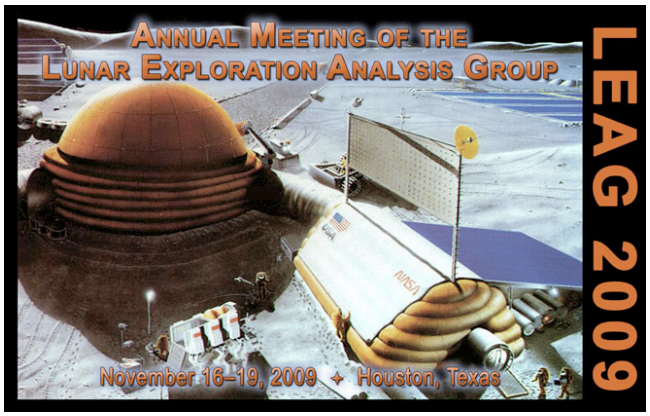
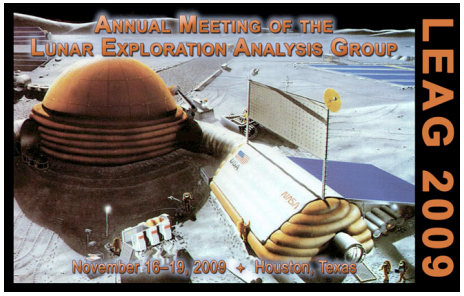
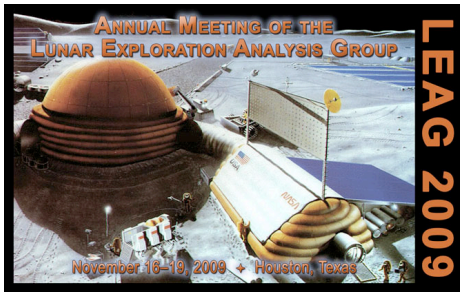
2009 LEAG Annual Meeting



The annual meeting of the Lunar Exploration Analysis Group was held at the Lunar & Planetary Institute in Houston, Texas, over 3.5 days (November 16-19, 2009). The meeting brought together over 150 NASA officials, lunar scientists and engineers, established commercial space companies, and entrepreneurial firms. The focus of the meeting was to discuss how to make the next phase of solar system exploration (robotic leading to human) sustainable and feed input to the Sustainability theme of the draft Lunar Exploration Roadmap (http://www.lpi.usra.edu/leag/ler_draft.shtml).



LEAG "Press Release"



- A sustainable* lunar enterprise requires the use of lunar resources to "live off the land."
- A sustainable* lunar enterprise begins with robotic missions as incremental steps to facilitate more productive human missions.
- A sustainable* lunar enterprise provides a basis for long-term human presence on the Moon, enabling exploration of the solar system and a space-based economy.

*Sustainable = enduring through consistent return of value greater than the investment required to create it.

Lunar Exploration Roadmap

- **In the broadest context, space exploration encompasses:**
  - Learning to live and work successfully and productively off world.
  - Expanding Earth's economic sphere beyond Earth orbit.
  - Strengthening existing and creating new global partnerships.
  - Engaging, inspiring, and educating the public.
- **The draft lunar exploration roadmap addresses why we are returning to the moon through three main themes:**
  - Pursue scientific activity to address fundamental questions about the solar system, the universe and our place in them.
  - Use the moon to prepare for future missions to Mars and other destinations.
  - Extend sustained human presence on the moon to enable eventual settlement.

LRO/LCROSS

- **Major Early Results**
  - Presence of water in a permanently shadowed crater is confirmed
    - Other volatiles (e.g. C_xH_y, CO_2, NH_3, etc.) may be present.
  - Enhanced concentrations of hydrogen suggested in polar regions outside of permanent shadow.
  - Improved imaging and mapping of terrain and temperature.
  - Refinement of locations with near-continuous illumination.
  - Understanding amplified through integration of multiple instrument observations.
- **Implications for exploration and science**
  - Resources may be richer and more accessible than previously thought;
  - Ground truthing of results is needed.
  - Risk to future lunar exploration is reduced.
  - The Moon provides a laboratory to study the solar system volatile flux history.
  - Missions have captured the attention of multiple, diverse communities.

LEAG Summary and Implications

- **What is required to make lunar exploration sustainable?**
  - Identification and pursuit of complementary science and exploration objectives that concern not only the Moon but destinations beyond.
  - Robotic missions that locate and characterize lunar resources and pursue critical technology risk reduction, making the human lunar return more productive.
  - Strengthened participation by international partners and commerce;
  - Human-Robot integration for exploration & science moving to ever finer scales.
  - Impressive results from NASA's LCROSS-LRO, Japan's Kaguya, and India's Chandrayaan-1 indicate the presence of important lunar resources that are vital for sustainable human presence, and which could significantly reduce the cost of human space exploration.

LEAG Summary and Implications

- **How does a sustainable lunar exploration program benefit lunar science and solar system exploration?**
  - Achievement of common objectives of lunar science and lunar resource determinations will form the basis for enduring cooperation between the science and exploration constituencies.
  - Establishment of cis-lunar transportation, lunar surface infrastructure, and resource utilization builds confidence, reduces risk, and prepares for human exploration of Mars, NEOs/Asteroids, and beyond.

LEAG Summary and Implications

- **Lunar in-situ resource utilization (ISRU)**
  - Increased understanding of potential lunar resources is of significant interest and is compelling for sustaining lunar exploration.
  - Development and field testing of lunar ISRU by NASA, industry, and international space agencies lowers the risk of incorporating ISRU early into lunar exploration plans.
  - Reducing technology risk through early access to the lunar surface lowers economic entry barriers and enables commercial opportunity.
  - Developing international cooperation increases sustainability.
- **The need for lunar samples and simulants**
  - Lunar simulants of adequate fidelity and quantity are required to support fundamental technology evaluation as well as hardware development and certification.
  - Access to lunar samples is required to anchor and validate development through use of simulants.