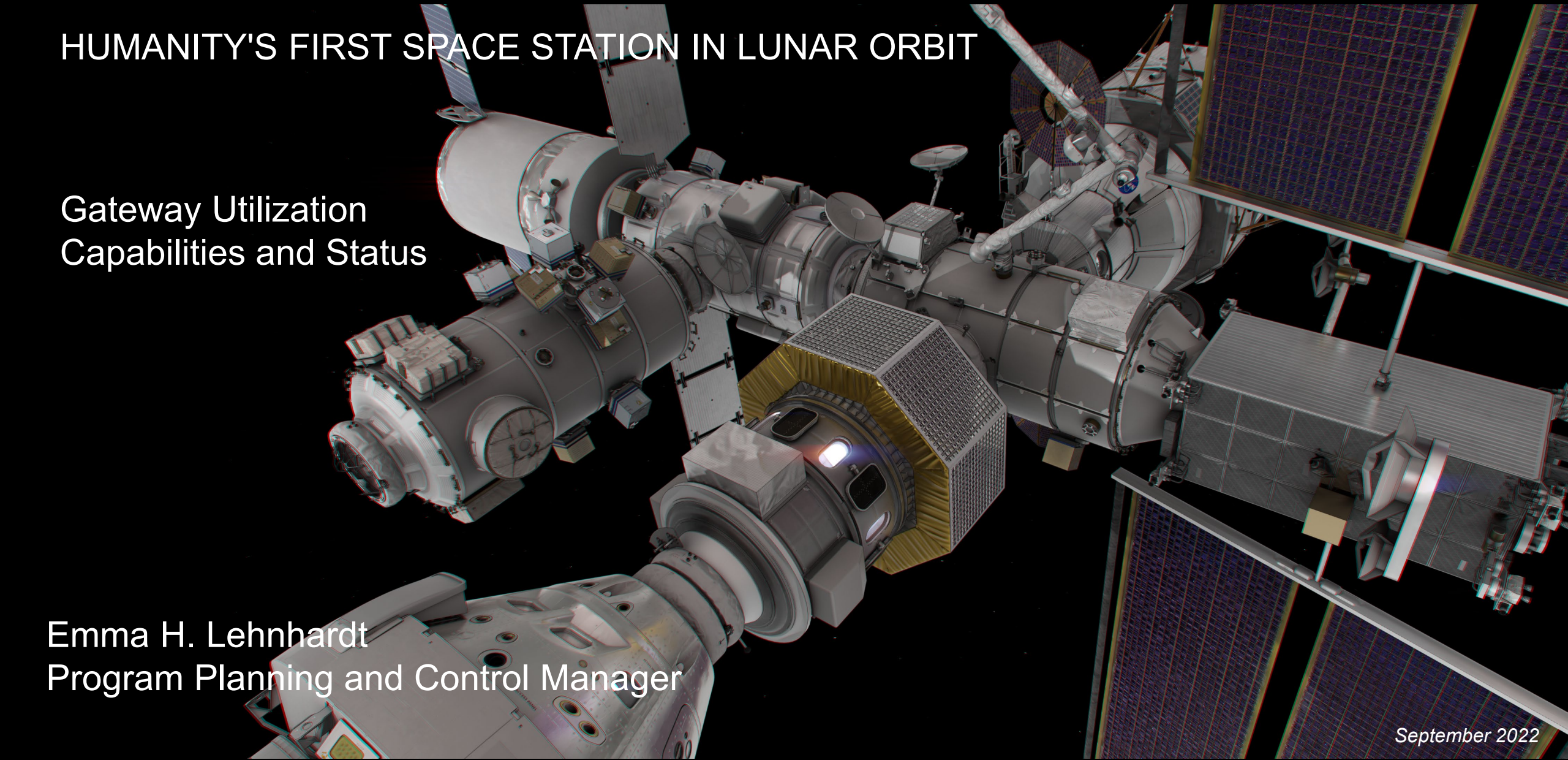
GATEWAY

HUMANITY'S FIRST SPACE STATION IN LUNAR ORBIT



Gateway Utilization Capabilities and Status

Emma H. Lehnhardt
Program Planning and Control Manager

September 2022

ARTEMIS

Artemis is the twin sister of Apollo and goddess of the Moon in Greek mythology.

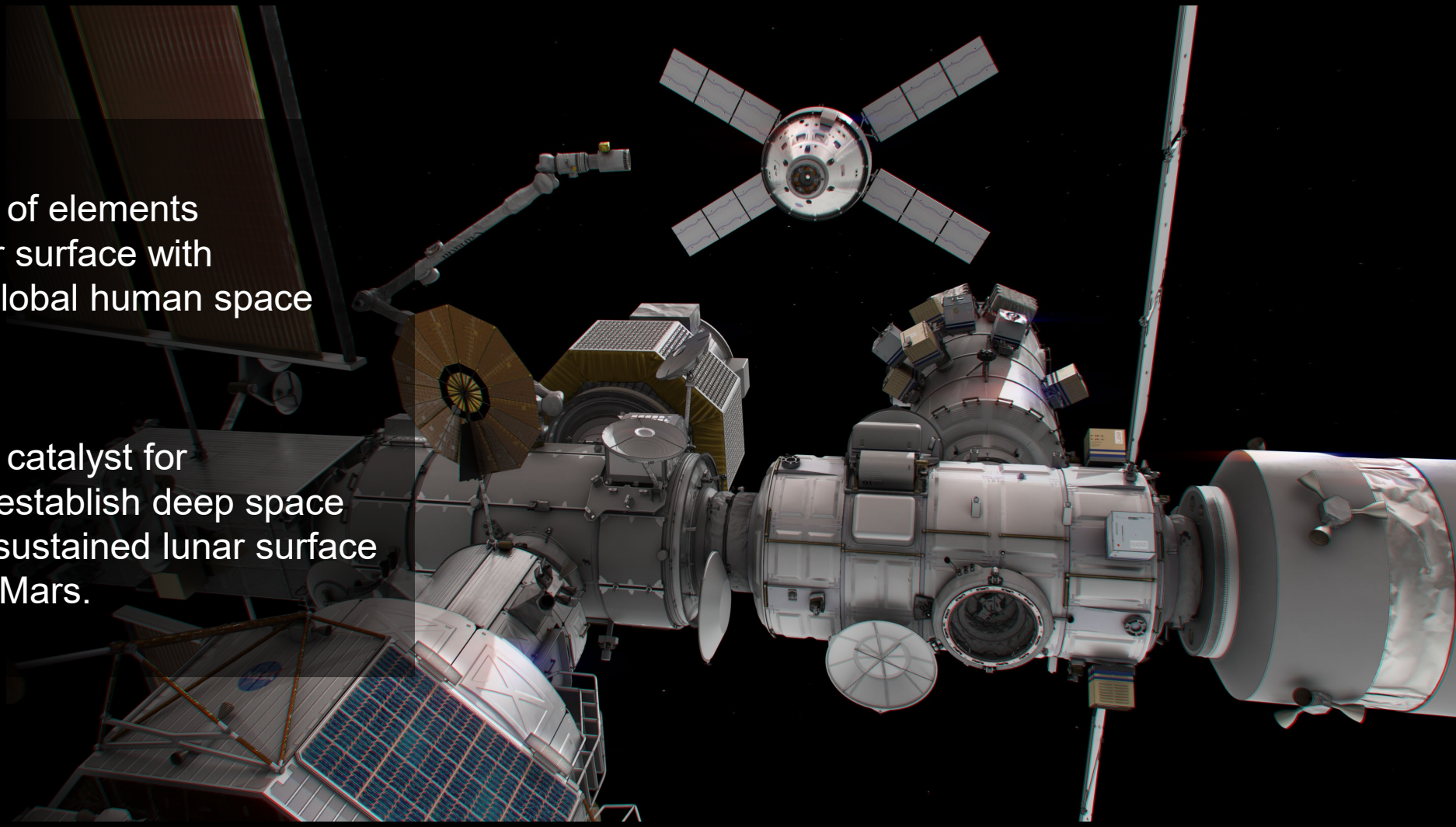
Now, she personifies our path to the Moon as the name of NASA's program to return astronauts, including first woman and first person of color, to the lunar surface.

Gateway is a foundational element of NASA's planned infrastructure at the Moon and for deep space travel, along with the Orion spacecraft, Space Launch System rocket, Human Landing System, and the Extra Vehicular Activity & Human Surface Mobility Program.

A FOUNDATION IN DEEP SPACE

Gateway is an assembly of elements situated around the lunar surface with capabilities to advance global human space exploration goals.

It will serve as a unifying catalyst for international partners to establish deep space scientific investigations, sustained lunar surface access, and missions to Mars.



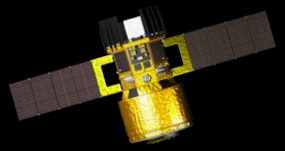
GATEWAY INTEGRATED SPACECRAFT CONFIGURATION

Co-manifested (PPE/HALO)
Launch Vehicle (not pictured)
SPACEX

Power and Propulsion Element (PPE)
MAXAR

Gateway External Robotic System (GERS)
CSA ASC

Logistics Module
SPACEX



HTV-XG
JAXA

ESPRIT-Refueler
esa

Airlock
Provider TBD

Human Landing System (HLS)
(government reference concept shown)

Habitation and Logistics Outpost (HALO)
NORTHROP GRUMMAN
JAXA esa

International Habitat (I-HAB)
esa JAXA

Orion
NASA
esa

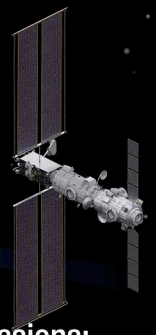
ARTEMIS : LANDING HUMANS ON THE MOON

Lunar Reconnaissance Orbiter: Continued surface and landing site investigation

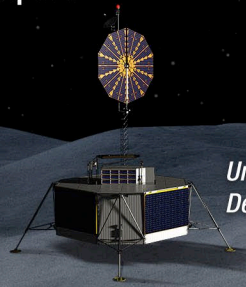
Artemis I: First human spacecraft to the Moon in the 21st century

Artemis II: First humans to orbit the Moon and rendezvous in deep space in the 21st century

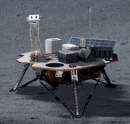
Gateway begins science operations with launch of Power and Propulsion Element and Habitation and Logistics Outpost



Artemis III-V: Deep space crew missions; cislunar buildup and initial crew demonstration landing with Human Landing System



Uncrewed HLS Demonstration



Early South Pole Robotic Landings

Science and technology payloads delivered by Commercial Lunar Payload Services providers

Volatiles Investigating Polar Exploration Rover

First mobility-enhanced lunar volatiles survey

Humans on the Moon - 21st Century

First crew expedition to the lunar surface

LUNAR SOUTH POLE TARGET SITE

INITIAL GATEWAY COMPONENTS

POWER AND PROPULSION ELEMENT (PPE)

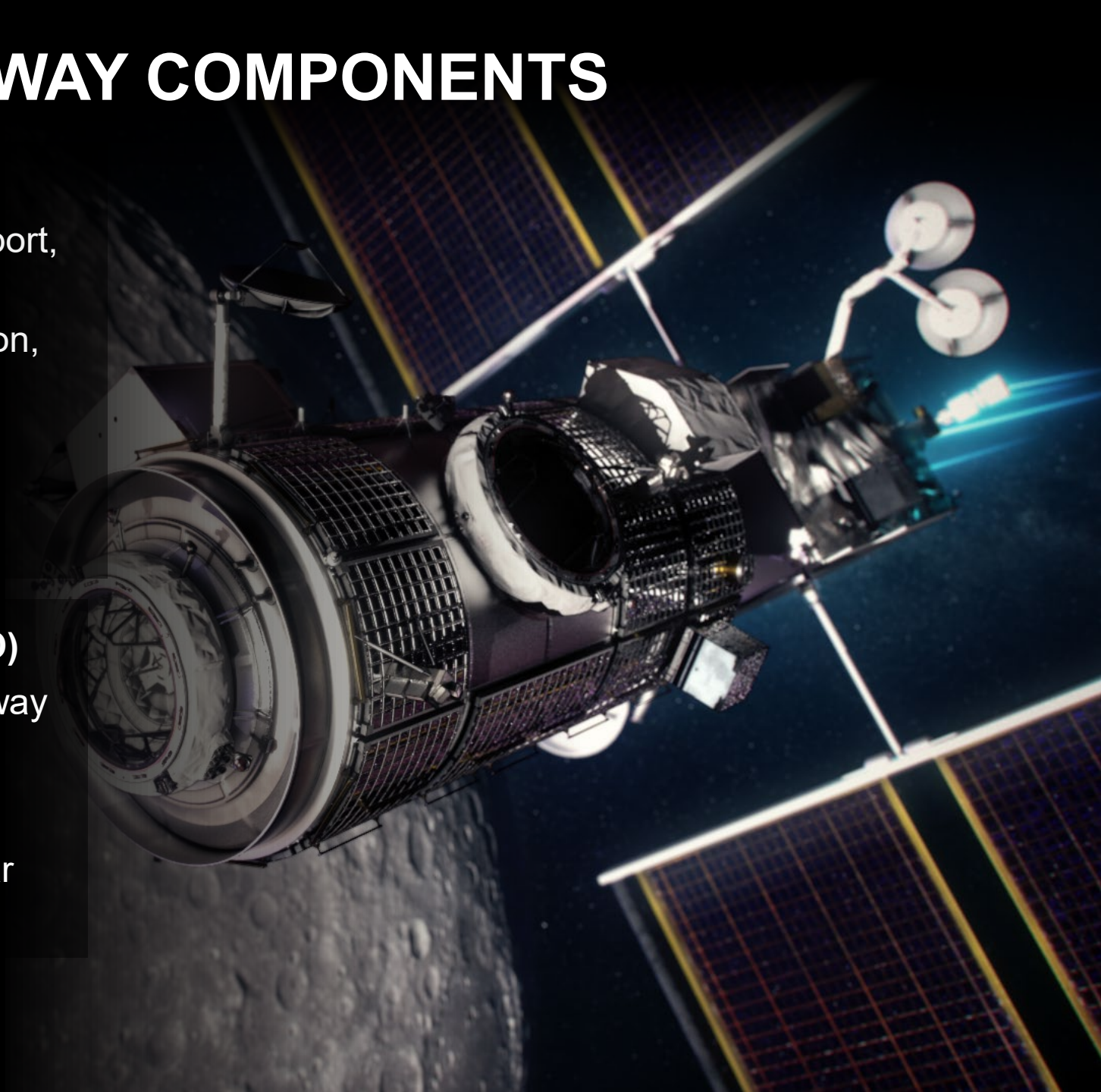
- Supporting electric propulsion as well as life support, communications, science, thermal, etc.
- Provides Gateway with electrical power, propulsion, and communication capabilities
- Accommodates science and technology demonstration payloads

MAXAR

HABITATION AND LOGISTICS OUTPOST (HALO)

- Initial crew cabin for astronauts visiting the Gateway
- Multiple docking ports for visiting spacecraft
- Cargo space for science and stowage
- HLCS for high data rate communication with lunar surface (contribution of ESA)

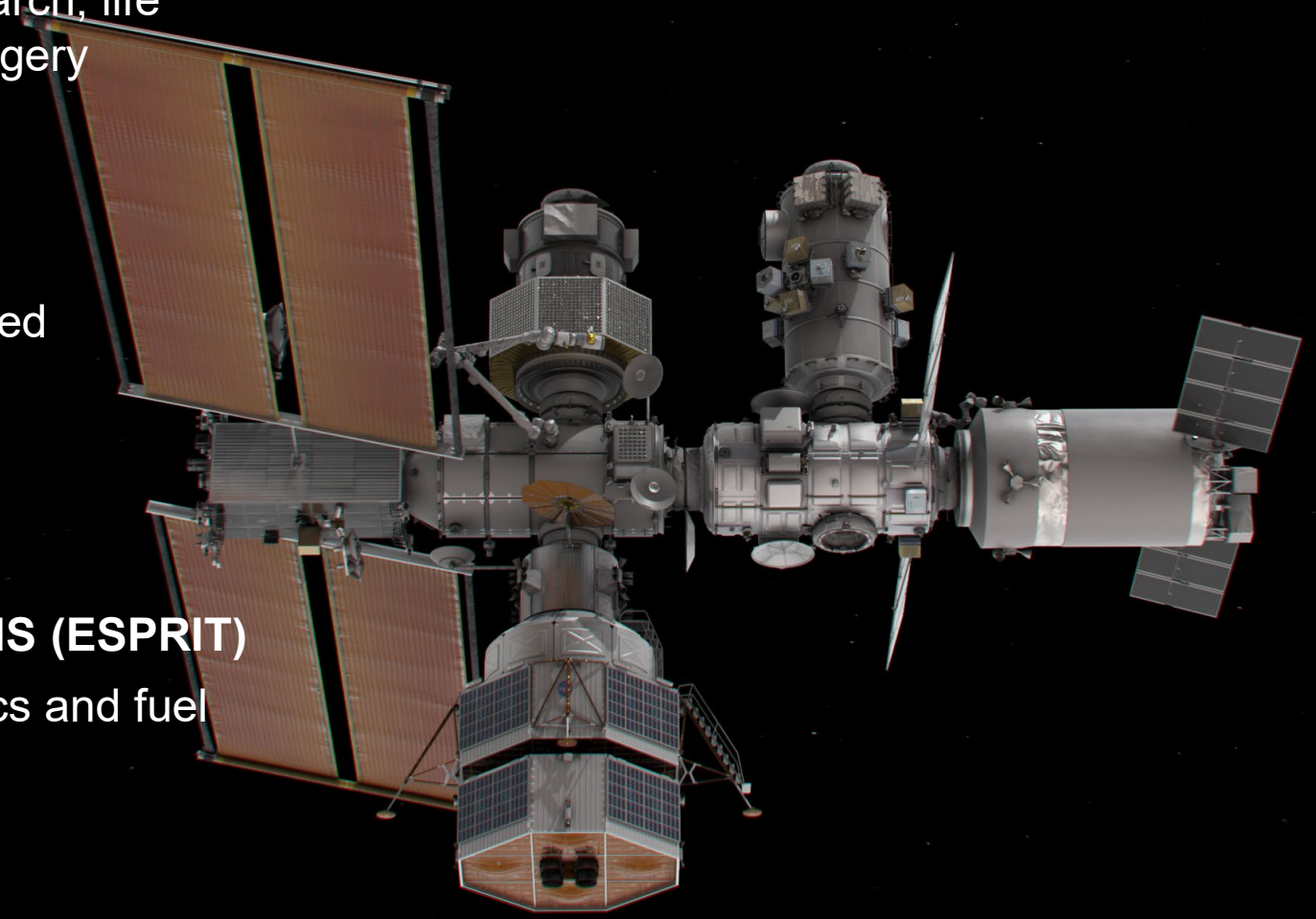
NORTHROP GRUMMAN



GATEWAY COMPONENTS

INTERNATIONAL HABITATION MODULE (I-HAB)

- Enhances Gateway capabilities for scientific research, life support systems and crew living quarters and imagery components
- Enables longer crewed mission durations
- Includes additional docking ports
- To be launched with Orion on SLS as co-manifested payload



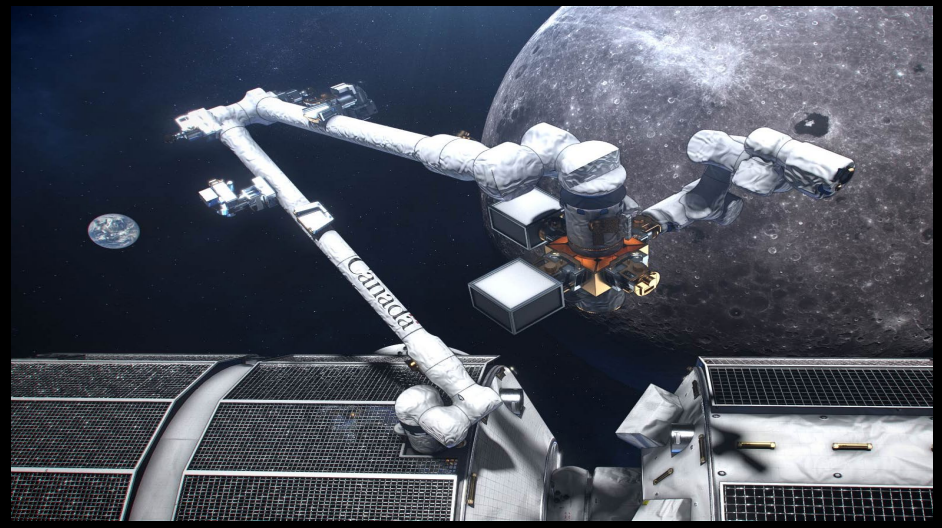
EURPOEAN SYSTEM PROVIDING REFUELING INFRASTRUCTURE AND TELECOMMUNICATIONS (ESPRIT)

- Fuel to resupply and docking port for future logistics and fuel resupply
- Houses windows to capture space imagery
- Cargo storage for Gateway logistics
- To be launched with Orion on SLS as co-manifested payload

GATEWAY COMPONENTS

CANADARM3

- Next-generation robotic arm capable of moving end-over-end to reach Gateway's exterior
- Robotic support for exterior maintenance and inspection
- Transfer and install external hardware and science payloads between Gateway modules, logistic vehicles and science airlock



Canadarm3 Illustration

AIRLOCK

- Enables crewed space walks
- Transfers science experiments and hardware between the pressurized cabin and the exterior of Gateway

TBD partner agency

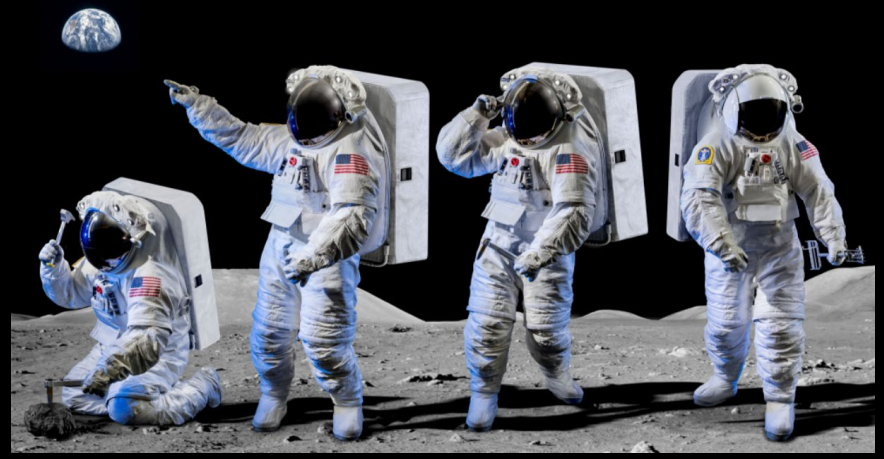
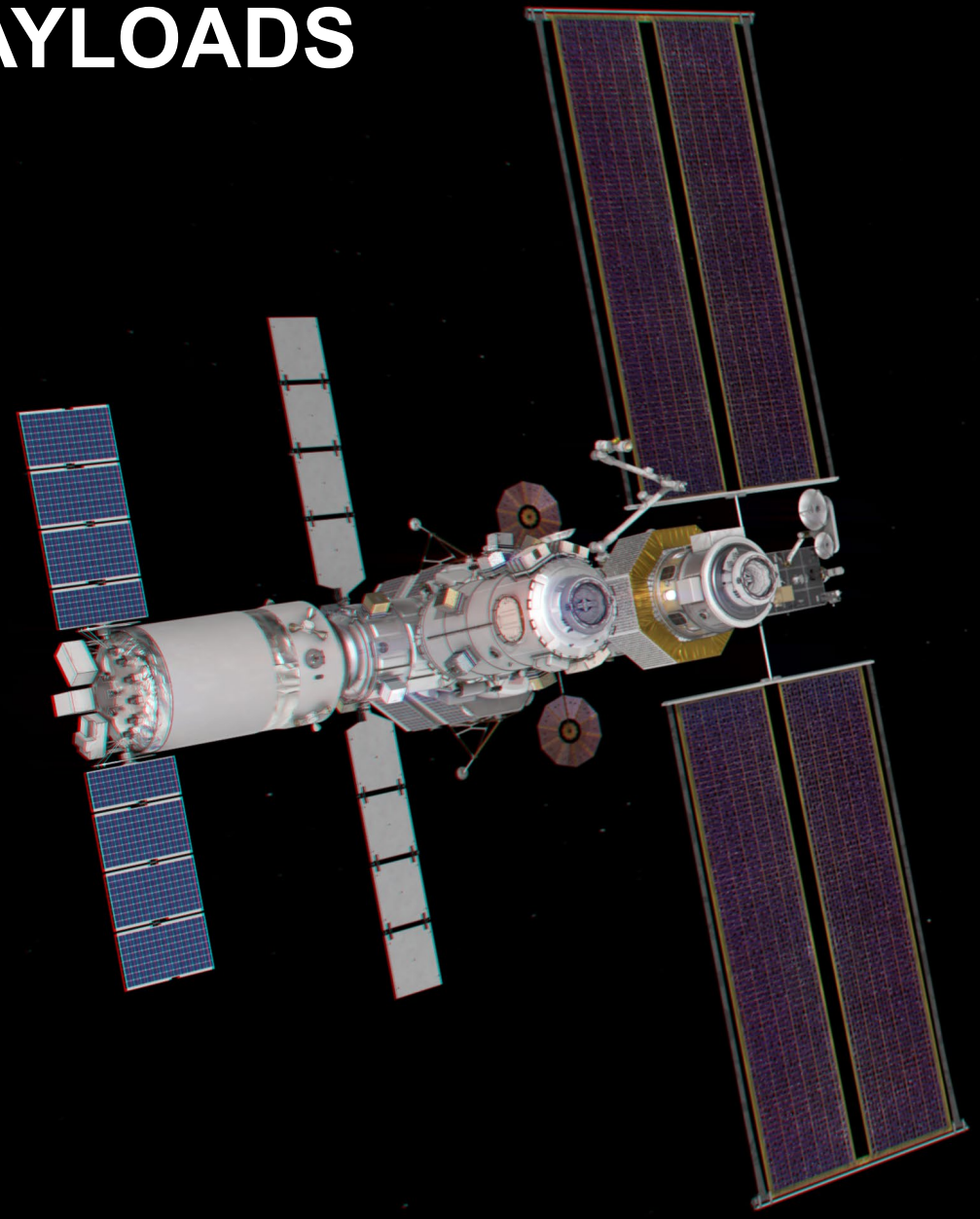


Illustration of xEVA suits

INITIAL GATEWAY PAYLOADS

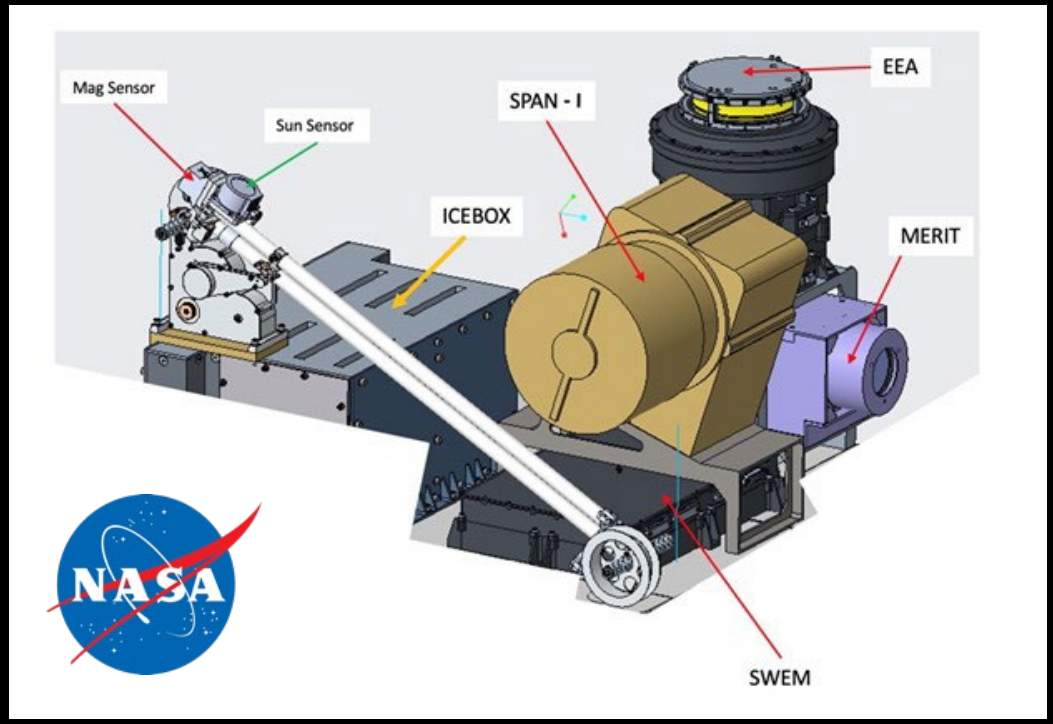
Gateway will be a powerhouse for groundbreaking research of the deep space environment's impact on human body and vehicle systems that has not been possible from low-Earth orbit.

Gateway's orbit will offer unique opportunities for heliophysics, human health research, space biology and life sciences, astrophysics, and fundamental physics investigations. As new modules are added, science capability will increase.



HELIOPHYSICS ENVIRONMENTAL RADIATION MEASUREMENT EXPERIMENT SUITE (HERMES)

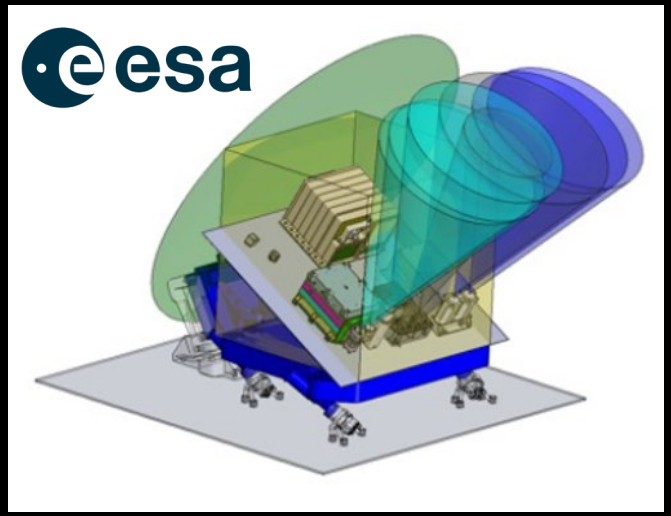
NASA's space weather instrument suite will observe lower energy solar particles critical to scientific investigations of the Sun including the solar winds



Heliophysics Environmental and Radiation Measurement Experiment Suite, HERMES, instrument

EUROPEAN RADIATION SENSORS ARRAY (ERSA)

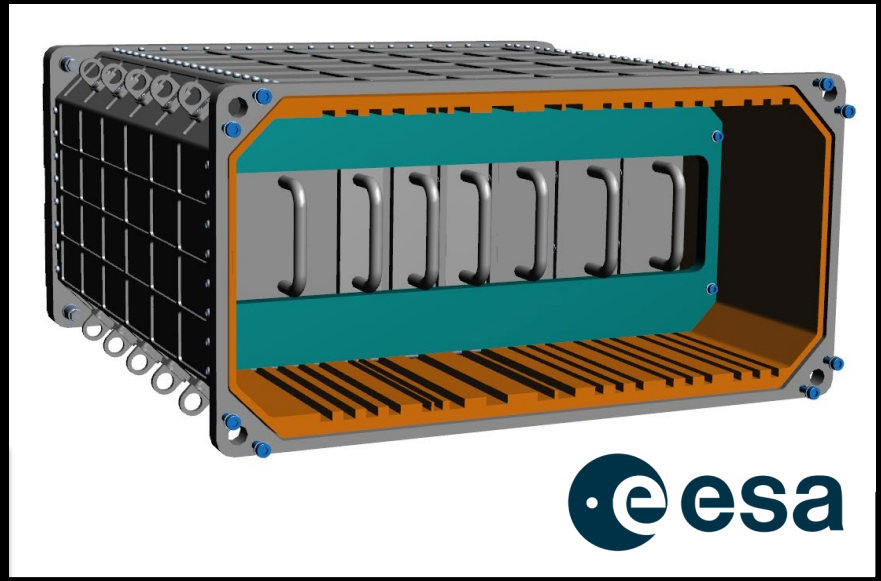
The European Space Agency's (ESA) radiation instrument package will help provide an understanding of how to keep astronauts safe by monitoring the radiation at higher energies with a focus on space weather.



European Radiation Sensors Array, ERSA, instrument

ESA’S INTERNAL DOSIMETER ARRAY (IDA)

Instruments including those provided by Japan Aerospace Exploration Agency (JAXA) will inform for improvements in radiation physics models for cancer, cardiovascular, and central nervous system effects, helping assess crew risk on exploration missions

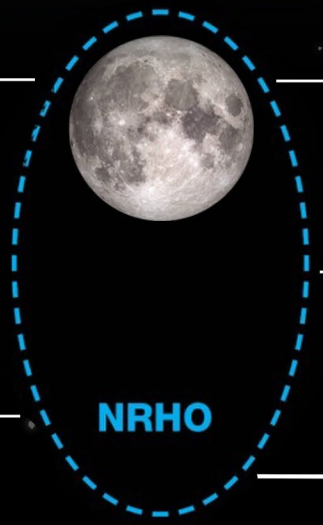


Internal Dosimeter Array, IDA

GATEWAY'S UNIQUE ORBIT

There are many ways to orbit the Moon, and each has its pros and cons. Gateway will travel in a near-rectilinear halo orbit to support missions to the lunar surface and serve as a staging point for exploration farther into the solar system, including Mars.

NEAR-RECTILINEAR HALO ORBIT (NRHO)



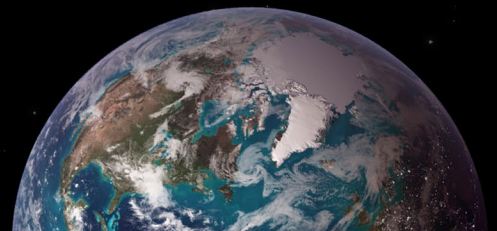
ACCESS
Easy to access from Earth orbit with many current launch vehicles; staging point for both lunar surface and deep space destinations

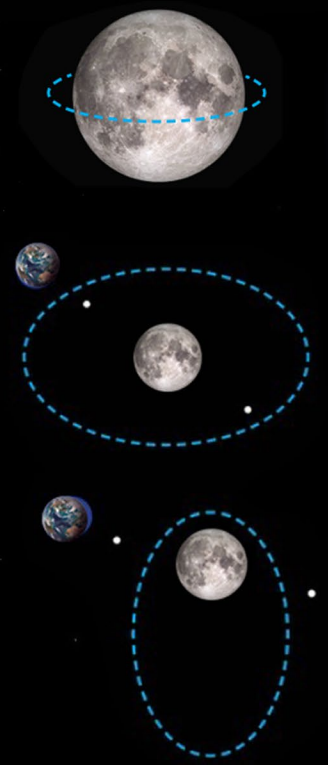
ENVIRONMENT
The deep space environment is useful for radiation testing and experiments in preparation for missions to the lunar surface and Mars

SCIENCE
Favorable vantage point for Earth, sun and deep space observations

COMMUNICATIONS
Provides continuous view of Earth and communication relay for lunar farside

SURFACE OPERATIONS
Supports surface telerobotics, including lunar farside; provides a staging point for planetary sample return missions





ORBIT TYPES

LOW LUNAR ORBITS
Circular or elliptical orbits close to the surface; excellent for remote sensing, difficult to maintain in gravity well.

» Orbit period: 2 hours

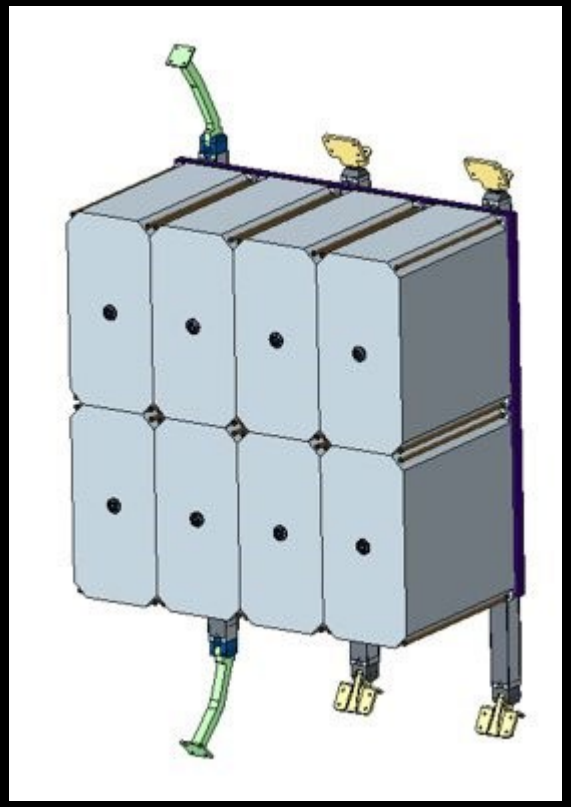
DISTANT RETROGRADE ORBITS
Very large, circular, stable orbits; easy to reach from Earth, but far from the lunar surface

» Orbit period: 2 weeks

HALO ORBITS
Fuel-efficient orbits revolving around Earth-Moon neutral-gravity points

» Orbit period: 1-2 weeks

INTERNAL UTILIZATION CAPABILITIES



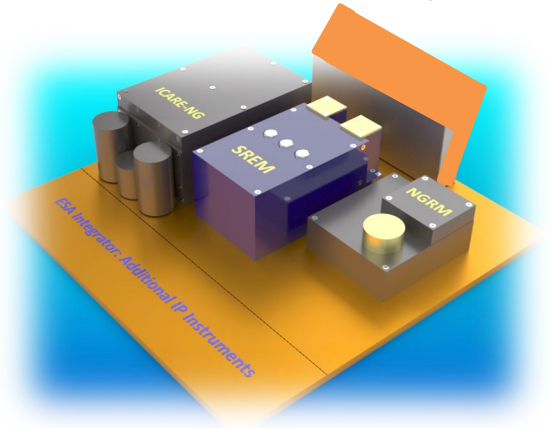
Gateway Payload Bank Concept

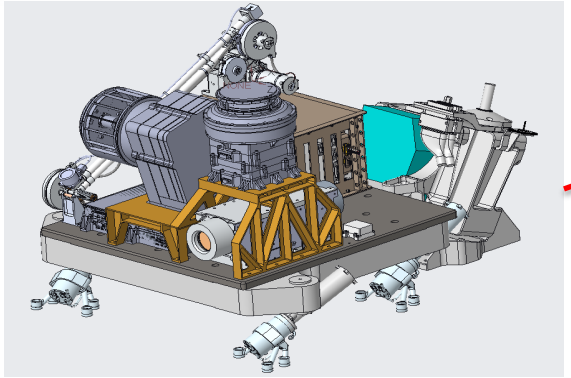
- **Payload Bank**
  - Power
  - Data connection
  - Thermal cooling
  - Physical mounting
- **Cabin Deployed Payloads**
  - Power
  - Data connection
  - Physical mounting
- **Autonomous Research Capabilities**
  - Gateway has capability to conduct research when uncrewed
  - Systems built to respond to anomalies without ground operator input

Gateway Portable Equipment Panel Concept

EXTERNAL UTILIZATION CAPABILITIES

European Radiation Sensors Array (ERSA)
ESA/ESTEC
Space Weather
(Includes JAXA Low-Velocity Dust Monitor)



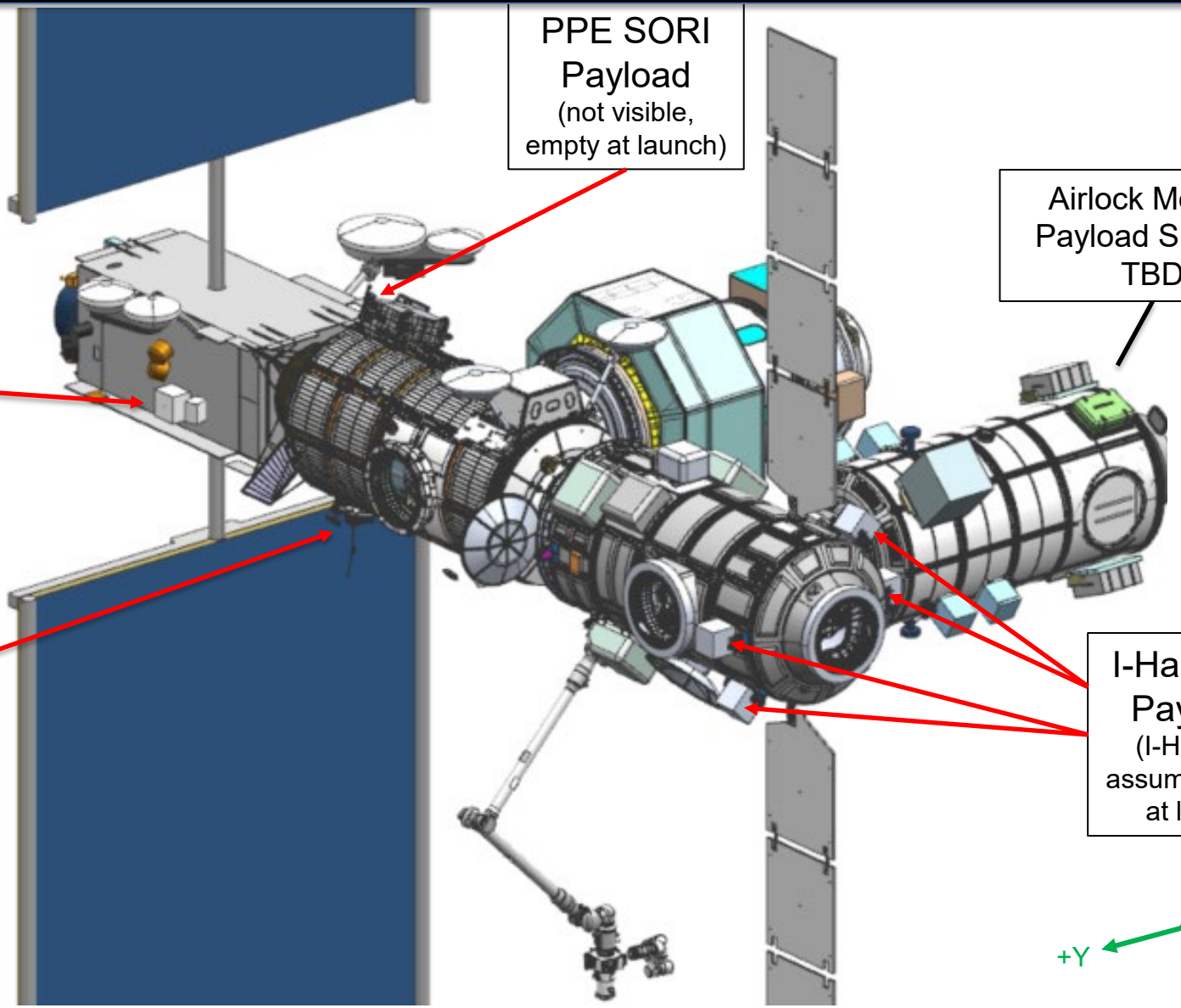


Heliophysics Environmental & Radiation Measurement Experiment Suite (HERMES)
NASA/GSFC
Heliophysics

PPE SORI Payload
(not visible, empty at launch)

Airlock Module Payload Support TBD

I-Hab SORI Payloads
(I-Hab PDR assumption: one at launch)



GATEWAY AND THE INTERNATIONAL SPACE STATION

Size: roughly a studio apartment

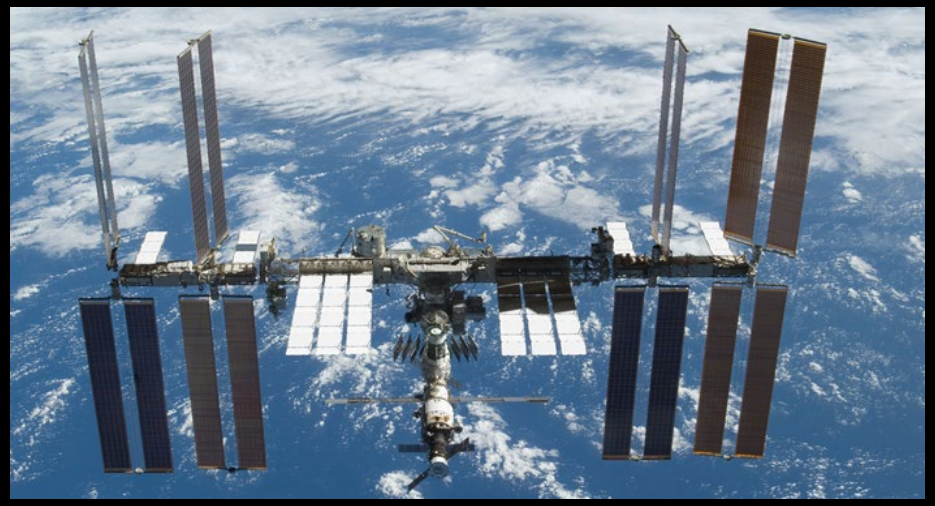
Vehicle Life: at least 15 years

Crewed: 30+ days/year

Uncrewed: 330 Days/year up to 3 years

Logistics: 1 logistics re-supply vehicle per crewed mission (1 re-fueler for Life of Gateway)

EVA Capability: With airlock arrival



Size: roughly **a** 6-bedroom house

Vehicle Life: initially 15 years, extended to 30 years

Crewed: 365 days per year

Uncrewed: 0 Days in 21 years

Logistics: ~7 logistics re-supply vehicles from 3 different providers (3 re-fuelers per year)

EVA Capability: Continuous

MOON BEFORE MARS

On and around the Moon, we can take reasonable risks while astronauts are just days away from home.

There, we will prove technologies and mature systems necessary to live and work on another world before embarking on multi-year missions to Mars.

While we are there, we will collect valuable research, technology, and scientific data to benefit humanity.


GATEWAY
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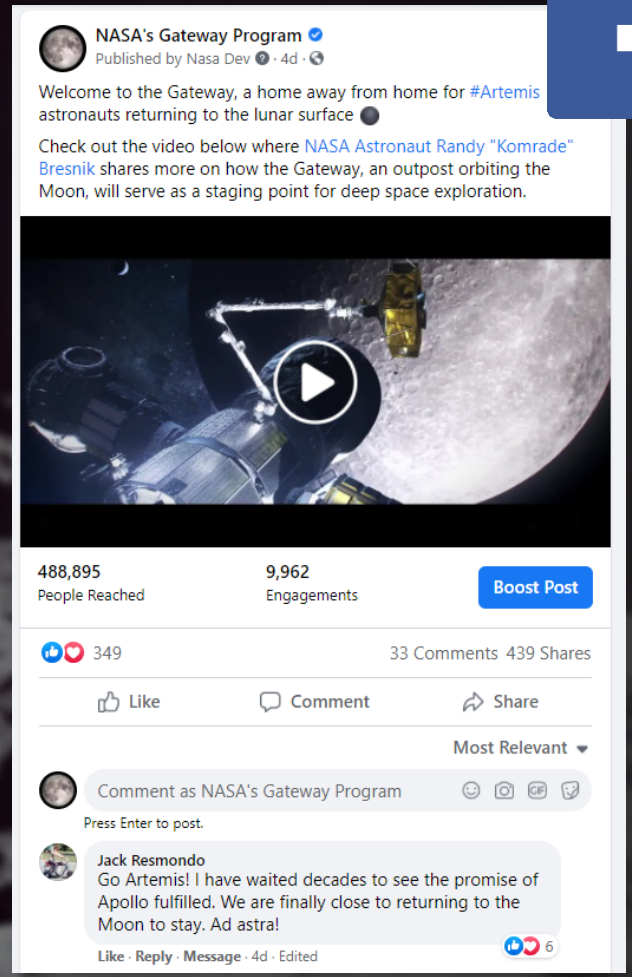

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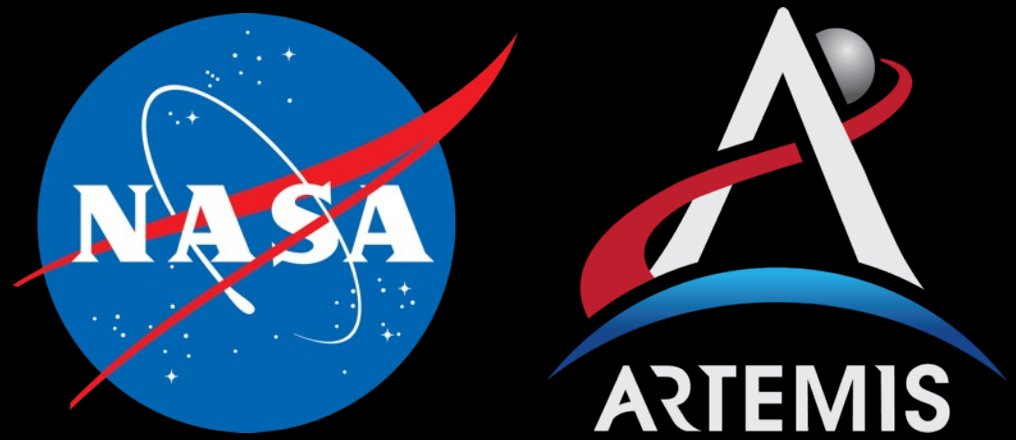
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