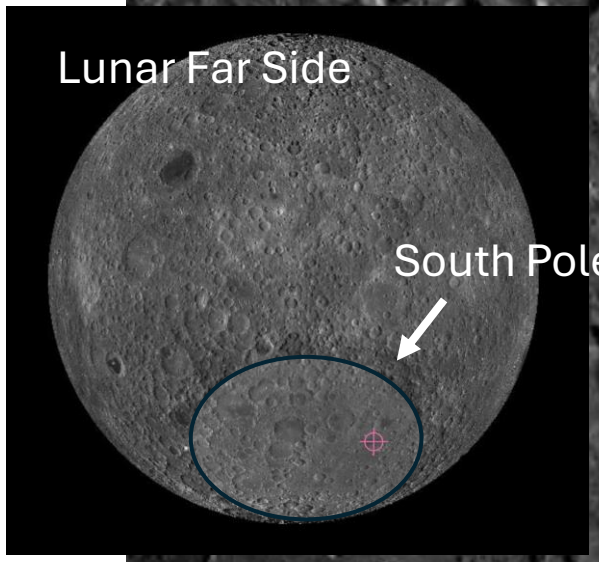

# Lunar Discovery and Exploration Program Update

## PAC

July 10, 2024

**Joel Kearns**
Deputy Associate Administrator for Exploration
Science Mission Directorate, NASA




Apollo Basin

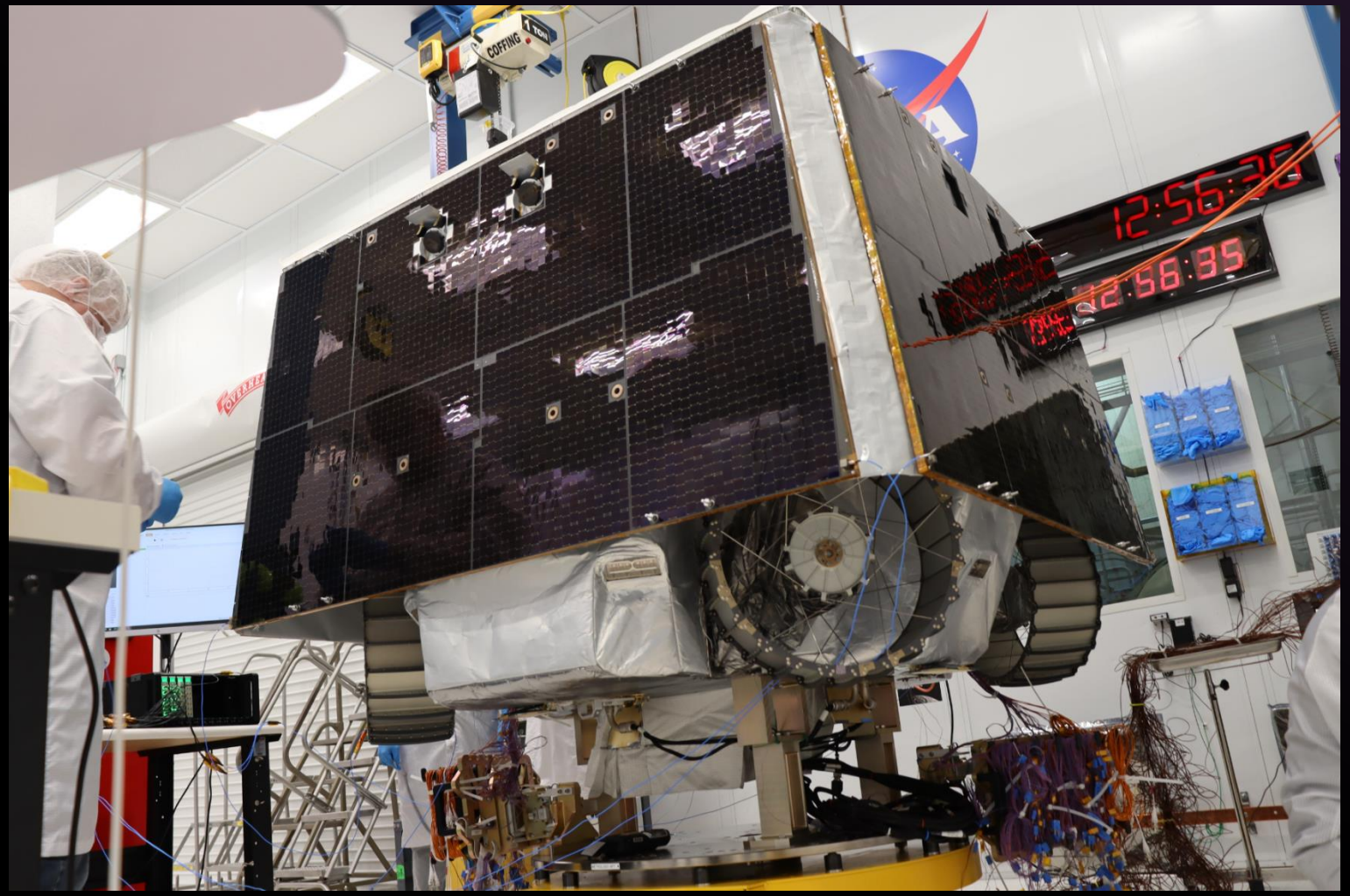

Technicians remove the samples collected on the moon's far side from the return capsule of the Chang'e 6 lunar mission. (Image credit: CCTV)

41.63º S, 153.99º W

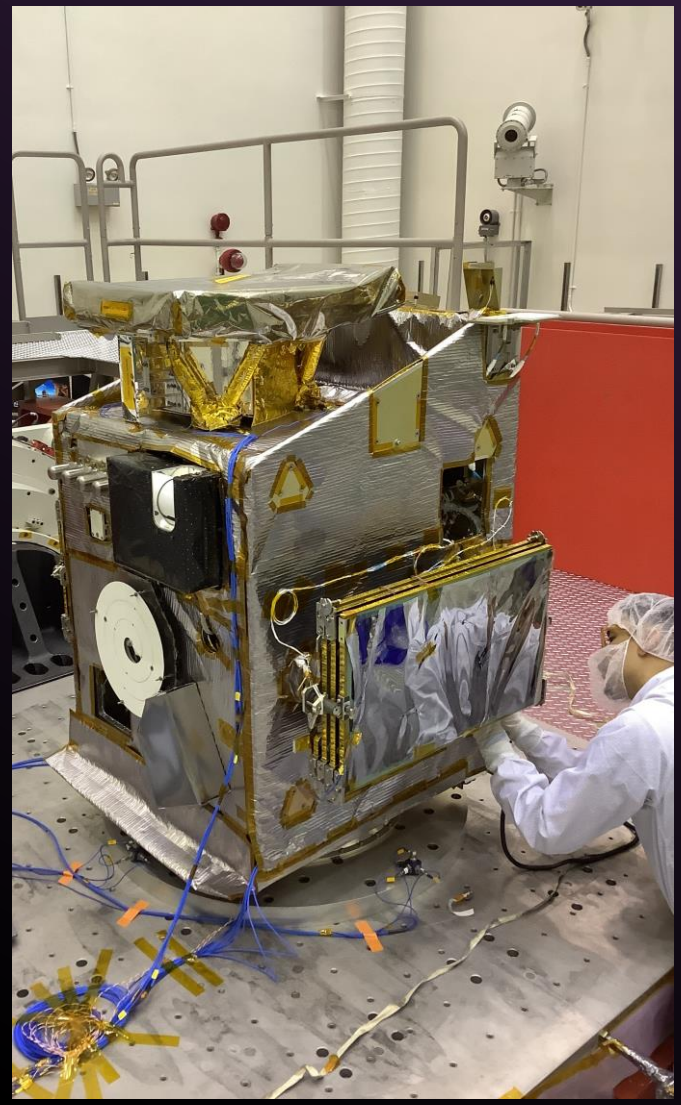
# Chang'e-6 Landing Site in Apollo Basin on the Far Side of the Moon

# LRO images Chang’e-6 lander

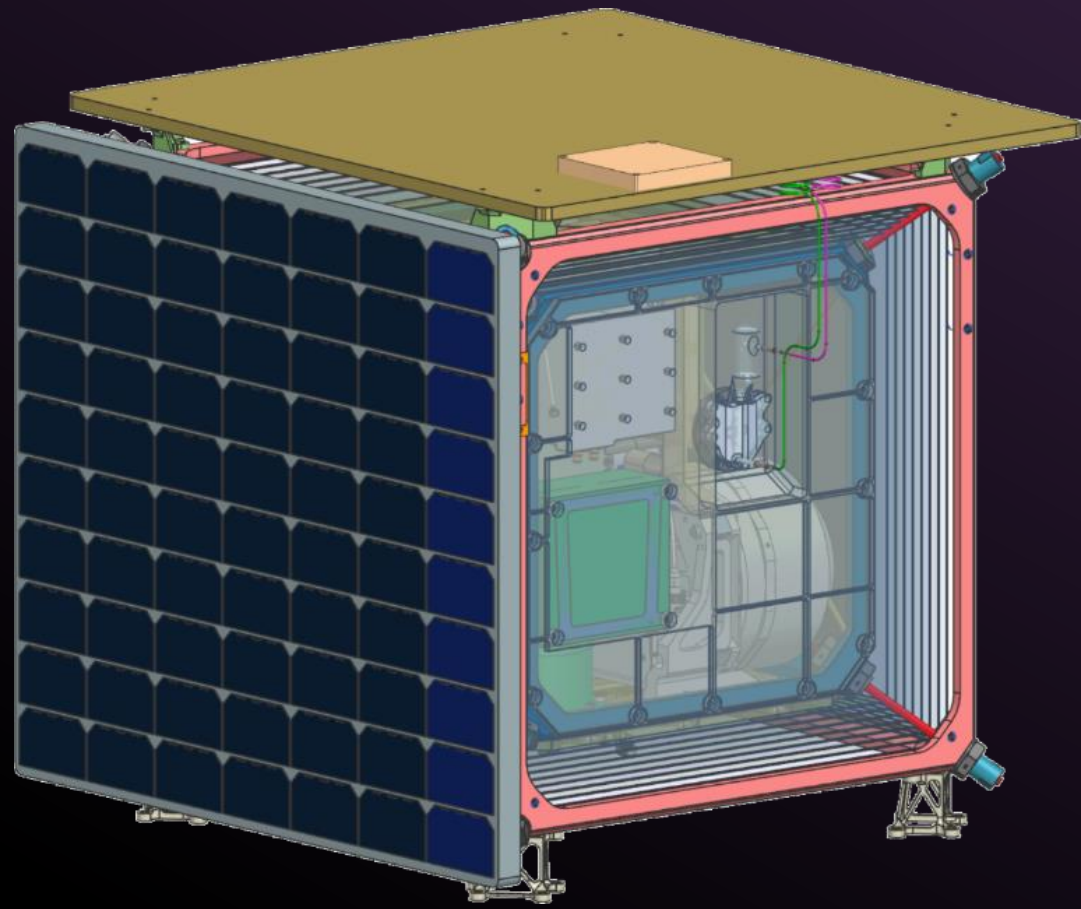
- NASA’s Lunar Reconnaissance Orbiter (LRO) imaged China’s Chang'e 6 sample return spacecraft on the far side of the Moon on June 7.  LRO acquired the image showing the Chang'e 6 lander on the rim of an eroded, 50-meter-diameter crater.
- The Chang'e 6 landing site is situated toward the southern edge of the Apollo basin (about 306 miles or 492 km in diameter, centered at 36.1 degrees south latitude, 208.3 degrees east longitude). Basaltic lava erupted south of Chaffee S crater about 3.1 billion years ago and flowed downhill to the west until it encountered a local topographic high, likely related to a fault. Several wrinkle ridges in this region have deformed and raised the mare surface. The landing site sits about halfway between two of these prominent ridges. This basaltic flow also overlaps a slightly older flow (about 3.3 billion years old), visible further west, but the younger flow is distinct because it has higher iron oxide and titanium dioxide abundances.




VIPER Flight Rover – completed assembly (June 2024)



Lunar Trailblazer - on the vibration table (January 2024)



FSS Assembled (March 2024)
Hardware Readiness Certification Review held June 11 at JPL

Competitions:

- Artemis III Deployed Instruments (A3DI) announced
  - **Lunar Environment Monitoring Station** (LEMS)
    - *PI: Mehdi Benna, University of Maryland*
  - **Lunar Dielectric Analyzer** (LDA)
    - *PI: Hideaki Miyamoto, University of Tokyo*
  - **Lunar Effects on Agricultural Flora** (LEAF)
    - *PI: Christine Escobar, Space Lab Technologies LLC*

Upcoming Competitions:

- PRISM Stand Alone Site Agnostic (SALSA) instruments call
  - Draft call for community comment July 2024
- Planning: A4DI call
- Planning: LTV instruments call
- Planning: PRISM4 call
- Planning: A4 Hand-Held Instruments RFP

# CLPS Task Order – PRIME1


## *Mission Details*

- *Lander Provider*: Intuitive Machines, Nova-C
- *Landing Date:* **Q4 2024**
- *Landing Site:* Shackleton Connecting Ridge, South pole

## *Manifest*

- **STMD PRIME-1** Polar Resources Ice Mining Experiment - 1
  - ***TRIDENT*** *Drill (Honeybee Robotics)*
  - ***MSolo*** *Mass spectrometer (NASA KSC)*
- NASA STMD Tipping Points
  - *Deployable* ***μ-Nova Hopper*** *(IM & Arizona State)*
  - *LTE/4G Communication System* ***Nokia Rover*** *on a Lunar Outpost Rover*

## *Science Goals*

- **Lunar In-situ Resources – Surface and subsurface Volatiles/Water**
- **In-situ temperature measurements, sun-lit and permanently shadowed**

## *Technology Goals*

- **Drilling capabilities to 1-m depth**
- **Hopper mobility, including into a Permanently Shadowed Region (PSR)**
- **Broadband Communications Node on the rover**

***IM-2 Mission***

**South Pole region**

**Shackleton Connecting Ridge**

# CLPS Task Order – 19D

## *NASA Manifest*

- Next Generation Lunar Retroreflector (NGLR)
- Radiation Tolerant Computer System (RadPC)
- Regolith Adherence Characterization (RAC)
- Lunar Magnetotelluric Sounder (LMS)
- Lunar Environment heliospheric X-ray Imager (LEXI)
- Lunar PlanetVac (LPV)
- Lunar Instrumentation for Subsurface Thermal Exploration with Rapidity (LISTER)
- Stereo Cameras for Lunar Plume Surface Studies (SCALPSS)
- Electrodynamic Dust Shield (EDS)
- Lunar GNSS Receiver Experiment (LuGRE)

## *Mission Details*

- *Lander Provider*: Firefly Aerospace/ Blue Ghost
- *Landing Date:* **4Q 2024**
- *Landing Site:* Mare Crisium

## *Science Goals*

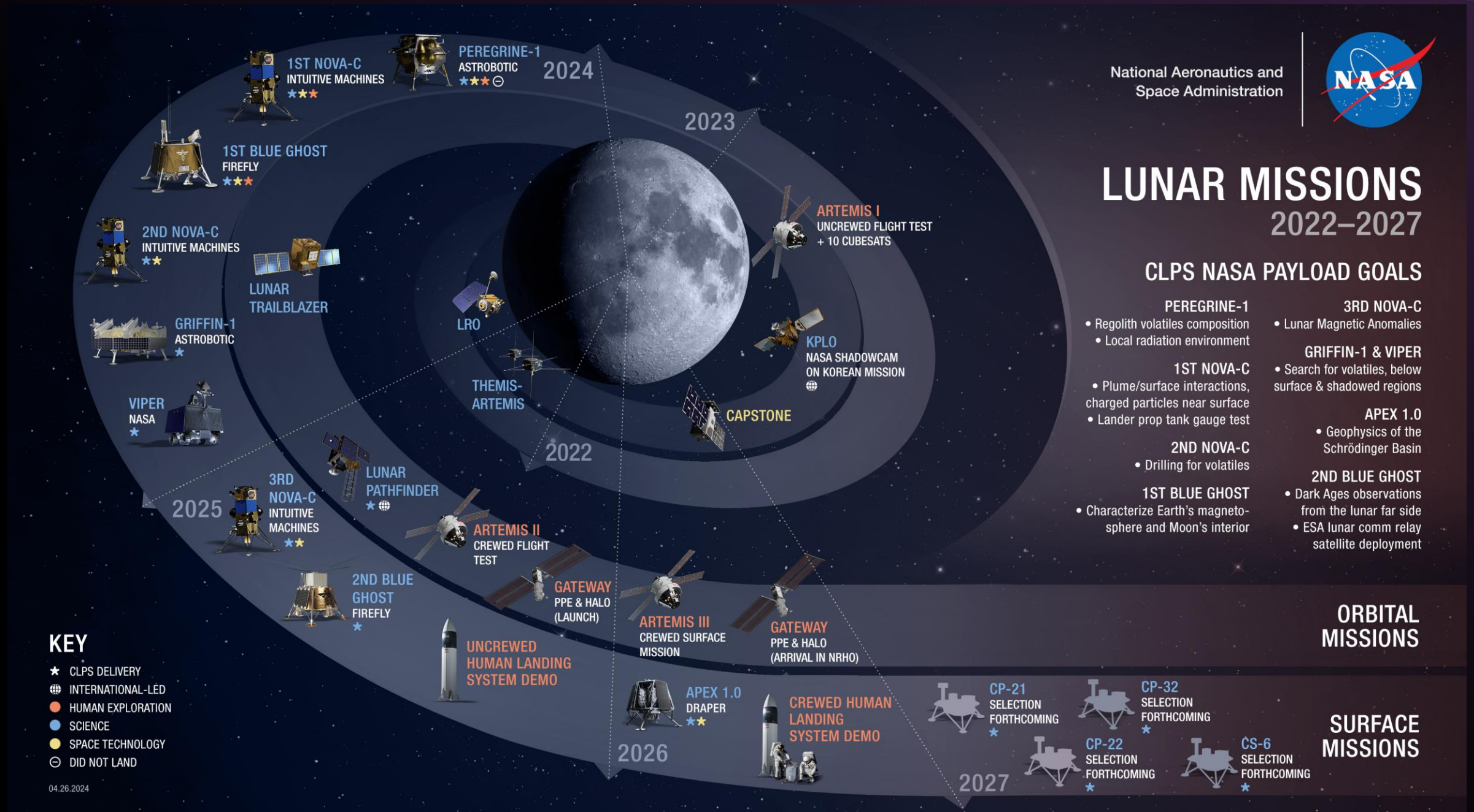
- **Lunar fiducial markers**
- **Test dust adherence on different materials and dust mitigation using electrodynamic fields**
- **Investigate the heat flow of the lunar interior**
- **Study plume-surface interactions**
- **Acquire X-ray images of Earth's magnetosphere**
- **Constrain temperature structure and thermal evolution by studying crustal electric and magnetic fields**

## *Technology goals*

- **Test a radiation tolerant computer system**
- **Investigate the first use of GNSS (Global Navigation Satellite System) in transit to and on the lunar surface**
- **Test regolith sampling technologies**

FIREFLY AEROSPACE

***Mission: BGM1***
**Mare Crisium**


National Aeronautics and Space Administration
NASA
LUNAR MISSIONS
2022–2027
CLPS NASA PAYLOAD GOALS
PEREGRINE-1
• Regolith volatiles composition
• Local radiation environment
1ST NOVA-C
• Plume/surface interactions, charged particles near surface
• Lander prop tank gauge test
2ND NOVA-C
• Drilling for volatiles
1ST BLUE GHOST
• Characterize Earth's magneto-sphere and Moon's interior
3RD NOVA-C
• Lunar Magnetic Anomalies
GRIFFIN-1 & VIPER
• Search for volatiles, below surface & shadowed regions
APEX 1.0
• Geophysics of the Schrödinger Basin
2ND BLUE GHOST
• Dark Ages observations from the lunar far side
• ESA lunar comm relay satellite deployment
2024
2023
2022
2025
2026
2027
1ST NOVA-C
INTUITIVE MACHINES
PEREGRINE-1
ASTROBOTIC
1ST BLUE GHOST
FIREFLY
2ND NOVA-C
INTUITIVE MACHINES
LUNAR TRAILBLAZER
GRIFFIN-1
ASTROBOTIC
VIPER
NASA
3RD NOVA-C
INTUITIVE MACHINES
LUNAR PATHFINDER
2ND BLUE GHOST
FIREFLY
LRO
THEMIS-ARTEMIS
ARTEMIS I
UNCREWED FLIGHT TEST + 10 CUBESATS
KPLO
NASA SHADOWCAM ON KOREAN MISSION
CAPSTONE
ARTEMIS II
CREWED FLIGHT TEST
GATEWAY
PPE & HALO (LAUNCH)
UNCREWED HUMAN LANDING SYSTEM DEMO
ARTEMIS III
CREWED SURFACE MISSION
GATEWAY
PPE & HALO (ARRIVAL IN NRHO)
APEX 1.0
DRAPER
CREWED HUMAN LANDING SYSTEM DEMO
ORBITAL MISSIONS
CP-21
SELECTION FORTHCOMING
CP-32
SELECTION FORTHCOMING
CP-22
SELECTION FORTHCOMING
CS-6
SELECTION FORTHCOMING
SURFACE MISSIONS
KEY
CLPS DELIVERY
INTERNATIONAL-LED
HUMAN EXPLORATION
SCIENCE
SPACE TECHNOLOGY
DID NOT LAND
04.26.2024


NASA
EXPLORE MOON to MARS
MOON LIGHTS THE WAY