SESAR-LITE: PROBING THE LUNAR SUBSURFACE WITH P-BAND RADAR. L. M. Carter[1] , R. F. Rincon[2], D. M. H. Baker[2] and E. S. Shoemaker[1,2], [1]University of Arizona (lmcarter@arizona.edu), [2]NASA Goddard Space Flight Center

Science Goals and Objectives: The surface of the Moon is covered in a thick regolith (2-10+ m deep) that is of great science and resource interest. The stratigraphy of this layer holds clues to the evolution of the lunar surface, and in polar regions the regolith may trap water ice. However, this layer can also hide many important geological features, such as lava flows, pits and lava tubes, impact melts and crater ejecta, that are also the focus of science and exploration goals.

Several of the Artemis Science Definition Team (SDT) Report science goals require orbital radar data that could image several meters below the surface over areas of interest. There are also multiple future landings anticipated for the Moon, including both Commercial Lunar Payload Services (CLPS) missions, and in the future, humans. The near-surface region (upper several meters) is close enough to the surface to be accessible to future human or robotic explorers and determining and mapping this stratigraphy will provide important context for understanding science at lunar landing sites.

Prior lunar data acquired at long wavelengths using the Arecibo Observatory radar system have demonstrated that 430 MHz radar polarimetry provides a unique view of the Moon that enables key science questions to be addressed [1,2,3,4]. These long-wavelength radar images reveal subsurface terrain that is not visible in any other data sets, including at shorter radar wavelengths.

We are developing SESAR-LITE (Space Exploration Synthetic Aperture Radar - Lunar Investigations Targeted Experiment), a compact P-band (70 cm wavelength) polarimetric synthetic aperture radar (Fig. 1). The instrument will leverage proven state-of-the-art technology advancements recently developed for SESAR (Space Exploration Synthetic Aperture Radar), a prior Maturation of Instruments for Solar System Exploration project (18-MATISE18_2-0020) that designed, built, and demonstrated a larger size radar [5].

Methodology: Our original SESAR instrument is designed for Discovery-class (or LRO-class) missions with space for a large antenna. SESAR-LITE will employ a compact deployable antenna and digital processing system to enable a set of focused mission goals for smaller payload opportunities. The development of SESAR-LITE will address accommodation flexibility on multiple launch vehicle families that require small packages. For example, SIMPLEx vehicles of opportunity for future lunar missions could impose a volume constraint of 106 x 116 x 96 cm. SESAR-LITE's innovative design will permit a stowing configuration that makes it compatible with most future lunar missions that will carry multiple payloads. Like the full-scale SESAR, SESAR-LITE will be programmable to provide polarimetric data at depths and resolutions that are well-matched to Artemis science objectives. The instrument will use high bandwidths (100 MHz) to achieve 2-10 m spatial resolutions with full or hybrid polarimetry. Additionally, it will provide scatterometry and nadir altimetry/sounding measurements at targeted sites.

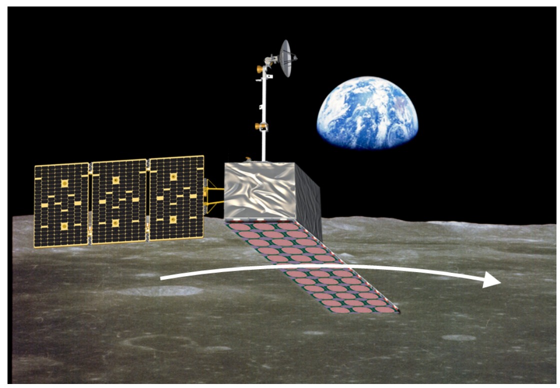

Fig. 1: SESAR-LITE is a fully-polarimetric P-band (70 cm) radar system capable of penetrating several meters into the surface to detect subsurface features. It is designed to fly on a smallsat, such as a SIMPLEx mission, and provide 10 m spatial resolution imaging that will address multiple Artemis science goals. Programmable beamforming allows SESAR-LITE to perform left or right looking SAR imaging, as well as sounding and scatterometry.

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