National Aeronautics and Space Administration

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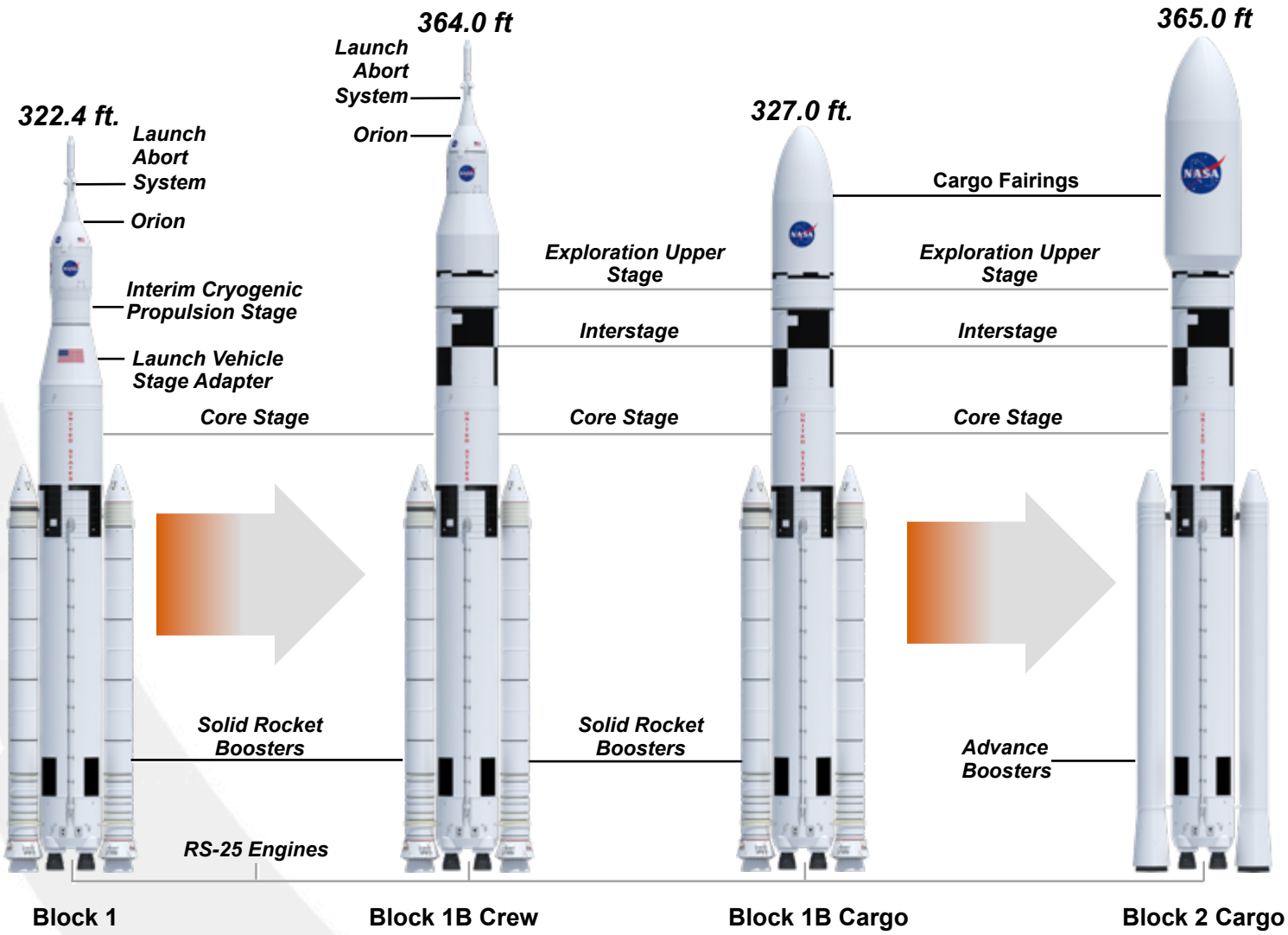
SPACE LAUNCH SYSTEM

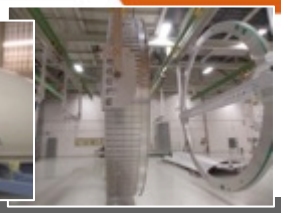
SLS Capabilities Overview

Steve Creech

SLS Evolution Overview



Building Today

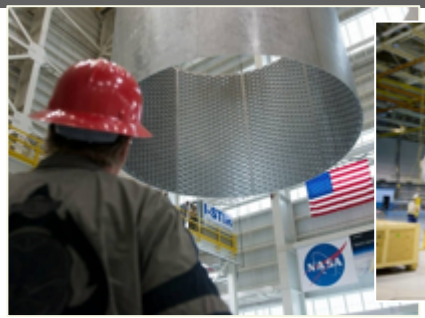


Interim Cryogenic Propulsion Stage: Currently in production.

Stage Adapters: First flight hardware launched on Exploration Flight Test-1 in December 2014.

Avionics: Software Integration Test Facility preparing for qualification in second quarter 2016.

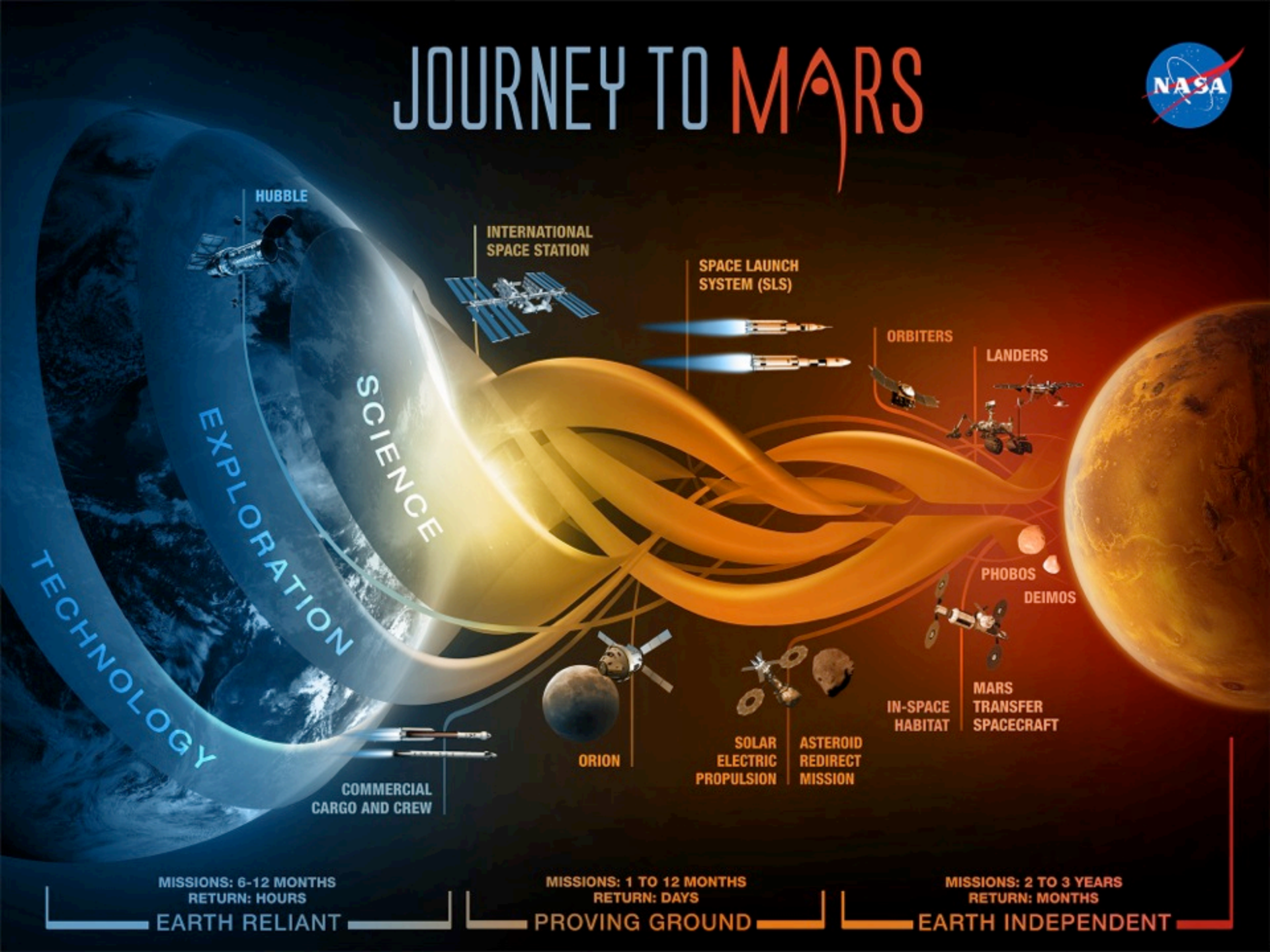
Core Stage: First full set of flight rings completed; production is underway on barrels for EM-1.



Boosters: Qualification Motor-1 test completed in March 2015.

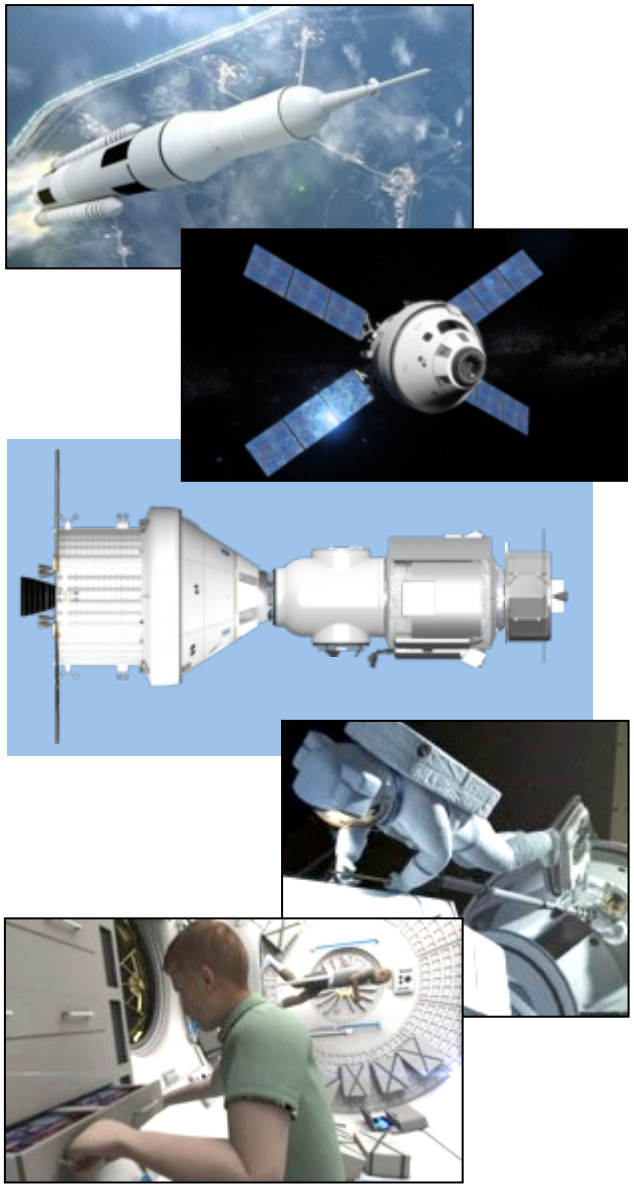
Engines: RS-25 testing has begun at Stennis Space Center; renovations underway to B-2 stand.

JOURNEY TO MARS

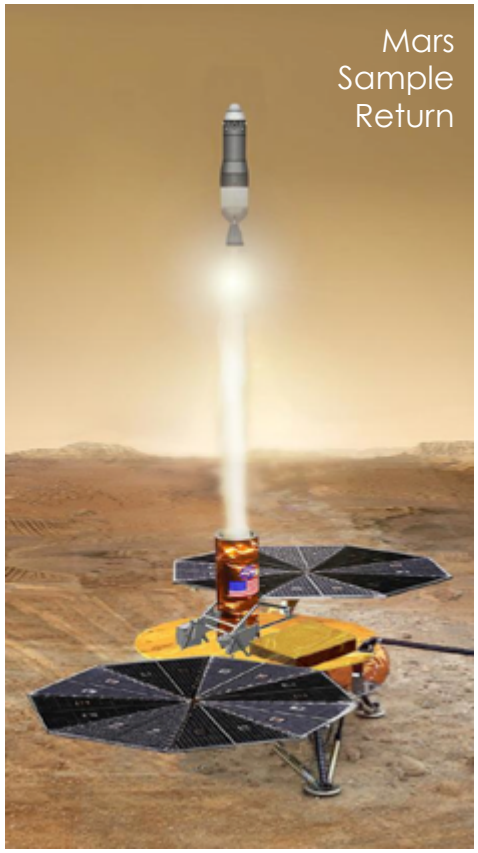


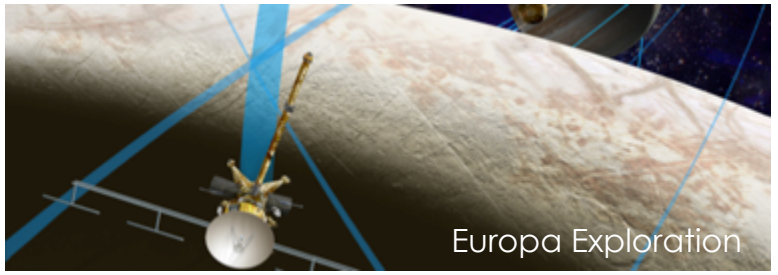
Early Proving Ground Objectives

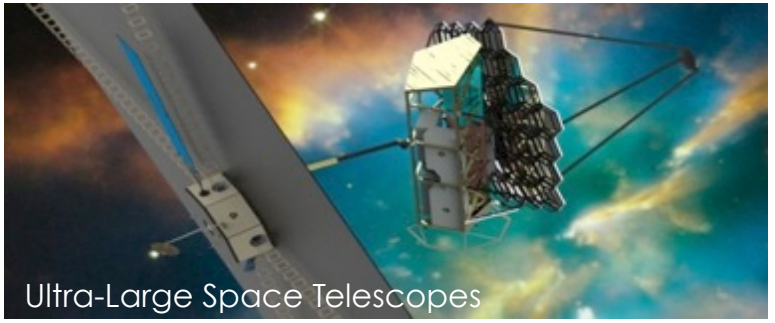
- **Demonstrate SLS and Orion in deep space**
  - Critical Mission Events
    - Separation Events, Key Maneuvers, Re-entry, Landing and Recovery
  - Co-manifested cargo capability with Orion incl loads, dynamics
  - Demonstrate integrated vehicle systems in flight
    - Deep space communications, power and thermal systems, in-space maneuvering
  - Validate environments
  - Autonomous operations
- **Conduct EVAs in deep space, micro-g environments**
- **Conduct human and robotic mission operations**
- **Evaluate crew health and performance in a deep space environment**
- **Demonstrate Solar Electric Propulsion (SEP) systems**
- **Demonstration of In-Situ Resource Utilization in micro-g**
- **Learn to operate with reduced logistics capability**
- **Demonstrate long duration, deep space habitation systems**
- **Demonstrate structures & mechanisms**
  - Low temperature and mechanisms for long duration, deep space missions
  - Inflatable structures

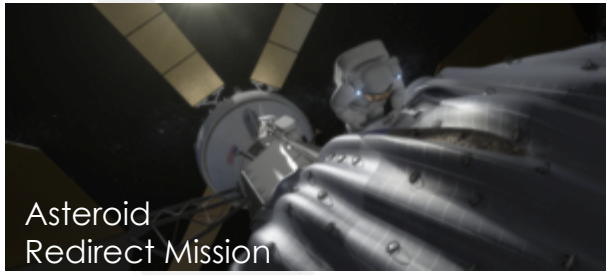


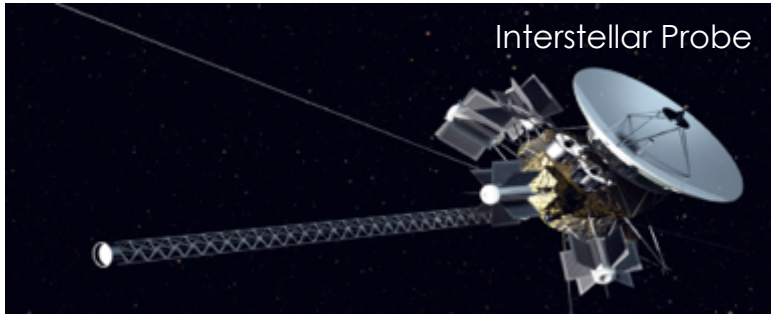
Game-changing Power For Exploration

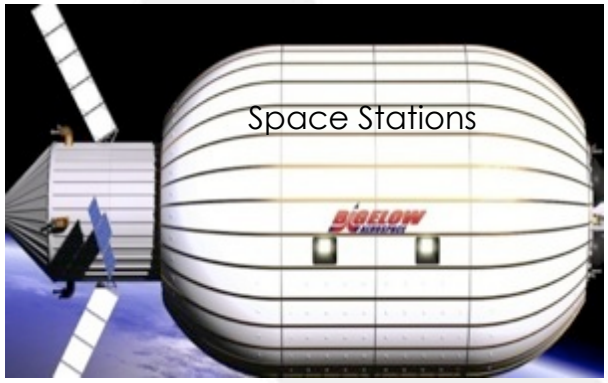




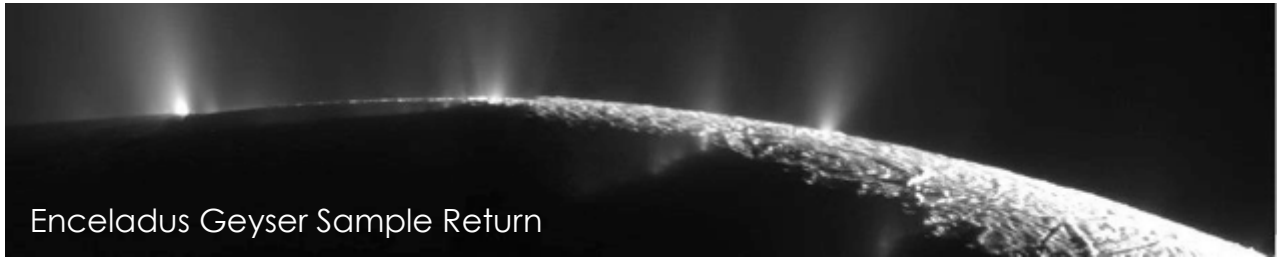






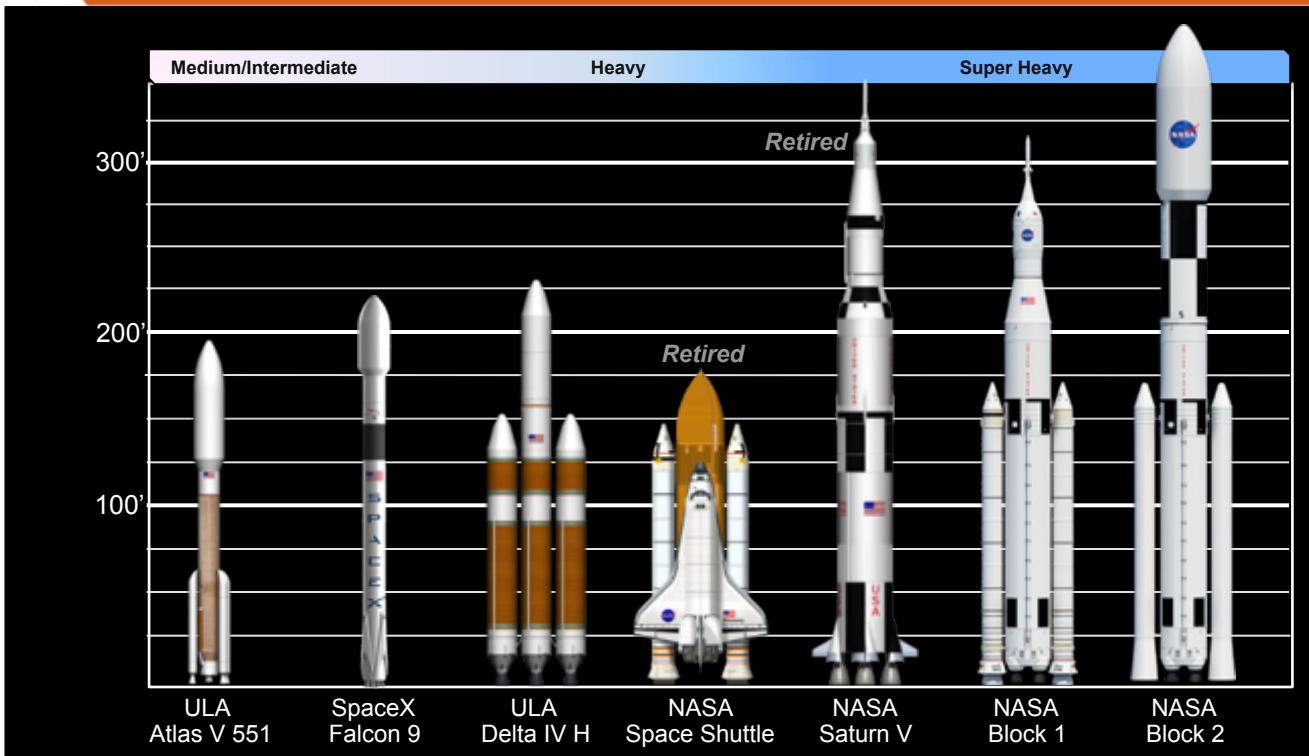


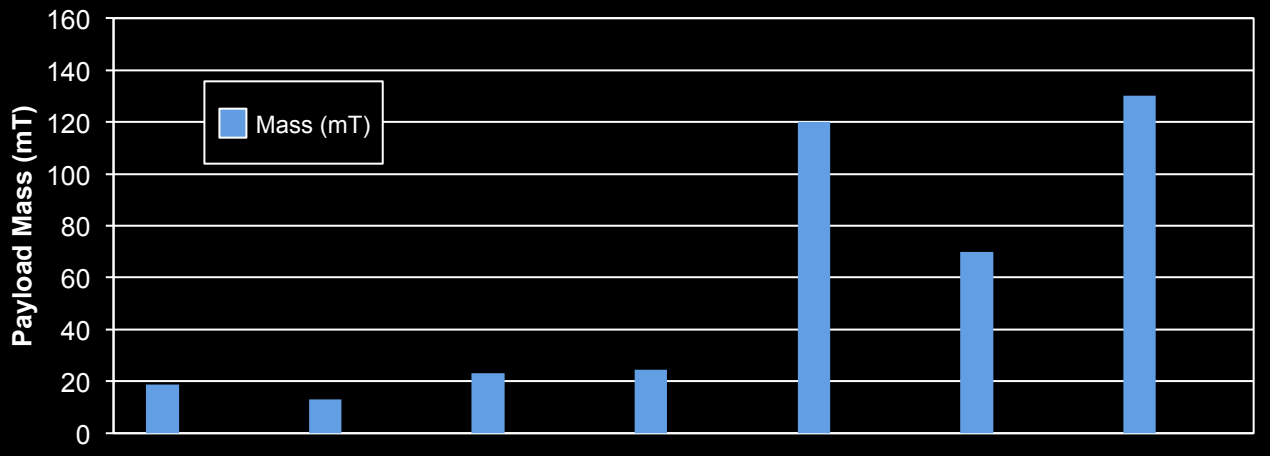
NASA's Space Launch System



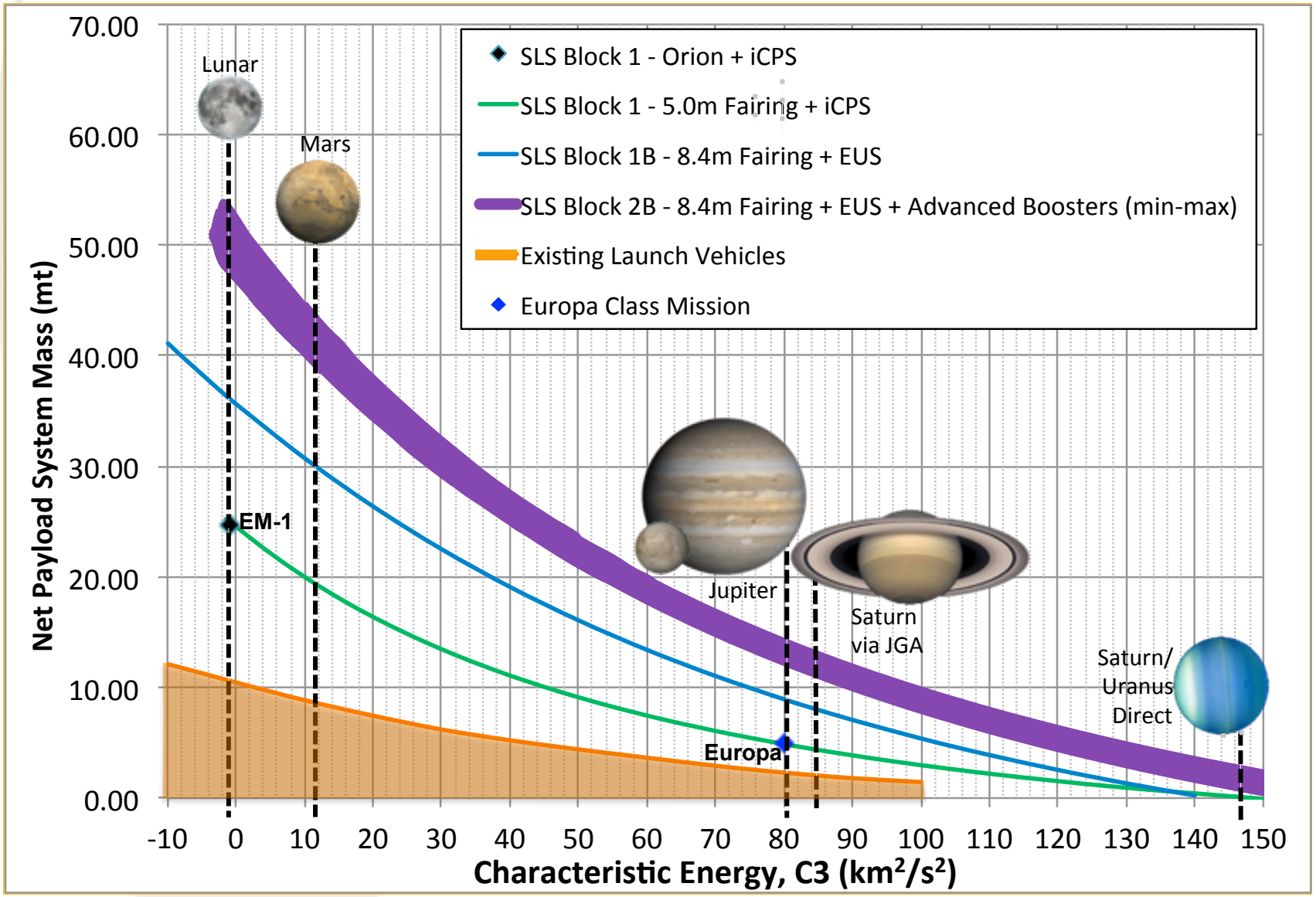
SLS Mass Lift Capability

- SLS initial configuration offers Block 1 to LEO.
- Future configurations offer Block 1B and Block 2 to LEO.
- Mass capability benefits mean larger payloads to any destination.



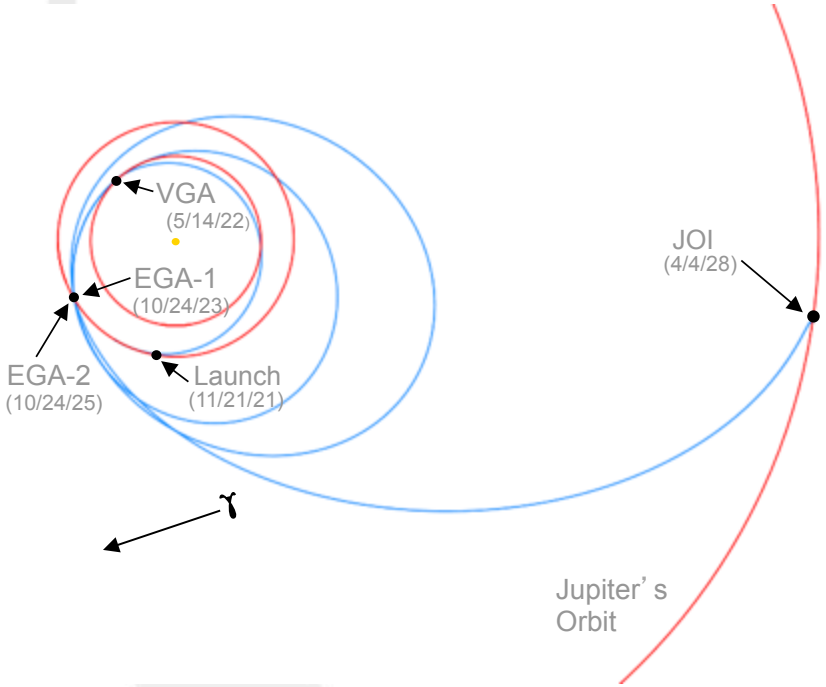


SLS Characteristic Energy

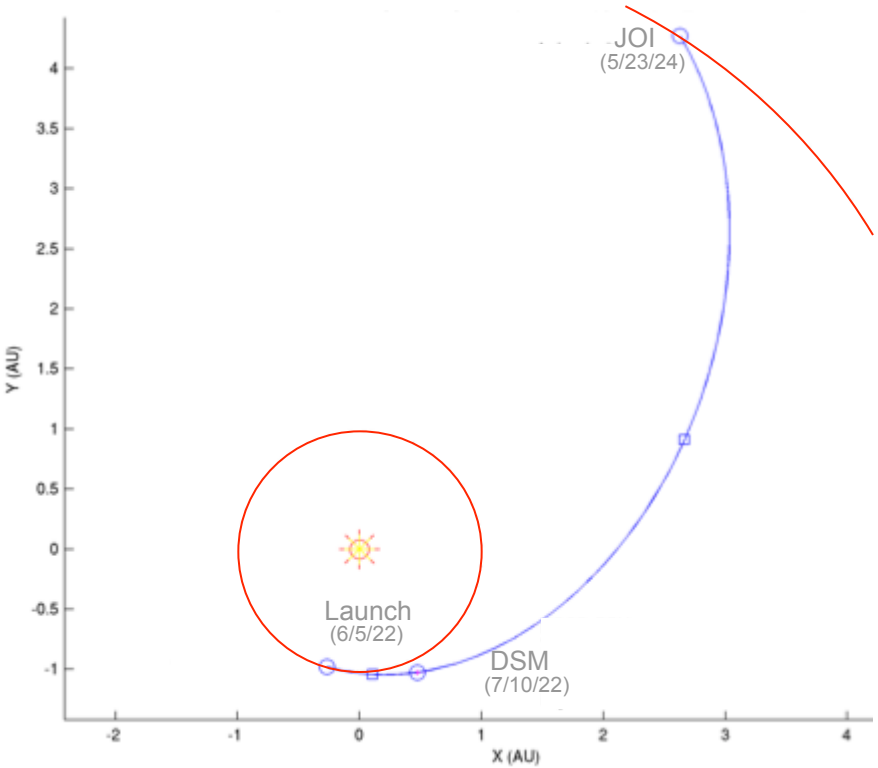


Europa Trajectory Comparison

Atlas V 551: VEEGA



SLS: Direct



REDUCES TRANSIT TIME TO EUROPA BY HALF

SLS Payload Configurations

Mission Elements

Exploration Upper Stage

Core Stage / Boosters

Mission concepts with 5m fairing

Europa Clipper

total mission volume = ~ 300m3

Mission concepts with Universal Stage Adaptor (includes additional payload capability)

Orion with EAM

total mission volume = ~ 400m3

Orion with ARV

total mission volume = ~ 400m3

5m fairing w/Robotic Lunar Lander & EAM

total mission volume = ~ 600m3

Mission concepts with 8m and 10m fairings

8m fairing with ATLAST

total mission volume = ~ 1200m3

10m fairing w/notional Mars payload

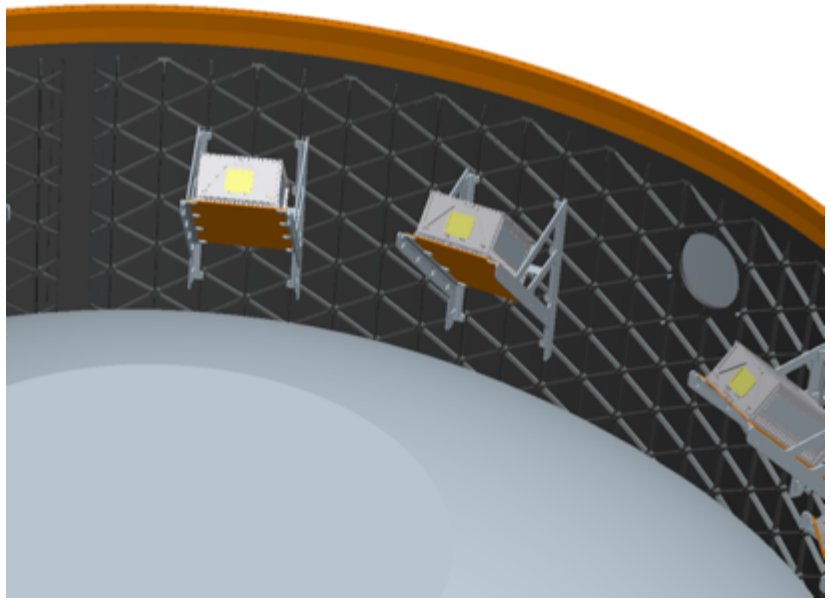
total mission volume = ~ 1800m3

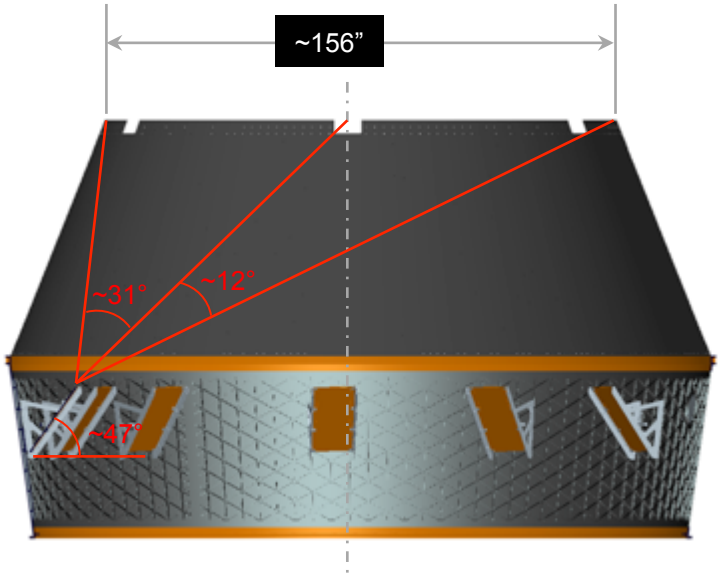
Secondary Payload Capability

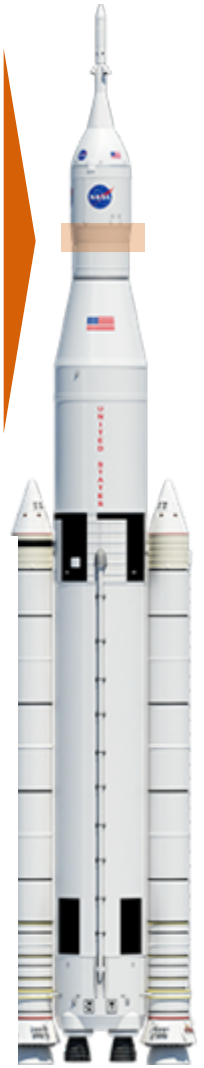
- Eleven 6U/12U payload locations
- 6U volume/mass is the current standard (14 kg payload mass)
- Payloads will be “off” from roll-out through Orion separation and payload deployment
- Payload Deployment System Sequencer; payload deployment will begin with pre-loaded sequence following MPCV separation and ICPS disposal burn
- Payload requirements captured in Interface Definition and Requirements Document

Advanced Exploration Systems candidate EM-1 payloads include:

- BioSentinel: Study radiation-induced DNA damage of live organisms in cislunar space; correlate with measurements on ISS and Earth.
- Lunar Flashlight: Locate ice deposits in the moon’ permanently shadowed craters
- Near Earth Asteroid (NEA) Scout: Flyby/ rendezvous and characterize one NEA that is a candidate for a human mission.







Summary

- **SLS provides capability for human exploration missions.**
  - Block 1 configuration enables initial flight tests.
  - Evolved configurations enable missions including humans to Mars.
- **SLS offers unrivaled benefits for a variety of missions.**
  - Block 1 provides greater mass lift than any contemporary launch vehicle; Block 2 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 highest-ever C3.
- **SLS is currently on schedule for first launch.**
  - Preliminary design completed in July 2013; SLS is now in implementation.
  - Manufacture and testing are currently underway.
  - Hardware now exists representing all SLS elements.