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NASA'S GATEWAY: A DESCRIPTION AND ANALYSIS OF SCIENTIFIC CAPABILITIES AND POTENTIAL

Abstract

NASA and the international spaceflight community, including multiple government agencies and industry partners, are coalescing around plans for extending human exploration of lunar space and beyond to Mars. Critical to NASA's exploration campaign is the Gateway, a spacecraft that will be assembled in lunar orbit and will be used as a staging point for missions to the lunar surface and destinations in deep space. The Gateway will be able to support crewed missions for between 30 and 90 days, while being fully automated during the interim uncrewed periods. The spacecraft will be in the Near-Rectilinear Halo Orbit (NRHO) around the Moon. The NRHO balances a stable orbit, requiring less propellant to maintain, with access to the lunar surface, as NRHO is on the way to the surface with capabilities to change orbits to meet other mission or long term Mars mission needs. The NRHO also offers constant line of sight with Earth in a deep space equivalent environment.

The habitation and utilization capabilities will provide habitable volume and short-duration life support functions for the crew in addition to internal and external utilization capabilities and resources. As such, the Gateway will also act as a facility that will provide unique scientific capabilities across a variety of domains. Broadly speaking, these are Heliophysics and Space Weather, Earth Science, Astrophysics and Fundamental Physics, Lunar and Planetary Science, and Life Science and Space Biology.

To understand the range of desired utilization across multiple domains, NASA's Science Mission Directorate, several of the NASA Centers and the Human Exploration and Operations Mission Directorate collaborated to host a Deep Space Gateway Science Workshop, held in Denver, Colorado from February 27 to March 1st, 2018. Based on the results from this workshop, the unique Gateway capabilities to support each of these scientific domains are discussed, along with a more detailed description of the potential scientific instrument capabilities to be supported within these domains. Furthermore, specific technical insights regarding Gateway design for scientific goals are laid out across multiple parameters. Data from these fields across core scientific domains are analyzed, and conclusions for Gateway science capabilities are discussed.