



Radio Astronomy from the Moon Enabled by NASA Commercial Lunar Payload Services Landers

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Exploration of the low radio frequency Universe from the Moon will soon be underway with landed payload missions enabled by NASA's Commercial Lunar Payload Services (CLPS) program [1]. CLPS landers are scheduled to deliver two radio science experiments, *ROLSSES* (Radio-wave Observations at the Lunar Surface of the photo-Electron Sheath) to the near side in 2022, and *LuSEE* (Lunar Surface Electro-magnetics Experiment) to the far side in 2025. These instruments will be pathfinders for a far side radio interferometric array. *ROLSSES* will operate at frequencies from 0.1-30 MHz and *LuSEE* is expected to observe from 0.1-80 MHz. Both radio instruments will investigate the plasma environment above the lunar surface and measure the fidelity of radio spectra on the surface. Both use electrically-short, spiral-tube deployable (STACER) antennas and radio spectro-polarimeters based upon previous flight models. *LuSEE* is expected to have sufficient battery power to operate through the lunar night. *LuSEE* will collect data from the radio-quiet farside within the wavelength window corresponding to the unexplored epoch of the early Universe - the Dark Ages ($z \approx 12-140$) – recently identified by the U.S. Astro2020 Decadal Survey as THE discovery area in cosmology for this next decade. *ROLSSES* and *LuSEE* will focus on characterizing the systematics associated with lunar-based low frequency measurements, including the galactic/extragalactic foreground, which is much larger than the expected 21-cm global Dark Ages signal, the interaction of the antenna with the lunar subsurface, and systematics arising from the receiver, gain and temperature offset. With *LuSEE*'s observations during the lunar night, our goal is to achieve precision measurements of the beam-weighted foreground at the level to either detect the Dark Ages global 21-cm signal or construct solid systematic foundations for follow-up CLPS instruments to attain this long-sought-after, revolutionary measurement.



Figure 1. The *LuSEE* radio astronomy instrument on a NASA CLPS lander will be delivered to the lunar far side in 2025. Cross-dipole spiral tube antennas are shown in their deployed stage.

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1. Burns, Jack O., R. MacDowall, S. Bale, G. Hallinan, N. Bassett, A. Hegedus, "Low Radio Frequency Observations from the Moon Enabled by NASA Landed Payload Missions", *Planetary Science Journal*, Volume 2, April 2021, Issue 2, id.44, 16 pp., doi: 10.3847/PSJ/abdfc3.