The Future of Exploration and Technology Innovation

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Deputy Director

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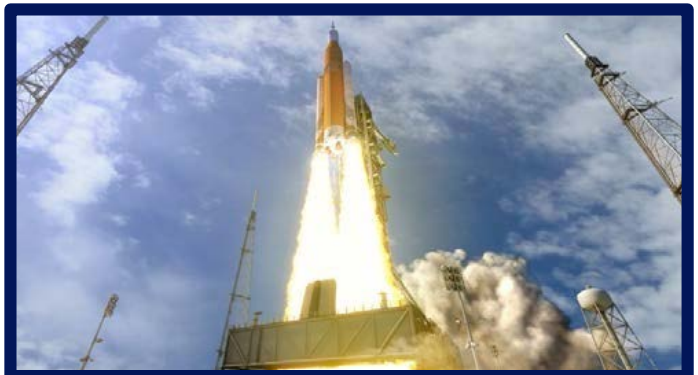
National Aeronautics and Space Administration

NASA

MARSHALL
SPACE FLIGHT CENTER

NASA Around the Country

The National Aeronautics and Space Administration



Human Exploration and Operations

Space Technology

Science

Aeronautics Research

Manufacturing and materials are critical to all NASA Mission Areas.

NASA Space Technology Portfolio

Transformative & Crosscutting Technology Breakthroughs

Technology Demonstration Missions

Small Spacecraft Technology Program

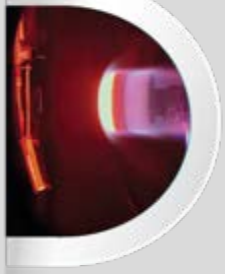
Game Changing Development

Pioneering Concepts/Developing Innovation Community

NASA Innovative Advanced Concepts (NIAC)

Space Technology Research

Center Innovation Fund



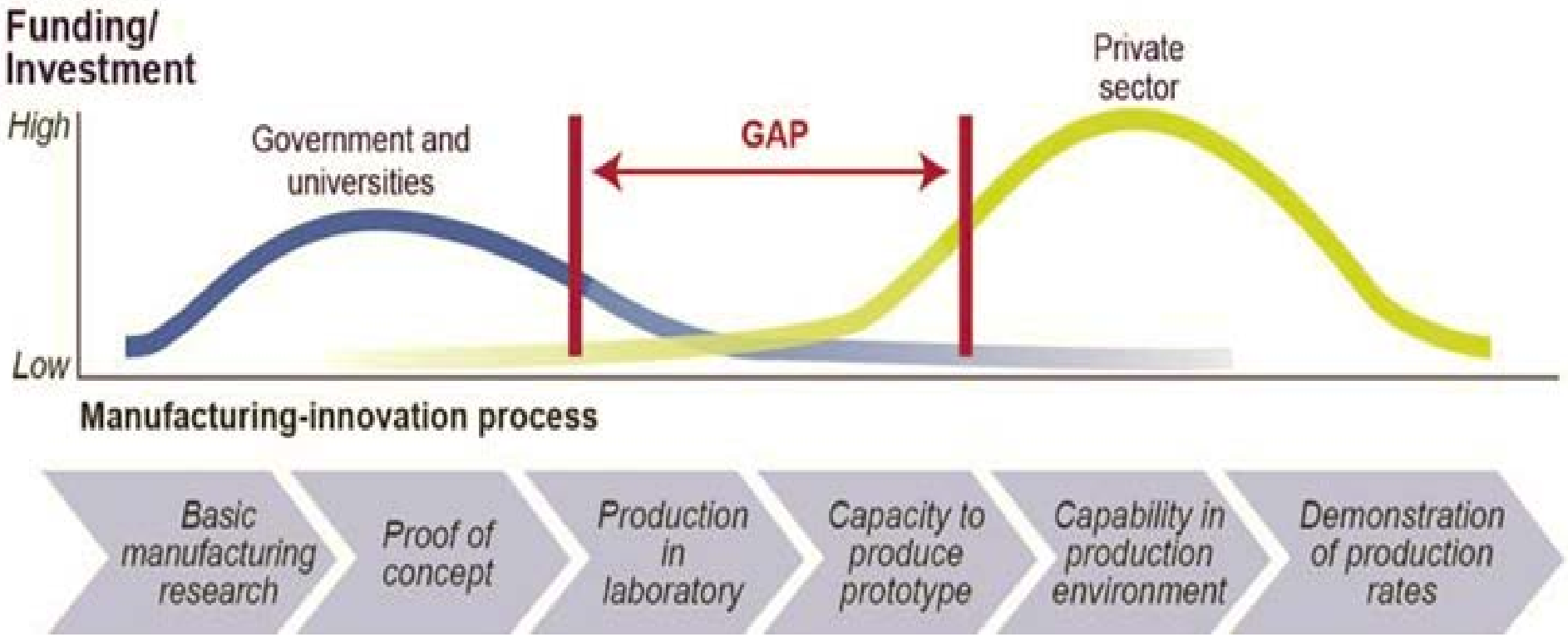
Creating Markets & Growing Innovation Economy

Centennial Challenges

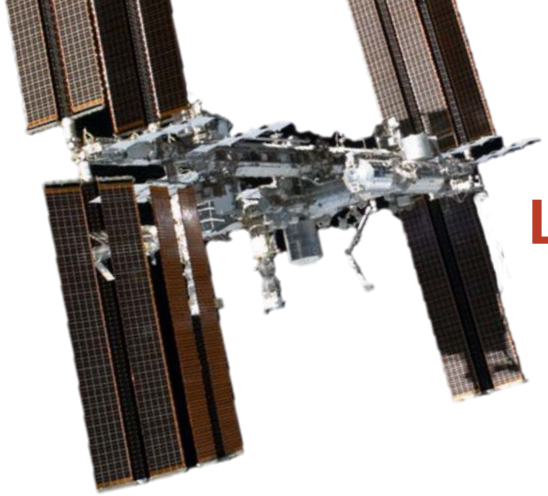
Flight Opportunities

Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)

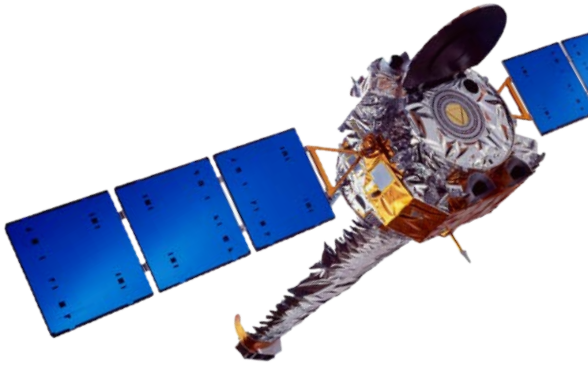
Filling the Gap from Low TRL to Production



Traveling To and Through Space



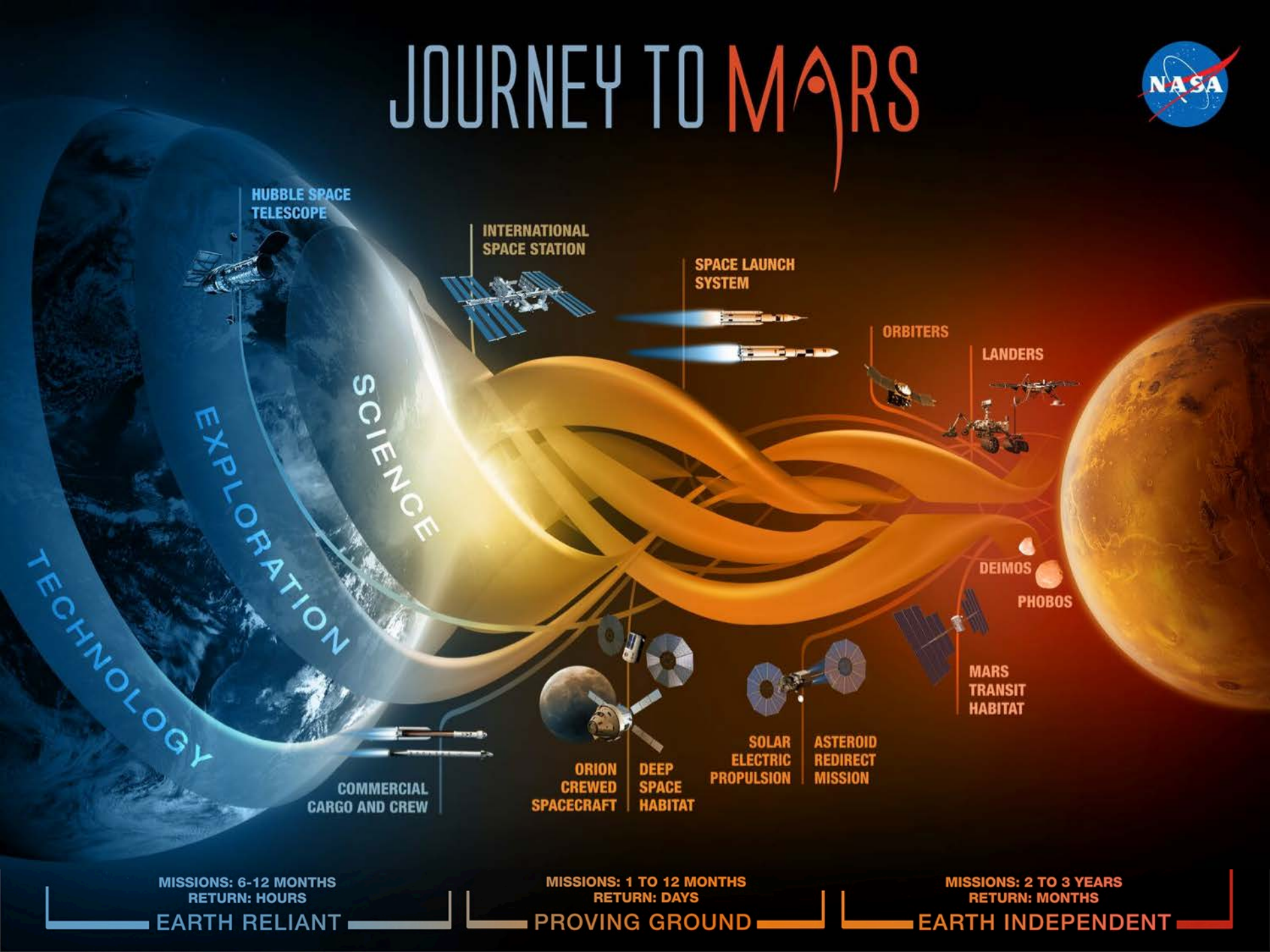
Living and Working in Space



Understanding Our World and Beyond

Marshall's Mission Areas

JOURNEY TO MARS

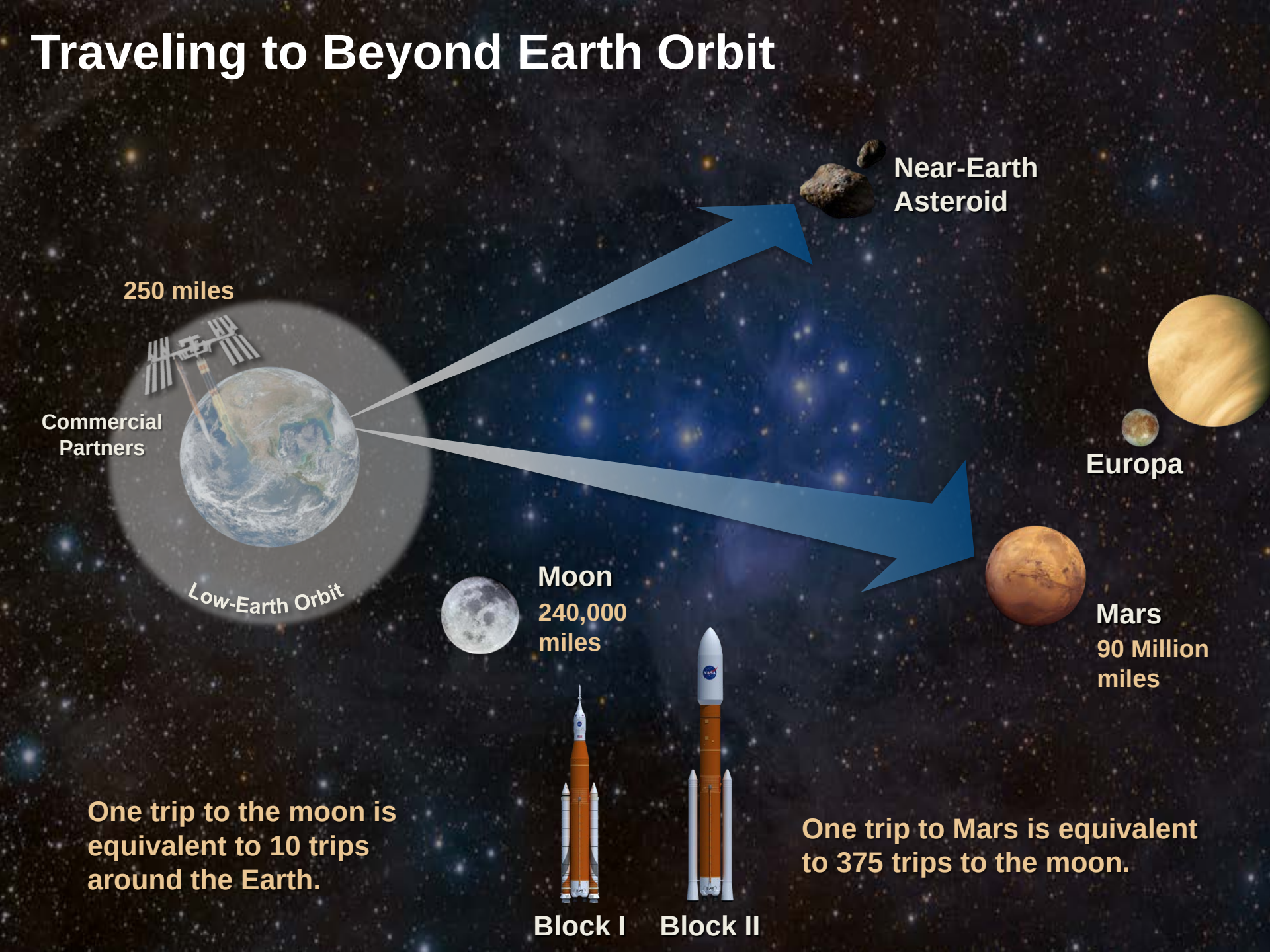


MISSIONS: 6-12 MONTHS
RETURN: HOURS
EARTH RELIANT

MISSIONS: 1 TO 12 MONTHS
RETURN: DAYS
PROVING GROUND

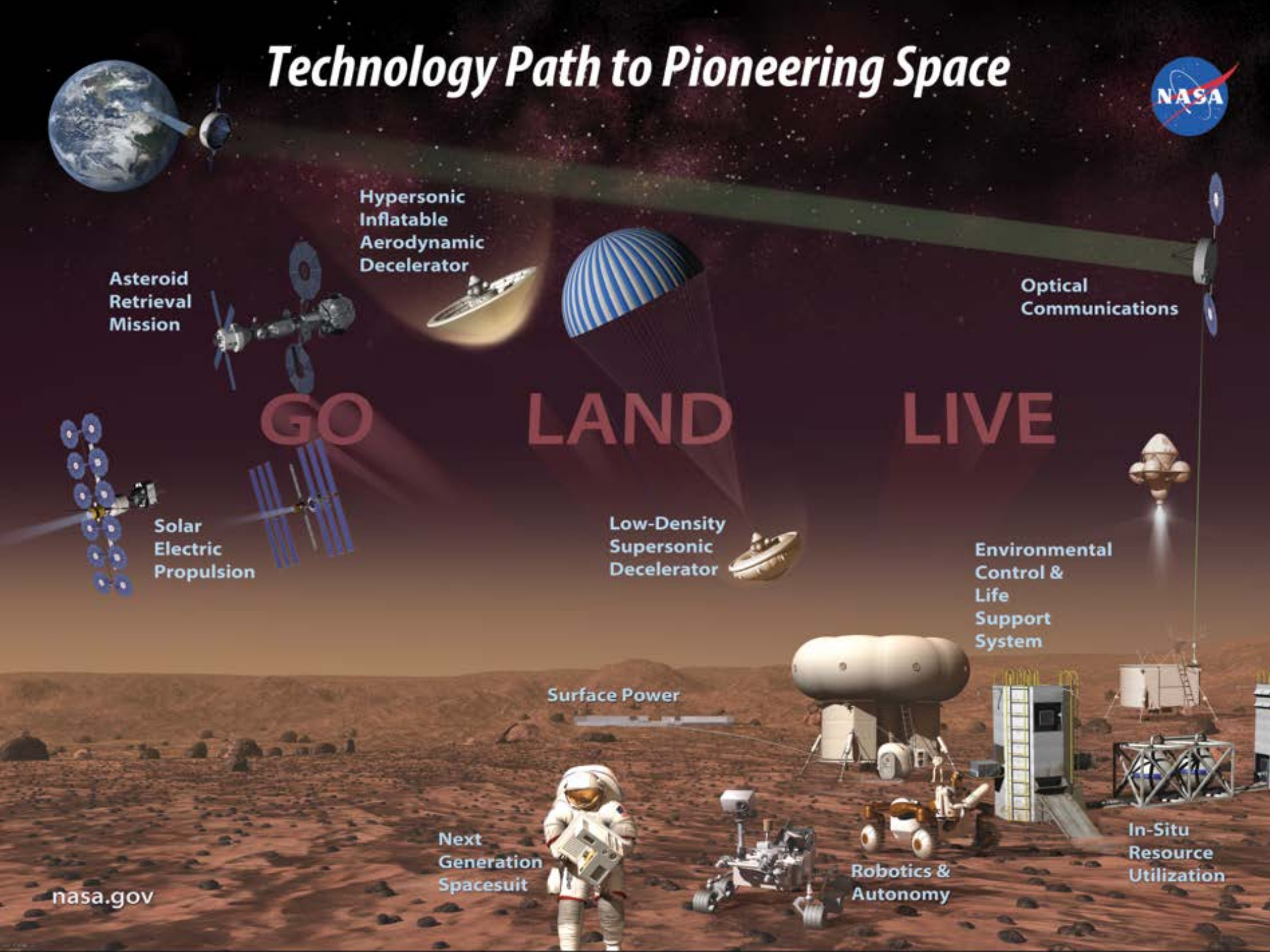
MISSIONS: 2 TO 3 YEARS
RETURN: MONTHS
EARTH INDEPENDENT

Traveling to Beyond Earth Orbit



One trip to the moon is equivalent to 10 trips around the Earth.

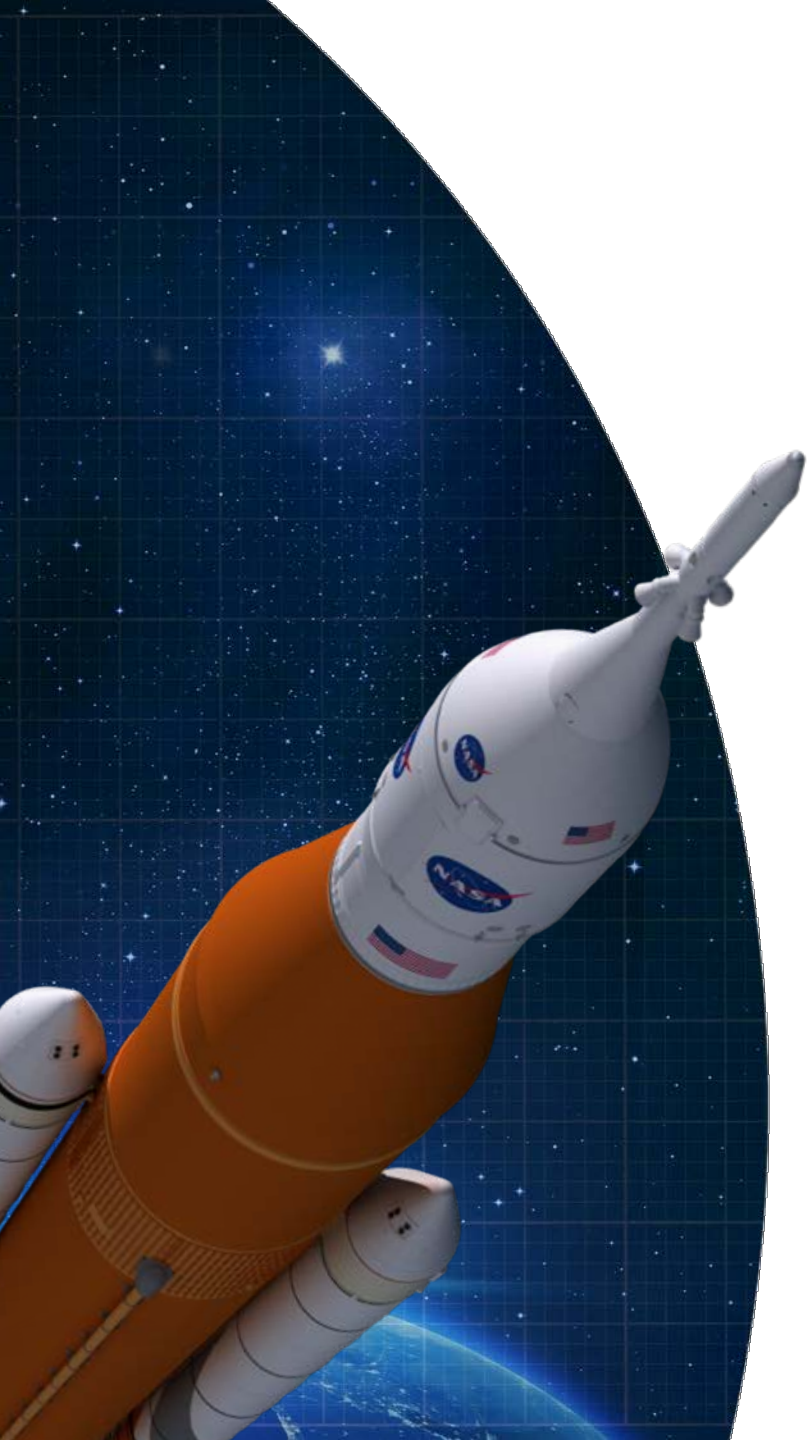
One trip to Mars is equivalent to 375 trips to the moon.

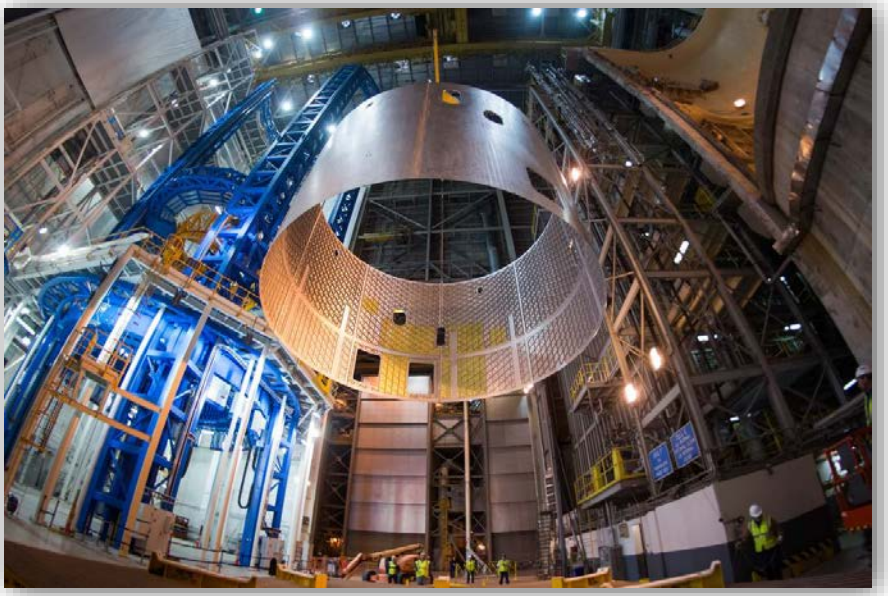

Technology Path to Pioneering Space
NASA
Hypersonic Inflatable Aerodynamic Decelerator
Asteroid Retrieval Mission
Optical Communications
GO
LAND
LIVE
Solar Electric Propulsion
Low-Density Supersonic Decelerator
Environmental Control & Life Support System
Surface Power
Next Generation Spacesuit
Robotics & Autonomy
In-Situ Resource Utilization
nasa.gov

Space Launch System

The **only** vehicle capable of sending humans to deep space **and** the large systems necessary for human exploration

SLS: Becoming a Reality





SLS Nationwide Team

- **Engaging the U.S. Aerospace Industry**
- **Strengthening Sectors such as Manufacturing**
- **Advancing Technology and Innovation for Deep-Space Exploration**

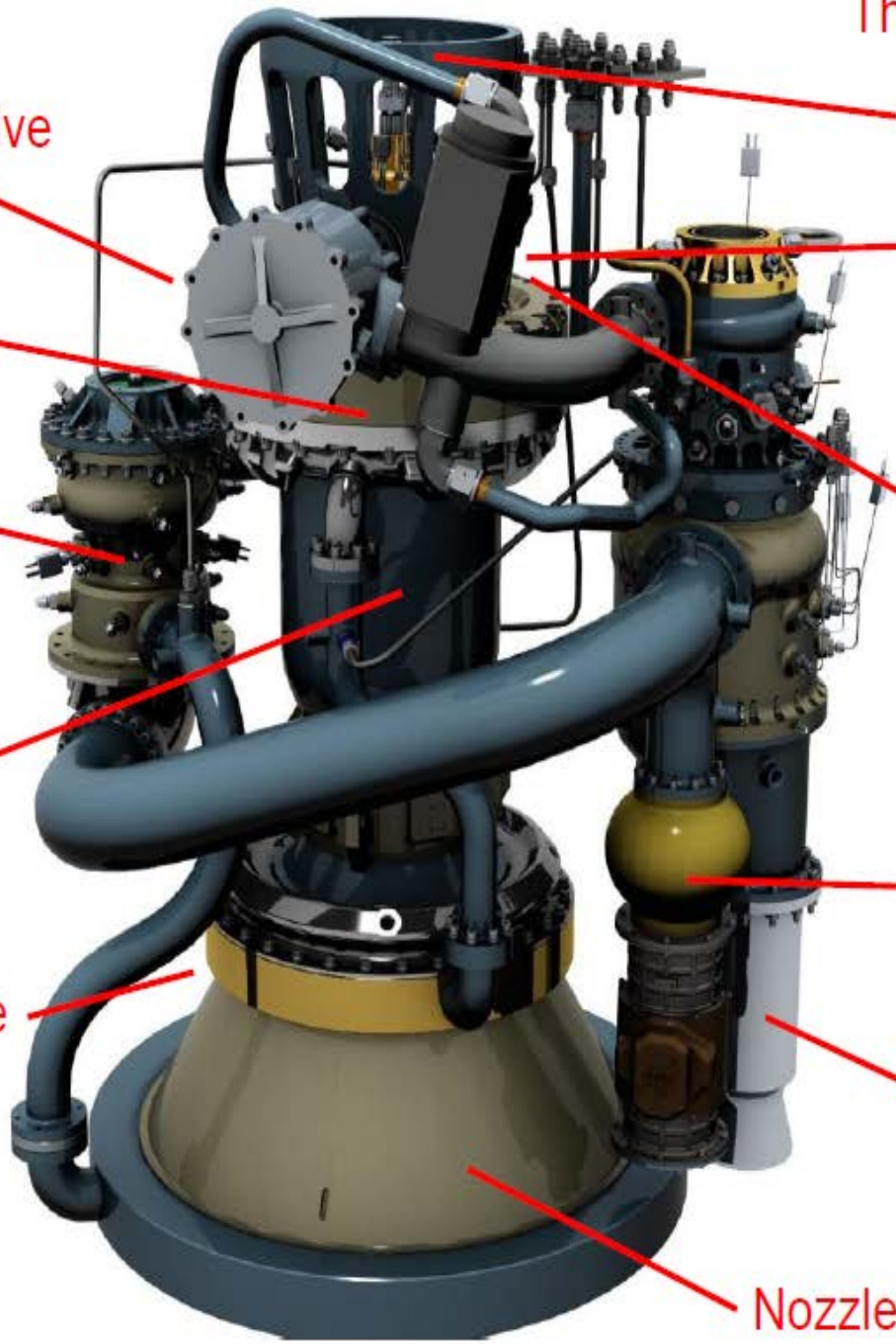
NASA Facilities

NASA Centers

Working with more than 800 companies in 43 states

Precision Meets Progress in Welding on SLS Liquid Oxygen Tank

◆ Approximate Part Counts



Thrust Structure

Main Oxidizer Valve
◆ 1 vs. 6

Main Fuel Valve (Hidden)
◆ 1 vs. 5

Injector
◆ 6 vs. 255

Mixer (Hidden)
◆ 2 vs. 8

Fuel Turbo Pump
◆ 22 vs. 40

Main Combustion Chamber

Oxidizer Turbine Bypass Valve
◆ 1 vs. 5

Chamber Coolant Valve (Hidden)
◆ 1 vs. 5

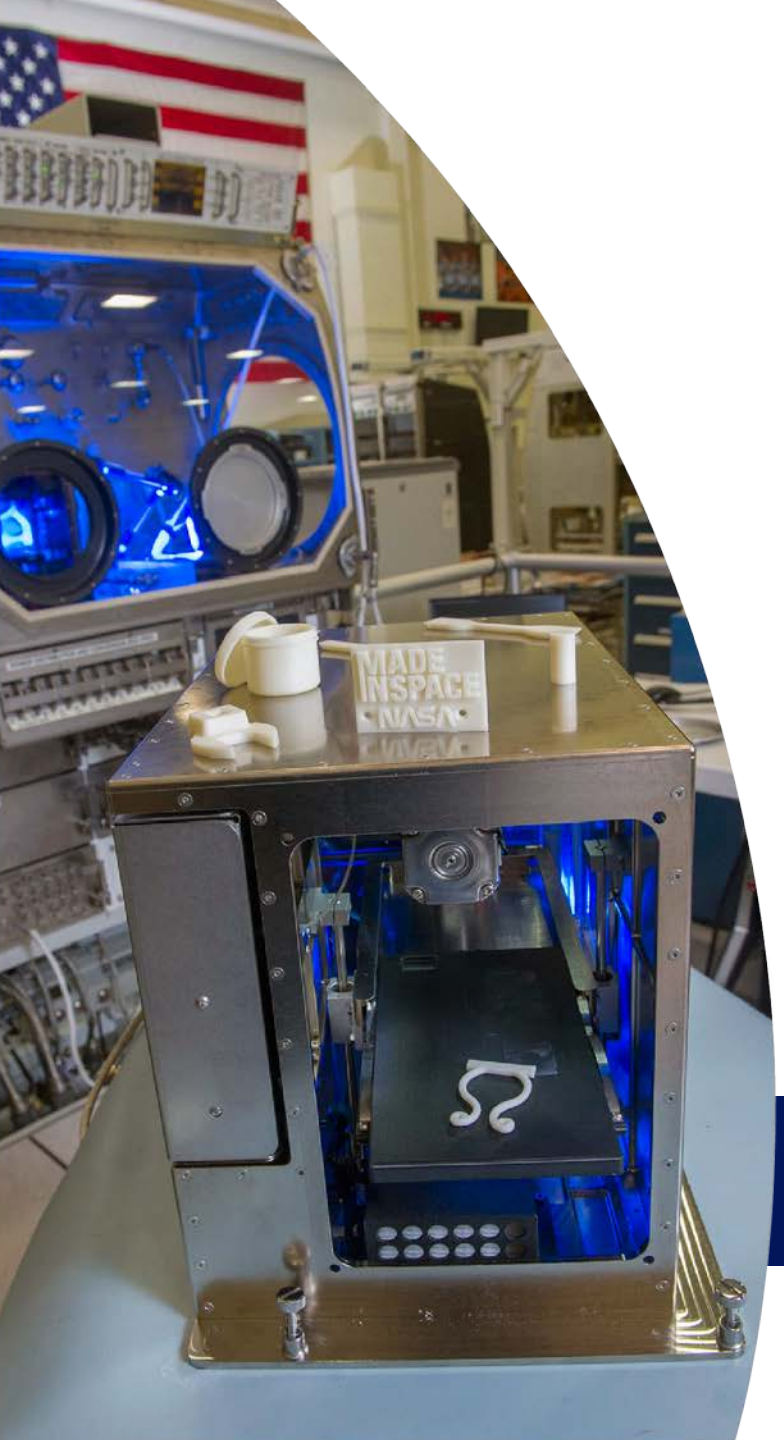
Turbine Discharge Duct

Nozzle

Note: Part counts examples are for major piece parts and do not include bolts, nuts, washers, etc

Common Propulsion for In-Space Transit

Methane Architecture



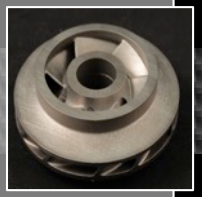
First 3D Printer in Space

ISM Task 1

Advanced Manufacturing at Marshall

Advanced Weld Facility

Additive Manufacturing – AM LOX Turbopump



Advanced Composite Structures

Additive Construction with Mobile Emplacement

Building the Network

Network Status and FY16 Plans

Future Network Goal: 45 Regional Hubs

Forthcoming Awards

Advanced Textiles

Smart Manufacturing

Flexible Hybrid Electronics
San Jose, CA

America Makes

Additive Manufacturing
Youngstown, OH

Integrated Photonics
Rochester, NY

New Institutes Planned for 2016

Open topic competitions

Selected topic competitions supporting agency mission, using agency authorities and budgets

DMDII

Digital Manufacturing & Design
Chicago, IL

lift

Lightweight Metal Manufacturing
Detroit, MI

iacmi

Advanced Fiber-Reinforced Polymer Composites
Knoxville, TN

PowerAmerica

Wide Bandgap Semiconductors
Raleigh, NC

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The journey to Mars
begins with…

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