NASA’s Space Launch System: An Enabling Capability for Discovery

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Space Launch System (SLS) Program
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SLS Initial Configuration Performance

- Lunar
- Mars
- Jupiter/Europa
- Saturn via JGA (mid 2030s)
- Saturn/Uranus Direct

Graph showing payload system mass (m(t)) vs. launch energy (C3 (km²/s²)).

- Block 1 SLS with DCSS
- Delta IV-H
- Atlas V 551
- Falcon Heavy
SLS Block Commonality

Orion, Multi-Purpose Crew Vehicle (MPCV- LMCO)

Interim Cryogenic Propulsion Stage (ICPS) (EELV 5m DCSS – Boeing/ULA)

Core Stage/Avionics (Boeing)

5-Segment Solid Rocket Booster (SRB) (ATK)

Core Stage Engines (RS-25) (PWR)

Launch Abort System

Commonality of Payload Interfaces

Core
Common design, & manufacturing
Avionics & Software
- Builds on Ares heritage

Evolutionary Path to Future Capabilities
- Minimizes unique configurations
- Allows incremental development
- Evolve for Expanding Mission Capability

30 ft (10 m)

Upper Stage

Advanced Solid or Liquid (i.e., RP Engines) Boosters

Commonality of Engines

Evolutionary Path to Future Capabilities
- Minimizes unique configurations
- Allows incremental development

Block 1
Initial Capability, 2017-21
70 metric ton Payload

Block 2 Capability
130 metric ton Payload
SLS Evolved Performance

SLS Offers Reduced Transit Times to Outer Planets

- 70 t SLS Shaves 5 Years off the Cruise Time for Titan Saturn System Mission
- 70 t SLS Shaves 4 Years off the Cruise Time for Uranus Orbiter and Probe

Payload System Mass (mt)

Characteristic Energy, c³ (km²/s²)

- Lunar
- Mars
- Jupiter/Europa
- Saturn via JGA (mid 2030s)
- Saturn/Uranus Direct

70 t Configuration
105 t Configuration
130 t Configuration

Dec. 2013
SLS Offers Unrivaled Payload Volume

- SLS is investigating utilizing existing fairings for early cargo flights, offering payload envelope compatibility with design for current EELVs
- Phase A studies in work for 8.4m and 10 m fairing options

4m x 12m (100 m³)  
5m x 14m (200 m³)  
5m x 19m (300 m³)  
8.4m x 31m (1200 m³)  
10m x 31m (1800 m³)
Global Exploration Roadmap

**International Space Station**

General Research and Exploration Preparatory Activities

Note: ISS partner agencies have agreed to use the ISS until at least 2020.

**Robotic Missions to Discover and Prepare**

- LADEE
- Luna-25
- Chandrayaan-2
- Luna-26
- Luna 27
- RESOLVE
- SELENE-2
- Luna 28/29
- SELENE-3
- Rosetta
- Hayabusa2
- OSIRIS-REx
- MAVEN
- ISRO Mars
- ExoMars
- InSight
- ExoMars
- Mars 2020
- JAXA Mars Precursor
- Apophis

**Mars Sample Return and Precursor Opportunities**

**Human Missions Beyond Low-Earth Orbit**

- Explore Near-Earth Asteroid
- Extended Duration Crew Missions
- Humans to Lunar Surface
- Missions to Deep Space and Mars System

Sustainable Human Missions to Mars Surface
SLS Mission Capabilities
SLS Benefits for Science Missions

◆ SLS Being Developed to Enable Exploration
  • Volume and mass capability/margin required for complex deep-space human mission
    ‐ Increased design simplicity
    ‐ Fewer origami-type payload designs needed to fit in the fairing
    ‐ Simplifies on-orbit operations
    ‐ Reduced risks and hazards

◆ SLS investment can be leveraged for other missions requiring large volume or mass, or reduced trip times
  ‐ Deep Space Exploration
  ‐ Planetary Landers
  ‐ Human Habitats
  ‐ Great Observatories
  ‐ Space Solar Power
  ‐ Outer Planet Missions
  ‐ National Security Space Payloads
Manufacture and Testing Underway
Summary

◆ **SLS provides capability for human exploration missions.**
  - 70 t configuration enables EM-1 and EM-2 flight tests.
  - Evolved configurations enable missions including humans to Mars.

◆ **SLS offers unrivaled benefits for a variety of missions.**
  - 70 t provides greater mass lift than any contemporary launch vehicle; 130 t offers greater lift than any launch vehicle ever.
  - With 8.4m and 10m fairings, SLS will over greater volume lift capability than any other vehicle.
  - Initial ICPS configuration and future evolution will offer high C3 for beyond-Earth missions.

◆ **SLS is currently on schedule for first launch in December 2017.**
  - Preliminary design completed in July 2013; SLS is now in implementation.
  - Manufacture and testing are currently underway.
  - Hardware now exists representing all SLS elements.