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NASA's Space Launch System: A New Capability for Science and Exploration

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Abstract

NASA's Marshall Space Flight Center (MSFC) is directing efforts to build the Space Launch System (SLS), a heavy-lift rocket that will launch the Orion Multi-Purpose Crew Vehicle (MPCV) and other high-priority payloads into deep space. Its evolvable architecture will allow NASA to begin with human missions beyond the Moon and then go on to transport astronauts or robots to distant places such as asteroids and Mars. Developed with the goals of safety, affordability, and sustainability in mind, SLS will start with 10 percent more thrust than the Saturn V rocket that launched astronauts to the Moon 40 years ago. From there it will evolve into the most powerful launch vehicle ever flown, via an upgrade approach that will provide building blocks for future space exploration. This paper will explain how NASA will execute this development within flat budgetary guidelines by using existing engines assets and heritage technology, from the initial 70 metric ton (t) lift capability through a block upgrade approach to an evolved 130-t capability, and will detail the progress that has already been made toward a first launch in 2017. This paper will also explore the requirements needed for human missions to deep-space destinations and for game-changing robotic science missions, and the capability of SLS to meet those requirements and enable those missions, along with the evolution strategy that will increase that capability. The International Space Exploration Coordination Group, representing 12 of the world's space agencies, has worked together to create the Global Exploration Roadmap, which outlines paths towards a human landing on Mars, beginning with capability-demonstrating missions to the Moon or an asteroid. The Roadmap and corresponding NASA research outline the requirements for reference missions for all three destinations. The SLS will offer a robust way to transport international crews and the air, water, food, and equipment they would need for extended trips to asteroids, the Moon, and Mars. SLS also offers substantial capability to support robotic science missions, offering benefits such as improved mass margins and radiation mitigation, and reduced mission durations. The SLS rocket, using significantly higher C3 energies, can more quickly and effectively take the mission directly to its destination, reducing trip time and cost. As this paper will explain, the SLS is making measurable progress toward becoming a global infrastructure asset for robotic and human scouts of all nations by providing the robust space launch capability to deliver sustainable solutions for advanced exploration.