Return to the Moon (02)
Goals and Status of Future Lunar Missions (2)

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# LUNAR RADIO TELESCOPES: A STAGED APPROACH FOR LUNAR SCIENCE, HELIOPHYSICS, ASTROBIOLOGY, COSMOLOGY, AND EXPLORATION

**Abstract**

Observations with radio telescopes address key problems in cosmology, astrobiology, heliophysics, and planetary science including the first light in the Universe (Cosmic Dawn), magnetic fields of extrasolar planets, particle acceleration mechanisms, and the lunar ionosphere. The Moon is a unique science platform because it allows access to radio frequencies that do not penetrate the Earth's ionosphere and because its farside is shielded from intense terrestrial emissions. The instrument packages and infrastructure needed for radio telescopes can be transported and deployed as part of Exploration activities, and the resulting science measurements may inform Exploration (e.g., measurements of lunar surface charging).

A illustrative roadmap for the staged deployment of lunar radio telescopes is the following.

Stage Ia: One (or a few) antennas on an orbiter. The prime science is to detect the global cosmological signal from the (highly redshifted) hyperfine 21 cm transition of neutral hydrogen that is excited by the ultraviolet and X-ray radiation fields of the first stars and accreting black holes.

Stage Ib: One (or a few) antennas on the lunar surface. If on the near-side, the antennas would monitor the lunar ionosphere and track the balance between solar wind-induced effects and interior outgassing of volatile gasses. If on the far-side, the antennas would detect and begin studying the highly redshifted 21 cm signal. Deployment could be done either during sorties or telerobotically, and the science measurements from them would be a powerful probe of lunar surface charging. This stage could occur in parallel with Stage Ia.

Stage II: A small telescope on the near side. The prime science is to study particle accleration within the inner heliosphere, and possibly in astrophysical sources. Such a telescope would be capable of detecting

the magnetically-generated emissions from solar system planets, and potentially from extrasolar planets. A target number of antennas would be 100, which could be deployed in an extended duration sortie or telerobotically.

Stage III: A large telescope on the far side. Such a telescope would be capable of studying the highly redshifted 21 cm signal from Cosmic Dawn and extending into the Dark Ages. It would also be capable of detecting the magnetospheric emission from extrasolar planets. A nominal number of antennas is 100,000, distributed over about ten kilometers. Deployment would be largely robotically, though possibly with astronaut oversight.