

SCIENCE ON THE LUNAR FAR SIDE FACILITATED BY LOW LATENCY TELROBOTICS FROM A LUNAR ORBITING PLATFORM-GATEWAY. J. O. Burns¹, ¹Center for Astrophysics and Space Astronomy, University of Colorado Boulder, Boulder, CO 80309 (jack.burns@colorado.edu).

NASA is preparing a series of human exploration missions using the four-person Orion crew vehicle and a Lunar Orbiting Platform-Gateway (LOP-G) (Figure 1) that will enable long duration (>30 days) operations in cis-lunar space. Operational efficiencies are expected to allow significant crew time dedicated to science experiments including low latency surface telerobotics. When the Gateway is unoccupied, it will function like other robotic planetary spacecraft with remote control from Earth. Importantly, the LOP-G will provide communication to and telemetry from surface assets, especially from the lunar far side. In this talk, precursor experiments, using the International Space Station (ISS) and the K10 rover at NASA Ames, a student-built teleoperated rover, and Virtual/Augmented Reality simulations, will be described which are laying the ground work for remote operation of rovers on the Moon by astronauts aboard the LOP-G. We discuss examples of two high-priority, lunar science missions that can be conducted using low latency surface telerobotics. First, an astronaut-assisted far side sample return mission within the Schrödinger impact basin will provide a key test of the lunar cataclysm hypothesis. Sample collection to address the science objectives of this mission require the mobility provided by a teleoperated rover. Second, the deployment of a low frequency radio telescope array will provide unique observations of the first stars and galaxies (Cosmic Dawn) (Figure 2). The construction of an array of low radio frequency telescopes will likely use a combination of supervised autonomy and telerobotics. Assembly to connect power, electronics, and communications will likely require the precision of low latency teleoperation. The lessons learned from these lunar operations will feed-forward to future low latency telepresence missions on Mars.



Figure 1. Lockheed Martin's Gateway concept supports lunar science objectives and serves as a state-of-the-art telerobotics platform.



Figure 2. Surface teleoperation of rovers from orbiting facilities is a key technology for astronaut-assisted deployment of a lunar far side polyimide antenna and collection of geological samples. Image is courtesy of Robert MacDowell and NASA GSFC.