NASA's Space Launch System (SLS) A Heavy-Lift Platform for Entirely New Missions

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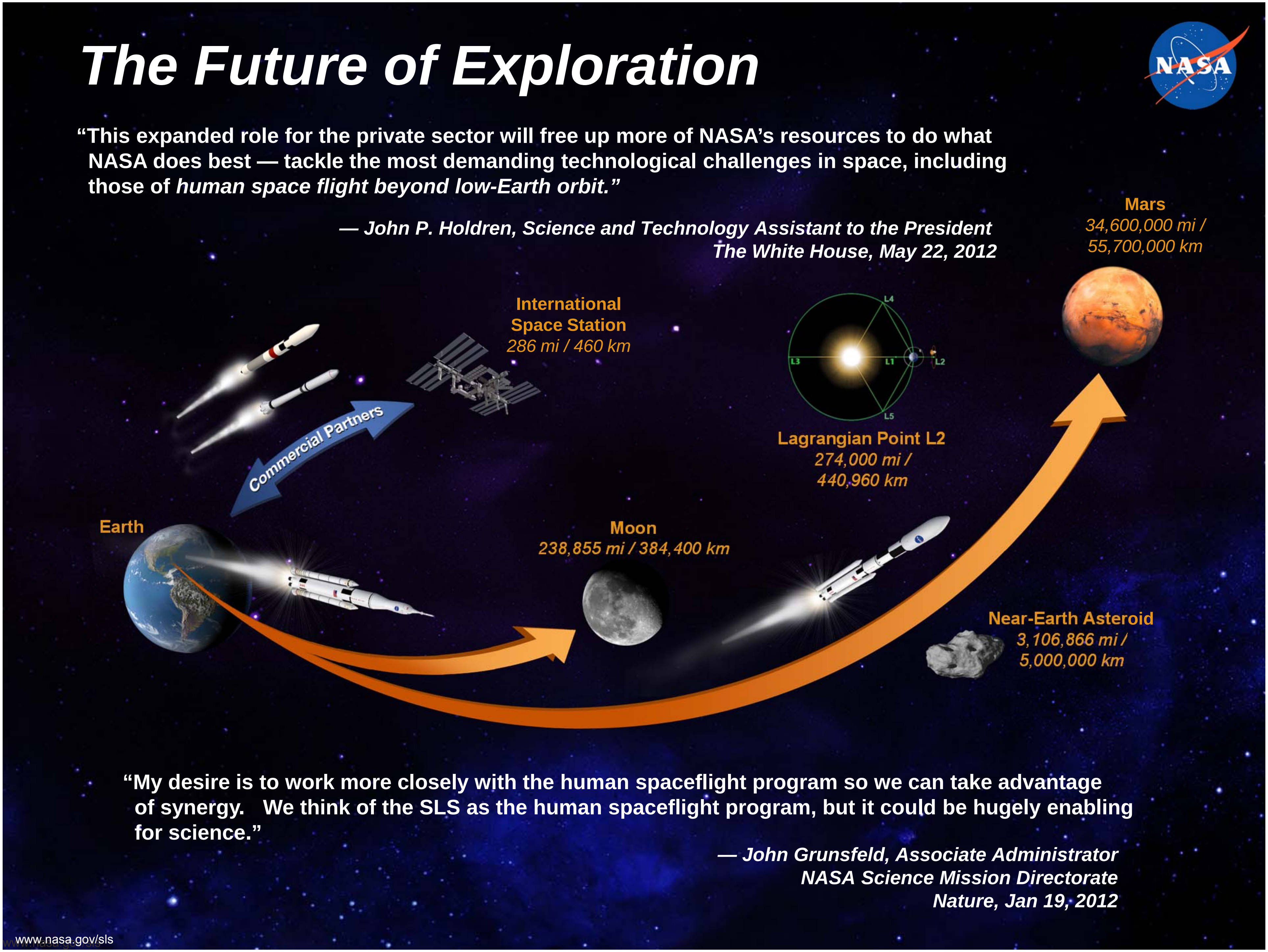
The Future of Exploration
NASA
"This expanded role for the private sector will free up more of NASA's resources to do what NASA does best — tackle the most demanding technological challenges in space, including those of *human space flight beyond low-Earth orbit.*"
— John P. Holdren, Science and Technology Assistant to the President
The White House, May 22, 2012
Mars
34,600,000 mi / 55,700,000 km
International Space Station
286 mi / 460 km
L4
L3
L1
L2
L5
Lagrangian Point L2
274,000 mi / 440,960 km
Commercial Partners
Earth
Moon
238,855 mi / 384,400 km
Near-Earth Asteroid
3,106,866 mi / 5,000,000 km
"My desire is to work more closely with the human spaceflight program so we can take advantage of synergy. We think of the SLS as the human spaceflight program, but it could be hugely enabling for science."
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Nature, Jan 19, 2012
www.nasa.gov/sls

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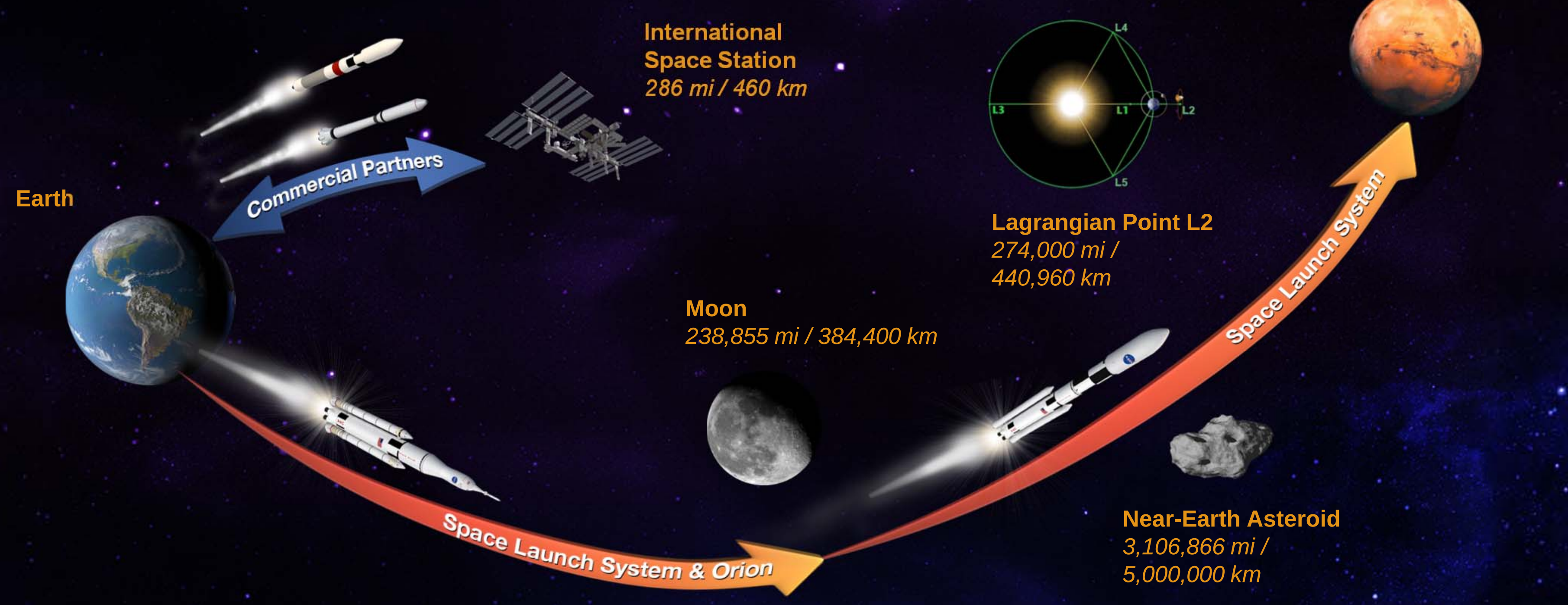

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SLS Driving Objectives

- ♦ **Safe: Human-Rated**

- ♦ **Affordable**
  - Constrained budget environment
  - Maximum use of common elements and existing assets, infrastructure, and workforce
  - Competitive opportunities for affordability on-ramps

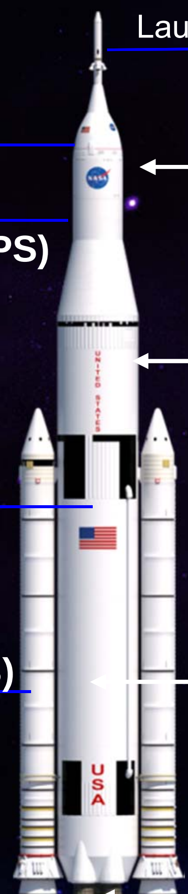
- ♦ **Sustainable**
  - Initial capability: 70 metric tons (t), 2017–2021
  - Serves as primary transportation for Orion and exploration missions
  - Evolved capability: 105 t and 130 t, post-2021
  - Large volume for science missions and payloads
  - Modular and flexible, right-sized for mission requirements

Flexible Architecture Configured for Going Beyond Earth's Orbit

SLS Block Approach

Block 1 Initial Capability, 2017–21
70 ton Payload

Block 2 Capability
130 ton Payload



Orion Multi-Purpose Crew Vehicle (Lockheed-Martin)

Launch Abort System

Interim Cryogenic Propulsion Stage (ICPS)
(Boeing/ULA)

Core Stage/Avionics *(Boeing)*

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

Core Stage Engines (RS-25) *(PWR)*

Commonality of Payload Interfaces:

- Mechanical
- Avionics
- Software

Commonality of Upper Stage & Core Stage

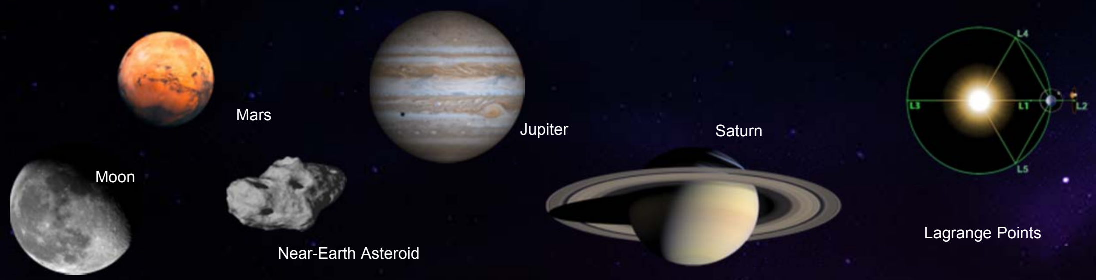
- Same diameter (27.5 ft.) and basic design
- Manufacturing facilities, tooling, materials, & processes/practices
- Workforce
- Supply chain/industry base
- Transportation logistics
- Ground systems/launch infrastructure
- Propellants

Commonality of Core Stage

Commonality of Engines

SLS Evolution

SLS Benefits for Payloads



Less Risk

↓ Increased lift capacity

Increased payload margin

Less Expensive Mission Operations

↓ High-energy orbit

Shorter trip times

Increased Design Simplicity

↑ Volume & Mass capability

Fewer deployments and critical operations

Increased Mission Reliability and Confidence

↑ Volume & Mass capability

Simpler technologies and redundant systems

Block IA **Block II**

Usable Volume (m^3)	1104
LEO Payload (mt)	70 / 105 / 130
Liftoff Thrust (MN)	36.87

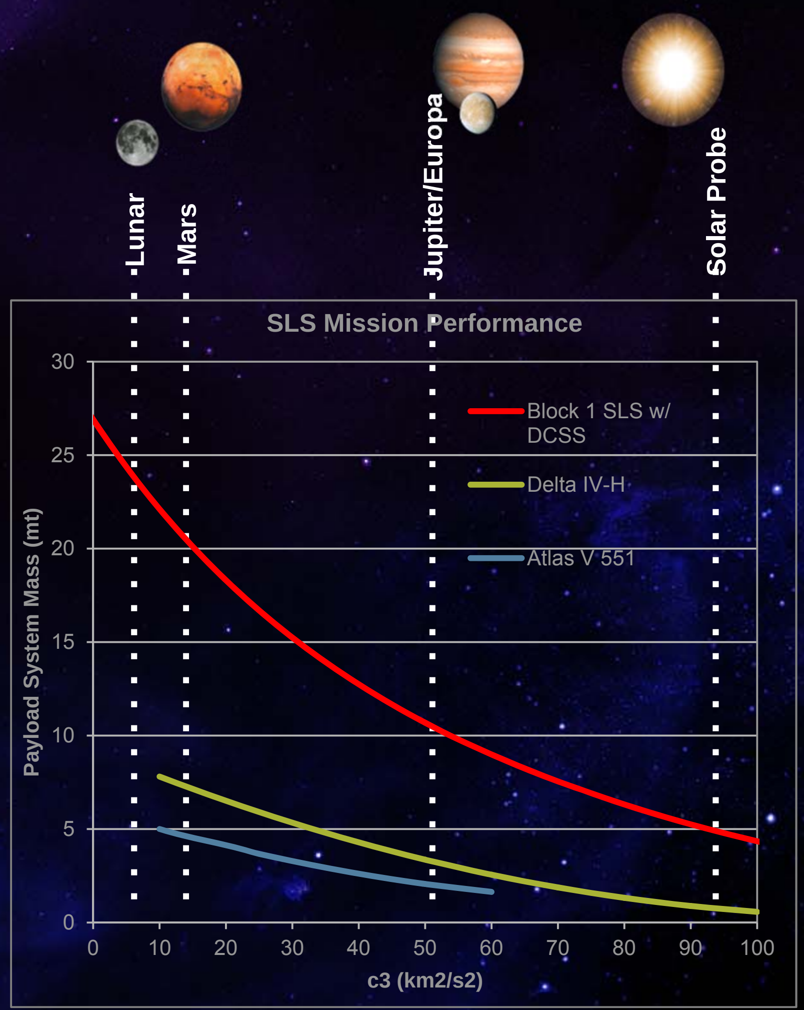
Vehicle Margin to Drive Payload Affordability & Functionality

Platform for Expanded Missions

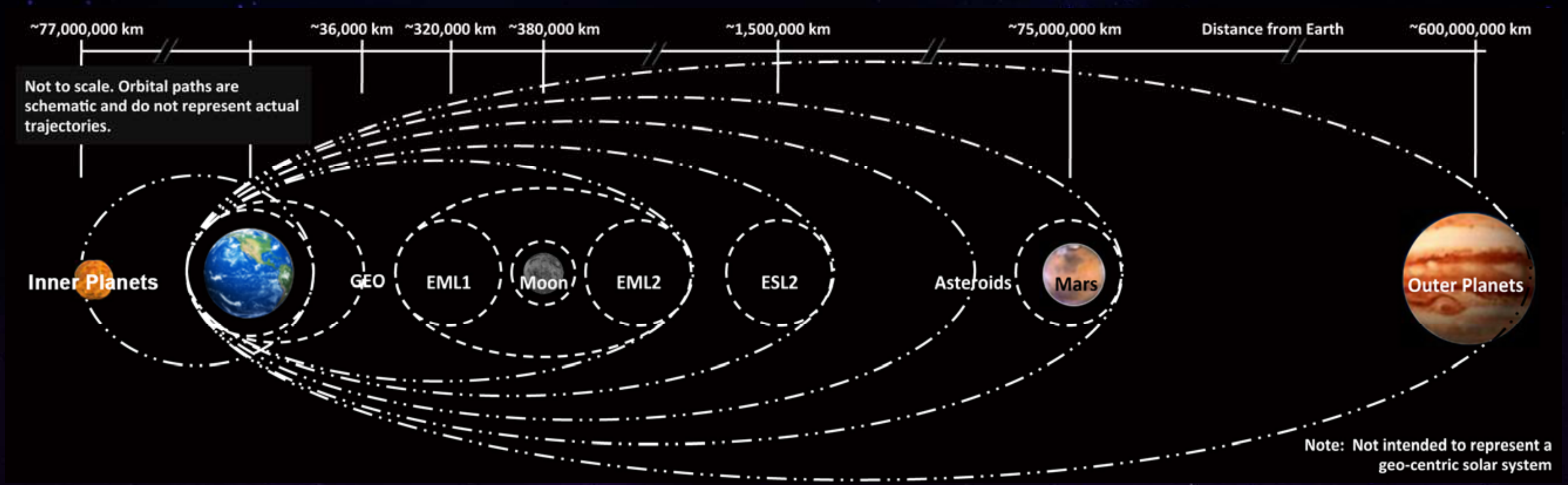
- **SLS Enables Exploration Missions**
  - Maintains reasonable number of launches per mission
  - Simplifies on-orbit operations
  - Maximize mission reliability
  - Very Large Payload Volume

- **SLS investment can be leveraged for other missions**
  - Deep Space Exploration
  - Planetary Landers
  - Human Habitats
  - Great Observatories
  - Space Solar Power
  - Outer Planet Missions
  - Department of Defense/ NRO Payloads

SLS Block 1 C3 Performance



SLS Potential Missions



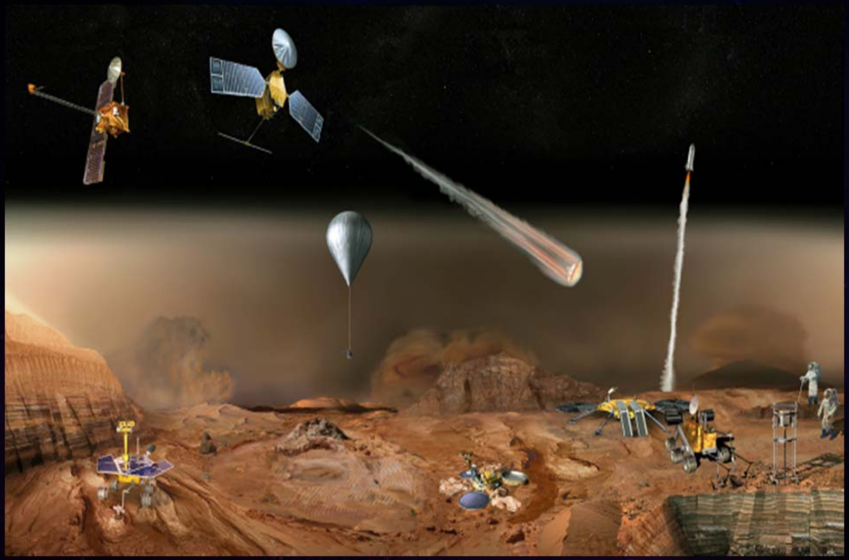
Mission Enabling

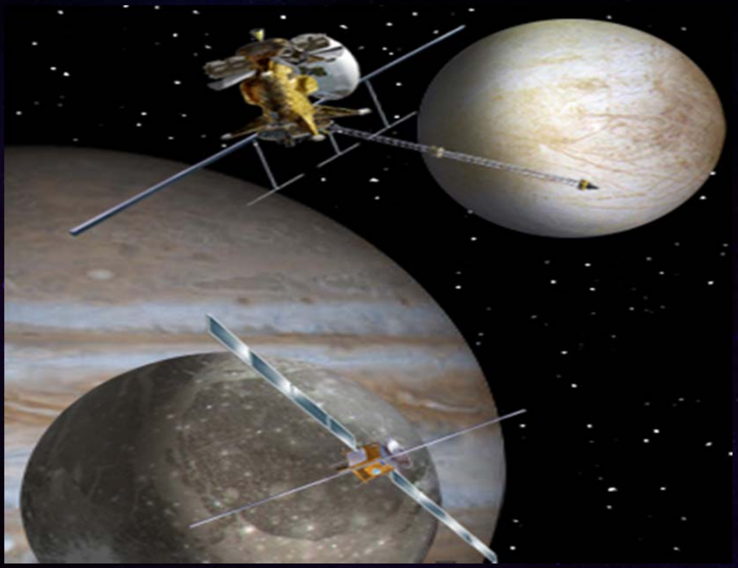
- Bigelow BA 2100
- Human lunar missions
- Earth-Moon L2 Lagrange Point
- Human asteroid missions
- Human Mars missions
- Outer Planet Sample Return

Mission Enhancing

- Mercury robotic missions
- Solar Power Satellites
- Bigelow BA 330
- GEO sat servicing
- Depots
- Telescopes
- Mars Sample Return
- JEO
- Ice Giant mission
- Saturn/Titan System
- Some robotic planetary missions

Planetary Mission Examples





- **High Priority Missions include Mars Sample Return and Europa Missions**
- **Challenges**
  - Multiple launches
  - Constrained sample sizes
  - Trip Time – 6 years for Europa
  - Radiation Environment
  - Mass constraints drive complex spacecraft and mission designs

- **SLS Benefits**
  - Trip Times Reduced 50% for Europa
  - Lower cost spacecraft design due to mass margins
  - Lower cost approaches for radiation mitigation
  - Significantly increased sample sizes
  - Reduced number of launches / mission complexity

Delivering Products and Progress

J-2X in test stand at SSC

Stages manufacturing process development at MSFC

Subscale solid rocket motor test at MSFC, March 2012

Avionics testbed at MSFC

Solid Rocket Booster development motor test, Promontory, UT, Sep 2011

RS-25 Core Stage Engine in the KSC Engine Processing Facility, 2011

MPCV/Stage Adapter designed and fabricated at MSFC

First Adapter Ring Forging, ATI/Ladish, Cudahy, WI, April 2012

For More Information

www.nasa.gov/sls