
Connecting Earth and Moon The Future of Space Communication

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Challenger Center Conference 2026

August 11, 2026

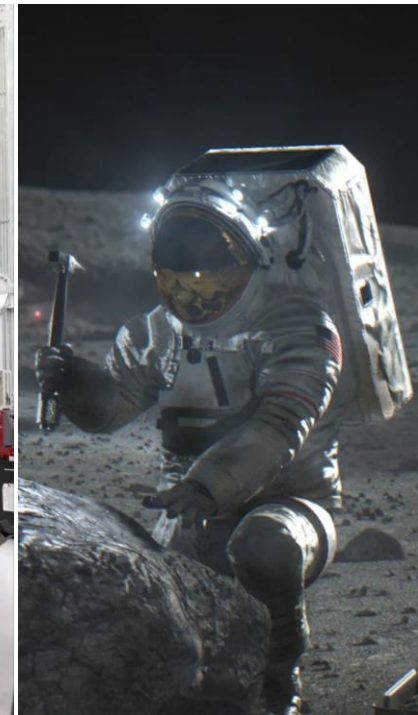
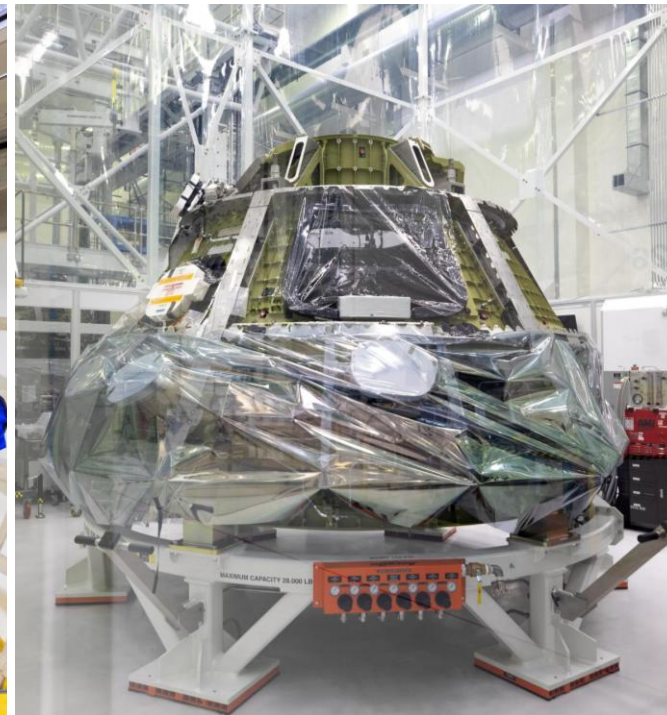


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NASA's Artemis Campaign



ARTEMIS I Completed (2022)

Uncrewed test flight of the SLS rocket and Orion capsule. Completed a 1.4-million-mile journey beyond the Moon and safely splashed down.

ARTEMIS II Completed(2026)

First crewed lunar flyby since the Apollo era. A crew of four astronauts—Reid Wiseman, Victor Glover, Christina Koch, and Jeremy Hansen—successfully flew around the far side of the Moon and returned to Earth.



ARTEMIS III Late 2027

A highly complex Earth-orbit demonstration mission. The crew (Randy Bresnik, Luca Parmitano, Andre Douglas, and Frank Rubio) will test critical rendezvous and docking operations with prototype commercial human landing systems (HLS) from SpaceX and Blue Origin.

ARTEMIS IV Early 2028

The official first crewed lunar landing of the program. Two crew members will descend to the lunar surface via a commercial lander and spend a week near the lunar South Pole.

ARTEMIS V Late 2028

Focuses on beginning infrastructure delivery and building out the semi-permanent Moon base.

The Benefits of Optical Communications

1 SMALL, LOW POWER TERMINALS

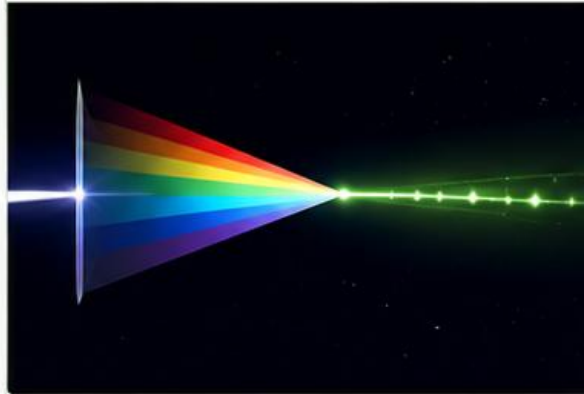


- Compact size and lightweight
- Lower mass and volume
- Lower power consumption
- Lower cost



Enables more capability within tighter constraints

2 UNLIMITED, UNREGULATED SPECTRUM

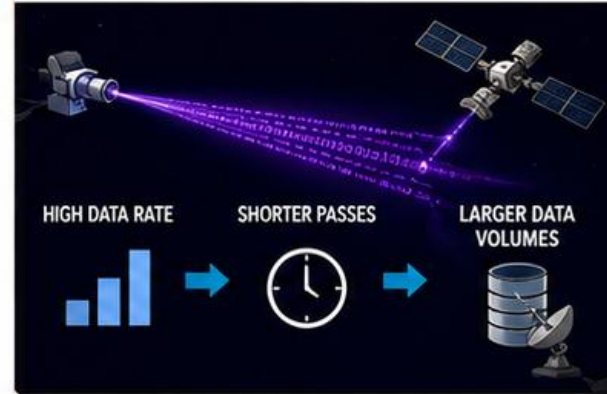


- Access to a vast optical spectrum
- No licensing or spectrum congestion
- Future-proof for growing demand



Vast capacity for present and future missions

3 HIGH DATA RATES

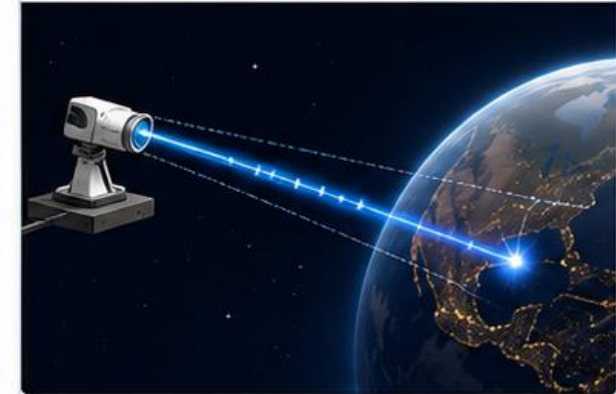


- Orders of magnitude higher than RF
- Enables shorter contact times
- Delivers larger data volumes over the duration of mission



More data, faster—transforming mission outcomes

4 NARROW BEAM



- Diffraction-limited beams with small apertures
- Reduced interference and spectrum sharing
- Enhanced security and lower risk of signal interception



Precision links for reliable, secure communications

Communicating Across the Moon-Earth Distance

LLCD: FIRST LUNAR COMMUNICATION DEMONSTRATION

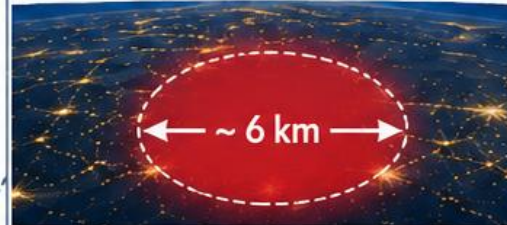


Lunar Laser Communication Demonstration (2013)

The first high-rate optical communications demonstration from lunar distance, proving laser communications are feasible over nearly 400,000 km.

~384,000 km
Earth-Moon Distance

LLCD Laser Beam Spot Size on Earth



Beam footprint diameter
~ 6 km on the ground
(varies with pointing and
atmospheric conditions)



Table Mountain Facility
Wrightwood, California, USA

LLCD achieved:
622 Mbps downlink
20 Mbps uplink

MAJOR CHALLENGES



EXTREME POINTING ACCURACY

- Earth is nearly 400,000 km away
- Laser beams are extremely narrow
- Spacecraft pointing errors of only a few microradians can miss the ground terminal entirely



ATMOSPHERIC EFFECTS

- Turbulence distorts the optical wavefront
- Clouds completely block optical links
- Multiple geographically separated ground stations are required



LONG DISTANCE

- Approximately 384,000 km propagation path
- About 1.3 seconds one-way light time
- Very low received optical power



SPACECRAFT MOTION

- Spacecraft and Earth are both moving
- Continuous pointing and tracking corrections are required
- Accurate ephemerides and closed-loop tracking are essential



HYBRID RF + OPTICAL ARCHITECTURE

- RF provides reliable command, telemetry, and backup communications
- Optical communications provide 100× higher data rates for science data, HD video, and future exploration



Artemis II and O2O Timeline



O2O

O2O Activation
& Latch Release
(06:50)

First links to WSC
(13:05) and ANU
Terminal (downlink
only) 15:22

**First light with TMF
Ground Terminal;**
error free 80 Mbps
downlink and 20 Mbps
uplink video over
Opcom; Initial file
downloads (09:54)

Demonstrated WSC link
acquisition and comm
during DSN outage;
< 100 GB downloaded

260 Mbps downlink
to ANU

Downlinked 2,291
images and files;
demonstrated 4K HD
video via ANU;
optical comm during
crew exercise

> 120 GB
downlinked to
a single
terminal in a
single day

Demo of
error-free file
downlink to
WSC without
feedback

Extended optical
link to ANU as
long as possible;
operated
through burn

4/1/2026 4/2 4/3 4/4 4/5 4/6 4/7 4/8 4/9 4/10



Launch 22:35

Translunar
Injection
Burn
23:49



First Images (R.
Wiseman) on social
media ~ 04:00



A moment of reflection
(C. Koch)
Released on 4/4

Farthest
distance
406,778 km
23:07



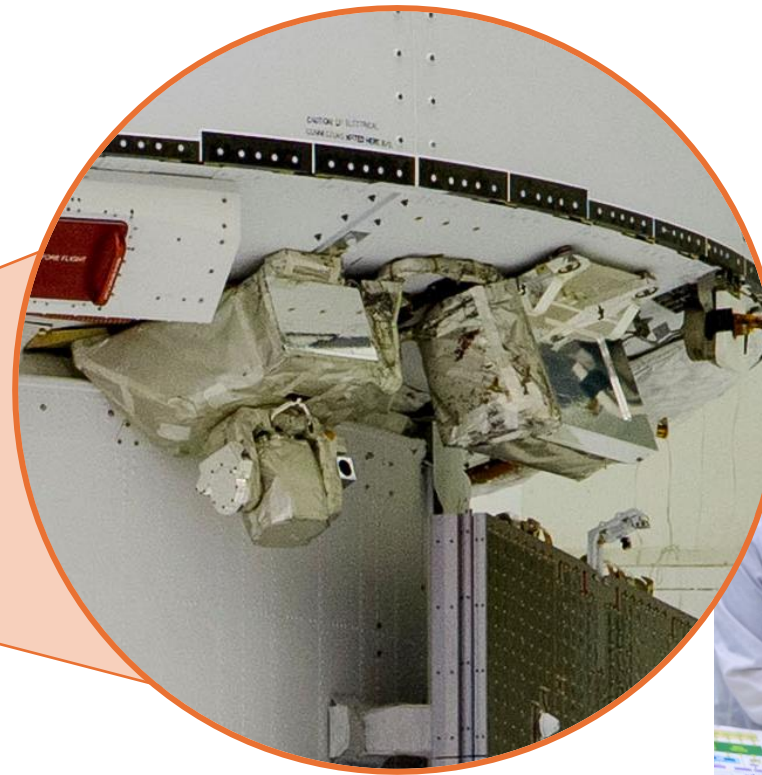
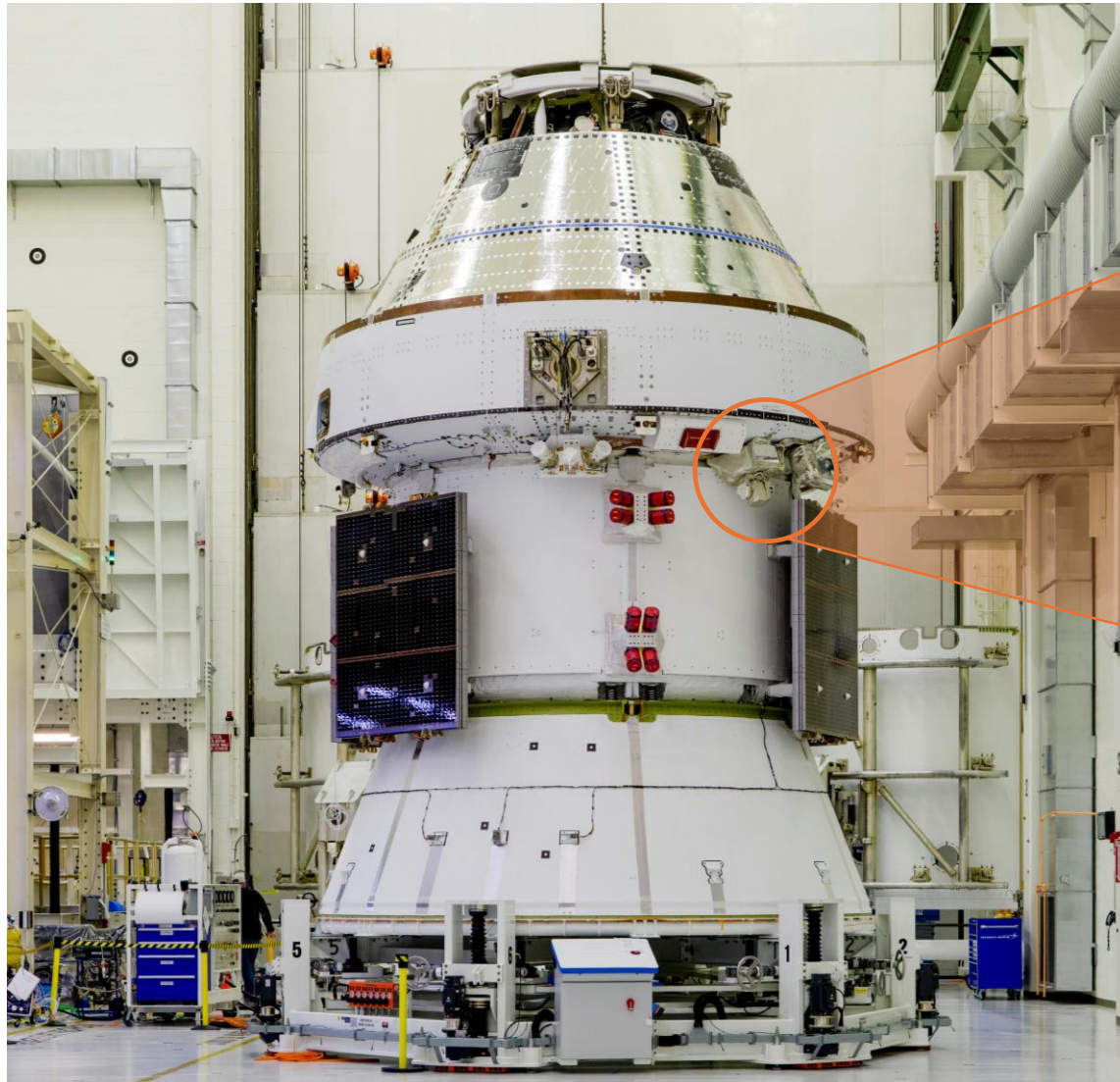
Earthset (R. Wiseman)
Released on 4/7



Splashdown
4/10 0:007

ARTEMIS II

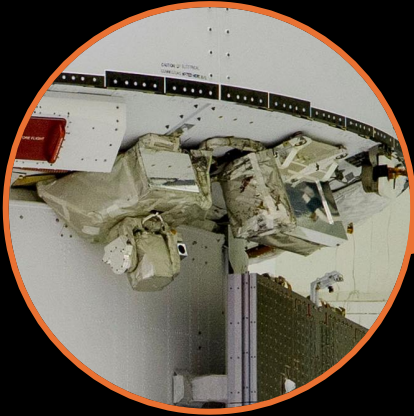




**March 2025 in
Operations & Checkout
Building at Kennedy
Space Center**



**June 2023: O2O payload
installed on Orion**



We are here!

*Artemis II on
launch pad,
Feb 2, 2026*

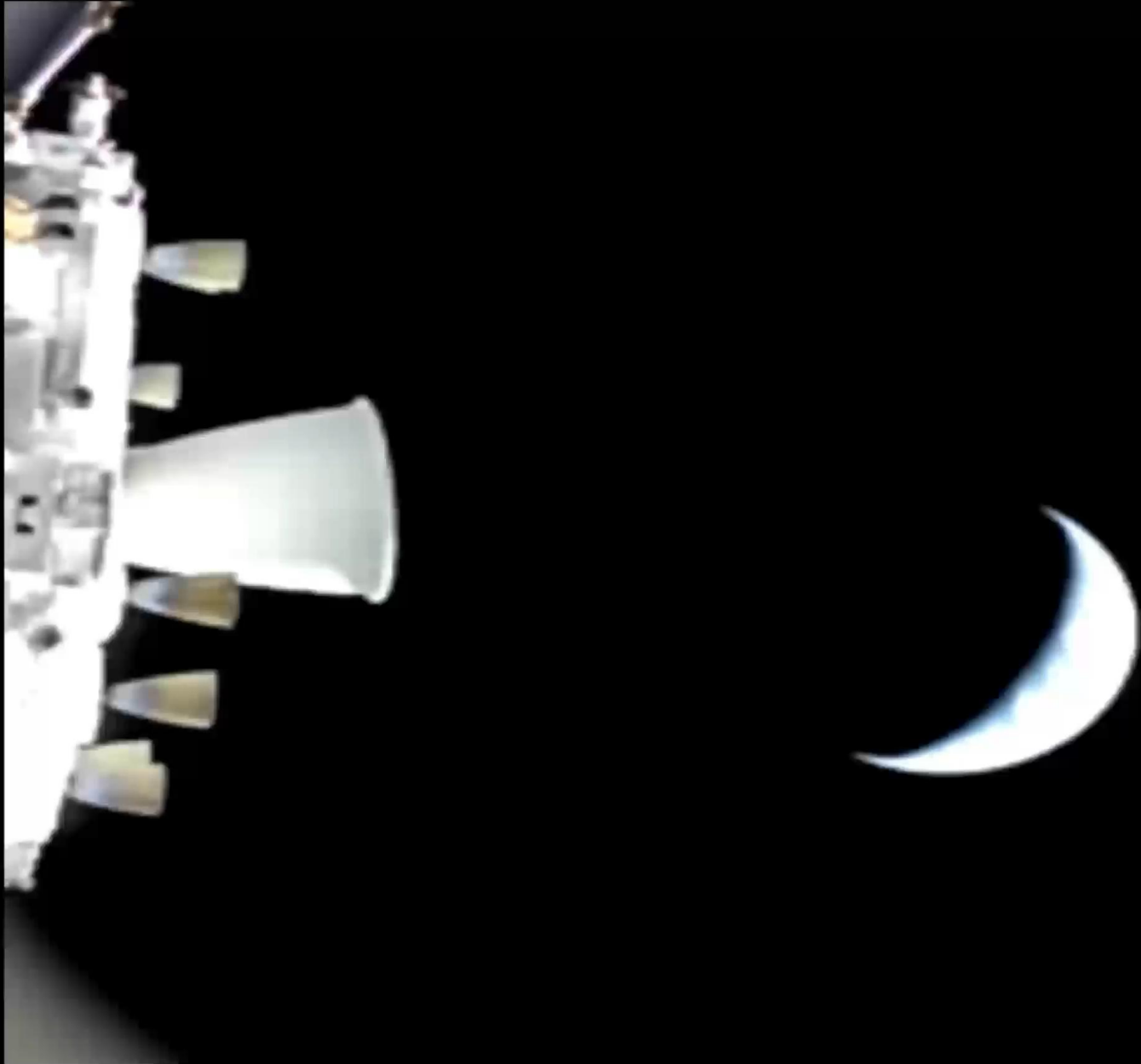


Mission launched April 1 2026





S-band radio



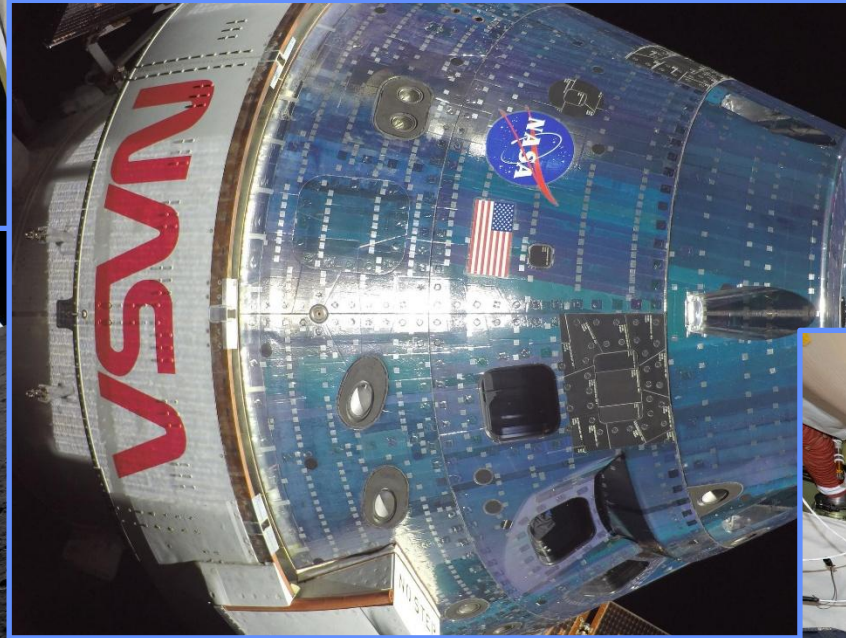
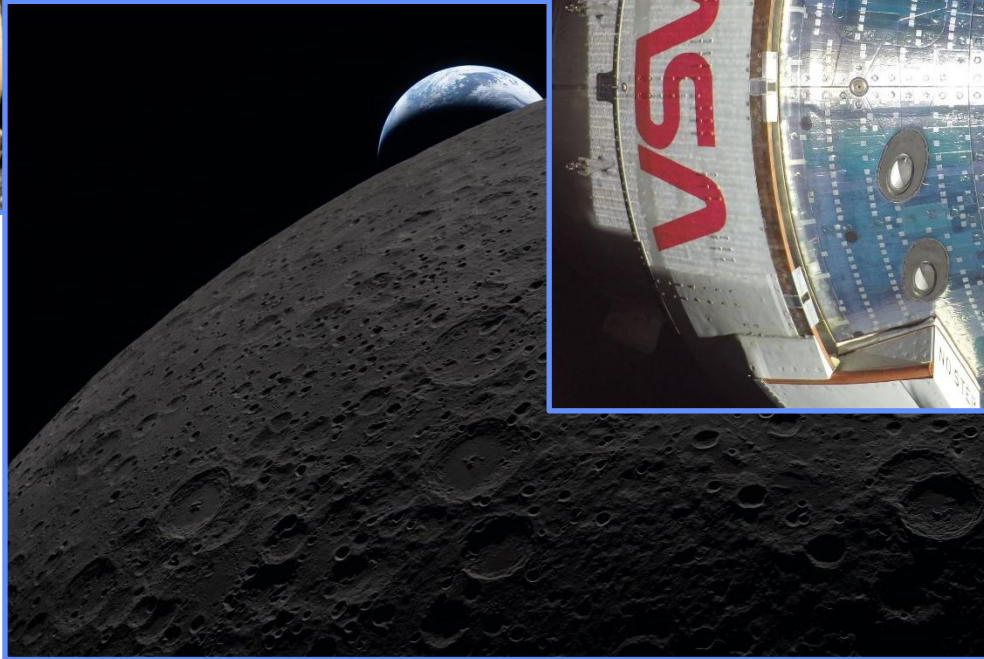


O2O Ground Terminal NASA White Sands Complex (WSC)





Artemis 2 Images and Videos Downloaded by the Lasercom Downlink



- **Artemis II demonstrated the operational utility of lasercom**
 - 474 GB downloaded data
 - >20,000 images
 - Real-time high-definition videos
 - Operated through thin clouds, low elevations, crew exercise sessions, Orion maneuvers
- **Enabled public engagement with the mission**

