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Space Transportation Solutions for Deep Space Missions (4-D2.8)

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NASA'S SPACE LAUNCH SYSTEM: PAYLOAD OPPORTUNITIES FOR LUNAR EXPLORATION, SCIENCE MISSIONS

Abstract

Nearing its first launch, NASA's new super-heavy lift launch vehicle, the Space Launch System (SLS), will enable the agency to return its human exploration program to the Moon as well as launch game-changing science missions. SLS will evolve to progressively more powerful crew and cargo configurations for launching astronauts in the Orion spacecraft and large exploration-class cargo such as pressurized crew modules. The flexible architecture can also potentially offer additional mission capture through tailored configurations, such as supporting multiple upper stages to launch high-energy science missions to the outer solar system or even to interstellar space. SLS will meet NASA's varied launch needs for the next generation of deep space exploration by providing greater mass to destination, unrivalled payload volume and higher departure energy than commercial vehicles. The initial Block 1 vehicle is nearly complete and will launch an uncrewed Orion on a test flight to lunar orbit known as Exploration Mission-1 (EM-1), along with providing deep-space deployment for smallsat secondary payloads. Following that thorough checkout mission, crew will return to the lunar vicinity for the first time since Apollo 17 on Exploration Mission-2 (EM-2). The first SLS mission to incorporate a payload fairing is expected to be Science Mission-1 (SM-1), which would send the Europa Clipper probe on a direct trajectory to Jupiter's icy moon for a multiple flyby mission. A standard 5.1 m-diameter shroud will encapsulate the Europa Clipper spacecraft, expected to have a six metric ton (t) mass. The SLS Block 1B configuration, scheduled to launch in the mid-2020s, will use a more powerful upper stage, known as the Exploration Upper Stage (EUS), to increase mass-to-destination capability and enable the largest-diameter payload shrouds ever – at least 8.4 m in diameter – to launch ambitious science missions. For the Block 1B crew vehicle, payload space is available in a Universal Stage Adapter (USA) that connects the core stage to Orion's spacecraft adapter. NASA plans to use the co-manifested capability in the USA on the Block 1B vehicle to launch elements of the Gateway lunar outpost and lunar lander along with crew. The ultimate Block 2 vehicle, which will lift at least 45 t to TLI and potentially accommodate a 10 m-diameter fairing, will enable human missions to Mars. This paper will discuss the capabilities that SLS offers for enabling ambitious missions of deep-space science and exploration.