

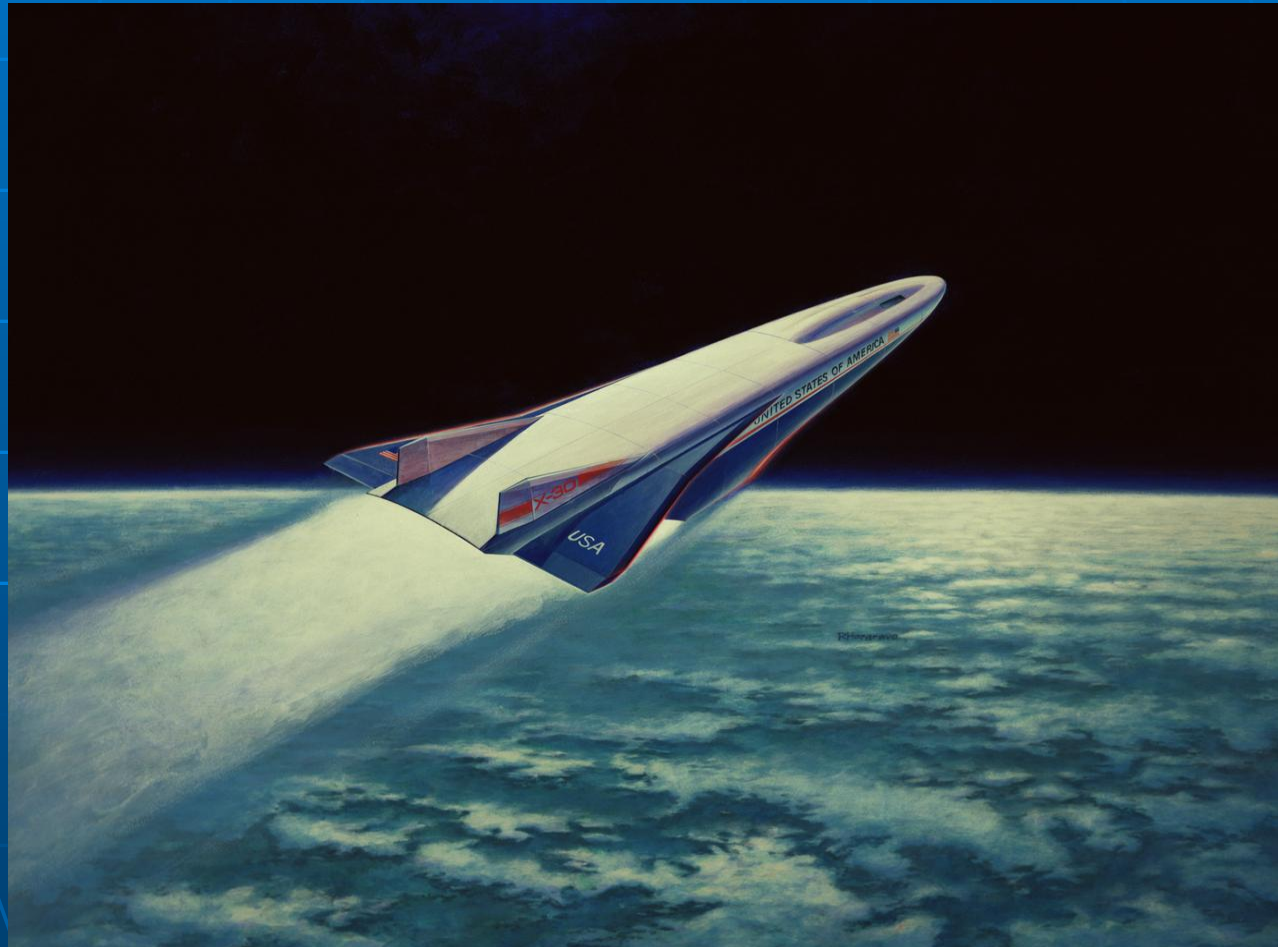
# The Future of the U.S. Manned Spaceflight Program

By

Dr. Guy Bluford, Jr., Ph.D  
NASA Astronaut



# X-30 National Aerospace Plane

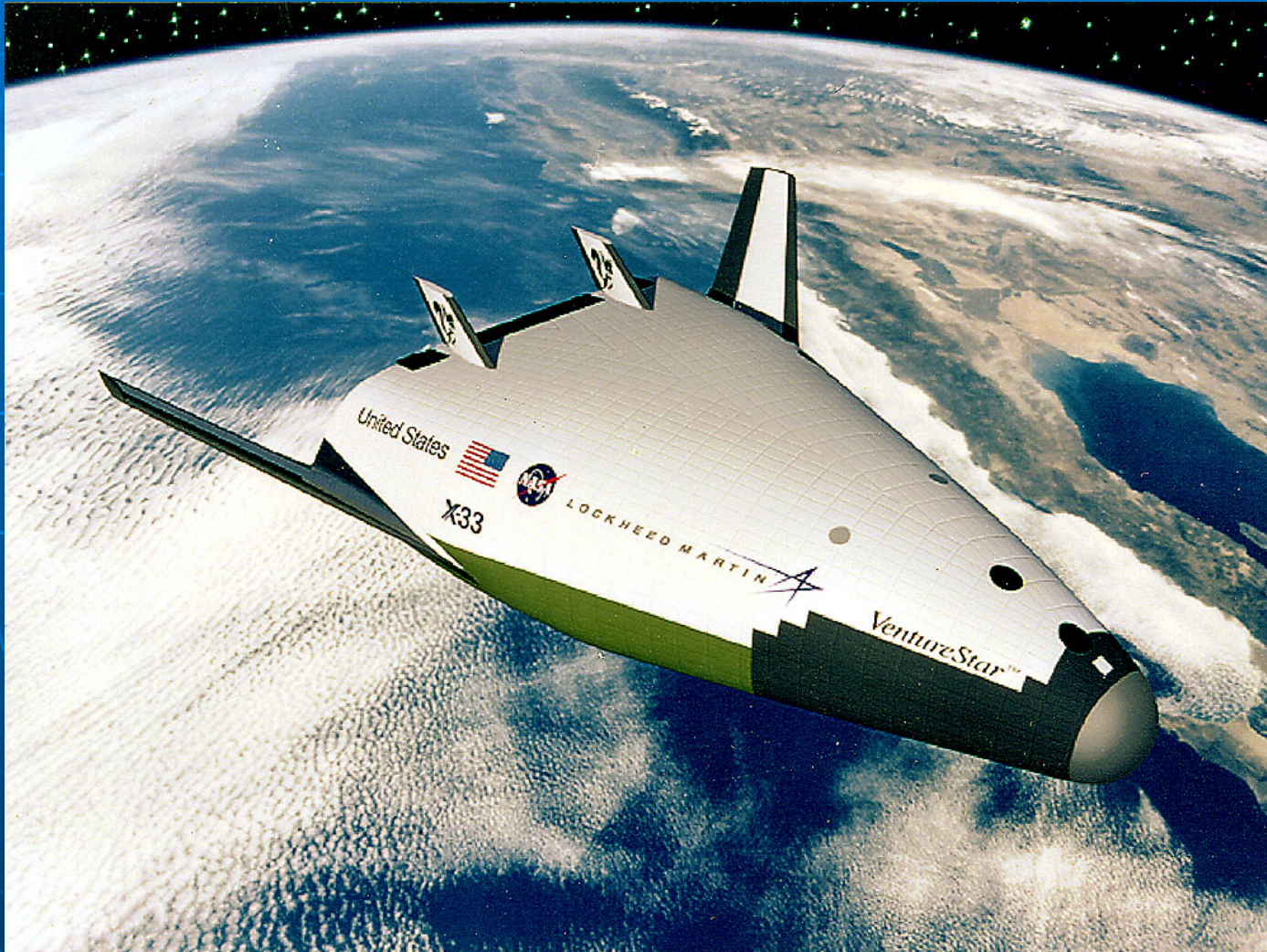


National Aerospace Plane (NASP) program  
NASA Langley Research Center

11/14/1990

Image # EL-2001-00432

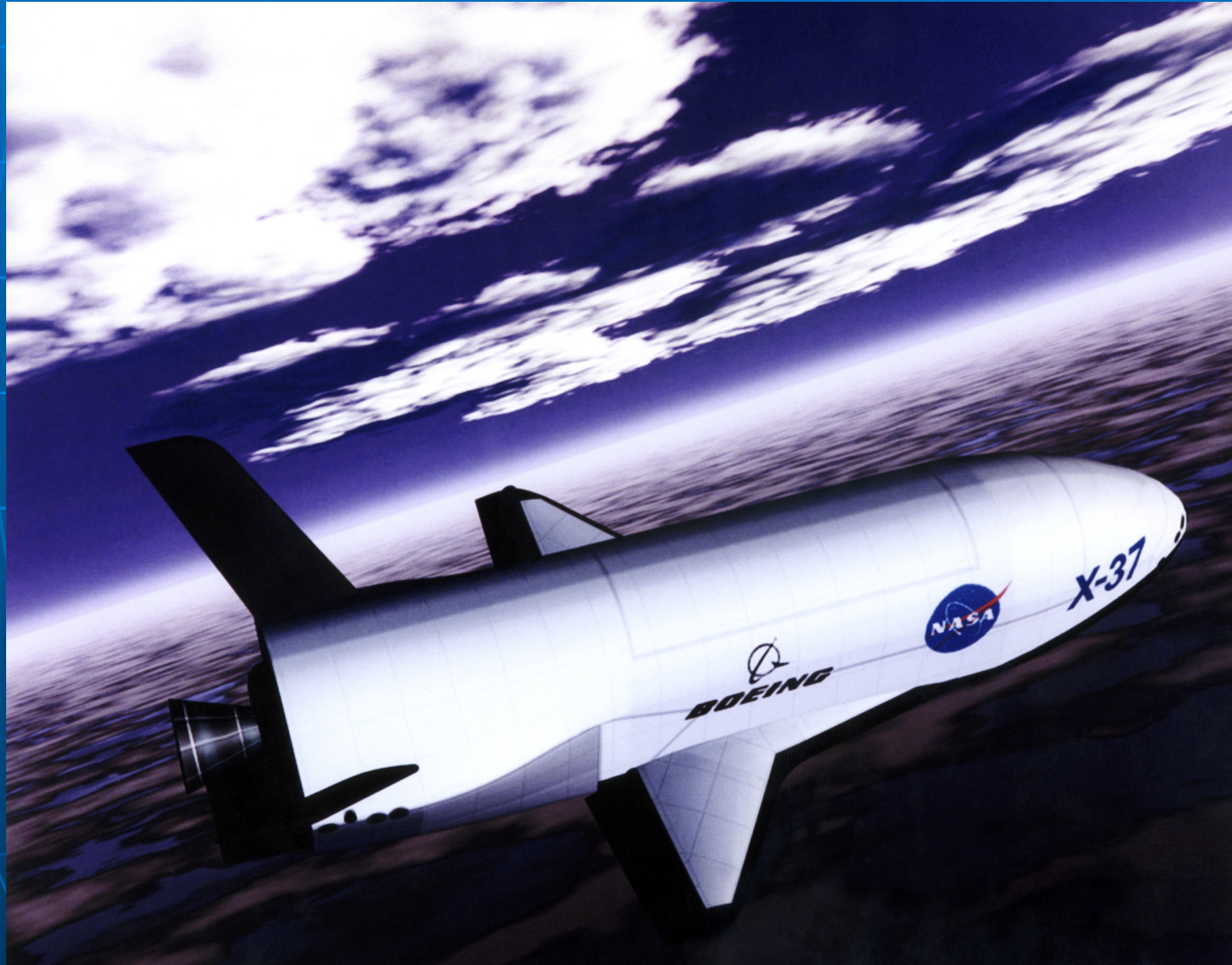
# X-33 Single Stage to Orbit Demonstrator



# X-34 Reusable Launch Vehicle



# X-37 Orbital Space Plane



# X-38 Crew Return Vehicle



# X-40A Space Maneuver Vehicle





# STS-107 Columbia Crew



# Columbia Accident Investigation Board Findings

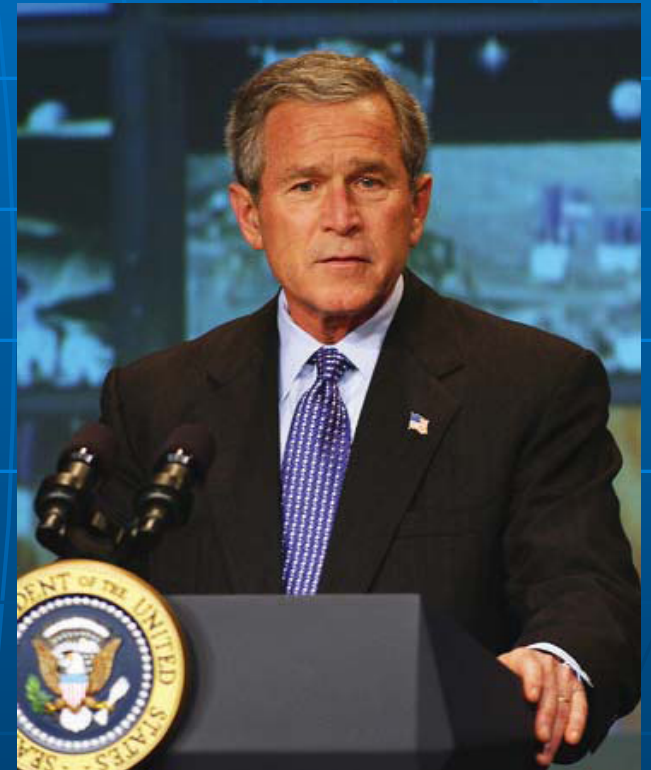
*“Because of the risks inherent in the original design of the Space Shuttle, because that design was based in many aspects on now-obsolete technologies, and because the Shuttle is now an aging system but still developmental in character, it is in the nation’s interest to replace the Shuttle as soon as possible as the primary means for transporting humans to and from Earth orbit.”*

# THE VISION FOR SPACE EXPLORATION

*Remarks by President Bush at NASA Headquarters*

*January 14, 2004*

- Complete the International Space Station
- Safely fly the Space Shuttle until 2010
- Develop and fly the Crew Exploration Vehicle (Orion) no later than 2014
- Return to the Moon no later than 2020
- Extend human presence across the solar system and beyond
- Implement a sustained and affordable human and robotic program
- Develop supporting innovative technologies, knowledge, and infrastructures
- Promote international and commercial participation in exploration



# NASA Authorization Act of 2005

The Administrator shall establish a program to develop a sustained human presence on the Moon, including a robust precursor program to promote exploration, science, commerce and U.S. preeminence in space, and as a stepping stone to future exploration of Mars and other destinations

# Vision for Space Exploration Strategy Themes

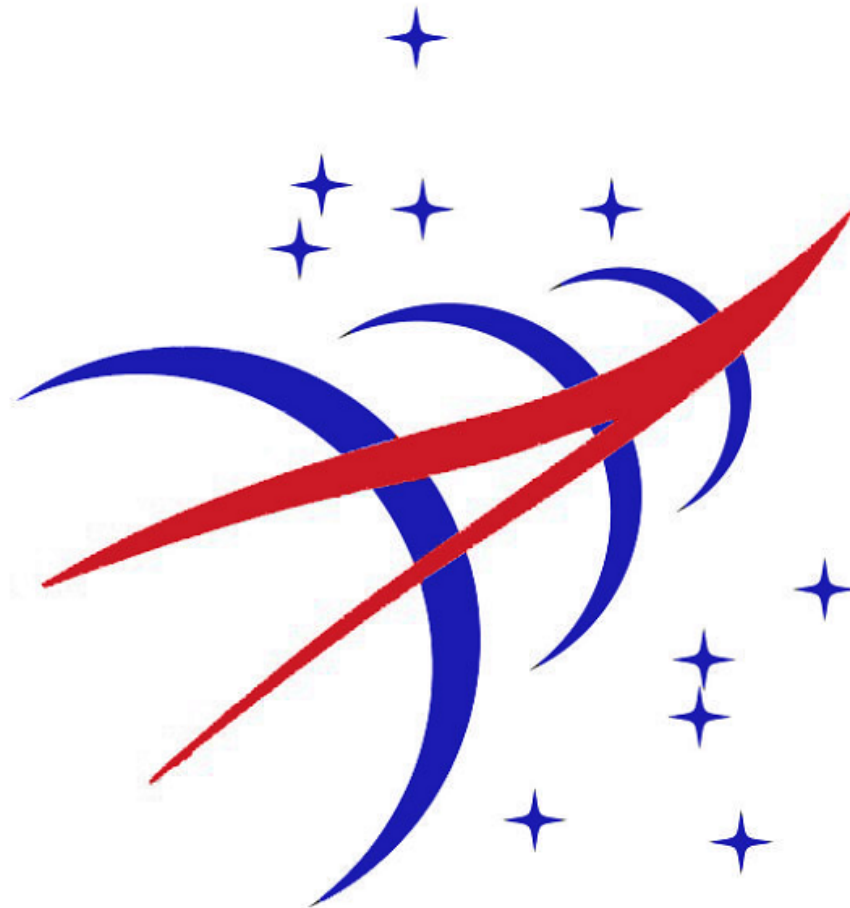
- Use the Moon to prepare for future human and robotic missions to Mars and other destinations
- Pursue scientific activities to address fundamental questions about the solar system, the universe and our place in them
- Extend sustained human presence to the Moon to enable eventual settlement
- Expand Earth's economic sphere to encompass the Moon and pursue lunar activities with direct benefits to life on Earth
- Strengthen existing and create new global partnerships
- Engage, inspire, and educate the public

# Exploration Systems Mission Directorate



# NASA's Exploration Systems Architecture Study

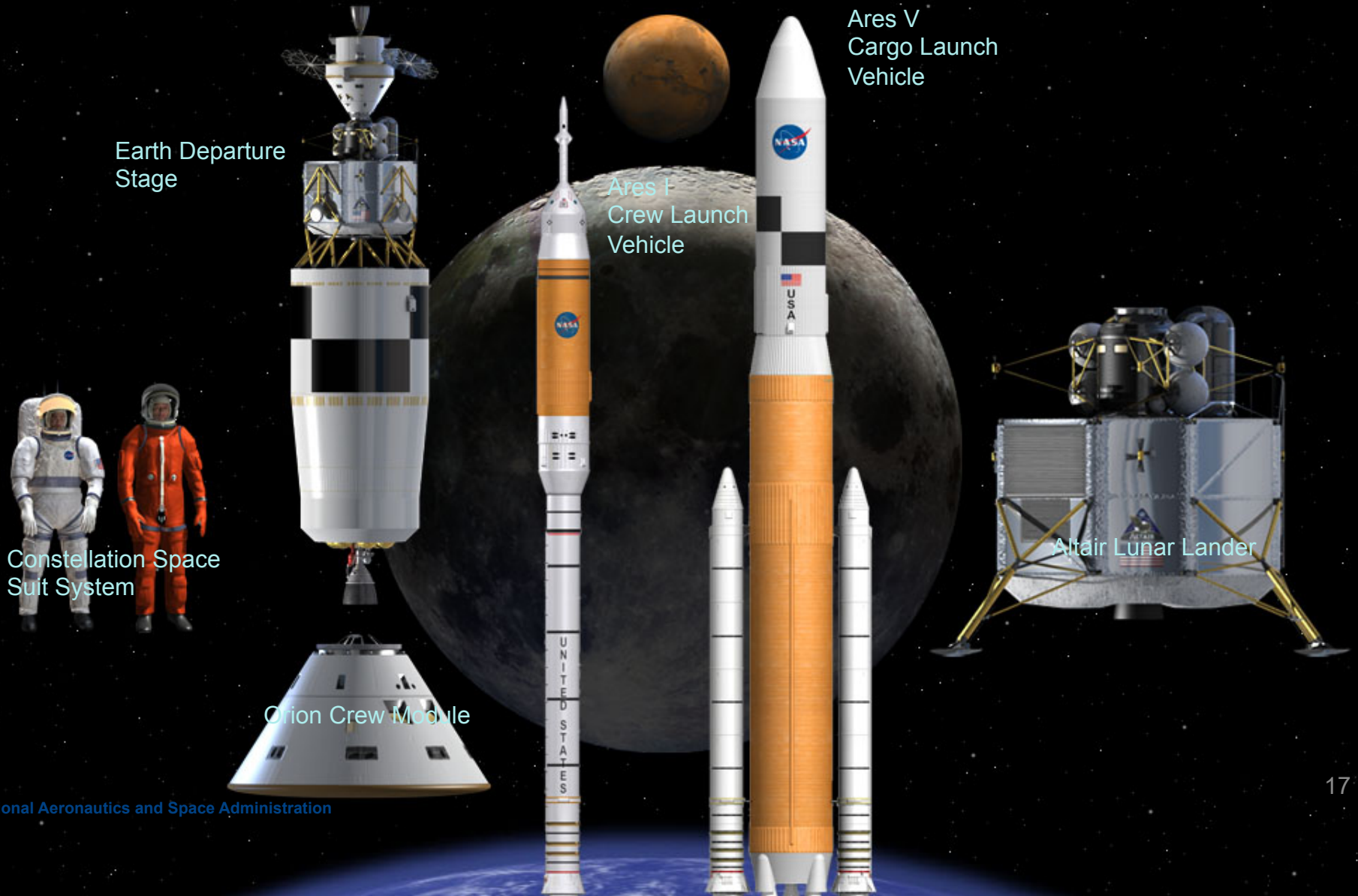
- Assess the top-level Crew Exploration Vehicle (CEV) requirements and plans that will enable the CEV to provide transport to the International Space Station (ISS) and will accelerate the development of the CEV and crew launch system to reduce the gap between Shuttle retirement and CEV Initial Operational Capability (IOC)
- Define the top-level requirements and configurations for crew and cargo launch systems to support the lunar and Mars exploration programs
- Develop a reference exploration architecture concept to support sustained human and robotic lunar exploration operations: and
- Identify key technologies required to enable and significantly enhance these reference exploration systems and a reprioritization of near-term and far-term technology investments



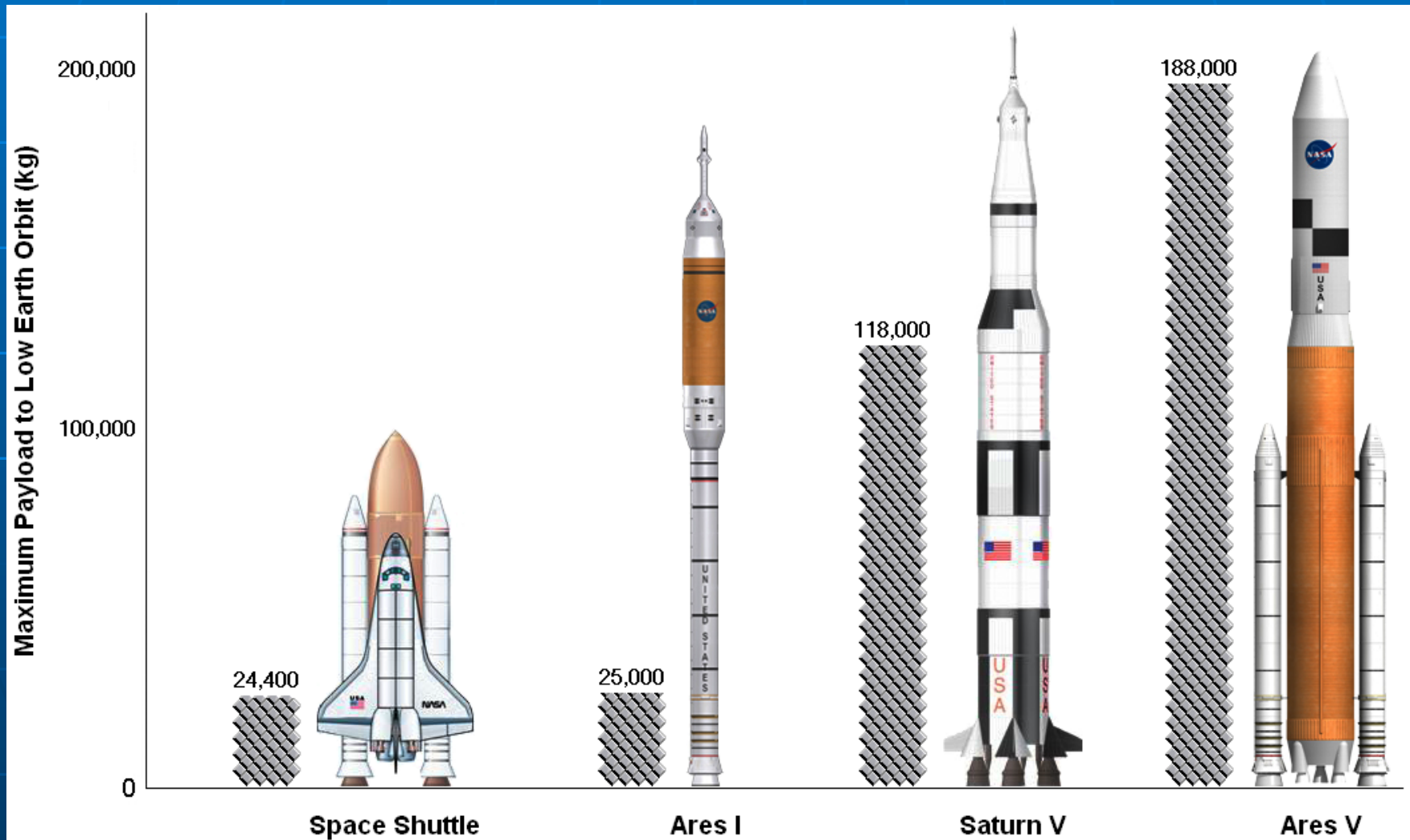
CONSTELLATION



# Components of the Constellation Program



# Ares Rockets



# Ares 1 – Crew Launch Vehicle



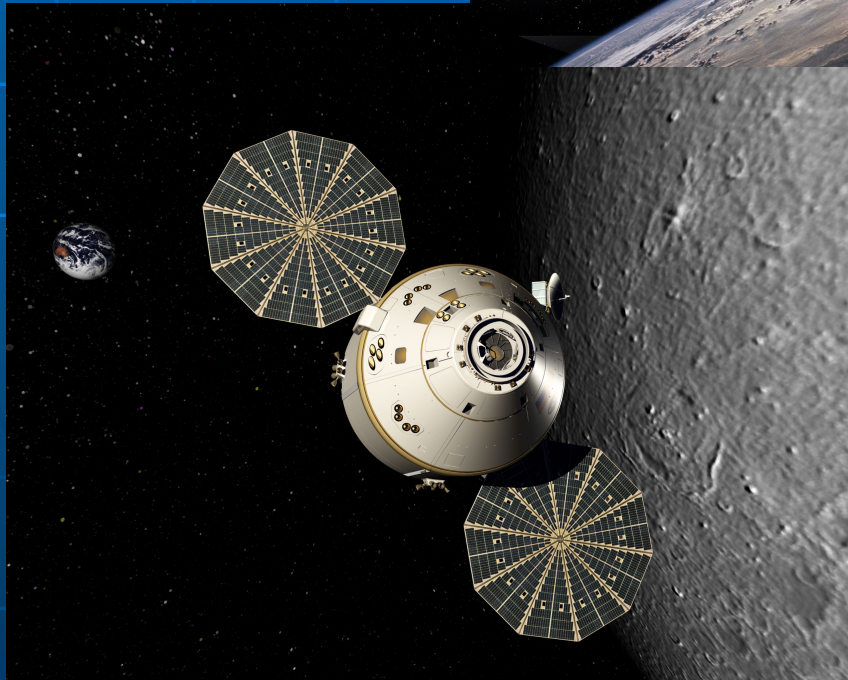
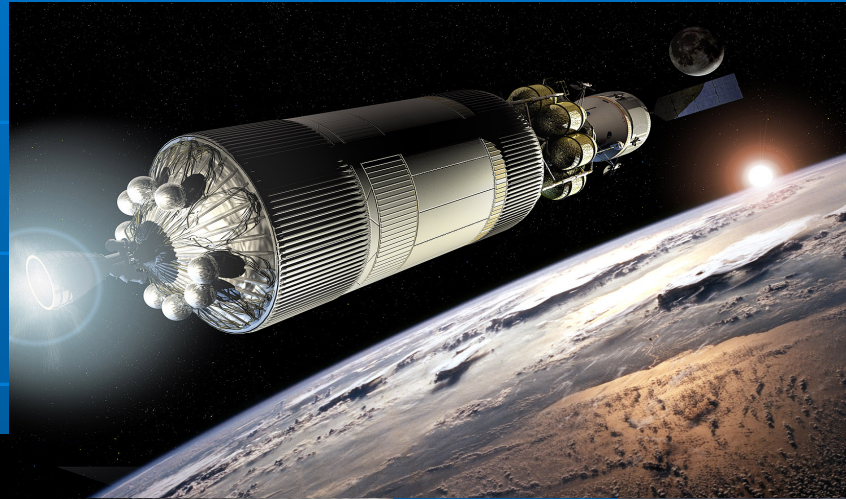
- 5 Segment Reusable Shuttle Solid Booster
- Liquid oxygen/liquid hydrogen upper stage J2X engine
- 22Metric Tons to LEO
- Liftoff weight 910 Metric Tons
- Height 98 Meters

# Ares V- Heavy Cargo Launch Vehicle



- Core Stage with 5 liquid oxygen/liquid hydrogen engines
- Two 5 Segment Reusable Shuttle Solid Boosters
- 131 Metric Tons to LEO
- Liftoff weight 3310 Metric Tons
- Height 109 Meters
- Lunar Lander
- Earth Departure Stage

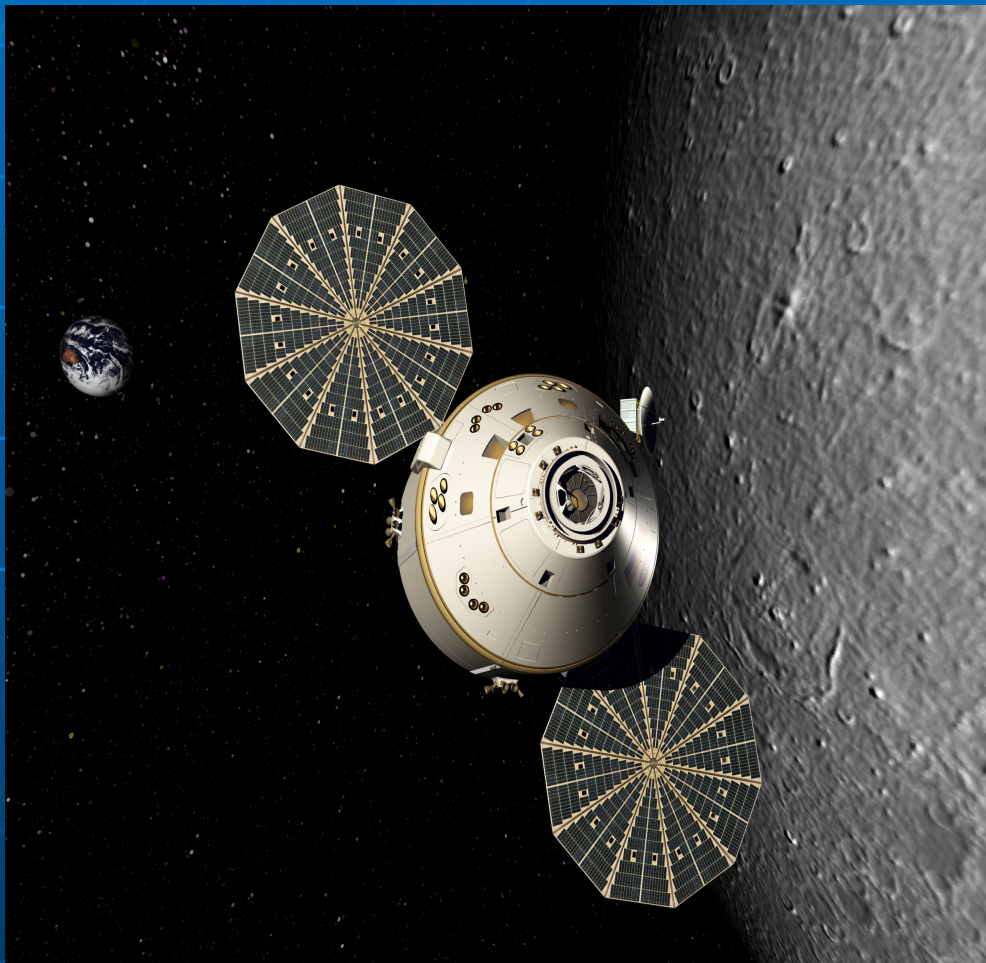
# Constellation Components



# Orion Crew Exploration Vehicle



# Orion Crew Exploration Vehicle



- Transport 6 crew to ISS, 4 crew to Moon
- 210 day stay at ISS
- Pressurized Cargo to ISS & Moon
- ISS Emergency lifeboat

# Earth Departure Stage



- Liquid oxygen/  
liquid hydrogen  
J-2X engine
- Al-Li Structure
- 226 Metric  
Tons



# Altair Lunar Lander



- Transport 4 crew to and from surface
- Anytime return to Earth
- Land 20 Metrics Tons of Dedicated Cargo
- Airlock Capabilities
- Descent Stage: Liquid oxygen/liquid hydrogen Engine
- Ascent Stage: Storable Propellants

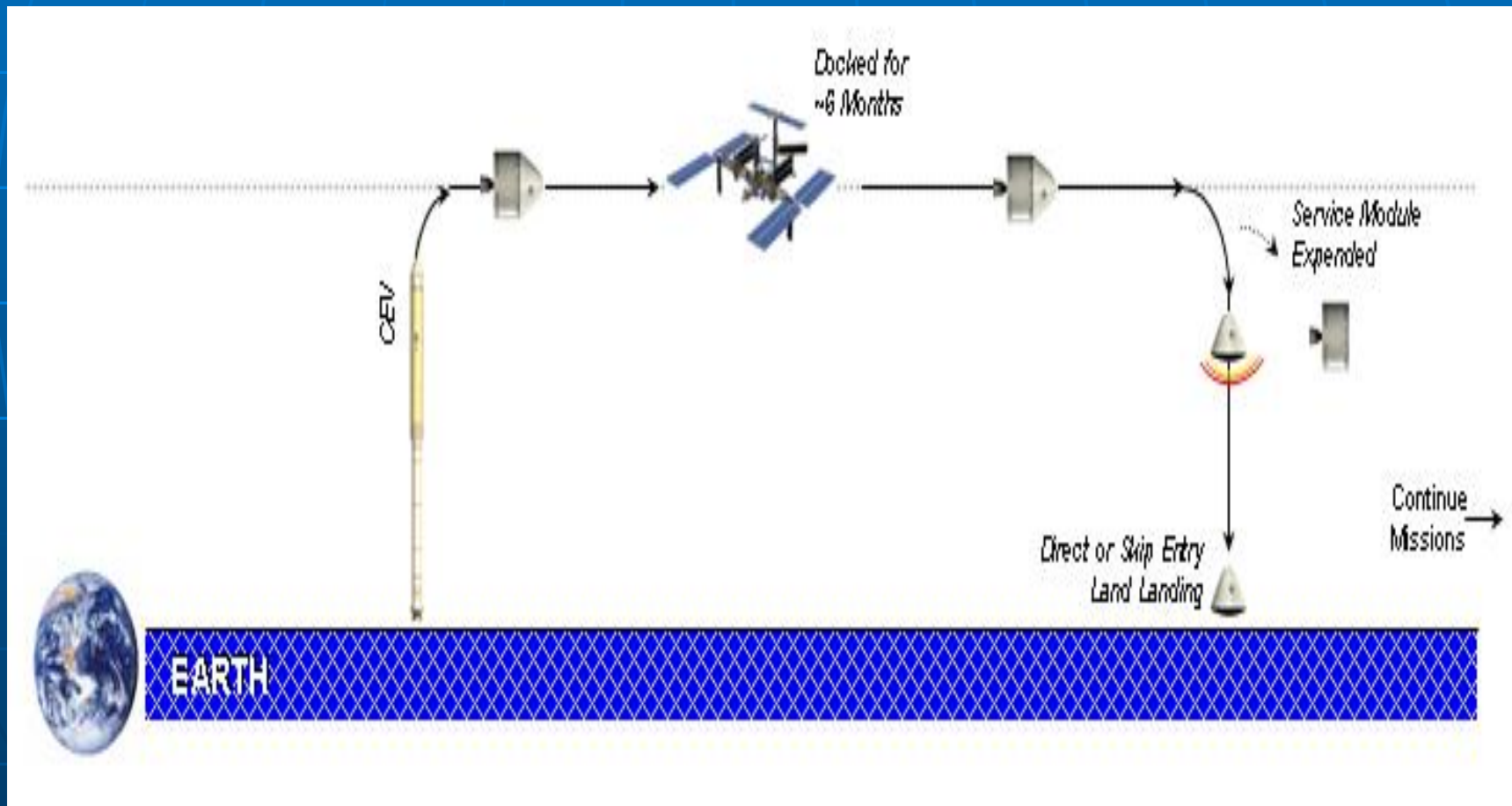
# Constellation Space Suit System



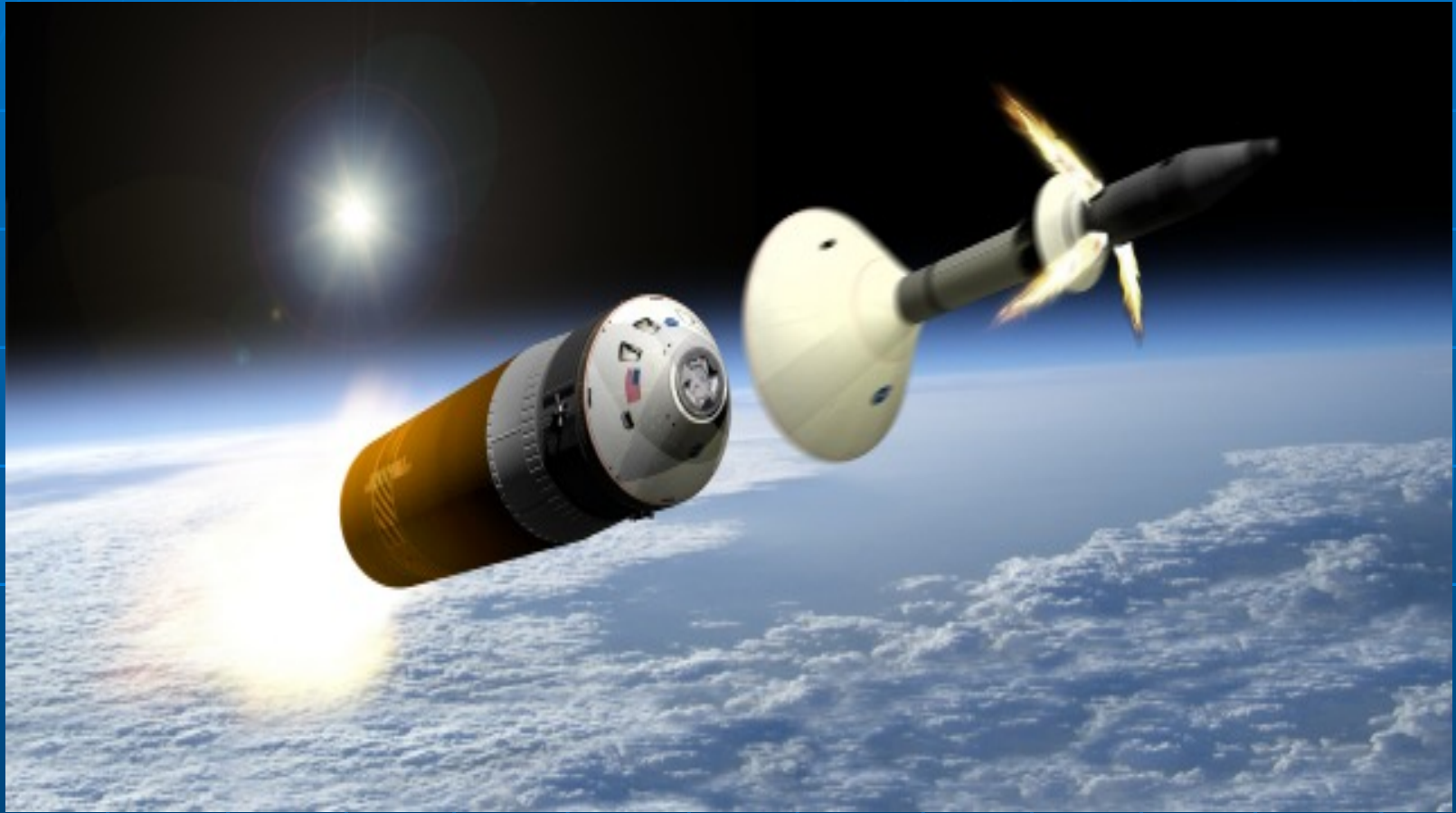
- Left: EVA, Launch, Re-entry, ISS EVA suit
- Right: Lunar and Mars exploration EVA suit

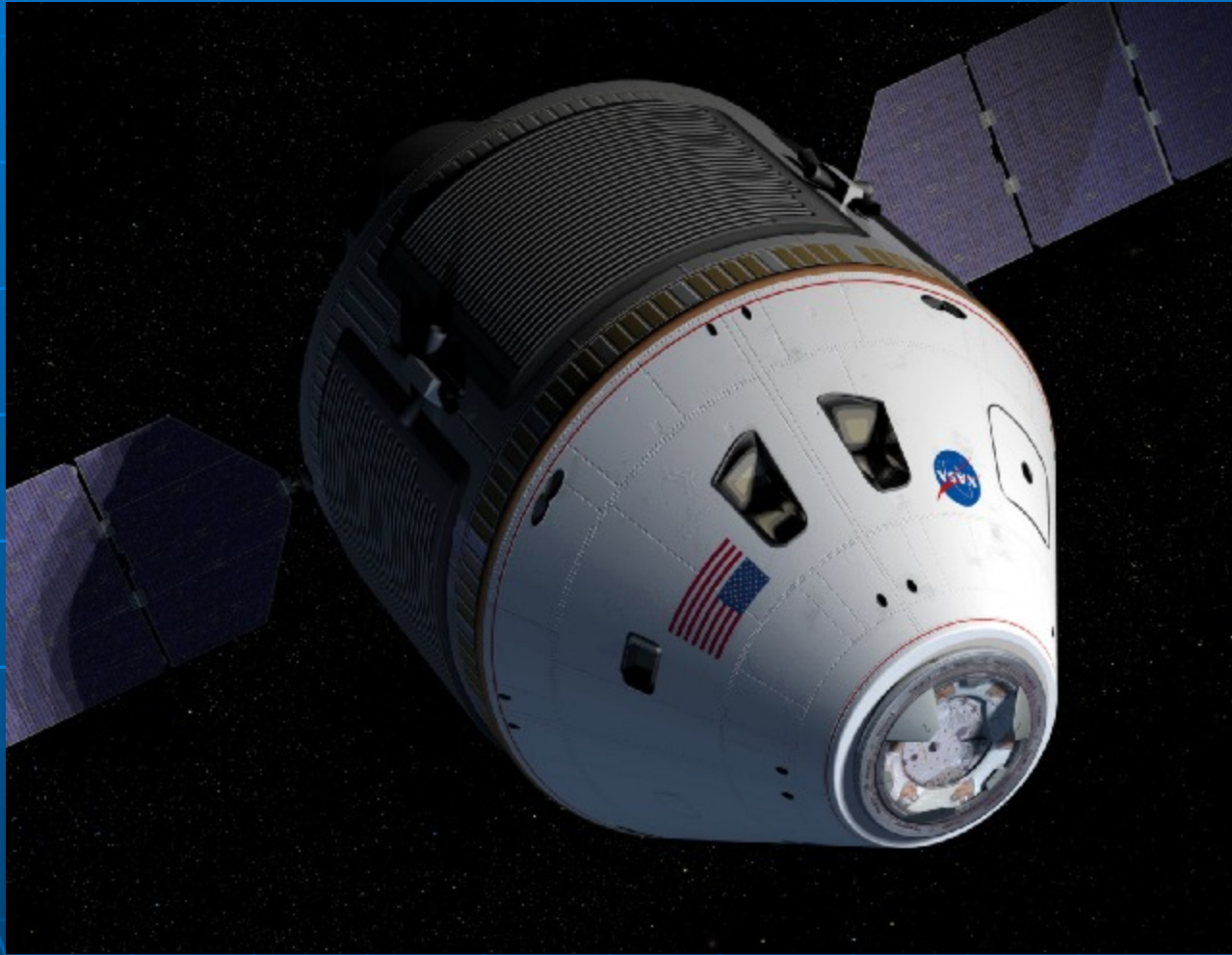
# Constellation Mission Scenarios

# Constellation ISS Mission









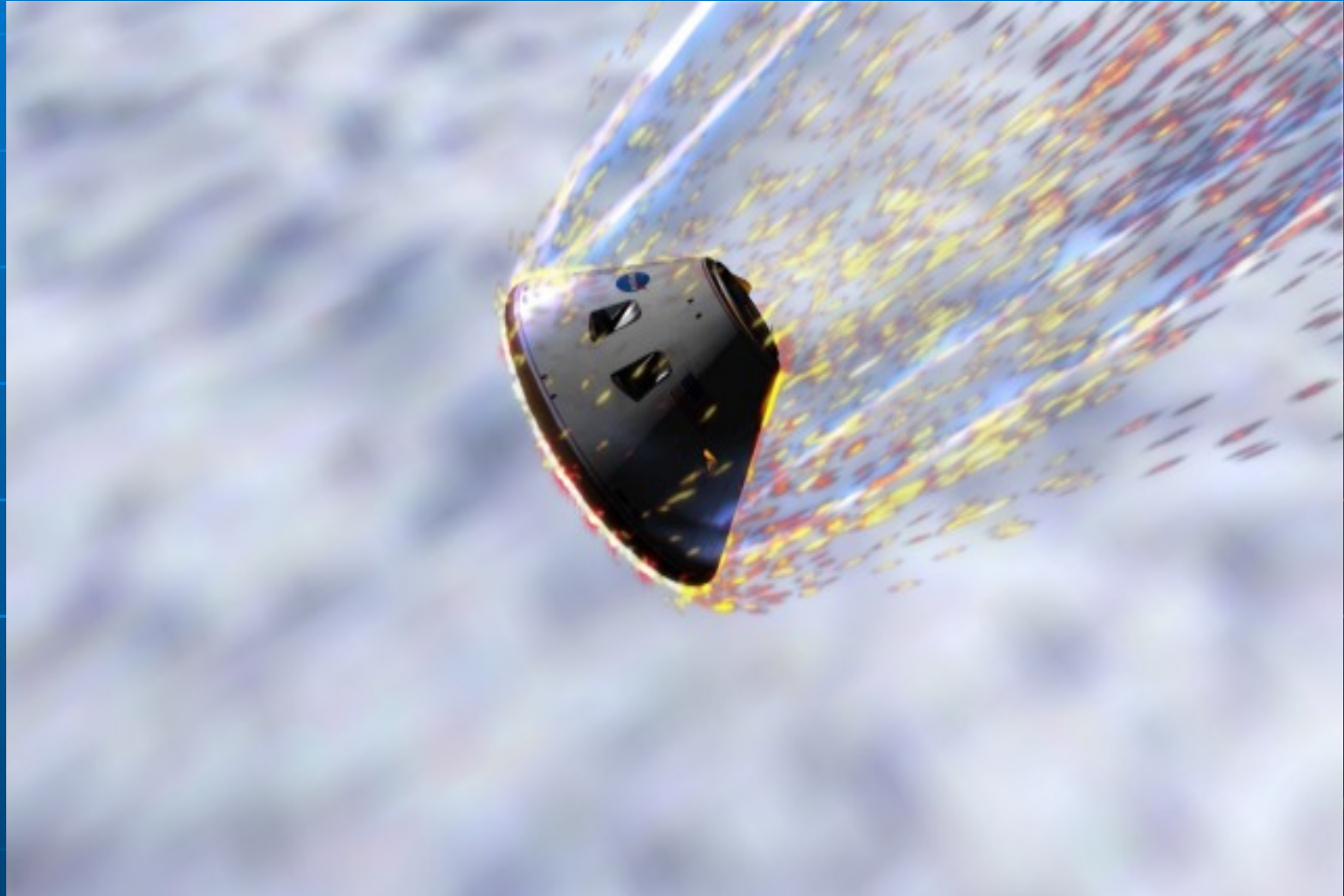


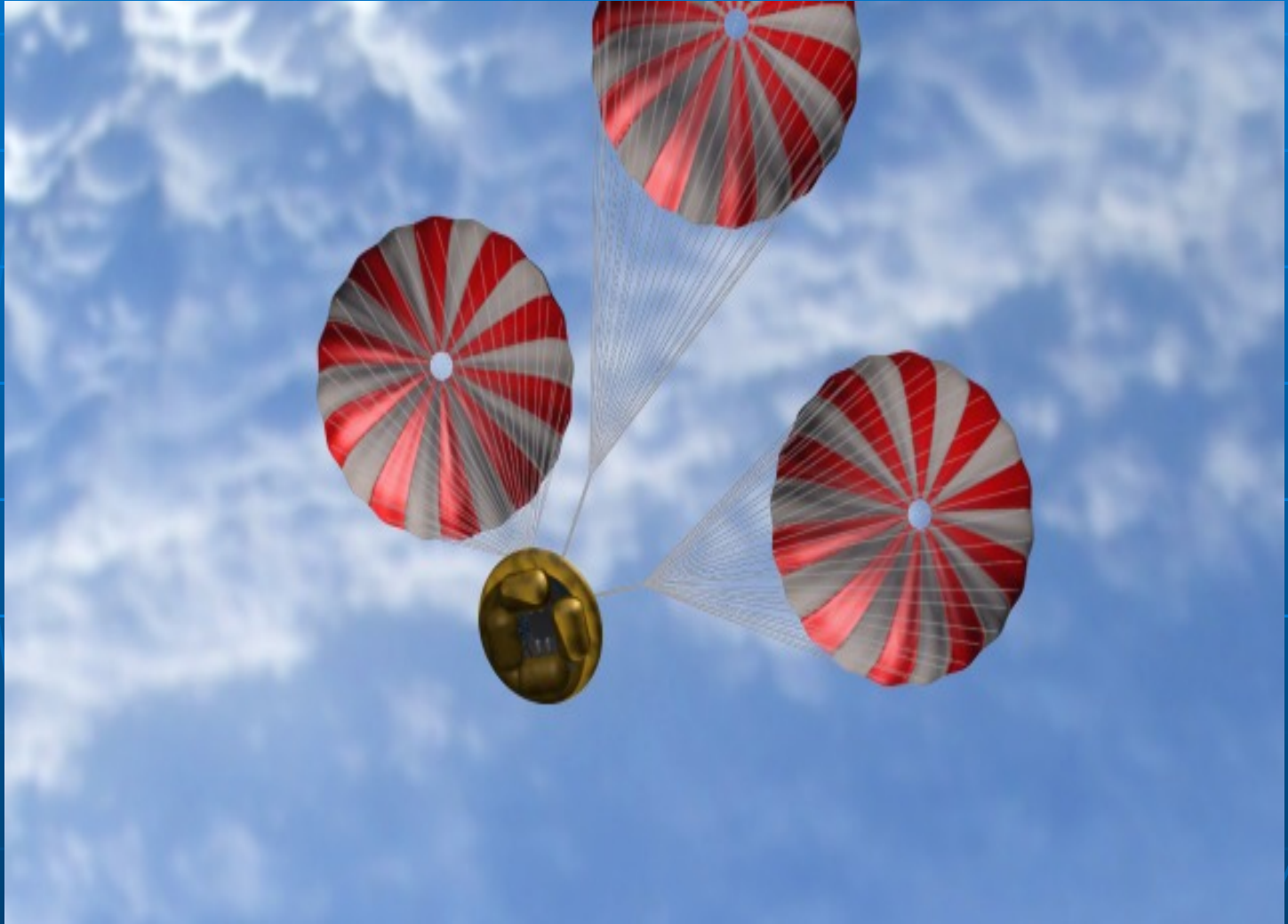




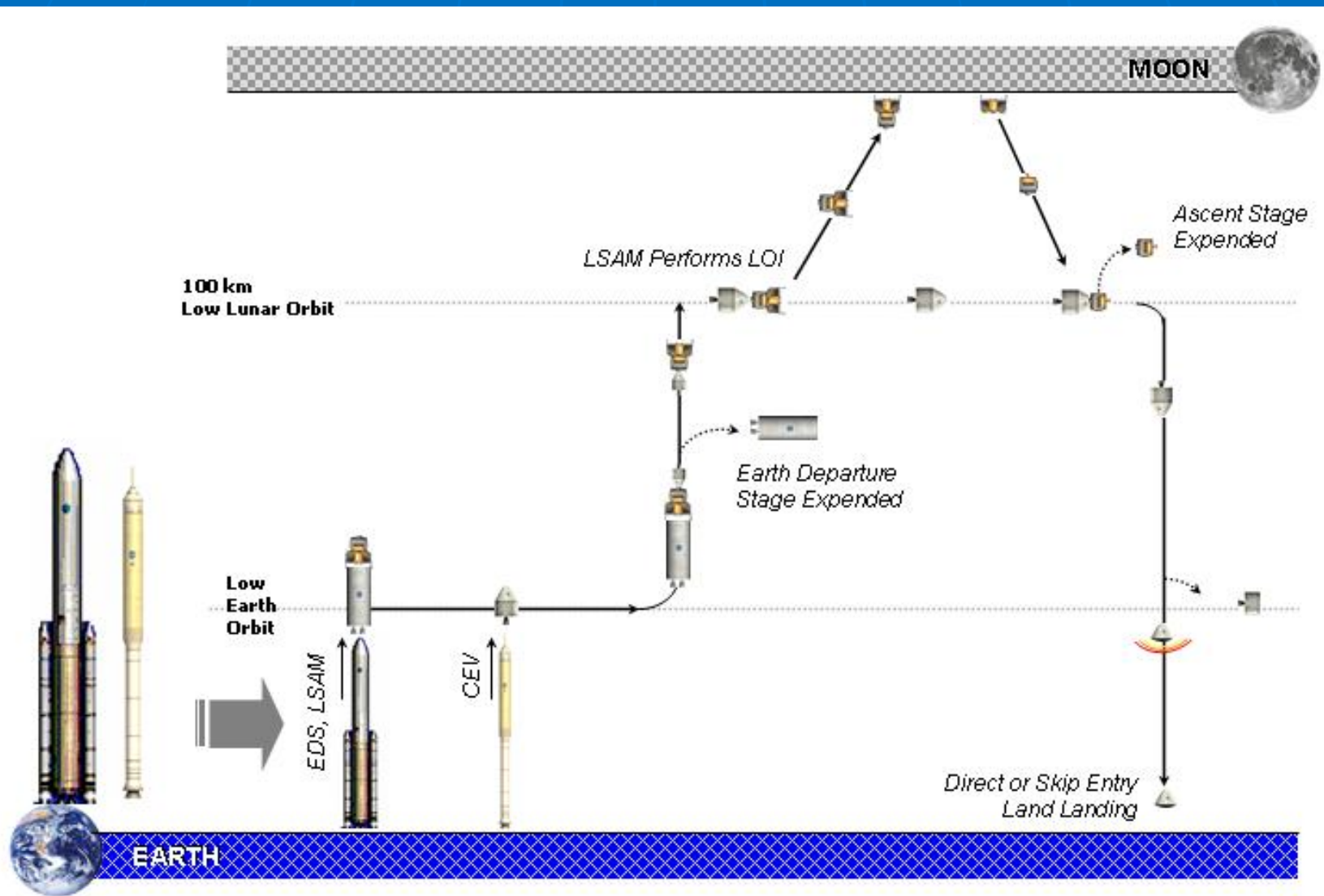




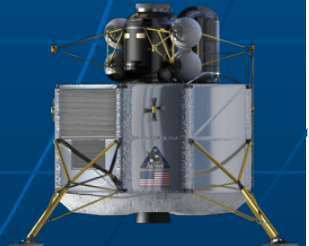
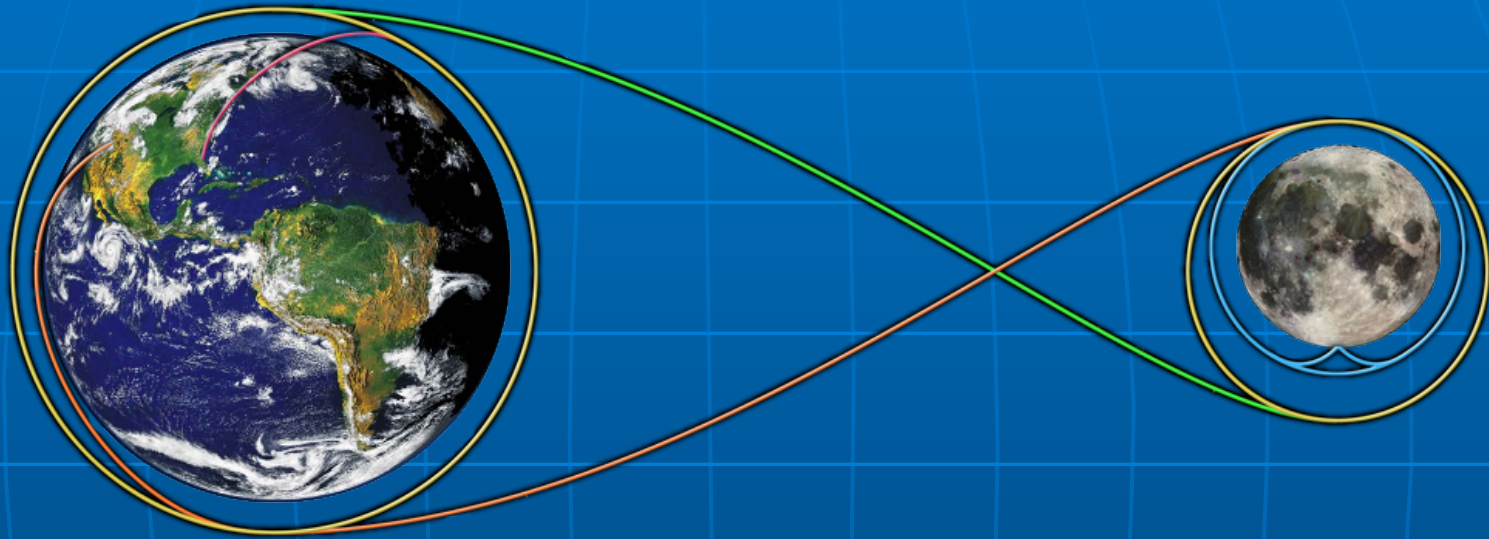




# Constellation Moon Mission



# Constellation Moon Mission





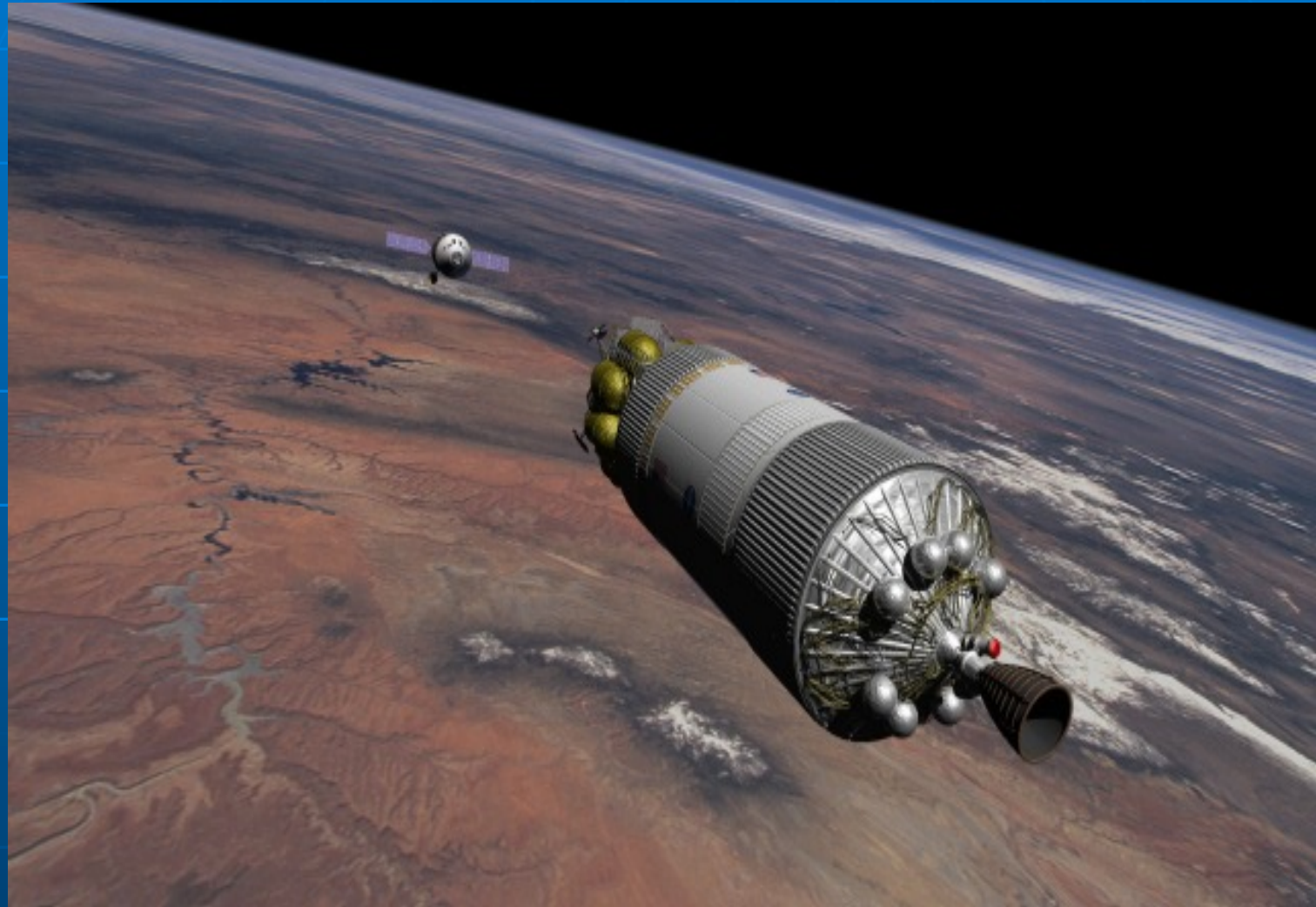


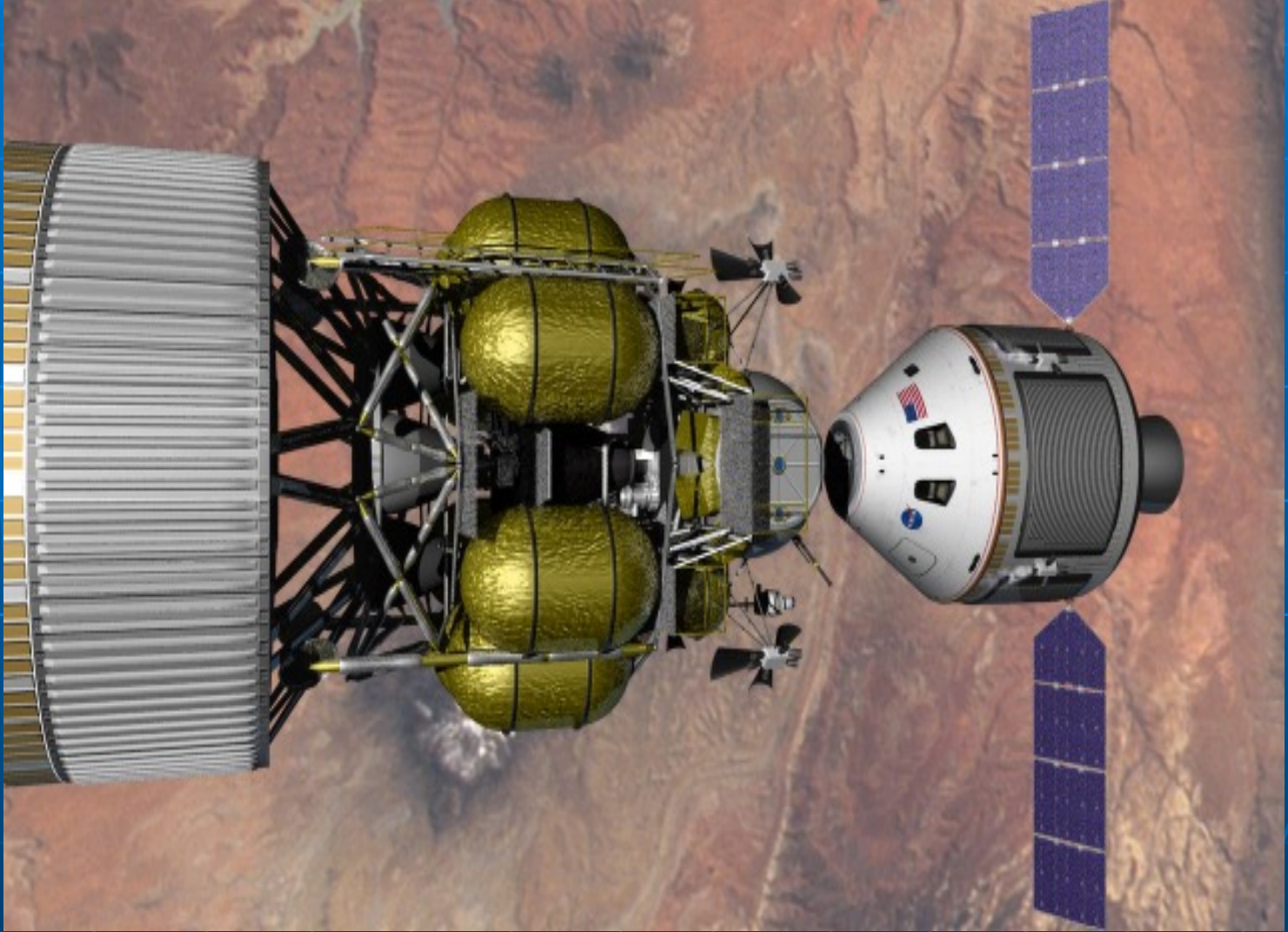




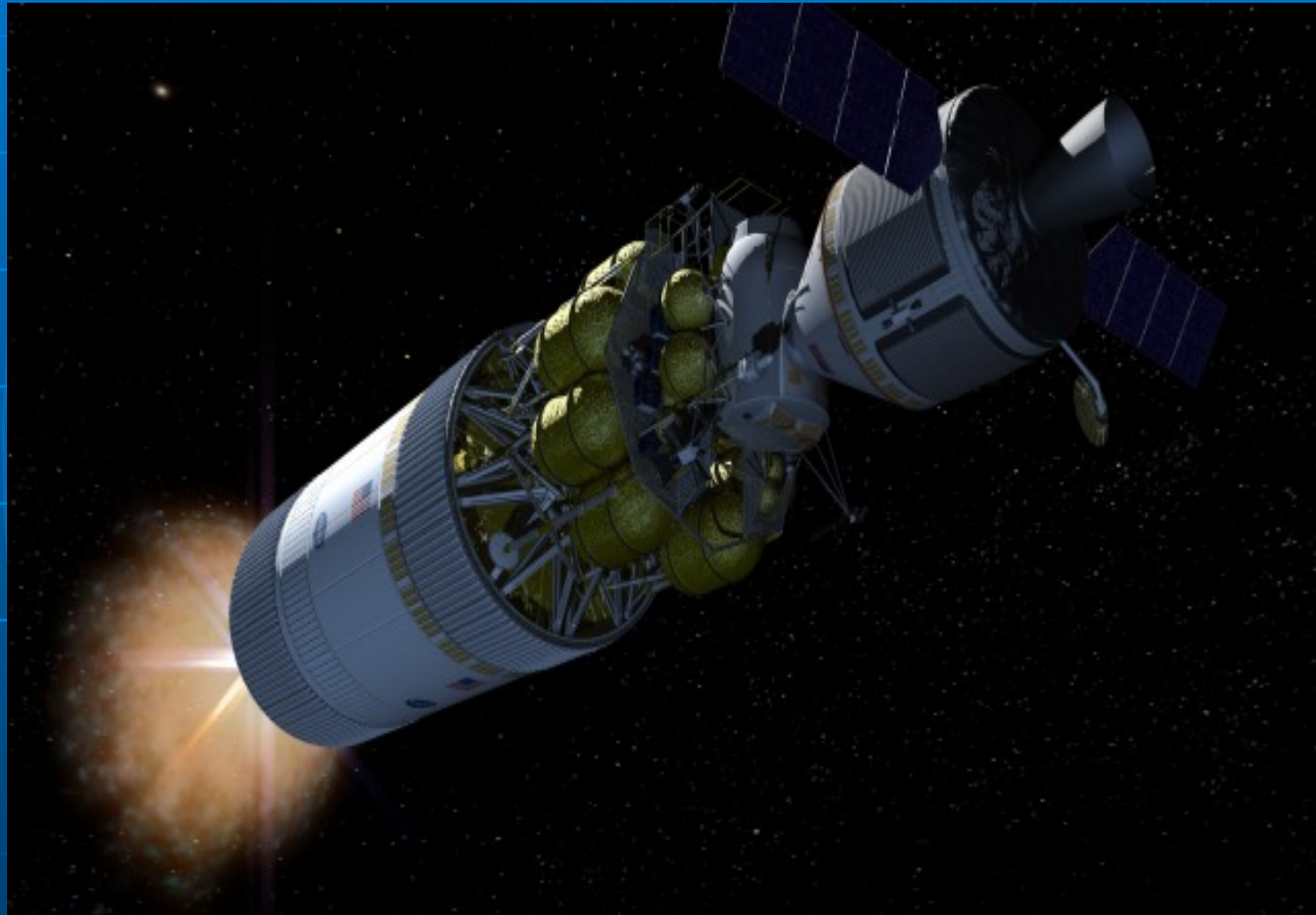




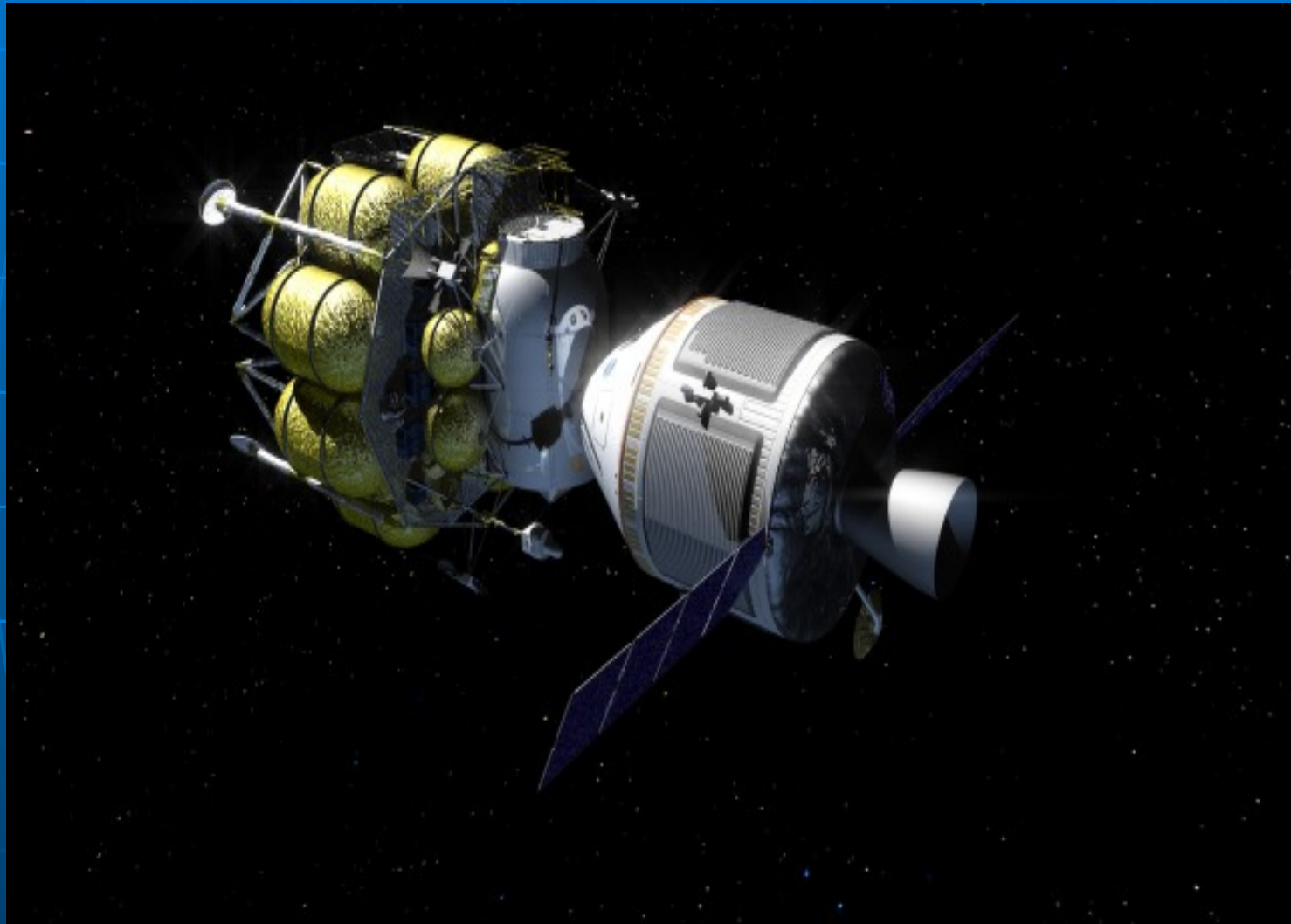


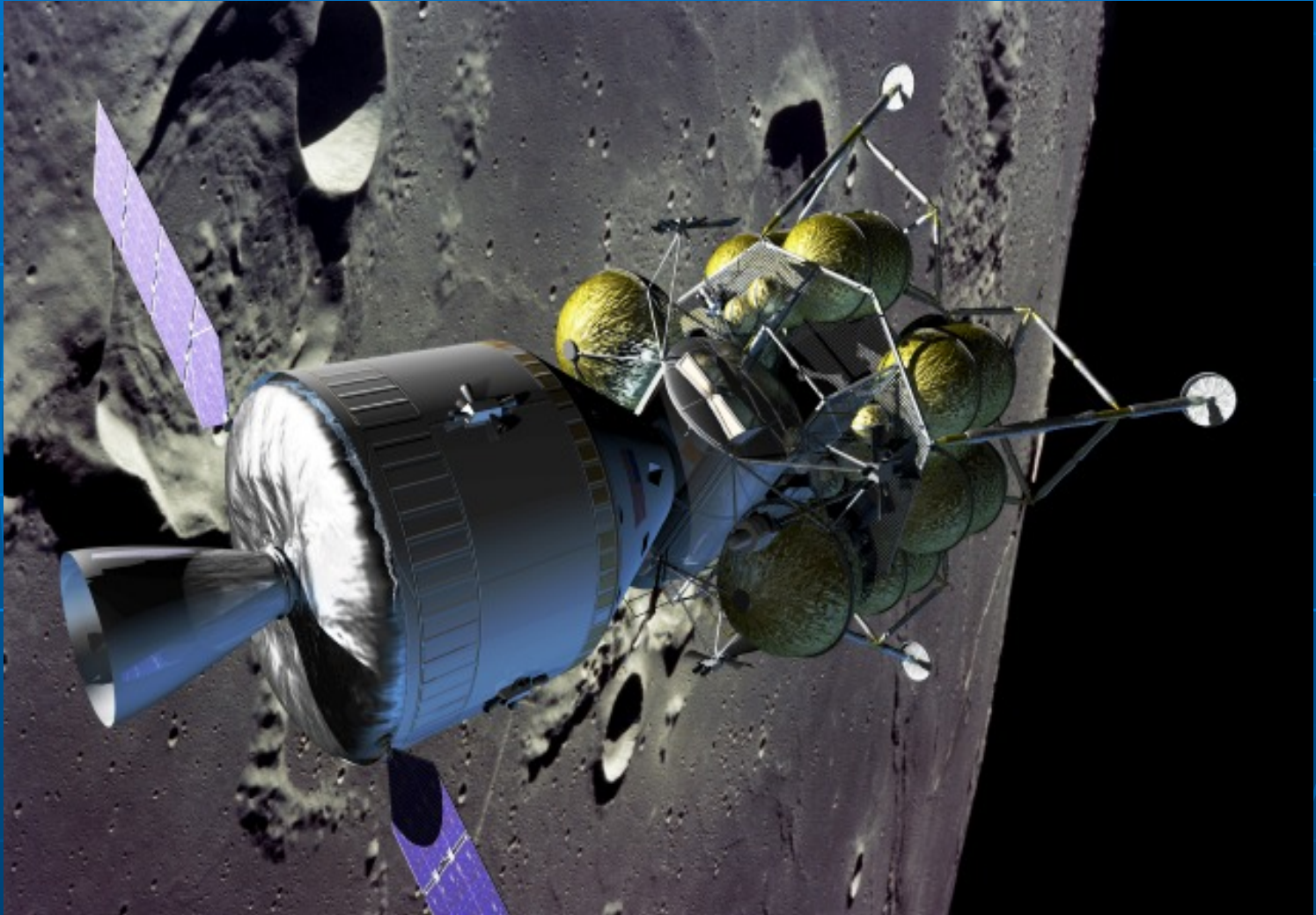


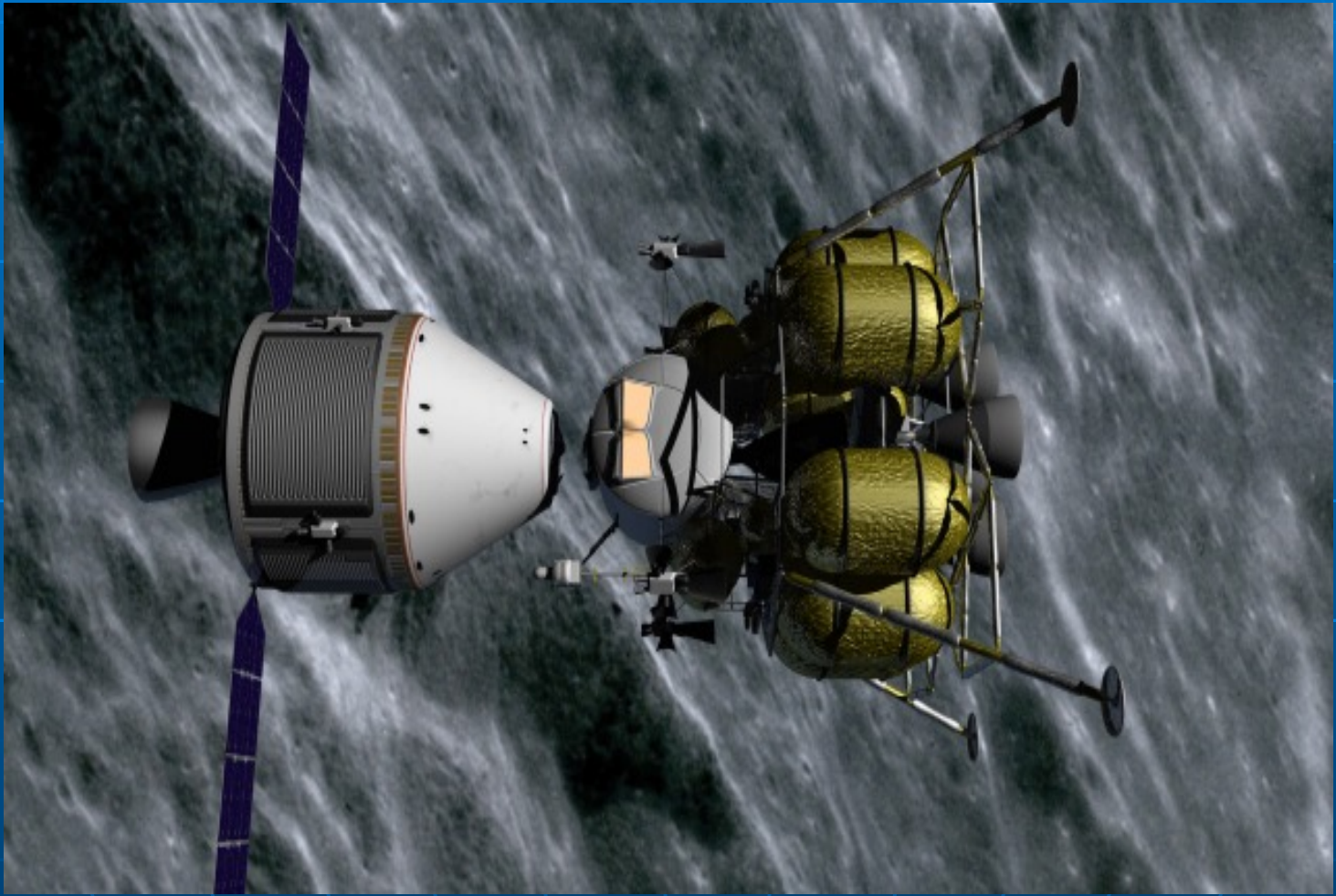




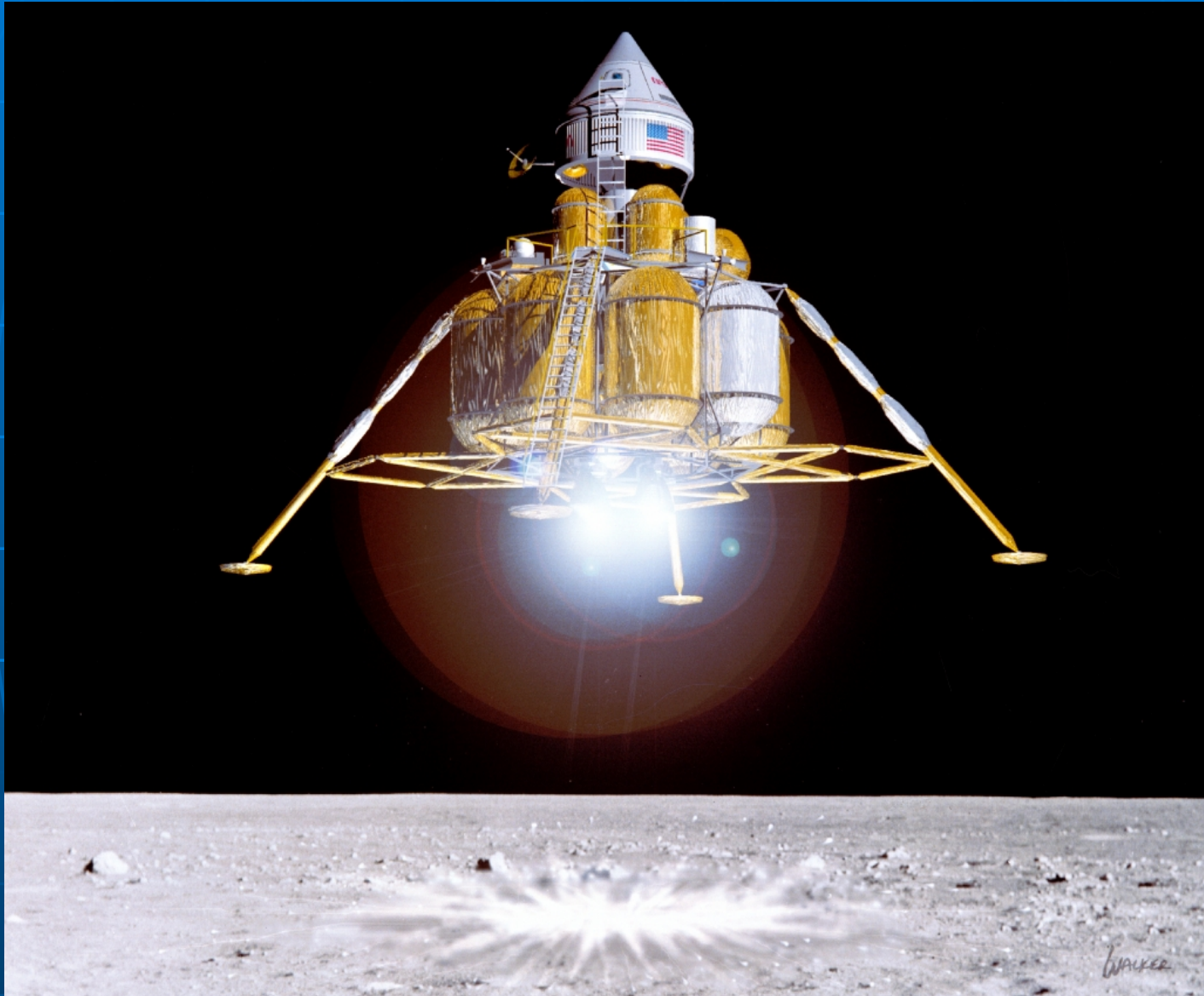


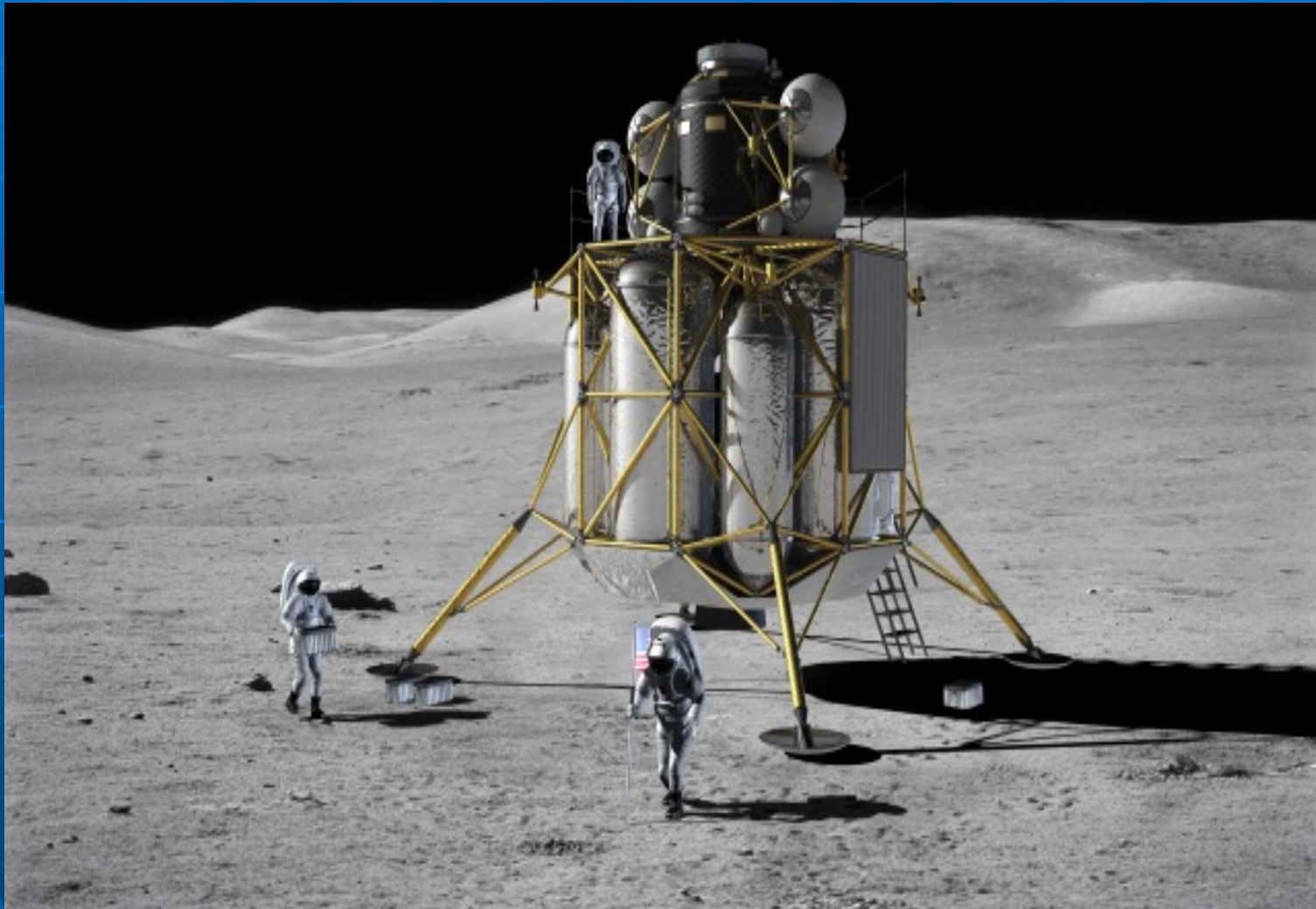




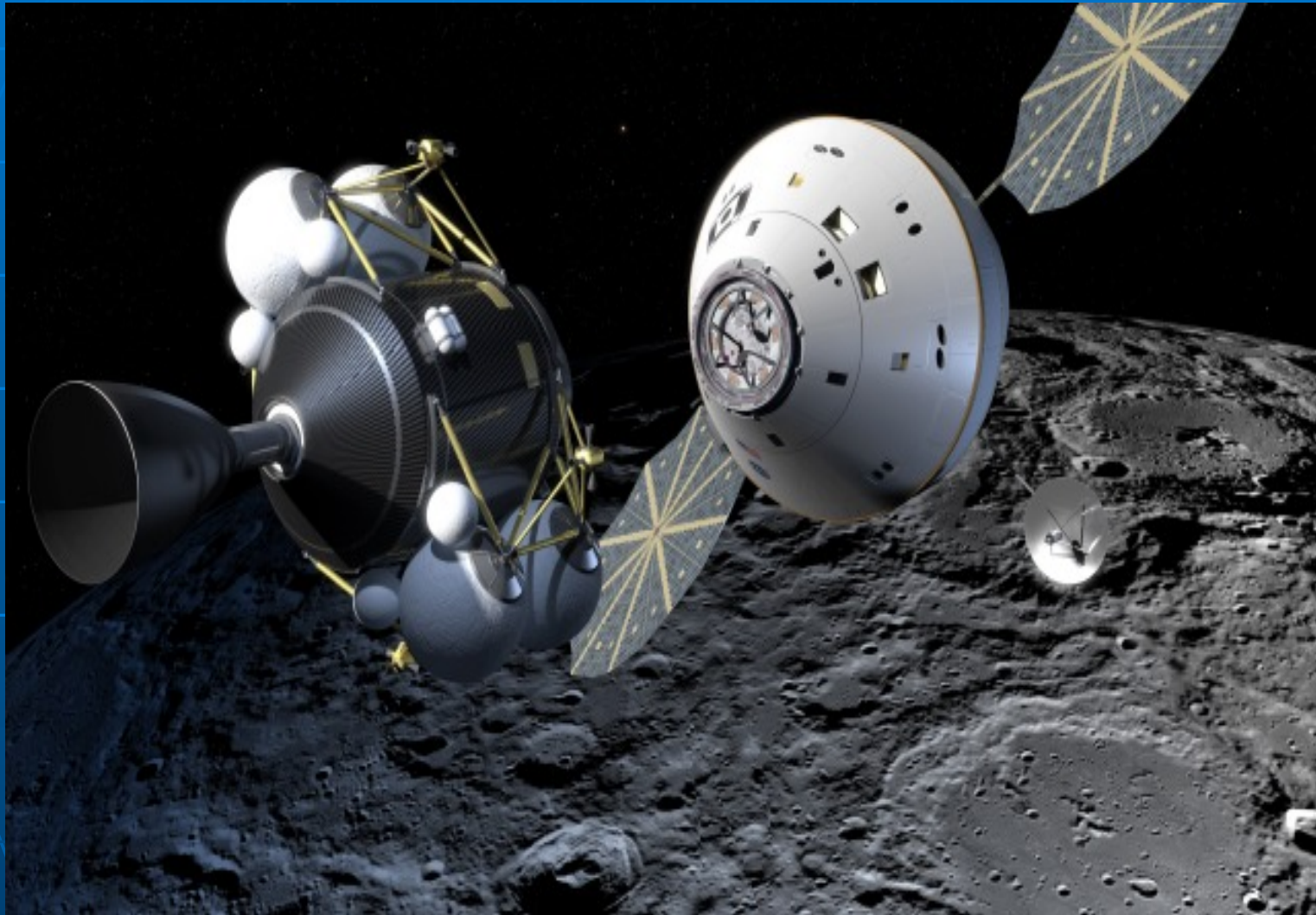














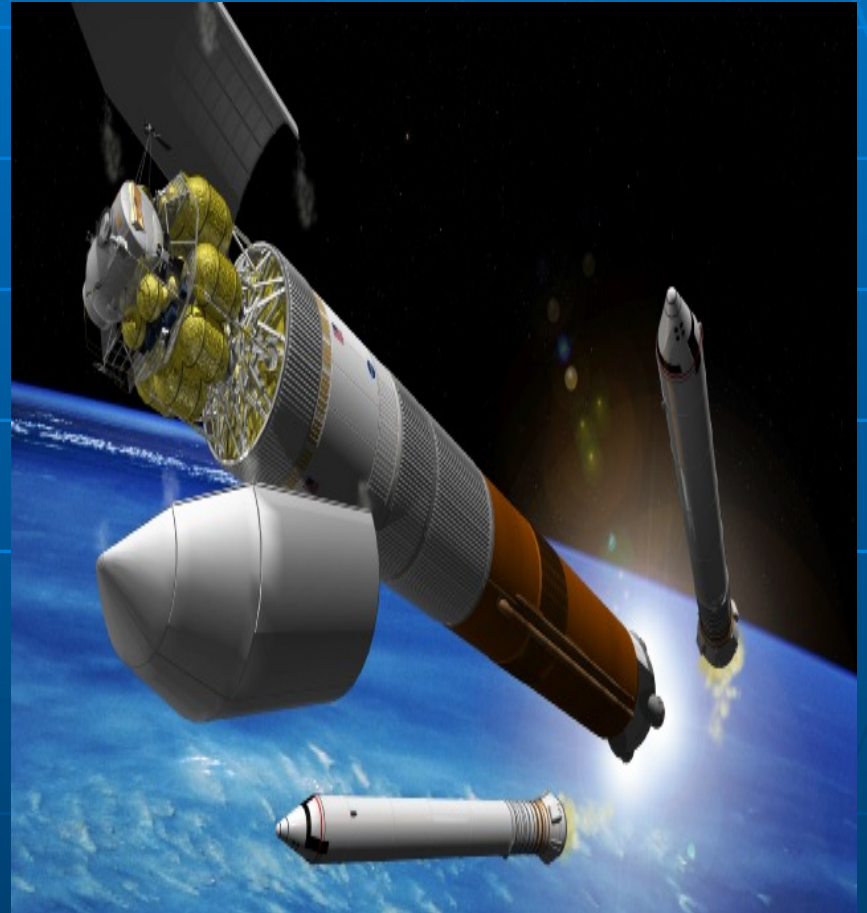






# Constellation Program Status Video

# Ares V Cargo Launch Vehicle Status



# Altair Lunar Lander Status







# Constellation Space Suit Development

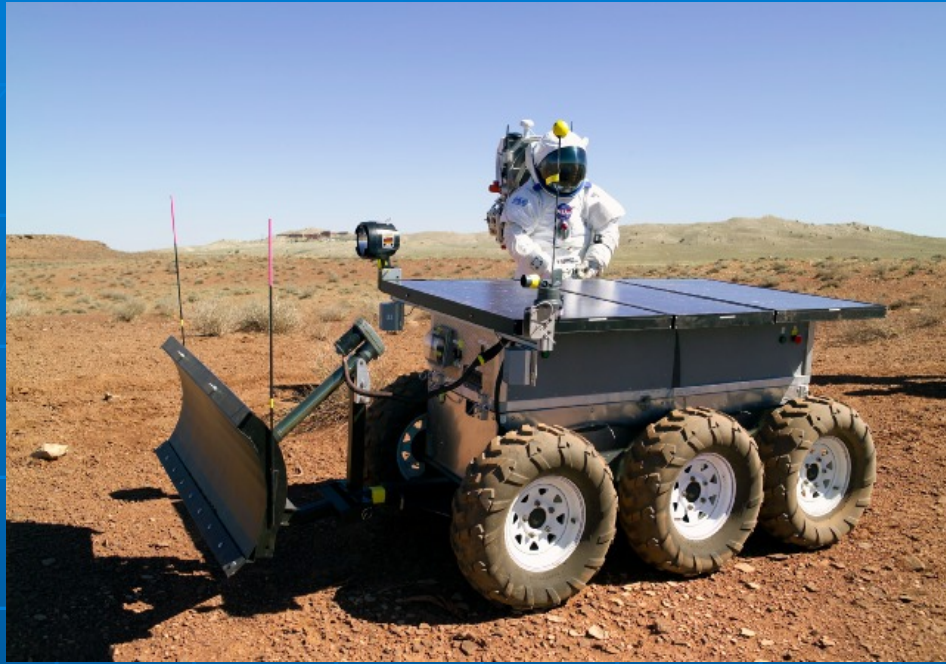




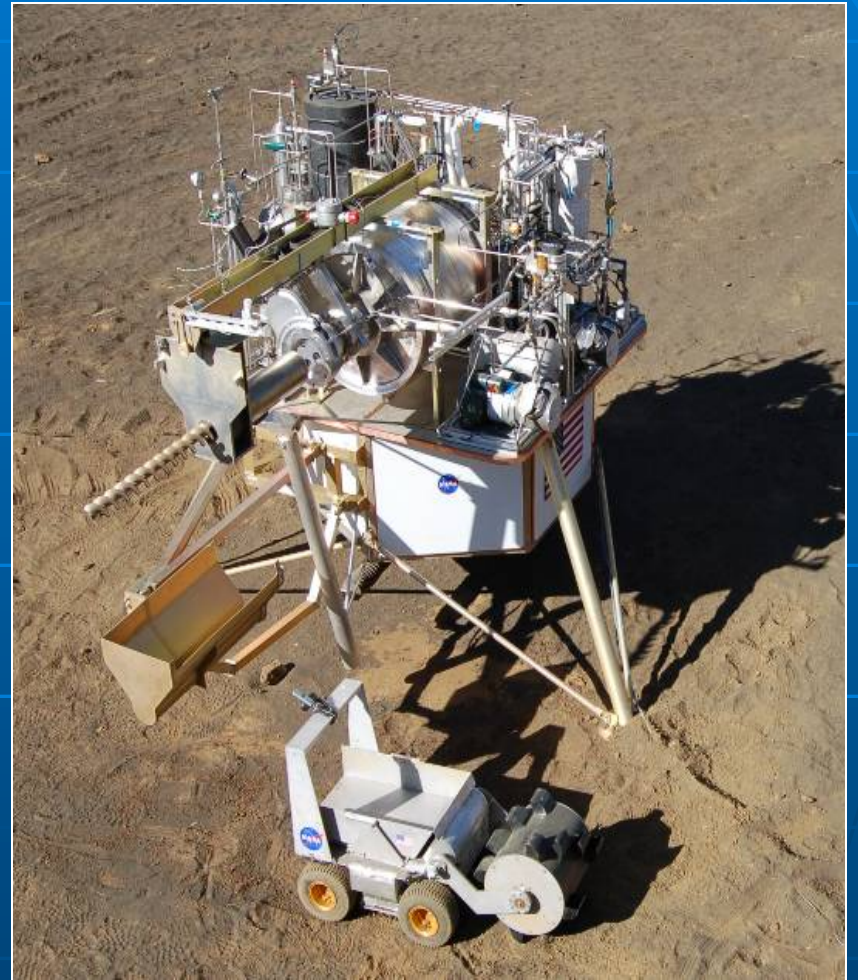


# Lunar Architecture Field Testing













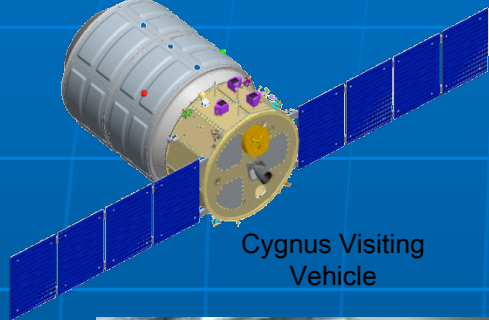


# Commercial Orbital Transportation Services



# Commercial Orbital Transportation Services

**Orbital**



Cygnus Visiting Vehicle



Avionics section



Fairing mold tool



Taurus II

**SPACEX**

Space Exploration Technologies



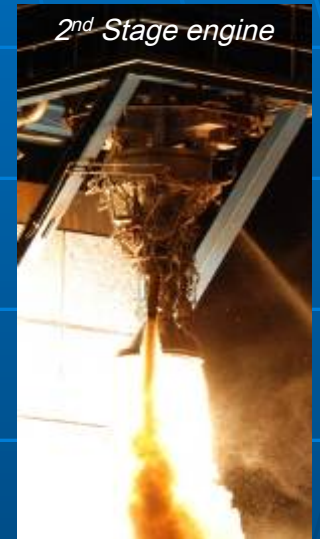
Falcon 9



Dragon Capsule & Trunk



Draco RCS Thruster



2nd Stage engine



F9-001 1st stage tank

The background is a solid blue color with a subtle grid pattern of lighter blue lines. The grid consists of vertical and horizontal lines that create a grid of squares across the entire page.

# Review of U.S. Human Spaceflight Plan Committee Report

# Committee Objectives

The Committee shall conduct an independent review of ongoing U.S. human space flight plans and programs, as well as alternatives, to ensure the nation is pursuing the best trajectory for the future of human space flight- one that is safe, innovative, affordable and sustainable. The purpose of this effort is to develop suitable options for consideration by the Administration regarding a human space flight architecture that would:

- Expedite a new U.S. capability to support utilization of the International Space Station
- Support missions to the Moon and other destinations beyond low Earth orbit
- Stimulate commercial space flight capability
- Fit within the current Administration's 2010-2014 budget profile for NASA exploration activities



# Committee Findings

- The right mission and the right size
- International partnerships
- Short-term Space Shuttle planning
- The human-spaceflight gap
- Extending the International Space Station
- Heavy lift
- Commercial launch of crew to low-Earth orbit
- Technology development
- Pathways to Mars
- Options for the human spaceflight program

# Program Options

- Option 1: Program of record. Constrained to the 2010 -2014 Administration's budget
- Option 2: ISS and Lunar Exploration. Constrained to the 2010-2014 Administration's budget
- Option 3: Program of record with budget of \$3.0 Billion annually above 2010 -2014 Administration's budget
- Options 4: Moon First with enhanced budget
- Option 5: Flexible path with enhanced budget

# Option 1

- ISS with Lunar Exploration in the 2030s
- Administration's 2010-2014 budget
- Fly Space Shuttle to FY 2011
- Maintain ISS to 2016 and then deorbit it
- Ares 1 & Orion not avail until after 2016
- Heavy Lift vehicle Ares V not avail until late 2020s
- Altar Lunar Lander in the 2030's

# Option 2

- ISS and Lunar Exploration in the 2030s
- Fly Space Shuttle to FY 2011
- Extend ISS to 2020
- Develop Ares V Lite, as heavy lift vehicle, for use in late 2020s
- No funds to develop Ares 1, Orion & the Altair Lunar Lander for the next two decades
- Use commercial services for crew transport to low Earth orbit

# Option 3

- ISS with Lunar Exploration in the 2020s
- \$3.0 billion annually above the Administration's 2010-2014 budget
- Fly Shuttle to FY 2011
- Maintain ISS to 2016 and then deorbit it
- Develop Orion & Ares 1 by FY 2017
- Develop Ares V and Altair Lunar Lander for return to Moon by mid 2020s

# Option 4

- Moon First with return in 2020s
- \$3.0 billion annually above the Administration's 2010-2014 budget
- Fly the Space Shuttle to FY 2011
- Extend ISS operation to 2020
- Develop Orion, & Altair Lunar Lander
- Use commercial services for crew transport to low Earth orbit
- Develop Ares V Lite or Shuttle derived variant with on-orbit refueling as heavy lift vehicle

# Option 5

- Flexible Path in early 2020s with lunar fly-bys, Lagrange points, near Earth objects
- \$3.0 billion annually above the Administration's 2010-2014 budget
- Fly Space Shuttle to FY 2011
- Extend ISS operation to 2020
- Use commercial services for crew transport to low Earth orbit
- Use Ares V Lite, EELV, or Shuttle derived variant with on-orbit refueling for heavy launch lift

# Current Status

- Final Space Shuttle Mission will be flown in 2010
- Under the current Constellation Program, Ares 1 and Orion will not be ready for human spaceflight until at least 2015 or later
- Obama Administration is currently reassessing what the future path will be for NASA's manned space flight program