LUNAR SCIENCE AND EXPLORATION AT MARSHALL SPACE FLIGHT CENTER. R. C. Weber[1], J. Dankanich[1], N. Herrmann[1], [1]NASA Marshall Space Flight Center, Huntsville, Alabama (renee.c.weber@nasa.gov).

Introduction: Under the Artemis program for lunar science and exploration, the Agency is planning an ambitious path forward to the Moon. NASA's Marshall Space Flight Center (MSFC) offers unique capabilities in propulsion, technology, engineering, science, and exploration, providing a rich environment for fostering new partnerships that will create and sustain a renewed human presence on the Moon. In the next five years, MSFC will execute multiple undertakings in fundamental research, payload development, lander technologies, environmental definition and test, and both surface and orbital missions.

Science Research: MSFC scientists maintain broad expertise in support of planetary remote sensing and in-situ data analysis and modeling, payload development, mission formulation, and laboratory work. Specific subdisciplines include: geophysical and interdisciplinary analysis and modeling of terrestrial planetary interiors; geological and geomorphological investigations of terrestrial planetary surfaces; and studies of the electrostatic charging, optical, and gas accretion properties of dust. Missions supported include Mars InSight, Venus VERITAS, VIPER, multiple CLPS missions, and LRO.

Science and Exploration Integration: Recognizing that science and exploration are mutually enabling, MSFC aims to integrate science subject matter experts into its human spaceflight, engineering, and technology programs and projects, to provide input into mission destinations and vehicle/payload requirements, evaluate performance, and assist in development efforts. Missions/programs supported include the Human Landing System, the Gateway, and the Solar Cruiser technology demonstration mission.

Propulsion and Lander Technologies: MSFC is an Agency leader in innovative advanced propulsion and lander technologies, including solid and liquid propulsion elements, green propellant thruster and feed system development, suppressed freezing point pressure feed thrusters, electric pump-fed engines, solar sails, electrostatic solar sails, nuclear propulsion concept studies, large cargo landers, and small lander technologies. Missions and programs supported include MAV, Mars Sample Return, Europa Clipper, Europa Lander, Lunar Flashlight, NEAScout, Solar Cruiser, TALOS, and the lunar CATALYST program.

Environmental Test: MSFC's Space Environmental Effects (SEE) Test Capability maintains the most complete set of space environment test capabilities at any one location in the Agency. Most of our Space Environmental Effects (SEE) testing capabilities/facilities are unique within NASA and we customize every test to meet specific customer requirements. Over the years our SEE team has supported a range of activities including materials, component and instrument development testing as well as flight unit calibration and qualification.

Payload and Mission Development: MSFC scientists, technologists, and engineers are involved in the development of multiple lunar payloads and future mission concepts, the following of which are represented at this meeting:

Lunar Node 1: LN-1 is an S-band Navigation beacon that will be delivered to the Moon's surface on Intuitive Machine's NOVA-C lander in early 2022. LN-1's goal is to demonstrate navigation technologies that can support surface and orbital operations around the Moon, enabling autonomy which would decrease dependency on heavily utilized Earth-based assets like the Deep Space Network.

The Lunar Geophysical Network: LGN is a mission in development for NASA's New Frontiers 5 AO, supported by MSFC scientists. LGN's primary goal is to understand the initial stages of terrestrial planet evolution, through detailed lunar investigations.

Other instruments and payloads in development include the Kinematic Navigation and Cartography Knapsack (KNaCK) frequency-modulated continuous wave LiDAR sensor, and the Neutron Measurements on the Lunar Surface (NMLS) instrument onboard the CLPS 2022 Astrobotic Mission 1.

Mission Operation Development: MSFC applies decades of experience with science customers and instruments to continually advance mission operations capabilities for science and exploration. The Huntsville Operations Support Center (HOSC) implements the latest best practices and state-of-the-art distributed operations services to continuously improve ISS payload operations for thousands of remote teams and investigators. In the next few years, there will be parallel, ongoing human mission and payload operations in LEO, cislunar space, on the lunar surface, in-transit to Mars, and ultimately on and around Mars. As mission planning progresses, MSFC will support these missions by enabling multidisciplinary payload development, utilization, and maintenance; supporting infrastructure; and operations management and training.

References: Abstracts for MSFC projects and programs represented at this meeting include those by the following first authors: [1] Anzalone, E. [2] Haviland, H. [3] Bremner, P. [4] Nehls, M. [5] Howley, I. [6] Kessler, P. [7] Grubbs, R.