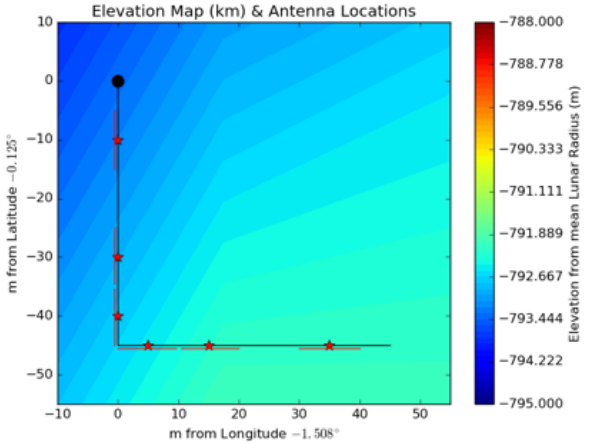
SSERVI Monthly Report
NESS/PI Burns - May, 2020

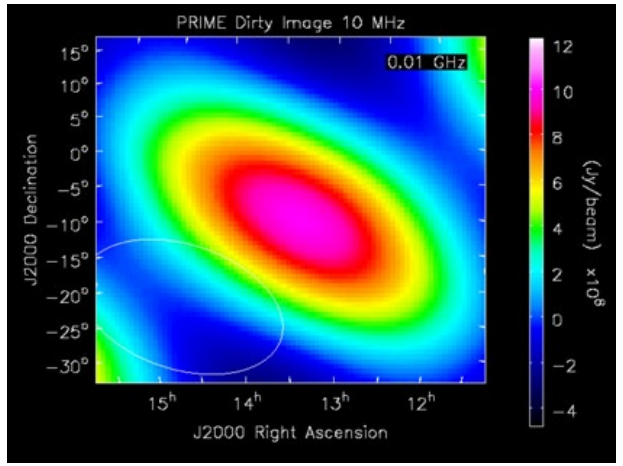
Progress Report:

- **Papers:** (1) "Formulating and critically examining the assumptions of global 21-cm signal analyses: How to avoid the false troughs that can appear in single spectrum fits", **Tauscher**, **Rapetti**, **Burns**, arXiv:2005.00034, submitted to ApJ; (2) "A Methodology to Assess the Human Factors Associated with Lunar Teleoperated Assembly Tasks", **Kumar**, **Bell**, **Mellinkoff**, **Sandoval**, Martin, **Burns**, arXiv:2005.08120, for the 2020 IEEE Aerospace Conference; (3) "Transformative Science from the Lunar Farside: Observations of the Dark Ages and Exoplanetary Systems at Low Radio Frequencies", **Burns**, arXiv:2003.06881, submitted to Philosophical Transactions of the Royal Society A; (4) "Characterizing the Radio Quiet Region Behind the Lunar Farside for Low Radio Frequency Experiments", **Bassett**, **Rapetti**, **Burns**, **Tauscher**, **MacDowall**, accepted in Advances in Space Research, arXiv: 2003.03468.
- **News:** (1) NASA Selects Mission to Study Causes of Giant Solar Particle Storms, called the Sun Radio Interferometer Space Experiment (SunRISE), with PI **Kasper**; (2) article in Scientific American with quotes from **Burns** and **Hallinan** discusses the need to protect the lunar far side from radio contamination; (3) Intuitive Machines selects landing site for CLPS mission, which includes ROLSES with PI **MacDowall**.
- **Projects:** RFI responses for PRISM: (i) PRIME (Prototype Radio Interferometer on the Moon for Exoplanet studies) is a six-element interferometer prototype for a lunar farside low radio frequency array (FARSIDE) designed to study space weather and magnetospheres in habitable exoplanetary systems, with PI **Burns**, Deputy PI **Hallinan**, and Co-I's, Lux, Romero-Wolf, Teitelbaum, Chang, **Kasper**, **Hegedus**; (ii) ATLASS (Artemis Technology Lunar Astrophysics & Science Suite), Co-Is **Burns, MacDowall**. Proposal submitted for a KISS study "Planetary Magnetic Fields: Planetary Interiors and Habitability": Orbiting Radio Beacon (ORB) Cubesat, with PI **Hallinan**, Co-I's Harding, Romero-Wolf, Lux, **Burns**.
- **Meetings:** (i) The Lunar Surface Science Workshop, originally planned at Denver, Apr. 28-30, was postponed due to the covid-19 pandemic, and initial virtual sessions are planned for May 28-29. NESS presentations will be included in upcoming sessions. (ii) The European Lunar Symposium (May 12-14) became virtual and Burns presented on "Exploring the Low Radio Frequency Universe from the Farside of the Moon" on May 13.
- **Upcoming Meetings:** (i) 236th Meeting of the American Astronomical Society, virtual, June 1-3, with NESS presentations on: (1) "Robust Data Analysis Pipeline for Sky-Averaged Hydrogen Cosmology" by **Rapetti**; (2) "Ensuring the Robustness of SVD Analysis for Global 21-cm Signal Extraction" by **Bassett**; (3) "Robust Extraction of the Cosmological Global 21-cm Signal from Foreground and Instrumental Systematic Effects" by **Tauscher**; (contd. next page)

(Contd.) (4) "Low Radio Frequency Astrophysics from the Farside of the Moon" by **Burns**; (5) "Modelling the Galactic Foreground and Beam Chromaticities for Global 21-cm Cosmology" by **Hibbard** (iposter); (6) "The Netherlands-China Low Frequency Explorer" by Chen (Ping, **Falcke**, **Klein-Wolt**).

Moment of Exploration:





With the distribution of six PRIME antennas on the lunar surface shown in the left panel, the resulting interferometric "dirty" image at 10 MHz on the right panel illustrates the clear detection of a 109 Jy point source as expected for a Type II solar radio burst. The white ellipse is the FWHM of the array beam.

PRIME (Prototype Radio Interferometer on the Moon for Exoplanet studies) will be the first operating radio interferometer on the Moon. The PRIME suite will reduce risks for FARSIDE (Farside Array for Radio Science Investigations of the Dark ages and Exoplanets) in several ways: (i) Use of the JPL Axel rover will demonstrate the deployment of receiver/antenna nodes on the lunar surface. The rover will use a tether connected to the lander for power, communications, and data transmission. Thin wire, electrically-short 10-m antennas will be embedded within the tether, following a design concept developed for FARSIDE. (ii) Investigation of the electrical properties of the antennas placed directly on the dielectric regolith will characterize the impact of the reflection of radio waves from the subsurface. (iii) The electronics used in the antenna nodes will have heritage from NASA's heliophysics mission SunRISE, a six cubesat interferometer in Earth orbit to measure compact structure in coronal mass ejections. (iv) PRIME will test the thermal designs and baseline concept of operations for FARSIDE.

05/28/2020