters of Science Teaching" degree, to enable prospective teachers to earn their teaching certificate while improving their knowledge base of basic science, and increasing content knowledge of present teachers. The public outreach group, headed by co-leader Adjunct Professor Carolyn Sumners, brings Earth and Space Science education to the public via museum exhibits and planetarium shows. Over a million visitors have interacted with Rice-designed exhibits at many museums around the world, and roughly the same number via our web-based outreach pages. Over 30,000 people saw the 2000 "Powers of Time" show at the Houston Museum of Natural Science and our partner theater at Carnegie Museum of Natural History. One segment, featuring the "birth of the moon", was seen by approximately 20 million people over the Discovery Channel. Our 2001 show, "Force 5", features the effects of the most violent forces - tornadoes, hurricanes, and space storms. Showing at both HMNS and CMNH, it has reached 300,000 people in 2001.



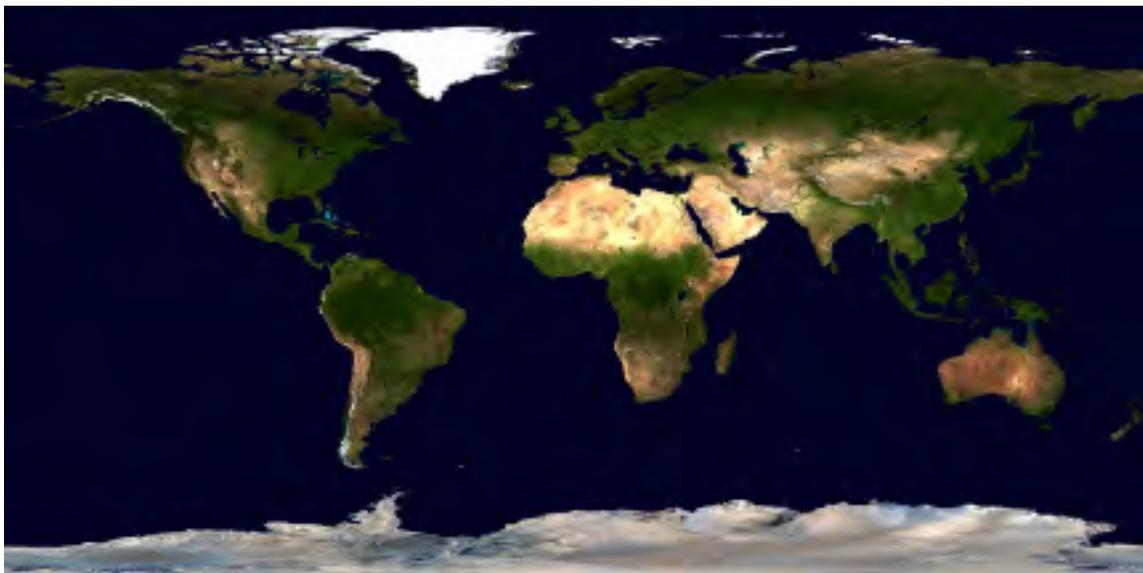
Space Remote Sensing



The remote sensing group is the newest of the Rice Space Institute groups, and is becoming one of the most active. With group leader Gary Morris, this group works with remote sensing of the Earth and its resources. Both atmospheric and geologic sciences are represented in the research of the RSI. Research is being conducted in the fields of stratospheric ozone,



Real-color image of the Earth, taken from the MODIS instrument on Terra, part of our outreach program.



using instruments provided by the Goddard Space Flight Center. The remote sensing meeting allowed Fondren librarian Lisa Sweeney to teach the group about the GIS capabilities on campus. The group is also discussing a potential Continuing Studies course. Another possible direction is creating an "Earth Imaging Center" on campus, with a public outreach display at the Houston Museum of Natural Science.

RSI Council

The RSI council sets policy and makes decisions for major thrusts. Group leaders are automatically members of the Council. New group leaders were elected in early 2001, and most of the 2002 members have been elected. The members of the RSI Council, which reflect the diversity of the RSI membership, are:

William Gordon, Emeritus Faculty, NAS/NAE
Anthony Elam, CITI Executive Director
Keith Berrier, Computational and Applied Mathematics, Exploration (2001-2002)
Trevor Garner, Physics and Astronomy, Space Weather (2002)
Lissa Heckelman, Education (2001-2002)
Paul Jeffries, Physics and Astronomy, History and Public Policy (2002)
Carter Kittrell, Chemistry, Technology (2001)
Edison Liang, Physics and Astronomy, Astronomy and Astrophysics (2001-2002)
Uwe Oberlack, Physics and Astronomy, Technology (2002)
Sherrilyn Roush, Philosophy, History and Public Policy (2001-2002)
Carolyn Sumners, Houston Museum of Natural Science, EPO (2002)
Ian Smith, Physics and Astronomy, Astronomy and Astrophysics (2001-2002)
David Talent, Lockheed Martin, Technology (2002)
Frank Toffoletto, Physics and Astronomy, Space Weather (2002)
Tom Williams, History, History and Public Policy (2002)

Future Thrusts

Associate Members

Our first Corporate Member, Lockheed Martin/CSOC, Chief Scientist, Dr. David Talent, has become heavily involved in the planning of the oncampus observatory and will be the leader of the aerospace engineering group. We now have a number of "Associate" members of the Rice Space Institute, drawn from alumni, adjunct, community, and corporate members. We expect that this area of the RSI will continue to grow and will eventually become a significant source of resources (human and financial) for RSI research and programs.

We had participated in many meetings with the American Institute of Aeronautics and Astronautics on the planning for the World Space Congress, and we are certain that the planning for this huge event (15,000 expected) will bring even closer ties to the aerospace community in "Space City".



World Space Summit

The planning for the World Space Congress, to be held in October 2002 in Houston, is our major thrust for 2001 and 2002. We are actively engaged in several facets of this program: The Houston Local Organizing Committee (Reiff is a member); the Education and Public Outreach Task Force (Sumners, Reiff and Cantú are members). The EPO task force is planning a "Make Space for Kids" night at the Houston Museum of Natural Science on Wednesday, which includes an exhibit for the public. We will bring talented K-12 and undergraduate students to the campus for special programs, tours, and talks. This will conveniently fall on Fall Break, to minimize problems with finding classrooms. Rice will also be on the "Science Tours" list, with opportunities for departments to have displays open to the WSC participants. A special meeting for museums will be held the final weekend, and a special "Space Rocks" concert will be held Friday evening. This will be a celebration of the Kennedy "To the Moon" speech.

In conjunction with the World Space Congress, we are working closely with the Baker Institute for Public Policy to plan and host a policy meeting of the highest ranking space administrators of all the spacefaring nations, the first "Space Policy Summit". Planning is well underway for this first historic event. We expect that the space policy set here at the Rice Summit will be quoted internationally for decades to come. President Bush has been invited to provide a keynote address of breadth, power, and impact similar to the JFK speech, which will guide the civilian space program in peaceful cooperation for the coming century.

To set the stage for the Space Policy Summit, "Space: A Critical Issues Workshop", funded by Boeing, will be held on the Rice campus May 4-6. Crosscutting issues will be discussed by high-level representatives from government, industry and academia. Rapporteurs will be selected from Rice to report on and consolidate each section, resulting in "White papers" will be created, to be published in the Baker Institute journal. Neal Lane and George Abbey are the Rice organizers of this important workshop.

Research Programs

Building on strengths

In the first year, the focus was on identifying areas of strength in space research across the campus, in developing strategic ties among Rice faculty, staff, and students, and in learning the basics. Each group organized the program for one of the monthly meetings. Both the basic science and the opportunities for additional joint research were highlighted. In this second year, we focused on building on our strengths, taking our present research to new depths or to new areas of exploration.

Seed Money program

The Council decided to spend a significant fraction of the total RSI budget on fostering new research programs. We announced a competition, specifying that programs which spanned more than one department would have priority. Priority was also given to programs which could eventually compete for external funds from outside agencies. After external review, three projects were chosen for seed money for 2001:

F. C. Michel and B. A. Hausman: "Space Weather Timing Project": Paper entitled "Tangential Discontinuities: using "Fingerprints" in the Solar Wind for Event Timing" has been submitted for publication. RSI has been acknowledged as giving partial support. This study searched for specific time-markers in the solar wind (for example, shock waves) and used them to study timing of the propagation of solar wind from upstream monitors to their effects on Earth. Since timing shifts of up to 20 minutes are possible, such studies are important to generating accurate Space Weather forecasts.

A. A. Chan: "Support of ISEC 2001"; This seed money was used to help organize a major conference on the measurement, theory and modeling of energetic electrons. These "killer" electrons become extremely hazardous two days after a CME shock wave passes the earth, and can damage and destroy spacecraft systems. The RSI's sponsorship of the meeting has given it international visibility.

P. Koucek, CAAM: "Numerical Solution of Homogenized Vlasov Equations Applied to the Magnetospheric Reconnection Problem." Granted \$1000 of RSI seed money, matched by \$1000 of CAAM money and \$1000 of CITI money, they proposed a method allowing for effective coupling of the Vlasov-Landau equation considered on small domains with large-scale models. To communicate physical properties across the domain interfaces, they made certain continuity requirements. To go from the Vlasov domain to the MHD domain, the probability density distribution function is integrated to obtain moments. To go in the reverse direction, a generalized transport equation is solved for a Boltzmann-like distribution function. The Boltzmann-like distribution results from solving an inverse problem for an integro-differential equation. They tested this approach on the propagation of the Langmuir Waves.

University Seed Money program

We are pleased that the administration has taken the oft-voiced suggestion of the Research Council to make similar seed money resources available to researchers. With such support, the need for additional dollar seed money in the future from RSI should be reduced, but we still expect to spend at least \$5000 - \$8000 per year in direct support for research.

Educational Programs

Education is one of our major goals, and our most visible success. First of all, the RSI has helped teach the Rice community about space. From RSI members:

"As a staff member of Rice who is not working in the space field, I appreciate the opportunities RSI creates for me to stay connected to space research and studies on campus. It gives me a sense of belonging to the commitment in space explorations. It also gives me a chance to meet people in this field whom I may not get a chance to meet otherwise or hear them speak. I find the meetings educational and inspiring."

"Thank you for all you do for the Rice community. I wouldn't appreciate solar or lunar eclipses, missions to Mars, Buckeyballs and tubes, or the universe half as much without your generous enthusiasm in sharing your expertise with the rest of us."

Colloquium Series

In order to bring all the members of the RSI "up to date" on present research, we organize a continuing colloquium series, as well as group research meetings. Below are the meetings of the RSI and their topics presented: (Not all meetings of interest groups are listed).

Name of Speaker/Session Chair	Title of Talk	Date of Talk/Meeting
Dr. Larry McIntire Bioengineering Dept Rice University	"Space biology research at Rice — NSCORT and NSBRI"	Jan. 22, 2001
Dr. Gary Morris/Session Chair	Remote sensing group meeting	Feb. 8, 2001
Dr. Louis Maher Exxon Mobil	"Methods enabling the blind to participate in science"	Feb. 19, 2001
Dr. Patricia H. Reiff/RSI Director	To foster dialog between NSCI and ENGR in space related issues. The upcoming World Space Congress 2002	Feb. 21, 2001
Dr. Gary Morris/Session Chair	Remote sensing group meeting	Feb. 22, 2001
Dr. Justin Wilkinson NASA/JSC	"Smog, smoke and dust; space shuttle views of Earth's tmosphere"	Mar. 26, 2001
Dr. James L. Burch Vice President, SWRI	"To see the invisible: First multispectral images of the Earth's plasma environment"	Mar. 28, 2001
Dr. Thomas R. Williams CSST/Rice University	"Discovery as a career turning point: mellish, hubble, and the variable nebula"	Apr. 30, 2001
Dr. Angelo Iasiello and Mike Lewis AIAA Headquarters/Washington	Planning of the World Space Congress 2002	Sept. 17, 2001
Mike Lewis/AIAA Headquarters/ Washington	Local roll out meeting of the World Space Congress 2002	Oct. 10, 2001
Dr. Patricia H. Reiff/RSI Director Dr. Anthony Chan & Dr. Petr Kloucek/Rice University	Seed money proposal Meeting RSI seed money reports from two funded projects P.I.'s	Oct. 29, 2001
Dr. Gary Morris/Session Chair	Remote sensing group meeting	Oct. 29, 2001
Dr. Gary Morris/Session Chair	Remote sensing group weeting	Nov. 12, 2001
Dr. Michael Golightly, Johnson Space Center	"Space Weather and astronaut Radiation protection"	Nov. 19, 2001
Dr. Gary Morris/Session Chair	Remote sensing group meeting	Dec. 6, 2001

Oncampus Observatory

We provided the principal means of the alumni donations to the Oncampus Observatory. The account, managed through the Physics and Astronomy Department, has now raised over \$14,000 towards that important educational facility. In 2002, we will be using both Marlar Foundation resources and RSI resources towards purchasing and installing the telescopes and computers in that facility. We are continuing to contact our alumni and friends for additional resources for the observatory, its computers and instrumentation. A special pledge of \$25,000 has been received, given by an RSI member Tom Williams. A nearby offcampus site (on South Main St.) may become the logical choice for the facility, because of its combination of darker skies than on campus while being reasonably nearby for access.

Texas Space Grant Consortium

The RSI is the point of contact for the Texas Space Grant consortium, providing scholarships to students interested in space (<http://www.tsgc.utexas.edu>). The Texas Space Grant is also providing scholarships for Texas students to attend the World Space Congress in Houston.



Teacher Programs

The RSI is deeply involved in teacher education, both in formal and informal settings. Rice has a working partnership with Madison High School, the magnet for Earth and Space Science. Each year the juniors and seniors get a field trip to Rice to see scientists in action, and to provide expertise for the teachers.



The RSI is the point of contact for inservice and preservice teachers who seek a Rice **Masters of Science Teaching** degree. Two teachers are presently registered in the program. We are also one point of contact with Houston Independent School District's HU-LINC program, which promotes science and math improvements in local teachers. We have taught over 100 teachers in credit courses (partially funded by USRA - the Universities Space Research Association), and over 3000 teachers in workshops around the country.

In Spring 2001 Rice University offered ASTR 402: "Teaching Earth and Space Science". The grant supported tuition and course expenses for 5 inservice teachers (two preservice teachers also took the course using their own resources). The teachers were trained using activities from our CD-ROMs Earth Update and Space Update. As their class project, they designed and presented public demonstrations at "Sun Day" April 28, 2001. Over 3000 people viewed the exhibits.

Teacher intern Katty Furitisch explaining spectroscopy on "Sun Day", April 28, 2001.



In summer 2001 Rice, in cooperation with the Houston Museum of Natural Science, offered "Algebra Activities in a Math Museum", a two-week workshop for 20 teachers, half Algebra teachers and half IPC (Integrated Physics and Chemistry) teachers. The algebra of earth and space science was taught, using examples from earth science and planetary motions. The teachers were trained in the use of graphing calculators and data modules (motion detectors, light sensors, and magnetic field sensors). Each teacher created an activity. The feedback from the teachers at the end of the course was very positive, and we have been requested by the Houston Independent School District to offer it again in 2002.

Public Outreach

Museum Collaborations

Most of the interaction of the Rice University's space research efforts with the public is through the "Public Connection" program. Started in 1994 with funding from NASA's Digital Library program, it is now being funded by the Office of Earth Science and the IMAGE program. The program has three major outreach venues: interactive realtime museum displays, immersive digital planetarium productions, and interactive problem-solving group experiences.



We have developed two major pieces of realtime display software: "Space Update", which comprises Astronomy, Solar System, Space Weather, and Sky Tonight modules, and "Earth Update" which comprises Atmosphere, Biosphere, Cryosphere, Geosphere, and Hydrosphere modules. Each can be updated by the user with a single click.

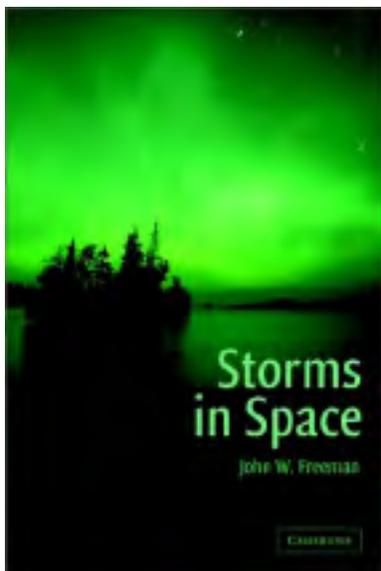
Our "Earth Update" CD, developed using ESE/ESIP resources and field-tested using our teacher courses, recently passed NASA review and has earned the "Seal of Approval". Over 2000 copies were distributed to teachers, museums, and the public, in 2001.



Our **"Space Update"** CD, initially developed using NASA Digital Library Technology money, has been updated using resources from the IMAGE project. That grant paid for teachers to field-test both the software and the activities as part of the course. That grant also paid for copies of "Space Update" to be distributed at NSTA, MATS, and other teacher workshops. Space Update has recently also passed NASA review and will be granted a NASA product number. Over 1500 copies were distributed in 2001.

In all, over 1,000 teachers have benefited from workshops at teacher meetings, and over 20 public lectures were presented.

Our digital theater productions create wide-screen (full dome or ultra [210° wide] panorama) video which are displayed on planetarium domes and other wide-screen theaters. Our main partners are the Houston Museum of Natural Science and the Carnegie Museum of Natural History, but other planetariums have used clips we have created. Our show for 2000 was "Powers of Time", demonstrating the fundamental cycles of Earth. Over 160,000 customers saw our shows at the Houston Museum of Natural Science and another 25,000 at Carnegie Museum of Natural History. One clip "The Birth of the Moon" was picked up by the Discovery Channel and is estimated to have been seen by 20 million people.



Our show for 2001 was "Force 5", which highlights the fiercest forces on Earth (tornadoes, hurricanes, volcanoes, and space storms). It opened December 2000 at Carnegie Museum of Natural History and opened in May 2001 at the Houston Museum of Natural Science. Over 300,000 visitors have experienced these storms surrounding them, and have learned the science which causes them.

"Storms in Space"

Prof. John Freeman published a popular-level book "Storms in Space", explaining space weather at a popular level (ISBN 0521660386, Cambridge University Press, 2001). This easy-reading book brings forth both the science and the drama of space weather. When the book was recently shown at the fall AGU meeting, the booth was sold out of copies long before the end of the meeting!

Girl Scout Day:

As part of the Girl Scout Day sponsored by the Society of Women Engineers program, we presented a amateur radio demonstration. Six groups of scouts, totaling over 100 girls, got to talk to other Boy and Girl Scouts around the country. Volunteers from the Northwest Amateur Radio Society provided the equipment and expertise. The girls learned first hand why amateur radio aficionados are called "hams"!



Public Presentations

The RSI has been very active in bringing space science to teachers and the public via many public presentations, some via the "Public Connection" program and some promoting the research of the IMAGE spacecraft program. We participate in many teacher meetings, both national (NSTA, AAPT) and local (e.g. Metropolitan Association of Teachers of Science). RSI members also serve as representatives on the HU-LINC University Coalition (an NSF program linking Universities and schools for systemic change). Two RSI members even contributed to a Christmas eve **Dallas Morning News** article on "Gifts of Wonder!" (Chemistry professor Jim Tour and alumnus Marc Hairston were also featured in that article).

Reiff, P. H., "Museums Teaching Planet Earth", ESIP Review meeting, Tuscon, January 12, 2001.

Sumners, C. and P. Reiff, "Live from Antarctica", public lecture, Houston Museum of Natural Science, February 12, 2001.

Reiff, P. H., "Earth Update / Space Update", demonstration, Metropolitan Association of Teachers of Science meeting, Houston Museum of Medical Science, February 24, 2001.

Reiff, P. H., "The cost-effectiveness of mid-sized missions", TV interview, "Galileo" program (German TV), Houston, March 16, 2001.

Burch, J. L. with Reiff, P. H., host, "The Fury of Space Storms", Marlar Distinguished Lecture, simulcast as a webcast, Houston, TX, (<http://www.rice.edu/webcast/>), March 28, 2001.

Sumners, C. and P. H. Reiff, "Career Challenge", NSTA meeting, St. Louis, Mo., March 22, 2001.

Reiff, P. H. and C. Sumners, "Stormcast", NSTA meeting, St. Louis, Mo., March 23, 2001.

Reiff, P. H. and C. Sumners, "What's Up in Earth and Space", NSTA meeting, St. Louis, Mo., March 23, 2001.

Reiff, P. H. and C. Sumners, "Sun-Earth Day", many public demonstrations and exhibits, Houston Museum of Natural Science, April 28, 2001.

Reiff, P. H. and N. James, presentations for Madison High School magnet students, May 3, 2001.

Reiff, P. H. and C. Sumners, "**Force 5**", planetarium show grand opening, Houston Museum of Natural Science, June 7, 2001.



- Reiff, P. H., C. Sumners, J. Goldstein and Jan Casey, "Algebra Adventures in a Math Museum", teacher workshop, July 9-20, 2001.
- Reiff, P. H., "Space Weather Effects on Electrical Systems", interview for "Energy News Live", August 15, 2001.
- C. Sumners and P. H. Reiff, ASTC meeting, Phoenix, October 8, 2001.
- Reiff, P. H. and C. Sumners, "Force 5", CAST meeting, Austin, November 3, 2001.
- Reiff, P. H., "Earth Update", NASA ESE Museum Educators Meeting, Minnesota, November 15, 2001.
- Reiff, P. H., "Earth Update", NASA ESE Products Showcase, Goddard Space Flight Center, November 29, 2001.
- Reiff, P. H., J. Goldstein, S. Mende, H. Frey, T. Onsager, L. Frank, and J. Sigwarth, "Conjugate Auroral Substorm Dynamics", Press conference at AGU meeting, San Francisco, December 12, 2001.
- Reiff, P. H., Quoted in article about science gifts, **Dallas Morning News**, December 24, 2001.
- Reiff, P. H., Quoted in article about the entire sequence of auroral storm studied at poles simultaneously, **Rice News**, Volume 11, Number 16, January 10, 2002.

Bill Gordon and the Arecibo Observatory

Arecibo Radar Antenna in Puerto Rico is Designated an IEEE Milestone
 BY DAVID P. AMBLER
 IEEE Staff Contributor

In the late 1950s, a small group of engineers led by Bill Gordon from Cornell University, Ithaca, N.Y., USA built the largest radar antenna in the world in coastal Puerto Rico. Three decades later, on 3 Nov. 2001, they joined again for a ceremony designating the Arecibo Observatory as an engineering landmark.

The IEEE History Center and the American Society of Mechanical Engineers (ASME) designated the telescope as both an IEEE Electrical Engineering Milestone and an ASME Mechanical Engineering Landmark. The ceremony was organized by the IEEE Puerto Rico and Caribbean Sections.

"We built a landmark antenna seemed impossible," Gordon said. "But after talking to civil and mechanical engineers, we decided to give it a try." Radio signals are sent out as well — the total energy Arecibo has received since 1951 is less than that produced by striking a match — which led scientists to construct a massive antenna. Along with a handful of other Cornell and Puerto Rican engineers, Gordon and Tilley would spend three years in the countryside building Arecibo.

Although the antenna has been a striking backdrop for movies such as *Conan and Gulliver*, Arecibo was designed just built to study radio signals in the Earth's atmosphere. The U.S. government's Advanced Research Projects Agency provided funding to investigate the ionosphere whose, altitude, and how people would fit. Puerto Rico offered the most suitable location, close to the equator for searching the

... It also had as unique structure topography with large natural indentations that could support Arecibo's dish structure.

... Astronomers cover the first miles systems, using radio-wave pulsars and to study the weather in Venus. A 1974 restoration made the

... dish structure made possible and a 1997 upgrade built a dome structure to allow better visibility and frequency range.

For all the astronomy discoveries, it was engineering that generated Arecibo its legacy. The project involved antenna design, signal processing and electronic instrumentation. All parts of the telescope are intricately positioned with millimeter precision.

The 20-year old IEEE Milestone Program has dedicated as other Arecibo is the second in the Western Hemisphere.

1 años, Gordon los momentos que vivió en el se le permitió obra maestra". "un radiotelescopio triángulo y un nple, pero con emociones".

... lo que la idea un radiotelescopio una noche lo en el año 1 medio de la levante y estas notas. La que las ondas interactuaran viera. Que se

... magnitud de su creación. "Es un monumento de la ingeniería electrónica y mecánica. Eso significa que es una gran construcción", expresó al referirse al premio que recibió el Observatorio el sábado pasado, otorgado por el Instituto de Ingenieros Eléctricos y Electrónicos en conjunto con la Sociedad Americana de Ingenieros Mecánicos. Ambas asociaciones declararon al radiotelescopio como un monumento histórico de la ingeniería mecánica y eléctrica. "Sólo hay siete premios de esta naturaleza en el mundo", comentó el oficial educativo del Observatorio de Arecibo, José Alonso.

EL PADRE fundador del Observatorio señaló que actualmente se podría construir este instrumento científico más grande que el que tiene Arecibo.

Sin embargo, calculó que lo que costó para la década de los años 60 \$9 millones, hoy podría costar unos \$200 millo-

... cada 10 instrumento edificio se convierte en uno más sensitivo; que ahora "es mucho mejor, gracias a los ingenieros puertorriqueños".

News accounts from around the world highlight the success of the giant radio telescope.

We are pleased that Emertus Professor Bill Gordon's pioneering work on the design, construction, and continuing use of the Arecibo Observatory has gained widespread recognition, including being named an "Electrical Engineering Milestone" and a "Mechanical Engineering Landmark" in a special ceremony in Puerto Rico in November. He received several accolades, including from the Puerto Rico government.

Bill Gordon, and his many alumni over the years, are the 'best of the best' in Space Physics at Rice. The Rice Space Institute is proud to have him as our most distinguished member.



Resources

Financial

With only a \$15,000 budget from the University, we have created a dynamic Institute with over 120 members from 19 departments and 6 offices, and over 20 associate members from the community. We have put \$3,000 into directly fostering new research thrusts, with more to be selected for the spring competition. We hope that our \$15,000 expense budget would be maintained or grow slightly, particularly in response to added expenses for the World Space Congress (see below).

We have doubled the Rice University contribution by the \$15,000 annual award of the "Marlar Foundation". This award goes to improving space research. We are using it this year for our annual Marlar speaker (which for 2001-2002 will be Dr. Alex Filippenko, UC Berkeley), our annual "Marlar Award" to the best graduate student, and for hardware to be put into the On-campus Observatory which will be built this coming year. In 2001 the Marlar awardee was David Streutker, who studied the Houston "Urban Heat Island" from space.

We are delighted to announce a \$15,000 in-kind donation of time from Lockheed Martin Corporation, in the form of 15% time of Dr. David Talent.

Finally, RSI member Tom Williams has pledged \$25,000 towards the construction of the on-campus observatory. Coupled with the \$14,000 we have raised from alumni and friends of the Space Physics and Astronomy Department at Rice, this gives a total of \$59,000 in external funds to accompany the \$15,000 Rice contribution.

Special request: We would like to suggest an extra \$5,000 allocation, for a Rice University booth at the World Space Congress, and to pay for expenses associated with the scientific tours of campus. The booth would highlight Rice University activities, including Space Science, Earth Science, and Biomedicine.

Summary

In summary, we are pleased with our accomplishments of our first full year, having grown in numbers of participants, and scope and breadth of our activities. We expect that 2002 will be a banner year, with our major participation in the "World Space Congress" and the first "Space Policy Summit" as banners in our crown.

Appendix 1:

Rice Space Institute members

(as of 1/1/2002)



Last Name	First Name	Department /S = staff /G = grad student /E = emeritus	Group GL = group leader	Research Interest
Ahn	Henry	Jones MGT		
Almaguer-Riesdorf	Joyce	EEB/G	Remote Sensing	
Almond	B.J.	News ofc	EPO	Science Writer
Bearden	Chuck	Fondren/S		
Behr	Marek	MECH	Technology	
Berrier	Keith	CAAM/G	GL: Exploration	
Boettcher	Markus	P&A	Astro	X-Ray Astronomy
Carroll	Michael	CAAM	Technology	Engineering
Cates	Susan	Bioc	Bioscience	
Chan	Anthony	P&A	Space Weather	Plasma Theory, Space Physics
Chapman	Walter	CHEME	Technology	
Chen	Yue	P&A/G	Astro	
Cloutier	Paul	P&A	Exploration-U	Venus/Mars
Collis	Scott	MECH	Technology	Mech E, CFD
Corcoran	Marjorie	P&A	Astro	Particle Physics/Cosmology
Daughterty	Jackie	Chem		
Dimond	Margot	Media Rel	EPO	
Ding	Lai	P&A/G	History & PP	
Dufour	Reggie	P&A	Astro	Observational Astrophysics
Dunning	Barry	P&A		Atomic collisions
Dye	Michael	ECE		
Earles	Christopher	Math/G		
Elam	Tony	Techno	Remote Sensing, Technology	Assoc Dean of Engineering
Ellett	Debra	Fondren/S		
Eliot	John	Kinesiology	Bioscience	bone loss in zero g
Englebretson	Robert	Linguistics		
Fei	Yue	P&A/G		
Few	Art	P&A	Remote Sensing	Atmosphere
Freeman	John	P&A	GL:Space Weather	Space Weather, Modeling, (EPO)
Fullaway	Daniel	UG	AA; SE	
Garner	Trevor	P&A	GL: Space Weather	Space Physics Modeling
Glover	Tim	P&A/G	Technology	Applied Physics, Plasma Rocket

Goldstein	Jerry	P&A/S	Space Weather	Modeling and Data analysis
Gomer	Richard	Bioc	Astro	Cataclysmic Variables
Gong	Bin	P&A		
Gordon	William	Emeritus-SPAC	Space Weather	Space Weather, Comm. & Electric Power
Hausman	Bonnie	P&A/S	Space Weather	Magnetospheric modeling
Heap	Aaron	Math/G		
Heckelman	Lissa	Educ	EPO	Teacher education
Henize	Vance	P&A/G	Space Weather	Magnetosphere Observations/Modeling
Heymann	Dieter	Emeritus: G&G	Exploration-U	Chemistry in Interstellar material/Meteorites
Huegerich	Tim	UG	Space Weather	IMAGE
Huston	Priscilla	Provost's ofc	EPO	Education
Jeffries	Paul	P&A/CSST	GL: History&Phil	foundations of physics, quantum non-locality, philosophy of science
Johns-Krull	Christopher	P&A	Astro	Observational Astronomy
Jones	Bryan	ECE/G	Technology	
Keilty	Kathryn	P&A/G	Astro	High Energy Observations/Lasers
Khabashesku	Valery	Chem/S		
Kittrell	Carter	Chem	GL: Instrumentation	Plasma rocket spectroscopy
Kloucek	Petr	CAAM	Space Weather	Computational Space Weather
Koller	Josef	P&A/G		
Lane	Neal	P&A		
Lassiter	William	F&E/S		exploration, astronomy
Latner	Alexis	Fondren/S	EPO	writes articles on space research
Lemon	Colby	P&A/G	Space Weather	Computational Space Physics Plasma
Lenardic	Adrian	G&G	GL: Explor-U	Planetary Physics, Io, Europa
Levy	Eugene	Provost	Astro	
Li	Yining	P&A/G	Astro	
Liang	Edison	P&A	GL:Astro	Astrophysics, High Energy, Laser/Plasma
Liebschner	Michael	BIOENG	Bioscience	
Lin	Dechun	P&A/G	Astro	Black holes
Lindsay	Bernard	P&A	Space Weather	Atomic Collisions
Linscott	Stephen	IS/S	Exploration, Astron, EPO	
Mack	Dinah	UG		
Martinez	Ipek	Budget Ofc		
McIntire	Larry	BIOENG	Bioscience	Bioscience
Meade	Andrew	MECH	Technology	
Mendell	Wendell	A/JSC	Exploration	
Menin	Jean-Louis	Provost's/S		
Merenyi	Erzsebet	ECE	Remote Sensing	
Meszlenyi	Roy	BIOENG	Bioscience	
Michel	Curt	P&A	Astro	Pulsars
Morris	Gary	P&A	Remote Sensing	
Naehr	Stephen	P&A	Space Weather	
Narbona	Jose	Hispanic&CS	EPO	
Oberlack	Uwe	P&A	GL: Techno, Astro	High Energy Astrophysics

Oliver	Robert	HIST	Hist/EPO	History, Biology, Exploration
O'Malley	Marcia	MECHE	Technology	
Ozturk	Kaan	P&A		
Padley	Paul	P&A	Astro	Particle Origins of Mass (Engineers)
Papanyan	Valer	ECE		
Pierce	George	Jones	Astro	
Reiff	Patricia	P&A	Director	Aurorae, Magnetosphere, Modeling
Reynolds	Daniel	CAAM		
Roberts	Margie	Economics		
Roush	Sherrilyn	Philosophy	GL: History	Reasoning
Sass	Ronald	EEB	Remote Sensing	Ecology
Sawyer	Dale	EarthSci	Exploration-U	Mars
Sazykin	Stan	P&A/S	Space Weather	
Siemann	Evan	EEB	Remote Sensing	
Smalley	Rick	CHEM		
Smith	Gwen	P&A/G	Exploration	
Smith	Ian	P&A	Astro	Astrophysics, (EPO)
Smith	Wayne	P&A/S		
Spanos	Pol	MECH	Technology	Aeronautical Eng'r: Civ E, Mech E
Spiro	Robert	P&A/S	Space Weather	Physics of Magnetospheres
Stebbins	Ronald	Emeritus:SPAC		Lab, Aeronomy
Stoll	Richard	PoliSci	Public Policy	
Streutker	David	P&A/G	Space Weather	Remote Sensing, (EPO)
Tannian	Bridget	ECE		
Toffoletto	Frank	P&A	Space Weather	Modeling, Space Weather
Unrau	Lia	News	EPO	Rice news
Vera	Jerry			
Vo	Trinh	CENG/G		
Wang	Jigang	P&A/G		
Wightman	Jennifer	CAAM/G	Space Weather	
Williams	Tom	Hist	History	History of Astronomy
Wolf	Richard	P&A	Space Weather	Magnetospheric Modeling, Space Weather
Wyatt	Rachel			
Yee	Weiqing	MECH		
Yepes	Pablo	P&A		
Yu	Bin	P&A		

Associate Members (Alumni, Adjuncts, Community, Industry)

Last Name	First Name	Status	Group GL = group leader	Research Interest
Anderson	Randy	community		
Benson	John	alumnus		
Bering	Edgar	community	WSC	
Brown	Robert	community		
Burke	Hsiao-Hua	alumnus		
Chang-Diaz	Franklin	Adjunct-P&A		
Dessler	Alex	Emeritus	Exploration; Space Weather	Jupiter's magnetosphere
Friesen	Larry	Alum: SPAC	Exploration; Public	
Galvan	Israel	community	WSC/SPS	
Kordzik	Kelly	Atty		Technology Transfer
Lach	John	community	WSC	
Lestrade	Patrick	A/SPAC	Astro	
Mendell	Wendell	alumnus	Exploration	
Netherland	Dennis	community		
Newman	James	alum; Adjunct	Exploration	
Nichols	Karen	P&A/S	EPO	Graphics for Educational Public Outreach
O'Rourke	Terry	Community		
Rhodes	Tristan	alum ('99)		
Schifflet	Mary	community	WSC	
Sumners	Carolyn	Adjunct-P&A	EPO	
Talent	David	alumnus	Technology; Astro	
Van Helden	Albert	Emeritus	History	