NASA LUNAR SCIENCE INSTITUTE

NASA Lunar Science Institute & Role of Virtual Science Institutes at NASA

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http://lunarscience.nasa.gov

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INTRODUCTION

The NASA Lunar Science Institute (NLSI) supplements and extends existing NASA lunar science programs through a nationwide, connected network of teams. The NLSI is sponsored by the NASA Science Mission Directorate and has significant support from the Exploration Systems Mission Directorate. It focuses on lunar science, to re-energize the lunar community in support of NASA missions and to train the next generation of lunar scientists.

WHY CREATE AN INSTITUTE?

The NASA Lunar Science Institute enables scientific collaboration across disciplines and within and between participating teams, irrespective of their geographic distribution. Relatively large research grants facilitate innovative, longer-term investigations. In addition to sponsoring research, the NLSI carries out programs to strengthen the lunar science community, support NASA lunar flight missions, train the next generation of lunar scientists, and communicate about lunar science with educators and the public. NLSI also helps link lunar-related research programs in SMD (science) and ESMD (exploration).

Operationally, NLSI is modeled on the successful NASA Astrobiology Institute, with central management at NASA Ames Research Center and teams selected through competitive proposals submitted in response to a NASA Cooperative Agreement Notice. Each team is funded for 4 years, with a new competition held every 2 years. International Affiliate Teams join through a letter agreement with NLSI.

NLSI MISSION

• Carrying out and supporting collaborative research in lunar science, investigating the Moon itself and using the Moon as a unique platform for other investigations;

• Providing scientific and technical perspectives to NASA on its lunar research programs, including developing investigations for current and future space missions;

• Supporting and catalyzing the lunar science community and training the next generation of lunar science researchers; and

• Supporting education and public outreach by providing scientific content for K-14 education programs, and communicating directly with the public.

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WHAT IS LUNAR SCIENCE?

For the NLSI, lunar science is broadly defined to include studies:

- ***Of the Moon:*** Investigations of the nature and history of the Moon (including research on lunar samples and on the impact flux through time) to learn about this specific object and thereby provide insights into the evolution of our solar system

- ***On the Moon:*** Investigations of the effects of the lunar environment on terrestrial life and the equipment that supports lunar inhabitants, and the effects of robotic and human presence on the lunar environment

- ***From the Moon:*** Use of the Moon as a platform for performing scientific investigations, including observations of the Earth and other celestial phenomena that are uniquely enabled by being on the lunar surface

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KEY QUESTIONS FOR INVESTIGATION

Of the Moon

• How did the Moon form and how did its interior structure arise?
• How has the impact history of the Earth-Moon system been recorded on the lunar surface?
• How do lunar studies illuminate the population of asteroids and comets over time and the dynamical history of the solar system?
• How have volcanic process on the Moon been initiated over lunar history and how do the volcanic flows reflect the interior composition.
• How have solar processes and space weather altered the lunar surface over time and been recorded in the lunar regolith?

On the Moon

• How will the lunar environment (e.g., dust) affect surface operations and influence designs for living on the Moon?
• What are the environmental conditions and the volatile content of the lunar poles?
• How will increased human activities alter the lunar environment?
• How can life from Earth adapt to long stays on the Moon?

From the Moon

• How can the Moon be used as a platform to advance important science goals in astronomy, Earth observation, and basic physics?

NLSI KEY DATES

10/07	NASA HQ announces NLSI, assigns management to Ames Research Center
11/07	Chris McKay selected to organize first LSC
01/08	David Morrison appointed Interim Director
03/08	LSI-central office opens in NASA Research Park
04/08	Institute Formal Dedication
05/08	CAN released for initial team selections
07/08	Canada becomes first international partner
07/08	NLSI Lunar Science Conference (July 20-23)
08/08	Proposals for membership received
11/08	Korea becomes NLSI partner
01/09	Seven initial U.S. member teams selected
01/09	UK becomes NLSI partner
03/09	First NLSI Executive Council meeting
04/09	First FY09 funding for selected US teams
07/09	Moon Day at ARC attracts 10,000 visitors
07/09	NLSI Lunar Science Forum (July 21-24)
10/09	NLSI supports LCROSS impact on lunar pole

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US Teams

Understanding the Formation and Bombardment History of the Moon
PI: Bill Bottke - Southwest Research Institute

Impact Processes in the Origin and Evolution of the Moon: New Sample-driven Perspectives
PI: David Kring, USRA/LPI

Dynamic Response of the Environment At the Moon (DREAM)
PI: Bill Farrell, NASA Goddard Space Flight Center

Colorado Center for Lunar Dust and Atmospheric Studies (CCLDAS)
PI: Mihaly Horanyi, University of Colorado – Boulder

The Moon as Cornerstone to the Terrestrial Planets: The Formative Years
PI: Carle Pieters, Brown University

Scientific and Exploration Potential of the Lunar Poles
PI: Ben Bussey, Johns Hopkins University

Lunar University Node for Astrophysics Research (LUNAR): Exploring the Cosmos from the Moon
PI: Jack Burns, University of Colorado - Boulder

INTERNATIONAL PARTNERSHIPS

NLSI has a program of partnerships with international lunar science organizations to provide collaborative research opportunities for all members of the international science community. Non-U.S. lunar science organizations can propose to become either Associate or Affiliate Members of the NLSI on a no-exchange-of-funds basis.

International partner membership requires long-term commitment from both the partner and the NLSI, together with tangible and specific plans for scientific interaction that will produce results of mutual benefit. Although the focus of this program is research in lunar science, it also includes collaborative activities that address any of the objectives defined in the NLSI Mission Statement, particularly space flight mission support and training of the next generation of lunar scientists. It is preferred that organizations proposing partnership be drawn from a broad range of academic or research groups that are able to represent the lunar science activity within a country.

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INTERNATIONAL AFFILIATE TEAMS

Canada
PI: Gordon “Oz” Osinski,
University of Western Ontario
Partnership signed July 2008

Korea
PI: IM Yong-Taek,
Korean Institute for Advanced Science & Technology (KAIST)
Partnership signed December 2008

United Kingdom
PI: Mahesh Anand,
Open University
Partnership signed January 2009

NLSI EDUCATION AND PUBLIC OUTREACH

… SEVEN Teams...

… ONE goal !

- **Public Outreach**
- **Informal Education**
- **Formal Education**
- **Science Outreach**
- **Web & Social Media**
- **Media Outreach**

… SOLID INFRASTRUCTURE
&
BALANCED PORTFOLIO …

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NASA & INTERNATIONAL LUNAR MISSIONS

- **Lunar Prospector,** launched January 7, 1998
- **SMART-1**, launched September 2006
- **Kaguya**, launched September 14, 2007
- **Chang'e-1**, launched October 24, 2007
- **Chandrayaan-1**, launched October 22, 2008
- **Lunar Reconnaissance Orbiter (LRO)**, launched June 18, 2009
- **Lunar Crater Observation Sensing Satellite (LCROSS)**, impacted October 9, 2009
- **Gravity Recovery and Interior Laboratory (GRAIL)**, launches 2011
- **Lunar Atmosphere and Dust Environment Explorer (LADEE)**, launches 2011

ROLES OF VIRTUAL SCIENCE INSTITUTES

Virtual science institutes can be created quickly in response to NASA requirements. Successive Cooperative Agreement Notices can be vectored to meet changing NASA needs.

NASA funds are highly leveraged since team members are already largely funded by universities and NASA centers.

The best scientists are brought into the NASA family without need to construct buildings or recruit civil service scientists (something that is increasingly difficult for NASA to do). Retaining NASA management ensures that work is linked to NASA missions.

Since many teams are university based, NASA gains access to labs, students and postdocs.

Geographic diversity provides opportunities for public outreach.

International affiliates provide access to international community.

RESEARCH IN THE VIRTUAL INSTITUTES

Teams are multi-disciplinary and multi-institutional. Emphasis on teamwork (using the most effective IT tools) enables broad collaboration, especially useful in creating a new discipline like astrobiology (e.g., encouraging biologists and physical scientists to work together), or linking different disciplines in lunar science (e.g., *of the* Moon, *on the* Moon, *from the* Moon).

With highly competitive selections, NASA gains access to the best scientists, the best labs, and the unique contributions of students and postdocs working in an academic environment. Linking universities with scientists at NASA Centers also strengthens NASA's in-house science capabilities. NASA leverages Silicon Valley and other industry investments in collaborative tools and technologies.

NASA retains top-level management to ensure that the research is relevant to NASA programs and missions. Institute senior management acts as a program office, reporting to both NASA Headquarters and to the Center Director.

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INSTITUTE ROLES IN TRAINING, EDUCATION & OUTREACH

Training the next generation of scientists is one of our most important challenges. NASA can best accomplish this through partnerships with universities. The institutes each link with dozens of universities. In the case of astrobiology, the NAI has been influential in defining this new discipline and encouraging graduate-level courses and degrees in astrobiology.

Partnership with the best universities also provides opportunities for NASA to contribute to undergraduate science education.

Active institute education programs address the basic need for improved scientific literacy. Each institute team is expected to spend 5% of its budget on EPO. Coordination from the central management office encourages pooling of resources and sharing of ideas.

Public outreach is also facilitated by sharing ideas and programs among the teams.

OPPORTUNITIES FOR ADDITIONAL VIRTUAL SCIENCE INSTITUTES

Institutes could be useful in any field where:

- NASA needs extramural scientific and technical expertise
- Challenging new problems demand fresh, multidisciplinary perspectives
- Partnership with diverse academic institutions strengthens public outreach and training of the next generation of scientists

Examples of potential institutes

- **Climate & Geoengineering:** Seeking (and evaluating) technical solutions to mitigate global warming
- **Radiation biology:** Understanding risks and devising countermeasures that will permit safe travel of humans beyond the Earth-Moon system

National Research Council 10-year

"*Assessment of the NASA Astrobiology Institute*"

Findings and Recommendations

Overall, the committee is unanimous in finding that the NAI has fulfilled its original mandate. The NAI has played a key role in supporting the development of astrobiology, has positively affected NASA's current and future missions, and should continue to be supported.

This should apply to all NASA virtual institutes!!


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LUNAR
SCIENCE
INSTITUTE
Bringing
Lunar Science
To a new generation
… around the world
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