Executive Summary

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Presentation Title

Recommendations from the Workshop on Science Associated with the Lunar Exploration Architecture, Tempe, Arizona, 2/27–3/2, 2007

Summary

The workshop addressed science objectives in astrophysics, Earth science, heliophysics, planetary science, and planetary protection for return-to-the-Moon planning. The workshop resulted in an assessment and prioritization of science objectives within the context of the developing lunar exploration architecture. This presentation will also address recommendations made to NASA by the Advisory Council stemming from the workshop findings.

Summary of Findings

High priorities for astrophysics include (1) meter-wavelength radio observations from the radio-quiet lunar farside to seek evidence of the strongly red-shifted 21-cm H line from the early universe and (2) laser-ranging retroreflectors or transponders to probe gravitational theory.

For Earth science, the Moon would provide a unique, stable, and serviceable platform for global, long-term, full-spectrum views of Earth to address climate variability, pollution sources and transport, natural hazards, and changes in the terrestrial cryosphere. Such observations would complement and provide synergetic context for current orbital assets (LEO, GEO, GPS).

For heliophysics, the Moon is a unique vantage point from which to better understand the Sun-Earth space environment. The analysis of lunar regolith will provide a history of the Sun. Work is needed to develop predictive capabilities for solar radiation events to safeguard human exploration activities and to better understand the dust-plasma environment at the lunar surface.

Key objectives from a planetary science perspective fall into four main themes. (1) Moon as a recorder of the impact history of the inner solar system; (2) Moon as a recorder of early planetary differentiation processes (key to understanding the Moon's interior is a geophysical network, especially to better determine global seismic structure); (3) the potential record of volatile deposition processes and the possibility of concentrated volatile-element deposits in permanently shaded craters; (4) better delineation of the character and distribution of potential resources and improved understanding of potential hazards to sustained human presence. Some of these objectives can be accomplished at a polar outpost site whereas others require access to multiple locations and sample collection.

Lunar exploration will not require special planetary protection controls; however, it will provide the opportunity for an integrated test bed of technologies and methods needed to protect samples and to understand and control mission-associated contamination on long-duration expeditions such as to Mars.

Concerns raised by the science subcommittees include the need to access more than one lunar location, surface mobility, transportation infrastructure to deliver payloads and to return materials to Earth, and adequate crew training and time on the surface to devote to specialized science experiments and in-situ resource utilization work. Participants stressed the need for a robust robotic precursor program to support scientific exploration and prepare the way for human missions. A mix of human and robotic exploration, space hardware design, and orbiting and landed laboratory science payloads are needed to maximize science return.