**THE LUNAR FARSIDE IS A SCIENCE AND EXPLORATION IMPERITIVE.** Jack O. Burns[1] and Neil Bassett[1], [1]Center for Astrophysics and Space Astronomy, University of Colorado Boulder, Boulder, CO 80516 (jack.burns@colorado.edu, neil.bassett@colorado.edu).

**Introduction:** The lunar farside presents an unprecedented opportunity for science and exploration. It contains the oldest impact crater in the inner solar system – the South Pole Aitken (SPA) Basin. A robotic sample return mission to the SPA basin, a priority of the Planetary Science Decadal Survey, will provide a test of the lunar cataclysm hypothesis which posits that the Moon and Earth were bombarded by asteroids and comets ~4 billion years ago. A major rearrangement of planet distances relative to the Sun and the first single-cell life on Earth both occurred at about this same time. Connecting these pieces using the SPA basin is a scientific imperative.

Equally important, the farside is the only truly radio-quiet location within the inner solar system, thus opening a new wavelength window at radio frequencies <50 MHz and an unexplored epoch of the early Universe – the Cosmic Dark Ages and Cosmic Dawn (see [1]). The farside also protects astrophysical observations from the Earth's radio frequency interference (RFI) and Auroral Kilometric Radiation which occurs below ≈0.5 MHz. In addition, low frequency system noise produced by electrons in the solar wind, which induce antenna currents, are reduced by the lunar wake cavity especially at night. While the farside is shielded from human-made interference over much of its surface, it is not perfectly radio-quiet due to the diffraction of low frequency waves around the limb of the Moon. Figure 1 shows candidate landing sites on the farside suitable for radio astronomy based upon electrodynamic numerical simulations [2]. In this talk, we will discuss locations on the farside that are best suited for the science goals described next.

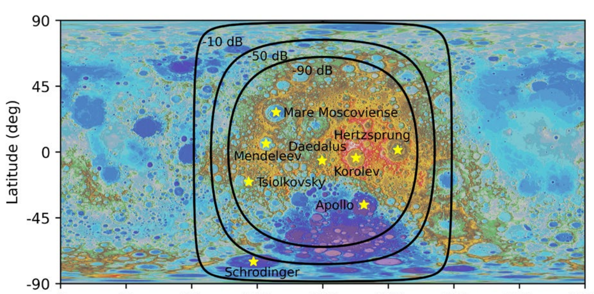


**Figure 1.** Map of RFI suppression at 100 kHz on the lunar farside based upon numerical simulations [1]. Contours indicate suppression of -10, -50, and -90 dB relative to the incident intensity. Map colors indicate elevation. A sample of potential landing sites is indicated by the yellow stars.

***LuSEE* on the farside is a diamond:** The first NASA radio astronomy instrument (*LuSEE*, Lunar Surface Electromagnetics Experiment) is manifested for the PRISM-1B mission slated to land on the farside within the Schrödinger basin in 2025 [1]. It will probe the plasma and dust environments of the farside and will make the first cosmological observations from the Moon using the redshifted 21-cm Global spectrum [3].

**Radio Interferometric Arrays:** *FARSIDE* (Farside Array for Radio Science Investigations of the Dark ages and Exoplanets) is a NASA-funded Probe-class mission concept that will deploy 256 100-m dipole antennas operating from 0.2-40 MHz within tethers deployed using JPL Axel rovers [1]. It will (a) investigate the first generation of stars and galaxies using the hyperfine 21-cm line of hydrogen, (b) image radio emission from coronal mass ejections, and (c) measure space weather and magnetic fields in potentially habitable extrasolar planetary systems.

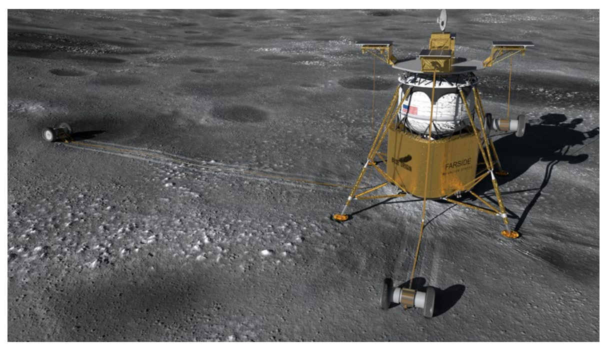

**Figure 2.** *FARSIDE* being deployed on the lunar surface from a Blue Origin lander using four rovers and tethers.

Recently, NASA's NIAC program funded a Phase I study of *FarView*, a low frequency (5-40 MHz) radio observatory that will be manufactured on the lunar farside using lunar regolith materials. *FarView* is a sparse array of ~100,000 10-m dipole antennas covering a ~120 km$^2$ area on the lunar farside. *FarView* will measure the spatial fluctuations in the 21-cm Dark Ages signal to test the standard cosmological model at the onset of structure formation.

**References:** [1] Burns et al. 2021, *Planet. Sci. J.,* 2:44. [2] Bassett, N. et al. 2020, *AdSpR*, 66, 1265. [3] Burns, J. et al. 2021, arXiv:2103.05085.

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