Annual Report on the Operation of the Lunar and Planetary Institute (NNX08AC28A)

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By
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Stephen J. Mackwell
Director
Lunar and Planetary Institute
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EXECUTIVE SUMMARY

Overview
Over the last twelve months the Lunar and Planetary Institute has continued to focus on scientific excellence both within the Institute and throughout the community. This year's efforts have resulted in planning for a new science initiative, bringing in a record number of postdocs, visiting fellows and interns and initiating the NASA Lunar Science Institute team activities.

It should be noted that wherever possible, the report only reflects the work at the LPI supported by this Cooperative Agreement (CAN) and should not be thought of as a comprehensive review of the activities of the Institute. Having said that, some discussion of non-CAN activities are necessary since leveraging CAN and non-CAN activities are an important way to cooperatively build a strong Planetary Science program. In these cases, the authors will clearly outline those efforts that are not funded by the CAN and those that are not.

Science
The Institute’s scientific activities continue to grow. Productivity in the Science arena at the LPI remained high, with 46 publications in the first 9 months in high-impact, peer-reviewed journals, and with 28 additional articles currently in press (Appendix I). Scientists and postdoctoral fellows were very active in professional meetings, with numerous oral and poster presentations (see Appendix II and III). Success at obtaining grants for scientific research from funding agencies remains high (Appendix IV), with over $2M in PI external science grants. Additionally, the proposal efforts in the NLSI competition resulted in LPI and the Astromaterials Research and Exploration Science (ARES) directorate at NASA JSC being selected as one of seven research teams to be funded. This four-year, $1.7M per year proposal also involves researchers at the University of Maryland, the University of Arizona, Notre Dame University, and Rice University, as well a lunar science teaching consortium of universities across Texas (including seven minority-serving institutions). In addition to this award, LPI scientists are also participating on the NLSI team at the Applied Physics Laboratory at The Johns Hopkins University.

The Institute continued to focus on workforce development and training the next generation of planetary scientists bringing in 34 summer interns and students. Sixteen of these summer participants were interns in the LPI/JSC Summer Undergraduate Intern program. Ten of these students participated in the Lunar Exploration Summer Interns program, developed at the LPI. This program was designed to bring lunar summer students to the Institute to work on science questions that are of interest to the NASA Constellation Systems central office at the Johnson Space Center (JSC). This year, five of these students were funded by the NLSI Cooperative Agreement and five were funded by the Constellation program. These two groups served as the core of the summer program with the remaining 8 students being supported directly from single PI grants.

This year the Institute had a class of 13 postdoctoral fellows working at the Institute and at JSC. Although the job market is very tight this year we did have two fellows complete
their stay and go on to jobs at JPL and CNRS. Four additional fellows moved on to another postdoc after completing their two or three year stay.

LPI scientists continue to participate in science missions both with NASA as well as other space agencies from around the world. LPI scientists Paul Spudis served as Instrument PI for the Mini-SAR instrument on the Indian Space Research Organization's Chandrayaan-1 Lunar Orbiter. Chandrayaan – 1 completed a successful mission this summer generating significant new data that the instrument team is currently working to process and interpret. Additionally, Dr. Steve Clifford has been appointed Deputy Science Team Lead for the WISDOM VHF ground penetrating radar and the EISS HF ground penetrating radar for ESA’s 2013 ExoMars Mission rover and lander respectively, and two LPI scientists are currently participating on Discovery class mission proposals, while the Director of the LPI, Dr. Stephen Mackwell is serving as PI of a third mission proposal. The Discovery class Mission proposals are expected to be submitted in early 2010.

After an extensive external search, Dr. David Kring officially joined the staff at the LPI as a Senior Staff Scientist, strengthening our lunar programs and complementing our current staff and activities. Dr. Kring was also named a Fellow of the Geological Society of America.

The LPI is also well represented on the NAS’s Planetary Science Decadal Survey with Dr. Stephen Mackwell serving on the steering committee and Inner Planets panel, and Dr. Allan Treiman serving on the Inner Planets panel. Dr. Mackwell also serves on the steering committee and Survey and Detection Panel for the NAS Committee to Review Near-Earth Object Surveys and Hazard Mitigation Strategies.

Service
The LPI Service organization is responsible for a variety of functions including meeting logistics, publications, scientific resources such as the library and the NASA RPIF, the LPI website, and all the electronic tools that make communication with the planetary science community possible.

In 2009, the LPI meeting group organized twenty-two (22) Meeting, Conferences and Workshops for the planetary science community in 2009. This number was down from last year largely due to the conference travel restrictions placed upon NASA by Congress. Now that these restrictions have been clarified, the LPI is expecting to see the continued growth experienced in the previous three years. To this end, the LPI is pleased to announce that it will be organizing the Astrobiology Science Conference 2010 to be held at South Shore Harbour in Houston, Texas.

This year also marked the 40th Lunar and Planetary Science Conference. It was the first year in the LPSC’s new home in North Houston at the Woodlands Waterway Marriott Hotel and Convention Center. The meeting had grown well beyond the capacity of the previous location at South Shore Harbour and although we were saddened to move this JSC tradition 50 miles north of the Center, the new venue will provide far greater flexibility in meeting organization, as well as provide an environment more suited
to a meeting of this scope. The meeting this year again exceeded 1500 participants from 23 different countries. Thirty percent of those in attendance classified themselves as students.

This year was the second year the LPI gave out Career Development Travel Awards. We had more than 250 applications and gave out 11 travel stipends. The winners of these stipends were recruited to work at the poster session and registration desk, allowing the LPI to reduce staffing costs while giving these young scientists an opportunity to meet a large cross-section of the planetary science community.

This year the LPI also sponsored, in partnership with ARES directorate at JSC, a grant writing workshop for young scientists. The workshop was open to all scientific staff at LPI, JSC and all surrounding colleges and Universities. Over 140 researchers took advantage of this one day workshop.

The Lunar Science and Exploration website continues to be an important resource for the Planetary Science community. This year we added a number of features that include:

1) The **Digital Atlas of Lunar Surface Flyovers**, which provides a spectacular view of the lunar surface and provides a new tool for scientists to study the geology of the lunar surface. It also provides a new tool for mission planners who need to select landing sites and design robotic and crew traverses. The atlas is being initiated with three flyovers and will grow as new missions provide additional data.

2) The **Lunar Impact Crater Database**, which is a GIS-compatible database with nearly 9000 lunar impact craters. Information about the size and location of each crater is integrated with calculations of impact-related physical parameters and, when available, the age of the crater. This database of real lunar craters complements our existing Lunar Impact Cratering tool, which provides students an opportunity to create their own lunar impact craters.

3) **Lunar (and Planetary) Science Conference Abstracts**. Online versions of the abstracts published between 1971 and 1996 (the famous yellow tomes) are now available, which doubles the number of abstracts available and brings the total to nearly 50,000 two- and three-page papers.

4) The **Database of Lunar Spacecraft Instruments** provides a list of lunar instruments and a search engine that can be used to sort specific types of instruments and their measurement capabilities. This site augments our existing website with Lunar Mission Summaries.

5) The **Lunar Sample Atlas** is a library of images that provides pictures of the Apollo samples taken in the Lunar Sample Laboratory, full-color views of the samples in microscopic thin-sections, cutting views and diagrams that illustrate how the samples were subdivided for scientific analyses, and in situ views of the samples on the lunar surface. The atlas contains information about the type of sample (e.g., rock, soil), the lithology (e.g., basalt, norite), and a description of the sample. Links to additional information about each sample are provided for those that have been previously described in The Lunar Sample Compendium and Lunar Sample Catalogs.
Education and Public Outreach (E/PO)

The LPI education program has had a very successful year reaching approximately 60,000 teachers, children and parents. The LPI only supports a small portion of the education activities out of the funding provided by the cooperative agreement, as most of the activities are supported by outside funding.

In addition to managing the NLSI funded LPI-JSC team’s education program, the LPI is also leading the education efforts for the SWRI team and collaborating with APL on their education efforts. Beyond the new NLSI funded activities, the LPI has been funded by SMD education to develop a new media portal called, MyMoon. This interactive website builds on the LPI's significant web presence and is designed to engage the general public of science enthusiasts between the age of 18 and 35. The website has received positive reviews and continues to grow in popularity.

Finally, the E/PO efforts successfully proposed to the Planetary Science Forum request for proposals in the spring. The LPI lead a team that included the Jet Propulsion Laboratory, Emily CoBabe and Associates, and the Mid-continent Research for Education and Learning (McREL). The Forum will work closely with the Planetary Science Education and Public Outreach (E/PO) Community and the Science Mission Directorate (SMD) Planetary Sciences Division Lead and the SMD E/PO Lead to increase the overall coherence of the SMD E/PO Portfolio of products and activities.
APPENDIX I: Peer-reviewed Publications

Published


In Press


Submitted


APPENDIX II: Conference Attendance and Abstracts Presented


Clifford


Filiberto


**Fu**


**Heggy**


**Gross**


**Hui**

Ito


Kiefer


Kiefer W.S. (2008), Gravity Evidence for Radiating Dike Swarms in the Thaumasia Region of Mars, American Geophys. Union Fall Meeting, abstract P52B-03. INVITED TALK.


**Kirchoff**


**Kirkland**


**Kring**


**Lasue**


Mackwell


McGovern


Moses


Park


Schenk


**Schwenzer**


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**Shafer**


**Spudis**


**Stepinski**


Treiman


Visscher


Wittmann


Wood


Zhang

APPENDIX III: Invited Presentation

Clifford


Filiberto

2) J. Filiberto (2009) Martian Magmas were Chlorine-rich and Water-poor. Institute of Meteoritics, University of New Mexico.

Ito

Kiefer

2) Kiefer, W.S. (2008), Gravity Evidence for Radiating Dike Swarms in the Thaumasia Region of Mars, AGU Fall Meeting, abstract P52B-03.


Kirchoff
Kring


2) **Kring, D.A.** “Cataclysmic bombardment throughout the inner solar system,” ESLAB 2008, Frascati, Italy. (November 2008).


7) **Kring, D.A.** “Targeting Complex Craters and Multi-Ring Basins to Determine the Tempo of Impact Bombardment while Simultaneously Probing the Lunar Interior,” LRO Science Targeting Meeting, Tempe, AZ. (June 2009).

Lasue

1) **Lasue J.** “Solid component of comets: from dust to cometary nuclei”, Los Alamos National Laboratory (Los Alamos, NM, USA) January 2009.

McGovern


Moses

1) **Moses, J.I.** (2009), Meridional And Temporal Variability In Saturn’s Middle And Upper Atmosphere, *European Planetary Science Congress*, Potsdam, Germany, abstract # EPSC2009-331, (September 13-18, 2009).

Park

1) **Park J.** $^{39}$Ar-$^{40}$Ar study of Martian shergottites and nakhlites and its implication for

Schwenzer
1) **Schwenzer S. P.:** Impact craters on Noachian Mars: alteration assemblages and implications.– talk at the LPI, on April 17, 2009.
2) **Schwenzer S. P.:** Impact craters on Noachian Mars: potential places of hydrothermal activity and clay formation.– talk at the seminar of Southwest Research Institute, Boulder Colorado, on January 13th, 2009.

Spudis
2) **Spudis P.D.,** and 14 others (2009) The Mini-SAR imaging radar on the Chandrayaan-1 mission to the Moon. 2nd NASA Lunar Science Forum, Special International Missions session

Treiman

Visscher

Wittman
1) **Wittmann A.** (2009), “Formation and emplacement of impactites in large terrestrial impact structures”. In NIR – Network on Impact Research, A PhD-student workshop and excursion with a special invited session on Crater mechanics and structural characteristics, Gol, Norway, June 8-11, 2009.
1) Zhang S., Livi K., and Veblen D. (2009) Quantification of manganese valence states using Mn L$_{2,3}$ electron energy-loss near-edge spectra. Microscopy and microanalysis meeting in July 2009 in Richmond, VA.
APPENDIX IV: Funding

ACTIVE

1. **S. Clifford**
   02/2009 – 01/2013

2. **S. Clifford**
   2003 – 2010

3. **S. Clifford**
   2007 - 2010

4. **S. Clifford**

5. **S. Clifford**

6. **S. Clifford**
   *Professeur Invité*, Institut de Physique du Globe de Paris and Université Paris 7, Paris, France,

7. **S. Clifford**
   Visiting Professor, University of Versailles, LATMOS (formerly CETP), Velizy, France.
   “*Geologic and Geoelectrical Modeling of the Martian Subsurface in Support of the WISDOM GPR for the 2016 ExoMars Mission,***
   2009 - 2010.

8. **S. Clifford**
   Visiting Professor, University of Grenoble, Le Laboratoire de Planétologie de Grenoble (LPG), Grenoble, France. “*Investigations of Martian Geology and Hydrology by the MARSIS, SHARAD, and WISDOM GPRs***.
   2009 - 2010.
9. **S. Clifford**
Co-Investigator, CNRS research travel grant for participation in European MARSIS and SHARAD Team meetings, Essam Heggy (PI) 2007-2009.

10. **J. Filiberto**
*Acid Fog on Mars II: Experimental and Analytical Studies Of Sulfur and Halogens in Martian Basalts and their Fluids.* NASA Mars Fundamental Research Program
05/2009 – 05/2011

11. **M. Ito**
“Coordinated microanalytical studies of refractory inclusions in carbonaceous chondrites” NASA Origins program (10/1/08 – 9/30/12), Messenger S. is PI, Ito M. is Co-I for ~ 60% salary.

12. **M. Ito**
“Origin and history of the solar system starting materials” NASA Cosmochemistry (10/1/08 – 9/30/12), Messenger S. is PI, Ito M. is Co-I for ~ 10% salary.


13. **W.S. Kiefer**
*Improved Models of Mantle Convection and Magma Production on Present-day Mars* NASA Mars Fundamental Research Program,

14. **W.S. Kiefer**
*Mars Inside and Out: Exploration Modules Comparing Mars and Earth for After-school Programs* EPO supplement to Mars Fundamental Research Program grant,

15. **W. S. Kiefer**
*Lunar Prospector Gravity Observations as Constraints on Lunar Volcanic Processes* NASA Discovery Data Analysis Program,

16. **W. S. Kiefer**
*Accessing the Moon: Earth-Moon Comparison Web Portfolios and Institutes for K-12 Educators* EPO supplement to Discovery Data Analysis Program grant,
02/2008 – 02/2010.

17. **W. S. Kiefer**
*Modeling the Martian Gravity Field: Constraints on Subsurface Structure and Lithospheric Properties in Ancient Tharsis and Along the Hemispheric Dichotomy* NASA Mars Data Analysis Program,

18. **W. S. Kiefer**
*Improved Models of Magma Production and the Thermal Evolution of Mars* NASA Mars Fundamental Research Program,
19. W. S. Kiefer

20. W. S. Kiefer

21. W. S. Kiefer

22. W. S. Kiefer

23. W. S. Kiefer

24. D.A. Kring
Petrological and Geochemical Studies of Impact Melts and Impact Breccias. NASA Cosmochemistry Program

25. D.A. Kring
Modeling of the Thermal Evolution of Impact-Generated Hydrothermal Systems on Mars. NASA Mars Fundamental Research Program

26. D. A. Kring
Chariot-GPR Integration and Field Test Involving Signal Ops to Simulated Mission Control and Science Backroom. NASA Moon and Mars Analogue Missions Activities
7/2008 - 12/2009

27. D. A. Kring
MyMoon: The Public’s Portal to Lunar Science Exploration through New Media. NASA Opportunities in Science Mission Directorate Education and Public Outreach
1/2009 - 12/2012

28. P. J. McGovern
29. P.J. McGovern

30. P. J. McGovern

31. P. J. McGovern

32. J. I. Moses

33. J.I. Moses

34. J. I. Moses

35. J.I. Moses

36. P. Schenk

37. P. Schenk

38. P. D. Spudis
Principal Investigator, *Mini-SAR and Mini-RF experiments*, Applied Physics Laboratory, approx. 6 months.
Co-Investigator, *NLSI Impact Processes Grant*, PI: D. Kring, LPI., approx. 1 month
39. T. F. Stepinski
*III-CTX-Small: Collaborative Research: Automatic Geomorphic Mapping and Analysis of Land Surfaces Using Pattern Recognition* NSF Science and Engineering Information program Award Period Covered:
09/01/08 – 08/31/11

40. T.F. Stepinski
*Automated Identification and Characterization of Landforms on Mars.* NASA AISRP. Award period covered
03/15/06 – 03/14/09.
Extended to 03/14/10

41. T.F. Stepinski
*Global GIS Database of Drainage on Mars.* NASA MDAP. Award Period Covered:
05/16/08 – 05/15/11

42. T.F. Stepinski
*Automatic Detection of Sub-Kilometer Craters in High Resolution Planetary Images.* NASA AISRP Award period covered 09/1/09 – 08/31/12.

43. A. H. Treiman

44. A. H. Treiman

45. A. H. Treiman

46. A. H. Treiman

47. A. H. Treiman

48. A.H. Treiman
49. **A. H. Treiman**  
*Acid Fog on Mars: Experimental and Analytical Studies Of Sulfur and Halogens in Martian Basalts and their Fluids.*  

50. **A. H. Treiman**  
*Antarctic Mars Analogue Svalbard Expedition.* NASA ASTEP.  

51. **A. H. Treiman**  

**PENDING**

1. **S. M. Clifford**  
*Investigations of Volatile and Mineralogical Processes in the Cryosphere and Vadose Zone of Mars* Co-Investigator, NASA Mars Fundamental Research Program, 2010-2013. (Pl: J. Lasue)

2. **Q. Fu**  
Experimental Investigation on Reaction Pathways and Isotope Signatures of Abiotic Organic Synthesis in Hydrothermal Systems NASA Astrobiology: Exobiology and Evolutionary Biology 09 Call

3. **J. Filiberto**  
*Volatile (H2O, Cl, and F) Element Abundances of Planetary Basalts: Constraints from Apatite and Amphibole.* NASA Cosmochemistry Program  
*Retrieving the Parent Magma of Martian Meteorites from Melt Inclusions: Development of Verifiable Analytical Methodologies.* NASA Mars Fundamental Research Program

4. **M. Ito**  
*“Diffusion kinetic, Thermal History and Thermodynamic Studies of Planetary Materials and Systems”* Submitted to NASA Cosmochemistry (2009) Ganguly J. (University of Arizona) is PI, Ito M. is Co-I.

5. **W. S Kiefer**  
*Impact-Induced Thrust Faulting along the Martian Hemispheric Dichotomy* Mars Data Analysis Program, submitted August 2009.  

6. **M. R. Kirchoff**  
*“Analyzing impact crater distributions of outer solar system satellites.”* NASA Outer Planets Research Program, 2008 Requested: 75% effort in years 1, 2 and 3  
*“Constraining impactor populations and histories of Saturn’s satellites with impact crater distributions of regular and irregular satellites.”* NASA Cassini Data Analysis Program 2009 Requested: 40% effort in years 1, 2 and 3
7. **D.A. Kring**  

8. **J. Lasue**  
*Comprehensive Classification of Interplanetary Dust Particles from Terrestrial Collections.* NASA Cosmochemistry 01/2010 – 12/2012

9. **J. Lasue**  
*Volatile and Mineralogical Processes in the Cryosphere and Vadose Zone of Mars.* NASA Mars Fundamental Research 01/2010 – 12/2012

10. **J. Moses**  
*Clues to the Deep Water Abundance on the Giant Planets from Novel Chemical Kinetics and Transport Models,* NASA Planetary Atmospheres Program (NNH08ZDA001N). J. Moses (PI) and C. Visscher (Co-I)

11. **J. Park**  

12. **P. Schenk**  
*Viscous relaxation and thermal histories of the icy Saturnian satellites.* NASA Outer Planet Research Program. May 2010 to April 2013

13. **P. D. Spudis**  
Co-Investigator, *NLSI Polar Processes Grant,* PI: B. Bussey, APL, approx. 2 months.

14. **S P. Schwenzer**  

15. **T. F. Error! Reference source not found.** Comprehensive Classification of Interplanetary Dust Particles from Terrestrial Collections. NASA Cosmochemistry. Award period covered 01/01/10 – 12/31/12.

16. **A. H. Treiman**  
17. C. Visscher
Clues to the Deep Water Abundance on the Giant Planets from Novel Chemical Kinetics and Transport Models, NASA Planetary Atmospheres Program (NNH08ZDA001N). J. Moses (PI) and C. Visscher (Co-I)
APPENDIX V: Service to NASA and the Scientific Community

Clifford
- Deputy Science Team Leader, WISDOM VHF ground penetrating radar (Valerie Ciarletti, PI), Pastuer instrument payload for ESA’s 2016 ExoMars Mission rover.
- Deputy Science Team Leader, NetStation ground penetrating radar (Valerie Ciarletti, PI). A network implementation of the EISS HF GPR originally developed for the ExoMars Humbolt Payload. With the cancellation of the Lander component of the ExoMars mission, EISS is being redesigned (with encouragement from CNES and ESA) for possible inclusion in the stand-alone and multi-station geophysical missions ESA plans to fly with NASA in 2018 and 2020.
- Member, ExoMars Science Working Team (ESWT), group responsible for identifying and developing the operational strategy for addressing the science objective of the ExoMars Mission. Composed of representatives of ESA management and each of the ExoMars instrument teams.
- U. S. Participating Scientist, MARSIS orbital radar sounding instrument (Giovanni Picardi and Jeff Plautt, PIs), ESA Mars Express Mission (currently in orbit).
- Science/Instrument Team Co-I, CONSERT HF radar orbiter/lander (Wlodeck Koffman, PI) on ESA’s ROSETTA comet mission, already in flight.
- Member, Committee for Planetary and Terrestrial Analogs, U.S. Subglacial Antarctic Lake Environment (SALE) Program, 2005 – present.

Filiberto
- LPSC Program Committee (2009)

Kiefer
- Venus Science and Technology Definition Team (2008-2009)
- Venus Exploration Analysis Group (2005–present)
- Outer Planets Research Program Review Panel (2009)
- Lunar Geophysical Instrument Package instrument development team (2006- )
- Venus High Temperature Seismometer instrument development team (2009- )

Kring
- Serving on LEAG Lunar Exploration Roadmap Committee (2008 –2009)
- Serving on LEAG Surface Scenarios for Human Exploration Committee (2009)
- Serving on the NLSI Executive Council (2009)
- Trained crew EVA test subjects how to conduct science operations (photography, sample collection, trenching, etc.) in NASA JSC outdoor analogue test facility (2008)
- Designed crew EVA traverses for a simulated lunar mission at Black Point Lava Flow: (a) two 1-day traverses to compare productivity of un-pressurized rover vs. that of pressurized rover; (b) one 3-day traverse in pressurized rover (2008)
- Conducted science operations in 4 simulations of lunar missions at the Black Point analogue test site (2008)
• Conducted field work at 4 other lunar analogue test sites, to prepare for future simulations of lunar missions (2008); briefed NASA about options (August 2009)
• Provided briefing materials about a lunar analogue site to a NASA JSC spectroscopy group wanting to field test a hand-held spectrometer for lunar crew (2008)
• Initiated the planning phase for a simulation of a 14-day-long lunar surface mission using the Lunar Electric Rover traverse concept. I hosted a planning workshop (March 2009) at the LPI. I led the design of a 1-day traverse and the design of a 3-day-long segment of a 14-day-long traverse. I am serving as a traverse PI during the simulated lunar mission at Black Point Lava Flow (2009), which is part of NASA's Desert Research and Technology Studies program and its support of NASA’s Constellation Lunar Surface Systems assessment and NASA’s Optimizing Science and Exploration Working Group.
• Supported “Space Nuclear Systems Forum 2009” at NASA JSC, which explored possible power systems for the lunar exploration architecture (2009)
• Created a digital data base to support NASA’s lunar analogue mission activities (2009); the data base is now being used by Constellation’s Lunar Surface Systems group, NASA Headquarters, and individuals at several NASA centers.
• Reviewed proposals for Mars Fundamental Research Program (2008)
• Reviewed proposals for Mars Data Analysis Program (2008)
• Authored a Statement about “Space: An Essential Frontier for Our Nation's Future” in response to a request from the Space Studies Board of The National Academies (2009).
• Provided an analysis of 3 lunar surface campaigns for the U.S. Human Space Flight Plan Review Committee (aka the Augustine Commission) (July 2009)
• Co-authored a Statement from the NLSI Executive Council to the U.S. Human Space Flight Plan Review Committee (July 2009)
• Authored a White Paper about “Using the Moon to Explore the Entire Solar System,” for the U.S. Human Space Flight Plan Review Committee (August 2009)

Lasue
• Science Working Group member for the European cometary mission Rosetta.
• Collaboration with the French Space Agency to prepare the rendez-vous of the European cometary mission Rosetta.
• COMetary Nucleus Sounding Experiment by Radiowave Transmission (CONERT), science team member.

McGovern
• NASA Mars Fundamental Research (MFRP) Review Panel (2008)
• NASA Planetary Geology and Geophysics (PG&G) Review Panel (2009)
• Science Team Member, Discovery Program submission “SAR Mission to Venus”

Moses
• Board Member, Cassini Senior Review (2009)
• Committee Member, NASA Planetary Systems Science - Management Operations Working Group (2007-present)
• Science Co-Investigator, Io Volcano Observer, Discovery Mission to be submitted; Alfred McEwen, P.I. (2009 – present)
• Science Team Member, UVS Instrument to be proposed, Outer Planet Flagship Mission; Kurt Retherford, P.I. (2009 – present)
- Panel Chair, NASA Outer Planet Research Program Proposal Review Panel (2008)
- PDS Atmospheres Node Advisory Group (1996 – present)

**Schenk**
- OPAG (Outer planet analysis group) Member, 2002-present, attend at least one of two meetings each year.
- Associate Team Member New Horizons Imaging Team: 2004-2009.

**Spudis**
- Panel member, Planetary Geology and Geophysics, Group D (Geology), Aug. 2008.
- NASA Planetary Data Facilities, LPI Data Facility Director, 2008-present.

**Treiman**
- NRC Decadal Survey: Member of Inner Planets panel (Mercury, Venus, Moon). June 2009 – present.
- VSTDT (Venus Science and Technology Definition Team), chair of Geochemistry Sub-group. 2008-2009.
- Lunar Sample Acquisition and Curation Review Team, Member Nov. 2008 – present.
- CAPTEM (Curation and Analysis Planning Team for Extraterrestrial Materials), Member, 2007 - present.
- VEXAG (Venus Exploration Analysis Group): Member of Steering Committee. May, 2008 - present.
- VEXAG (Venus exploration analysis group) Member, 2005 - present.

**Scientific Community**

**Clifford**
- Associate Editor:
  - --Astrobiology, Mary Ann Liebert, Inc. (2000 – present)
- Member, American Geophysical Union (1982 – present)

**Kiefer**
Kirchoff
- Dwornik Judge, LPSC XL, March 23-27, 2009

Kring
- Chair, Barringer Family Fund for Meteorite Impact Research (2008-2009)
- Chair, Eugene Shoemaker Impact Crater Award (2008-2009)
- Implemented periodic upgrades to LPI's Lunar Science and Exploration information portal. Two major upgrades were released in October 2008 and March 2009.
- Organized Workshop on Early Solar System Bombardment (held Sept 15-16, 2008)
- Organized a tutorial and prepared a “Field and Sample Guidebook to Apollo Impact Melt Breccias” that was given during the Workshop on Early Solar System Bombardment.
- Co-organizer of Workshop on Modeling Martian Hydrous Environments (to be held June 2009); although I am a co-organizer with Schwenzer and Clifford, Schwenzer should get most of the credit for this activity.
- Served on 2009 LPSC Program Committee (January 2009)
- With LPI staff, created a Lunar Sample Atlas (August 2009)
- Co-Chair, NLSI Focus Group on Impact Bombardment (which is also preparing input for the Decadal Survey)
- Co-Chair, NLSI Focus Group on the South Pole-Aitken Basin (which is also preparing input for the Decadal Survey)

Lasue
- Member, American Geophysical Union (2009-present)
- Member, Société Française d’Astronomie et Astrophysique (SF2A) (2004-present)
- Member, Europlanet exchange program for European planetary scientists (2007-present)

Moses
- Program Committee, Lunar and Planetary Science Conference (2009)
- Member, American Geophysical Union
- Member, American Astronomical Society, Division for Planetary Sciences.

Schenk
- Scientific Editor, *Lunar and Planetary Information Bulletin*

Schwenzer
- Organizer of the workshop: Modeling Martian Hydrous environments, June 1-3, 2009 in Houston, TX.
Treiman
• Associate Editor, Meteoritics & Planetary Sciences.
• LPSC Program Committee January, 2009.
• Convenor, Topical Session on Martian Meteorite Alteration. 2008 GSA Annual Meeting (October 2008).

Visscher
• Panel Judge, LPI Career Development Award, February 2009
APPENDIX VI: Education/Public Outreach Activities

Clifford
- Developing a science unit with Kenji Yoshikawa (University of Alaska, Fairbanks) on “Permafrost on the Earth and Mars” for native high-school students who are in charge of the long-term monitoring of the temperature in permafrost boreholes at ~40 remote villages throughout the Alaskan Arctic.

Gross
- Helping with Family and Space days

Filiberto
- Public talk about Mars Rocks, Falcon Pass Elementary School, May 2009
- Public talk A Martian Christmas, Mendel Elementary School, Dec 2008
- Teacher Training Workshop/Field Course: The Heat from Within: earthly insights into planetary volcanism, Eugene Oregon, 2009

Kiefer
- “Mars: The Inside Story” for Houston Health Museum, August 1, 2009.
- Content development and scientific review of LPI Education Products.

Kirchoff
- Science Fair Judge – K. E. Little Elementary 4th Grade, Dickenson, TX, April 2009

Kring
Kring

- Science Expert, film documentary about the Constellation program. Pre-production phase (2008). Kring is coordinating with the Constellation PR liaison at JSC. The goal is to generate a 10-yr-long series of films.
- Assisted with the scientific content and design of 3 educational posters about the Moon (2008).
- Science Expert, film documentary about asteroid impact on Earth; Episode titled “Asteroids” for the “How the Earth was Made” series on The History Channel (2009).
- Science Expert, pre-production phase regarding a special about Asteroid impacts for the National Geographic Channel (2009).
- Science Expert, BBC Radio show about lunar exploration, the Constellation Program, and simulation of a lunar robotic reconnaissance mission (2009)
- Science Expert, one-hour debate for NPR’s “On Point” (produced by Boston’s WBUR) about lunar and Mars-forward exploration vs Mars-direct colonization (2009)
- Science Expert, for production by Interstellar Studios, which is producing a PBS special about lunar exploration and inspiring the nation’s youth (2009)
- Provided an illustration for the textbook “Planetary Sciences” by Jack Lissauer and Imke de Pater (April 2009).
- Co-host of the Lunar Consortium for Higher Education, which is a collaborative effort involving faculty from 13 Texas universities (2009)
- Generated approximately a dozen classroom illustrations that are being distributed as part of the NLSI-CLSE training and education program (2009)

Lasue

- Public outreach seminar organized by Santa Fe Accueil (2009)

McGovern

- Co-convener and Lecturer, Rice University Earth Science Seminar ESci 524: “Advanced Topics in Earth Structure and Deformation: Comparative Lithosphere Structure and Deformation on Earth and the Terrestrial Planets”

Moses

- Manager, LPI Summer Intern Program: (2004-present)

Schwenzer

- 2 talks to 6th graders at the Science Discovery day of Zue Bales Intermediate School, March 12, 2009
Schenk
- Also interviewed 2 to 3 times a year concerning Saturn (or Jupiter) system discoveries.
- TV interview for Discovery Channel, Aug 19, 2009.
- Beyond the Cradle: new contributor to on-line “blog” of commentary group discussing personal or philosophical aspects of Space. April 2009 and future.

Spudis
- Invited speaker, LPI/USRA 40th Anniversary Series, 2008
- Speaker, LPI Cosmic Horizons Program, April 2009
- Speaker LPI Teacher’s Workshop, 2008-2009
- Speaker, NASA Exploration Interns, 2008-2009

Stepinski
- Served on PhD proposal defense committee for Chun-Sheng Chen who is a student at Computer Science department in U of H. The thesis title,”Finding Interesting Patterns in Spatial Datasets By Using Density Functions .” (Jan 17, 2009)

Treiman
- Organizer and Instructor for LPI Summer Planetary Geology Workshops for Science Teachers 2009.
- Present two public talks on the science of climate change.
- Talk to LPI Summer Interns on the amphibole-bearing chondrite, LAP 04840. June 2009.
APPENDIX VII: Mentoring

Clifford
- Francois Ruether, Imperial College of London, LPI No-Cost Visiting Summer Intern, 2009.
  - Tiffany Kataria, Stony Brook University, Stony Brook, NY. 2008 LPI Summer Intern with whom I continued research on comet structure through December 2008.
  - Julie Cosmidis, École Normale Supérieure de Lyon, Lyon, France. Current PhD candidate and 2007 LPI No-Cost Visiting Graduate Fellow.
  - Donald Barker, Department of Geosciences, University of Houston, Houston, TX. Current PhD candidate.

Galgana
- Assisted Dr. Pat McGovern with advising summer intern; Used image processing system for visualizations of Magellan imaging radar and digital elevation data.

Gross
- Assisted Dr. Allan Treiman with advising summer intern.

Ito
- PhD. Advisor: Kaori Jogo, University of Kyushu, Department of Earth and Planetary Sciences “Mineralogy and Mn-Cr isotopic systematics of secondary fayalite in CV3 carbonaceous chondrites: Implications to the nature and time scale of aqueous alteration during a parent body process” 2008/06 to present.

Kiefer
- LPI/NASA Summer Intern Program
- Supervised LPI Post-doc Qingsong Li (2006-2009)

Kring
- Secondary advisor of a Ph.D. student at the University of Arizona
- Helped a Ph.D. student at Humboldt University (Berlin, Germany) with a project for his dissertation. A paper with project results was published in January 2009 and the work was a chapter in his Ph.D. thesis.
- Advised student as part of the LPI/NASA Summer Intern Program (2009)
- Managed the NLSI/CLSE Lunar Exploration Summer Intern Program (2009), which involved ten visiting students.
- Advised visiting UK graduate student at LPI (2009)
- Advised an undergraduate intern projects at the University of Houston (2009)
- Mentored two post-doctoral researchers (2009)
Lasue
- LPI/NASA Summer Intern Program (2009)

McGovern
- LPI/NASA Summer Intern Program (2009)
- Masters student from Rice University (2007 – 2009)
- PhD Student from Rice University (2007 – 2009)

Moses
Advisor, undergraduate student Sarah Saslow, LPI Summer Intern Program (2009)
- Advisor, LPI postdoc Channon Visscher (2009)

Schenk

Shafer
- Undergrad student from University of Houston

Spudis
- Summer Intern Advisor, Chelsea Payne, Univ. Wisconsin, 2009, Project: Radar backscatter properties of the Moon from Mini-SAR data
- Post-doc (co-advisor), Catherine Neish, Applied Physics Laboratory, Project: Mini-SAR and Mini-RF radar data processing and interpretation

Stepinski
- Chaitanya Bagaria (June-August 2009), graduate student, University of Houston
- Lourenco Bandeira (June-August 2009), graduate student, Technical University of Lisbon, Portugal
- Josue Salazar (June-August 2009), undergraduate student, University of Houston Clear Lake
- Jue Wang (June-August 2009), undergraduate student, University of Massachusetts Boston
- Jonathan Mclane (June-August 2009), undergraduate student, LPI intern, University of Minnesota
- Sam Bell (June-August 2009), undergraduate student, LPI intern, University of Massachusetts, Amherst
- Wei Ding (June-August 2009) assistant professor, University of Massachusetts Boston

Treiman
- LPI/JSC Summer Intern Program 2009, Ms. Katie Robinson, of Univ. Chicago.
- Post-doctoral researcher: Justin Filiberto (2006 - 2009)
- Post-doctoral researcher: Juliane Gross (2009 – present)
- Post-doctoral researcher, probable: To be named (2006 - present)
- M.S. student at University of Houston: Heather Berglund (2007 - 2009)
Wittmann
- LPI/NASA Summer Intern Program: Undergraduate student from the University of New Brunswick, Canada.
APPENDIX VIII: Meeting, Conferences and Workshops

2009

**Inaugural Meeting of Small Bodies Assessment Group (SBAG);** January 12-13, 2009; College Park, Maryland; Faith Vilas (MMTO), Chair.

**Space Nuclear Systems Forum;** February 10-12, 2009; NASA Johnson Space Center, Houston, Texas; Attendance: 95; Shannon Bragg-Sitton (Texas A&M University); Michael Houts (NASA Marshall Space Flight Center); Steven D. Howe (USRA Center for Space Nuclear Research); John Scott (NASA Johnson Space Center).

**Venus Geochemistry: Progress, Prospects, and New Missions Workshop;** February 26-27, 2009; Lunar and Planetary Institute, Houston, Texas; Allan Treiman (Lunar and Planetary Institute)


**Spring CAPTEM meeting;** March 28-29, 2009; Lunar and Planetary Institute, Houston, Texas. Attendance 30; Chair: Meenakshi Wadhwa (Arizona State University)

**Spring Meteorite Working Group meeting;** March 28-29, 2009; The Woodlands, Texas. Attendance 15; Chair: Marc Caffee (Purdue University)

**Workshop on Micro-Raman Spectroscopy and Luminescence in the Earth and Planetary Sciences;** April 2-4, 2009; Mainz, Germany; Arnold Gucsik (Max Planck Institute for Chemistry)

**LEAG Extended Roadmap Meeting; May 4-7, 2009;** Lunar and Planetary Institute, Houston, TX; Attendance: 21; Chair: Clive Neal (University of Notre Dame)

**Lunar Sample Acquisition and Curation Review Panel;** May 7-8, 2009; Lunar and Planetary Institute, Houston, TX; Chair: Charles Shearer (University of New Mexico)

**Lunar Exploration Analysis Group (LEAG) Specific Action Team (SAT) regarding Surface Scenarios;** May 27-29, 2009; NASA Goddard Space Flight Center in Greenbelt, MD; Chair: Clive Neal (University of Notre Dame); travel support only for ~8 participants

**Workshop on Modeling Martian Hydrous Environments;** June 1-3, 2009; Lunar and Planetary Institute, Houston Texas; Susanne Schwenzer (USRA/Lunar and Planetary Institute); David Kring (USRA/Lunar and Planetary Institute); Stephen Clifford (USRA/Lunar and Planetary Institute).
Lunar Reconnaissance Orbiter Science Targeting Meeting; June 9-11, 2009; Tempe, Arizona; Mark Robinson (Arizona State University); Lisa Gaddis (U.S. Geological Survey); Brad Jolliff (Washington University); John Keller (NASA Goddard Space Flight Center); Samuel Lawrence (Arizona State University); Stephen Mackwell (USRA/Lunar and Planetary Institute); Wendell Mendell (NASA Johnson Space Center); Clive Neal (University of Notre Dame); Harrison Schmitt (University of Wisconsin/Madison); Dave Smith (NASA Goddard Space Flight Center); Jeff Taylor (University of Hawaii).

The Heat From Within: Early Insights into Planetary Volcanism Field Trip; July 12-19, 2009; Eugene, Oregon; Attendance: 32; Stephanie Shipp (USRA/Lunar and Planetary Institute).

72nd Annual Meeting of the Meteoritical Society; July 13-18, 2009; Nancy, France; Marc Chaussidon (CRPG-CNRS-Nancy); Guy Libourel (CRPG-Nancy); Bernard Marty (CRPG-Nancy).


New Mars Chemistry Workshop; July 27-28, 2009; Tufts University; Medford, Massachusetts; Attendance: 59; Michael Hecht (Jet Propulsion Laboratory); Samuel Kounaves (Tufts University).

Workshop on Antarctic Exploration Parallels for Future Human Planetary Exploration: The Role and Utility of Long Range, Long Duration Traverses; August 4-6, 2009; Lunar and Planetary Institute and NASA Johnson Space Center, Houston, TX; Attendance 50; Stephen Hoffman (SAIC).

OSEWG/LEAG Workshop on Robotics Supporting Human Science and Exploration; August 5-7, 2009; Lunar and Planetary Institute, Houston, Texas; Attendance: 73; Jennifer Heldmann (NASA Headquarters); Matthew Deans (NASA Headquarters).

LPI Summer Intern Conference; August, 2009; Lunar and Planetary Institute, Houston, Texas; Julianne Moses (LPI).

Workshop on the Microstructure of the Martian Surface; August 27-29, 2009; University of Copenhagen, Denmark; Thomas Pike (Imperial College); Urs Stauffer (University of Neuchatel); Michael Hecht (Jet Propulsion Laboratory); Morton Bo Madsen (University of Copenhagen); Walter Goetz (Max Planck Institute for Solar System Research)

Fall CAPTEM meeting; October 13-15, 2009; Lunar and Planetary Institute, Houston, TX; Attendance: Chair Meenakshi Wadhwa (Arizona State University)

Annual LEAG Meeting; November 16-19, 2009; Lunar and Planetary Institute, Houston, Texas; Clive Neal (University of Notre Dame); Bradley Carpenter (NASA Headquarters); Jeff Taylor (University of Hawaii); Paul Eckert (The Boeing Company); Stephen Mackwell (USRA/Lunar and Planetary Institute);
Gerald Sanders (NASA Johnson Space Center); Michael Wargo (NASA Headquarters); Thomas Morgan (NASA Headquarters); Charles Shearer (University of New Mexico).
APPENDIX IX: Department of Education and Public Outreach

The Lunar and Planetary Institute (LPI) Department of Education and Public Outreach (E/PO) focuses on preparing formal and informal educators, through materials development and training, to infuse Earth and planetary science into their programmatic efforts.

Staff - The Department is headed by Dr. Stephanie Shipp, with Education Specialists Ms. Christine Shupla, Ms. Keliann LaConte, and Mr. Andrew Shaner, and Education Assistant Buckaloo. It is anticipated to grow by at least one Education Specialist before the close of 2009, as a new Planetary Science E/PO Forum Coordinator is added to the team.

Programs

Planetary Science Education and Public Outreach Forum – Beginning in FY2010, the LPI, Jet Propulsion Laboratory (JPL), Emily CoBabe and Associates, and the Mid-continent Research for Education and Learning (McREL) will serve as the new Forum. The Forum will work closely with the Planetary Science Education and Public Outreach (E/PO) Community and the Science Mission Directorate (SMD) Planetary Sciences Division Lead and the SMD E/PO Lead to increase the overall coherence of the SMD E/PO Portfolio of products and activities. The SEPOF will facilitate:

- Communications activities that result in collaboration, and leveraging among Planetary science E/PO community members.
- Paths for new E/PO members, including planetary scientists, to become involved in E/PO activities.
- Integrative activities in which major planetary science discovery themes offer the organizational framework for presenting past, present, and future SMD E/PO programs, products and activities, and development of products that support these themes.
- Professional development activities that prepare the Planetary Science E/PO Community and front-line agents to deliver products and activities using proven best practices.
- Analysis activities that identify, review, and place planetary science E/PO products and activities in the context of themes and best practices that better enable audience members to access and use these products and participate in these activities.
- Cross-divisional activities that enable sharing and extension of knowledge of best practices, and ensure a coordinated and coherent approach to SMD E/PO programs and messages.

Collectively these activities are intended to result in a more effective and efficient community, and in SMD’s desired outcome of more effective, sustainable, and efficient utilization of SMD science discoveries and learning experiences.

NASA Lunar Science Institute Education and Public Outreach Programs – A primary goal of FY2009 was for the LPI E/PO team to become more involved in lunar science education. In addition to numerous formal and informal educator lunar science programs, the Department is supporting three of the selected NASA Lunar Science Institute teams in their education and public outreach efforts, including LPI, Southwest
Research Institute, and Johns Hopkins Applied Physics Laboratory (APL). Projects being undertaken by the Education Team include:

- Public website development by the Denver School of Science and Technology high school students (SwRI)
- Children’s program resources and training for librarians (SwRI)
- Scientist-mentored research projects for teams of high school students (LPI)
- Traveling exhibits for libraries (LPI)
- Online gallery for museums and science centers (LPI)
- Lunar institutes for high school teachers (APL)

**MyMoon** – In an effort to engage a population of new lunar enthusiasts – the population between 18 and 35 – LPI is collaborating with lunar scientists, educators, artists, and the public to develop a lunar education new media portal, *MyMoon*. Through *MyMoon*, the general public is invited to interact with lunar content that will inform them about NASA’s lunar science research and missions, and engage them in future plans for lunar exploration and eventual habitation. The site was released in August 2009 and continues to offer new lunar science content, media exhibits, events, and opportunities for involvement. At present, approximately 200 pages are served each day, and the population of visitors is skewed toward the 30’s, 40’s, and older. Efforts over the next year will be focused on engaging a larger and younger population.

**Explore! Program** – For over a decade Explore! programs have been sharing Earth and space science through informal venues such as libraries and after school programs. The program encompasses development of children’s activities and preparation of children’s program providers. To date, 565 librarians have been trained in 19 states. It is estimated that they are reaching over 30,000 children per year through their Explore programs. In FY2009, the E/PO Team:

- Completed the Explore! Ice Worlds International Polar Year online module and web-based training sessions for 150 librarians;
- Provided training on the Mars Inside and Out module for 17 Texas librarians at the Texas Library Association conference;
- Shared LPI and Explore resources with 55 librarians at a Texas Library Association conference workshop’
- Provided training on the Health in Space module for 35 Texas librarians; and
- Developed a training session focusing on exploration using existing activities from the Explore Rockets, LRO, Mars, and Colonies modules for NASA ESMD. Trained 31 librarians in North Carolina and 27 in Tennessee using the materials.

Currently, LPI is concentrating on the development of an outer solar system module for the Juno mission, with trainings planned for 90 librarians in Missouri/Arkansas, Kansas/Nebraska, and Kentucky/Tennessee. Another Explore module, focusing on the Moon, is being designed for the Southwest Research Institute’s NASA Lunar Science Institute team, with trainings for 90 librarians in Colorado/Wyoming, Montana/Idaho, North Dakota/South Dakota. A proposal has been submitted to NASA to develop an astrobiology module in collaboration with the NASA Astrobiology Institute.

**Educator Workshops** – The Education Team continues to work closely with the JSC Astromaterials Research and Exploration Science (ARES) Education Team and the Harris County Department of Education (HCDE) to provide deep training to classroom science teachers. A total of 501 elementary, middle, and high school teachers participated in LPI educator workshops in FY2009, including:
One- and two-day Earth and space theme-based trainings that concentrate on content and best teaching practices, offered through HCDE.

A week-long Lunar Science Institute at LPI, in collaboration with ARES, the Moon Mineralogy Mapper E/PO team, and the Lunar Reconnaissance Orbiter E/PO team.

The annual week-long LPI educator field trip, with Dr. Allan Treiman and post-docs Drs. Justin Filiberto and Juliane Gross. Twenty-seven participants examined volcanic features and processes in Oregon as analogs for volcanic features found within our solar system.

An eight-session distance learning course for 24 middle school teachers, taught in collaboration with the Moon Mineralogy Mapper E/PO team and offered through Montana State University.

A current focus is preparing Texas high school teachers to conduct a newly approved fourth-year course, Earth and Space Science. Toward this end, the LPI led proposal development for a two-year program to prepare Houston teachers and build a community of practice in collaboration with HCDE, ARES, the University of Houston, and Rice University. Future efforts will concentrate on funding similar offerings and supporting the field experiences.

**Faculty Institutes for NASA Earth and Space Science Education (FINESSE)** – LPI leads a collaboration of scientists and science education specialists, in partnership with the Association for Science Teacher Education (ASTE) and the National Association of Community College Teacher Education Programs (NACCTEP), to offer Institutes for faculty involved in teacher preparation. Through two-day institutes 60 faculty each year are immersed in best science education practices for teacher preparation, learn about curricular support resources for teacher educators that leverage NASA SMD content and data, and become part of a network of teacher education faculty from community colleges and universities nationwide. To date approximately 75 faculty have been trained through Institutes at the American Astronomical Society, ASTE, and NACCTEP. Over the next year, efforts will be focused on engaging these faculty in online professional development and collaboration.

**Family Space Day** - LPI’s monthly Family Space Day, now in its sixth year, shared solar system extremes, lunar viewing, careers, solar viewing, the International Space Station, staying healthy in space, and a variety of other topics with over 1330 parents and children in FY2009, through hands-on activities, books, and crafts. The number of participants per session averaged 121. Buckaloo presented the Family Space Day model to educators at the Conference for Advancement of Science Teaching, the Science Teacher’s Association of Texas annual conference.

**Cosmic Lecture Series** – Four lectures, held at LPI, shared the International Year of Astronomy with approximately 650 inquisitive members of the general public in the Houston area. Speakers covered the span of what we have learned since Galileo to the future of astronomy, and included Dr. Jeff Hester (Arizona State University), Dr. Craig Wheeler (University of Texas at Austin), Dr. Paul Spudis (Lunar and Planetary Institute), and Dr. Catherine Pilachowski (Indiana University). All lectures were well received by the public and the series will continue in FY2010, with a theme of Our Place in the Universe: Do Others Share It?
APPENDIX X: Summer Student Activities

LPI/ NASA JSC Undergraduate Summer Intern Program
June 8- August 14, 2009

<table>
<thead>
<tr>
<th>Intern</th>
<th>University</th>
<th>Advisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elena Amadar</td>
<td>University of California, Santa Cruz</td>
<td>Carl Allen</td>
</tr>
<tr>
<td>Denise Anders</td>
<td>Christian Albrechts University</td>
<td>David Kring</td>
</tr>
<tr>
<td>Steven Arauza</td>
<td>University of Texas, Austin</td>
<td>John Jones</td>
</tr>
<tr>
<td>Samuel Bell</td>
<td>Amherst College</td>
<td>Stepinski/Lasue</td>
</tr>
<tr>
<td>Jennifer Buz</td>
<td>Massachusetts Institute of Technology</td>
<td>Pat McGovern</td>
</tr>
<tr>
<td>Courtney King</td>
<td>University of Arizona</td>
<td>Kevin Righter</td>
</tr>
<tr>
<td>Laura Malone</td>
<td>University of New Brunswick</td>
<td>Axel Wittman</td>
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<td>Jonathan McLane</td>
<td>University of Minnesota</td>
<td>Tom Stepinski</td>
</tr>
<tr>
<td>Chelsea Payne</td>
<td>University of Wisconsin, River Falls</td>
<td>Paul Spudis</td>
</tr>
<tr>
<td>Katie Robinson</td>
<td>University of Chicago</td>
<td>Allan Treiman</td>
</tr>
<tr>
<td>Sarah Saslow</td>
<td>University of Mayland, College Park</td>
<td>Moses/Visscher</td>
</tr>
<tr>
<td>Chisato Sekigawa</td>
<td>Kobe University, Japan</td>
<td>Lindsay Keller</td>
</tr>
<tr>
<td>Kei Shimizu</td>
<td>State University of New York, Stony Brook</td>
<td>Will Stefanov</td>
</tr>
<tr>
<td>Nattavadee</td>
<td>University of Michigan</td>
<td>Walter Kiefer</td>
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<td>Srisutthiyakorn</td>
<td></td>
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<tr>
<td>Michelle Thompson</td>
<td>Queen’s University</td>
<td>Roy Christoffersen</td>
</tr>
<tr>
<td>Emily Worsham</td>
<td>University of Tennessee, Knoxville</td>
<td>Paul Niles</td>
</tr>
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NLSI Lunar and Exploration Graduate Interns
June 1- August 7, 2009

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<tr>
<th>Intern</th>
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<tbody>
<tr>
<td>Daniel Eldridge</td>
<td>University of Colorado, Boulder</td>
<td>David Kring</td>
</tr>
<tr>
<td>Megan Ennis</td>
<td>University of Tennessee</td>
<td>David Kring</td>
</tr>
<tr>
<td>Amy Fagan</td>
<td>University of Notre Dame</td>
<td>David Kring</td>
</tr>
<tr>
<td>Jarmo Korteniemi</td>
<td>University of Oula, Finland</td>
<td>David Kring</td>
</tr>
<tr>
<td>Trevelyn Lough</td>
<td>University of Buffalo</td>
<td>David Kring</td>
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<tr>
<td>James Pogue</td>
<td>University of California, Santa Cruz</td>
<td>David Kring</td>
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<tr>
<td>Simon Porter</td>
<td>Arizona State University</td>
<td>David Kring</td>
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<tr>
<td>Kaitlin Singer</td>
<td>North Carolina State</td>
<td>David Kring</td>
</tr>
<tr>
<td>Joshua Snape</td>
<td>University college, London</td>
<td>David Kring</td>
</tr>
<tr>
<td>Lesley Werblin</td>
<td>Mount Holyoke College</td>
<td>David Kring</td>
</tr>
</tbody>
</table>
## Summer Students, 2009

<table>
<thead>
<tr>
<th>Intern</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Chaitanya Bagaria</td>
<td>University of Houston</td>
<td>Tom Stepinski</td>
</tr>
<tr>
<td>Lourenco Bandeira</td>
<td>Institute of Superior Technology, Lisbon, Portugal</td>
<td>Tom Stepinski</td>
</tr>
<tr>
<td>Adam Paulus</td>
<td>University of Minnesota</td>
<td>Don Petit</td>
</tr>
<tr>
<td>Samuel Simmons</td>
<td>University of Houston</td>
<td>Jonathan Snow</td>
</tr>
<tr>
<td>Ross Potter</td>
<td>Imperial College London (UK)</td>
<td>Gareth Collins</td>
</tr>
<tr>
<td>Francio Ruether</td>
<td>Imperial College London (UK)</td>
<td>Steve Clifford</td>
</tr>
<tr>
<td>Jue Wang</td>
<td>University of Massachusetts, Boston</td>
<td>Tom Stepinski</td>
</tr>
</tbody>
</table>
APPENDIX XI: NASA Regional Planetary Image Facility and Library

The operation of library services and the NASA Regional Planetary Image Facility (RPIF) is managed under the Center for Information and Research Services (CIRS). The general mission of CIRS is to develop, organize, maintain, and provide access to a collection of space-science related materials in a variety of media that serve the needs of the scientific and educational communities as well as the public. To assist with the mission, CIRS is a member of the Online Computer Library Center (OCLC), a network of over 71,000 international libraries and AMIGOS, a network of over 700 regional libraries. These networks provide access to LPI library collections worldwide.

CIRS continues to serve a broad range of patrons, including funded scientists, educators, students, and the public. The collection is refreshed on a regular basis with the addition of books, journals, and data within the scope of the CAN. Imagery and cartography are available via scanning through the Internet for those in remote locations. The facilities are open to researchers and the public during normal business hours.

Facility Use in 2008:

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
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<tr>
<td>Items in collection</td>
<td>59776</td>
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<tr>
<td>Items processed / cataloged</td>
<td>847</td>
</tr>
<tr>
<td>Average # library card holders</td>
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</tr>
<tr>
<td>Items circulated</td>
<td>520</td>
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<tr>
<td>Interlibrary loans / photo dup</td>
<td>169</td>
</tr>
<tr>
<td>Requests for information</td>
<td>176</td>
</tr>
</tbody>
</table>

CIRS supports a “What’s New” page (www.lpi.usra.edu/library/whats_new.shtml) with “Recent Additions to the Collection” and “New and Noteworthy.” These pages are also available through RSS feeds, Twitter, and as a paper copy to suit user needs.

The staff continues to develop displays and exhibits using library and RPIF materials. Topical displays feature imagery, maps, books, and items from the LPI’s collection, the Internet, and other resources. Exhibit themes included Lunar Rovers, Space Policy, Volcanoes, Robotics, International Year of Astronomy, Apollo 11 40th Anniversary, Impacts, Women in Science, and Antarctica.

Library Services

Work continued on the scanning of books and documents of interest to lunar exploration efforts. Below is a selected list of documents which will be available as searchable PDF files on the LPI Web site, providing accessibility of out-of-print publications.

- Analysis of the Synthesis Group’s Space Resource Utilization Architecture
- Analysis of the Synthesis Group’s Science Emphasis for the Moon and Mars Architecture
- Analysis of Synthesis Group Architectures: Summary & Recommendations
- Analysis of the Synthesis Group’s Moon to Stay and Mars Exploration Architecture
- Apollo 17 Traverse Planning Data
• Apollo 16 Mission Science Planning Document
• Apollo 16 Sample Catalog
• Compilation of Lunar Sample Data Generated by Gast, Nyquist and Hubbard
• Early Apollo Investigations Field Test 5: Hopi Buttes, Arizona
• Geology of Apollo 16 Area, Central Lunar Highlands (GSP#1048)
• Geology of the Terrestrial Planets
• Glossary of Lunar Sample Terms
• Introduction to the Apollo Collections: Part I Lunar Igneous Rocks
• Introduction to the Apollo Collections: Part II Lunar Breccias
• Lunar Roving Vehicle Payload Handbook Apollo 16
• Lunar Missions Science Training Program Apollo 15 and Subsequent Missions
• Lunar Scout Program Preliminary Mission Analysis
• Lunar Soils Grain Size Catalog
• Report of the Ad Hoc Working Group on Apollo Experiments and Training on the Scientific aspects of the Apollo program (Sonett Report)
• Suggested Field Techniques for Geologic Exploration of Lunar Craters
• Summary of Edited Transcripts from the Lunar Exploration Program Review at GSFC
• Through Difficulties to the Moon
• To a Rocky Moon
• Where No Man Has Gone Before: A History of Apollo Lunar Exploration Missions

Support was provided for various education projects and programs including identifying and locating documents, maps and other resources for the Educator Field Trip, *The Heat from Within – Earthly Insights into Planetary Volcanism*. The library coordinated copyright permissions and secured the appropriate documents.

In response to the science community, a database of instruments flown on various lunar missions was compiled. The Lunar Instrument site ([http://www.lpi.usra.edu/lunar/instruments/](http://www.lpi.usra.edu/lunar/instruments/)) concept includes a description, observation category, instrument function, measurement, and resolution information for each instrument that has measured or observed the Moon. This will be an ongoing project.

**Regional Planetary Image Facility**

The NASA Regional Planetary Image Facility (RPIF) at the Lunar and Planetary Institute is led by Dr. Paul Spudis. As RPIF Director, Dr. Spudis provides overall direction of the facility, interfaces with NASA RPIF program management, and serves on NASA’s RPIF Board of Directors. The facility maintains an open-access policy for users and is available to the public during normal business hours. Requests and questions can be submitted through the Internet. Imagery, data, and other information are provided to researchers, educators, media, and the general public.

The LPI RPIF continues to expand access to the imagery and cartography through the LPI web site. With the interest in the 40th anniversary of Apollo 11, high resolution 70mm handheld images were added to the Apollo Image Atlas ([http://www.lpi.usra.edu/resources/apollo/](http://www.lpi.usra.edu/resources/apollo/)). High resolution Apollo 12 images have also been added in anticipation of that mission’s 40th anniversary in November. The
enhancement of the Apollo Image Atlas will continue with addition of Apollo 13 imagery in time for the April anniversary. The USGS 1:5M geology, shaded relief, and topographic maps along with the Lunar Equatorial Zone Mosaics (LEMC) have been added to the Lunar Map Catalog (http://www.lpi.usra.edu/resources/mapcatalog/). These maps cover large regions of the Moon, which are useful in mission planning and will provide a broad regional prospective in lunar exploration.

One of the RPIF collections unique to LPI is the lunar sample imagery. Major parts of the lunar sample collection have been translated into the newly launched Lunar Sample Atlas (http://www.lpi.usra.edu/lunar/samples/atlas/). Images taken in the Lunar Sample Laboratory, views of microscopic thin-sections, cutting views and diagrams, and in situ views of the samples on the lunar surface are featured. The atlas contains information about the type of sample, the lithology, and description of the sample. This approach broadens access to the LPI lunar sample collection and, along with contributions of imagery from lunar sample investigators, interweaves multiple facets of lunar sample research.
## APPENDIX XII: Seminar Speakers 2009

<table>
<thead>
<tr>
<th>Name</th>
<th>Affiliation</th>
<th>Date</th>
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<tbody>
<tr>
<td>Thomas D. Jones</td>
<td>Association of Space Explorers</td>
<td>January 15</td>
</tr>
<tr>
<td>Kenji Yoshikawa</td>
<td>University of Alaska Fairbanks</td>
<td>January 22</td>
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<tr>
<td>John F. Mustard</td>
<td>Brown University</td>
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<tr>
<td>James Oberg</td>
<td>Space Consultant</td>
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<tr>
<td>Ulrich Riller</td>
<td>McMaster University</td>
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<tr>
<td>Larry R. Nittler</td>
<td>Carnegie Institution of Washington</td>
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<tr>
<td>T. Mark Harrison</td>
<td>UCLA</td>
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<tr>
<td>David Kring</td>
<td>Lunar and Planetary Institute</td>
<td>March 10</td>
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<tr>
<td>Peter Smith</td>
<td>University of Arizona</td>
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<tr>
<td>Roger Wiens</td>
<td>Los Alamos National Laboratory</td>
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<tr>
<td>Faith Vilas</td>
<td>MMT Observatory</td>
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<tr>
<td>Rajdeep Dasgupta</td>
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<td>Michael Mischna</td>
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<td>Jennifer Blank</td>
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<td>Simona Costin</td>
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<td>Kiri Wagstaff</td>
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<td>Bob Craddock</td>
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<tr>
<td>Albert E. Saal</td>
<td>Brown University</td>
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<td>Paul Warren</td>
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<tr>
<td>Walter Kiefer</td>
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<td>Susan Lederer</td>
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<td>Seth Shostak</td>
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<td>Georgiana Kramer</td>
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<td>Kees Welten</td>
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<td>Michael D. Max</td>
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<td>Alice LeGall</td>
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<td>Timothy Swindle</td>
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<td>Bruce Banerdt</td>
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<td>Veronika Heber</td>
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<td>Brian Balta</td>
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<td>Horton Newsom</td>
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<td>Kurt Marti</td>
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<td>Jerry S. Delaney</td>
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<td>Bruce Watson</td>
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<td>Wright Horton, Jr.,</td>
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<td>William C. Feldman</td>
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<td>Bill Hartmann</td>
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<td>Cin-Ty A. Lee</td>
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<td>George J. Flynn</td>
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<td>Br. Guy Consolmagno</td>
<td>Vatican Observatory</td>
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<tr>
<td>John Grant</td>
<td>Smithsonian Institution</td>
<td>December 3</td>
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