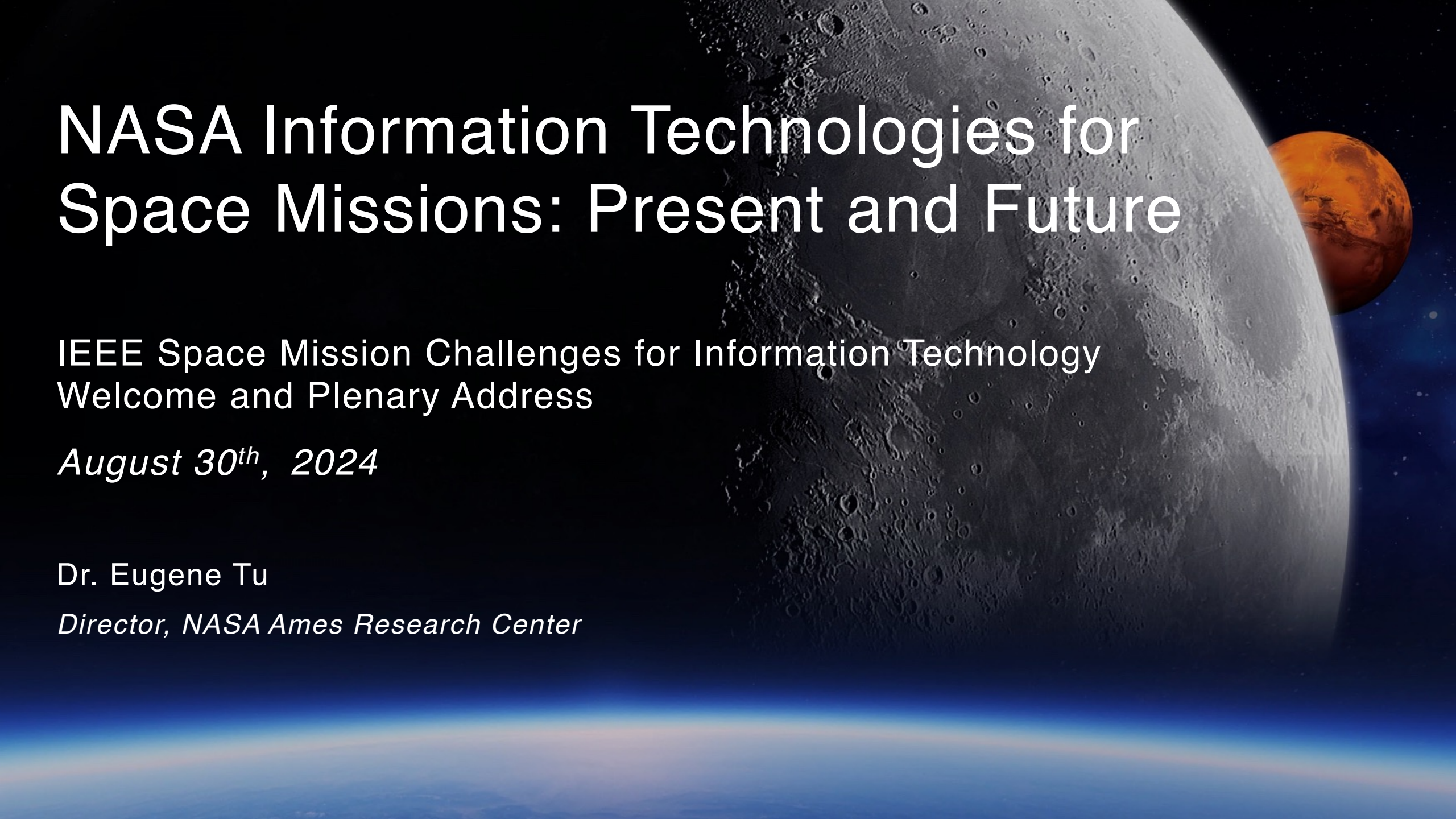


NASA Information Technologies for Space Missions: Present and Future

IEEE Space Mission Challenges for Information Technology
Welcome and Plenary Address

August 30th, 2024

Dr. Eugene Tu

Director, NASA Ames Research Center

What Does NASA Do?

Aeronautics Research







Transform Aviation through R&D

Space Operations





Launch and Space Operations

Deep Space Exploration Sys.









Moon to Mars Exploration

Science





Understand the Sun, Earth, and Universe

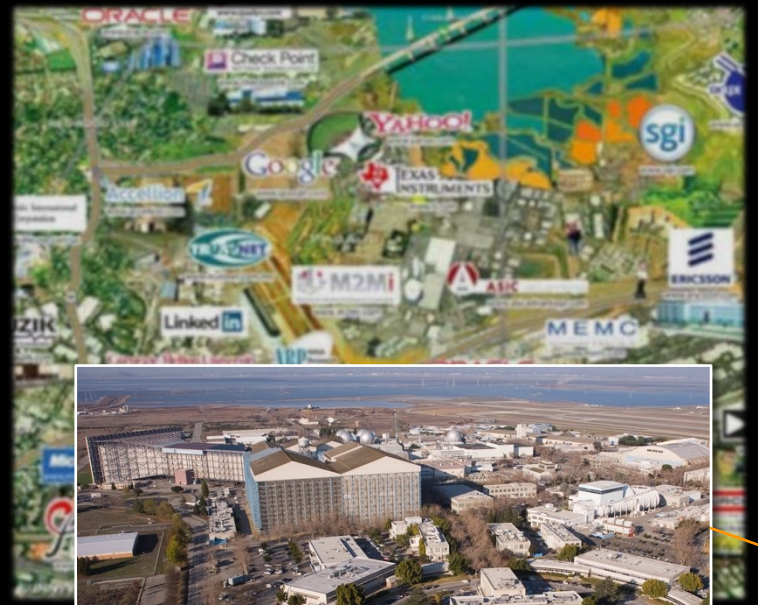
Space Technology





Develop and transfer revolutionary technologies

NASA Centers



Ames Research Center



Glenn Research Center



HQ



Goddard Space Flight Center



Langley Research Center



Marshall Space Flight Center



Armstrong Flight Research Center



Jet Propulsion Laboratory



Johnson Space Center



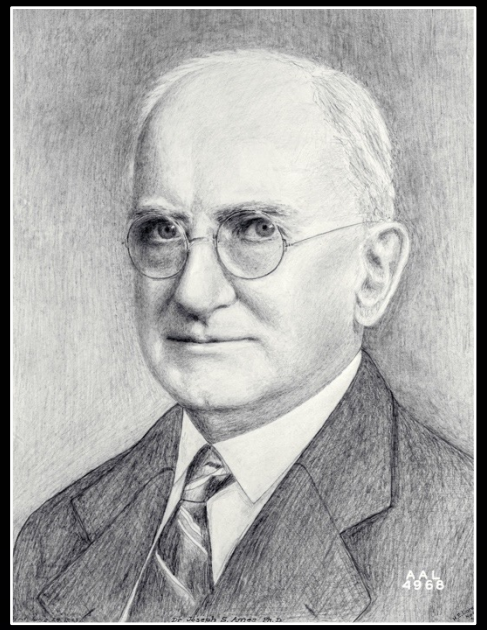
Stennis Space Center

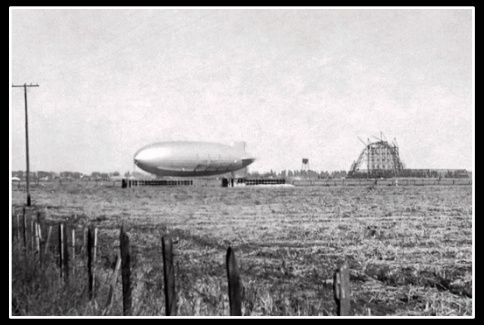


Kennedy Space Center

Ames Aeronautical Laboratory

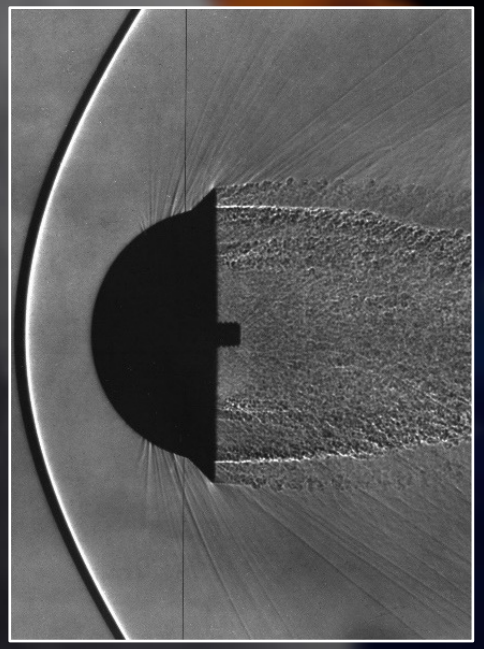
NACA's Second Laboratory

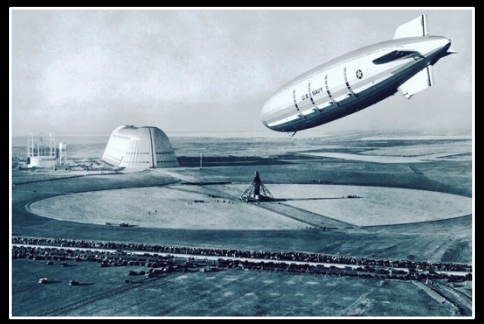


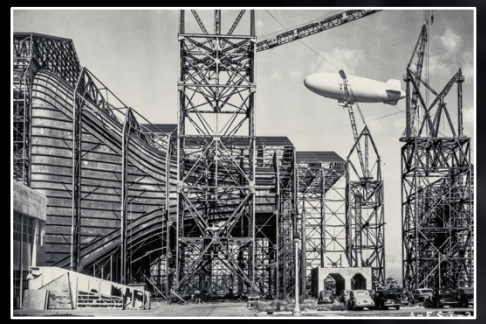










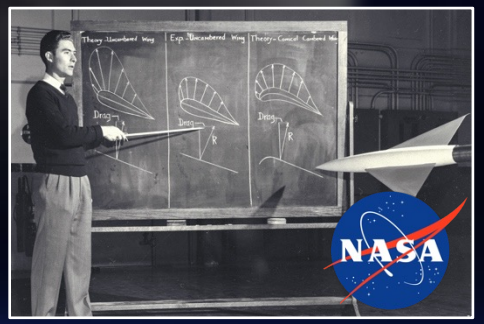












1915 1917 1939 1941 1946 1958

"Langley Memorial Aeronautical Laboratory"
Langley Research Center (LaRC)

"Ames Aeronautical Laboratory"
Ames Research Center (ARC)

"Aircraft Engine Research Laboratory"
Glenn Research Center (GRC)

"Muroc Flight Test Unit"
Armstrong Flight Research Center (AFRC)

Ames Today



Occupants (FY23)

~1,300 civil servants; ~1,900 on-site contractors
~5,800 NRP workforce
~700 students (OSTEM, Pathway, NRP(CMU) & Chabot SCC)

Real Property

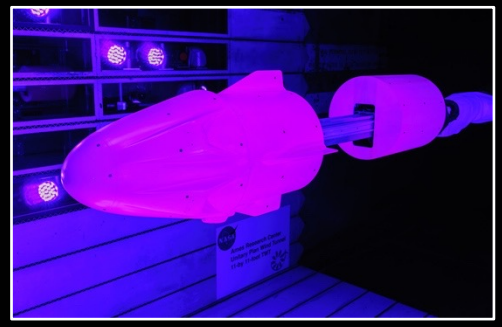
~1,900 acres; 400 acres security perimeter
5M building ft²
Airfield with ~9,000 and 8,000 ft. runways

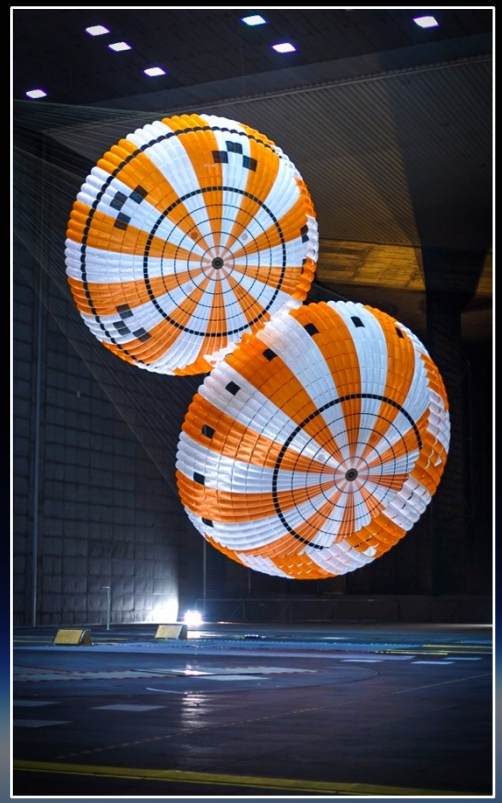
Budget (FY23)

~$1B (includes reimbursable/EUL)

Major Research Facilities

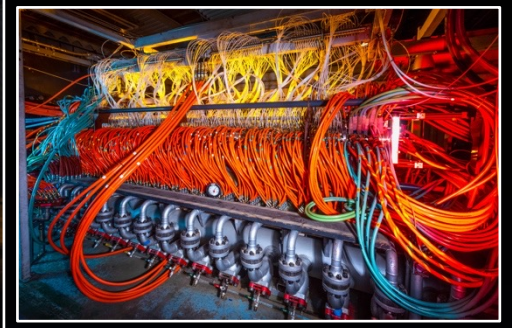
Wind Tunnels





Arc Jet Complex







Simulators







Supercomputing







Laboratories





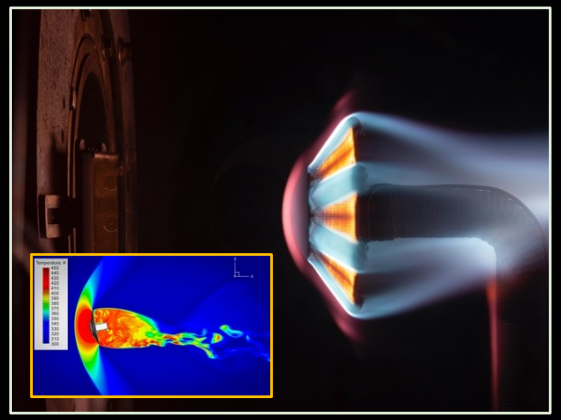


Core Competencies

Air Traffic Management



Entry Systems



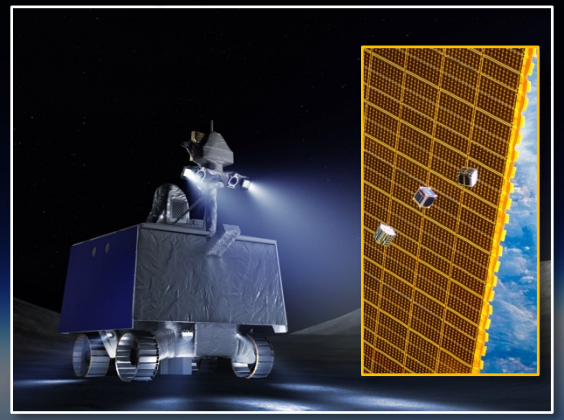
Advanced Computing & IT



Intelligent / Adaptive Systems



Cost-Effective Space Missions



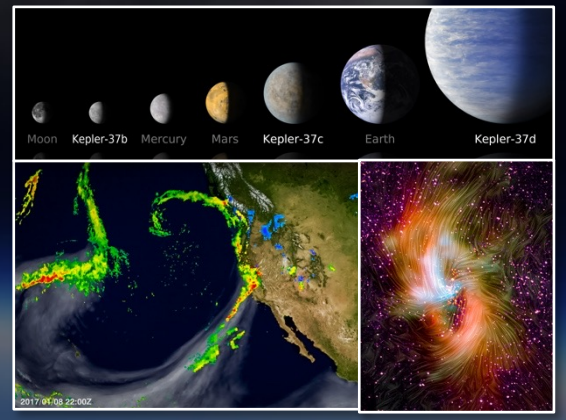
Aerosciences



Astrobiology & Life Science



Space & Earth Sciences



Modeling & Simulation – Critical to Vehicle Design and Mission Analysis

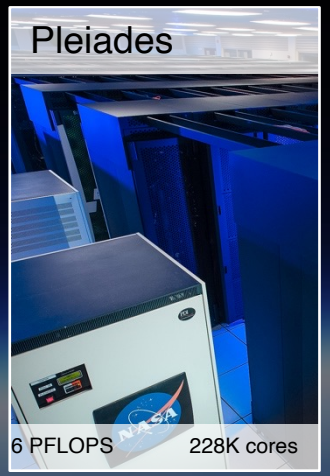
Launch Abort
Orion



Passive particles seeded at nozzle exit and vehicle surface colored by pressure for a simulation of the Orion launch abort system during a low altitude high angle of attack transonic abort scenario.

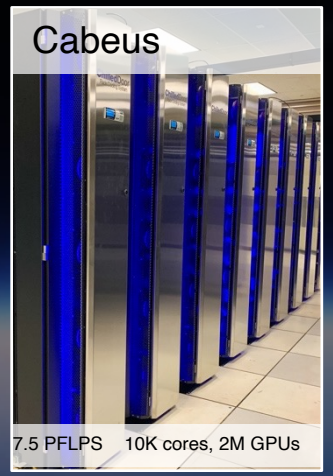
high

low







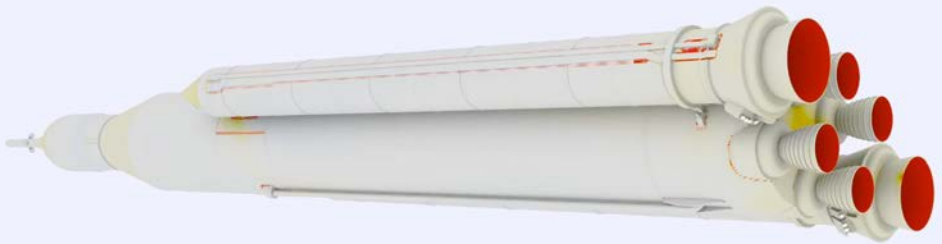


Multiphase launch environment simulation of SLS during take-off at KSC Pad 39-A.



Launch Environment
Space Launch Vehicle

Particle traces colored in time during SLS Stage Separation even



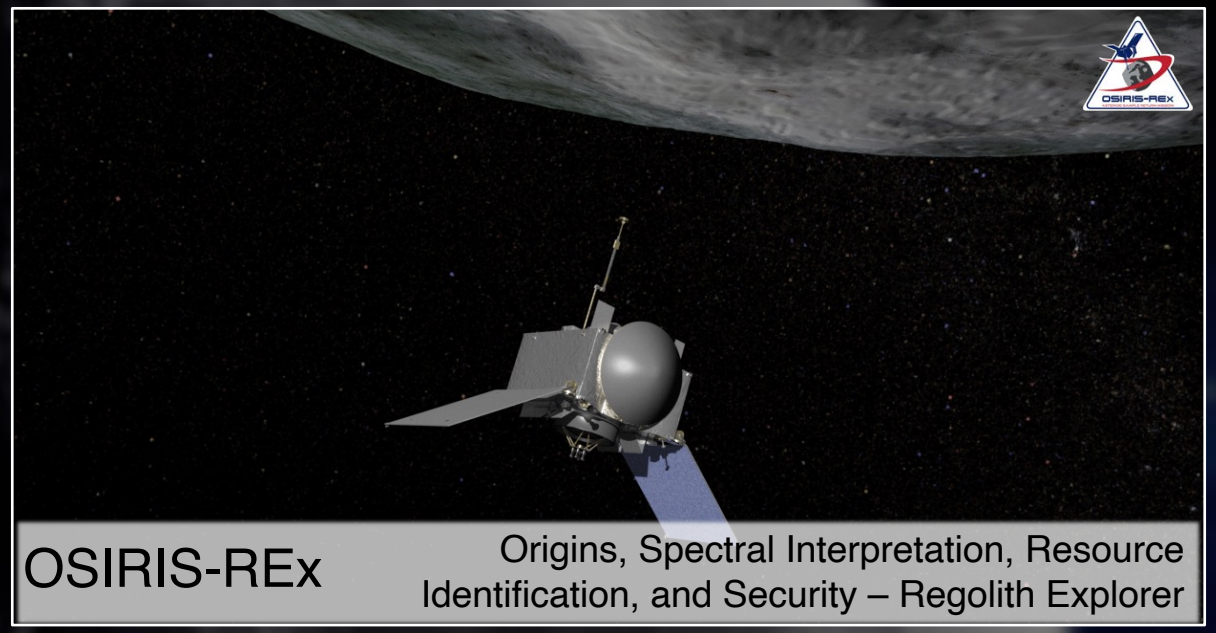
SRB Separation
Space Launch Vehicle

0 ' 0 "

Autonomy – Critical to Mission Success



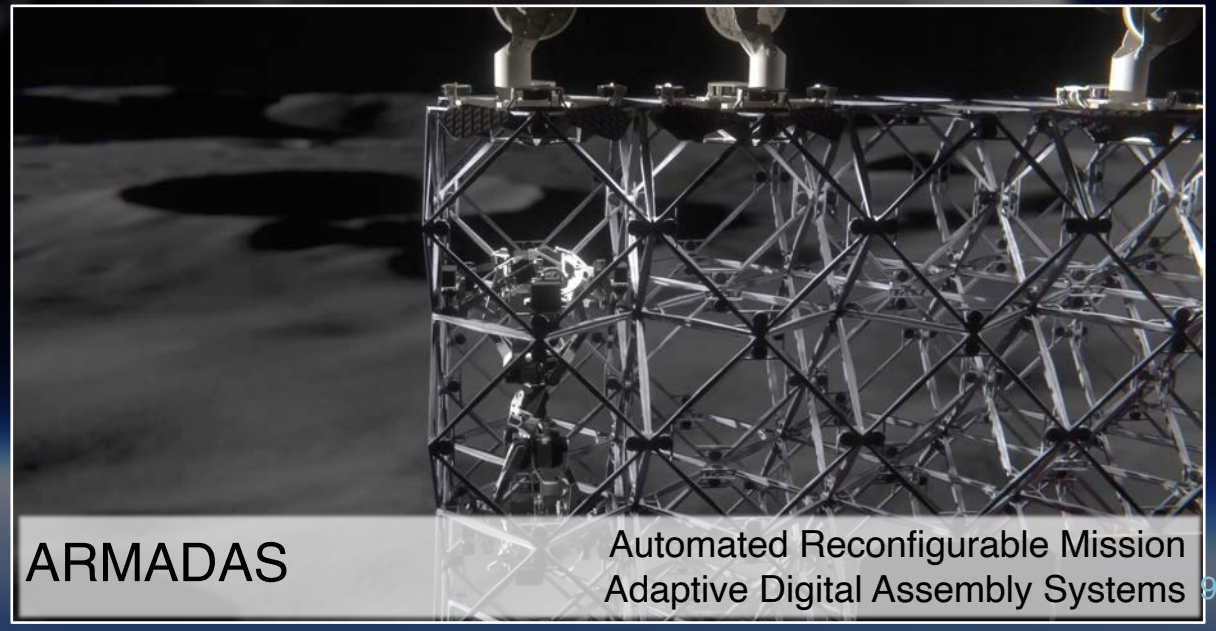
“Ingenuity” and “Perseverance” Teaming Up



OSIRIS-REx — Origins, Spectral Interpretation, Resource Identification, and Security – Regolith Explorer



Astrobee — Robotic Teammates To Working Alongside Astronauts On The ISS

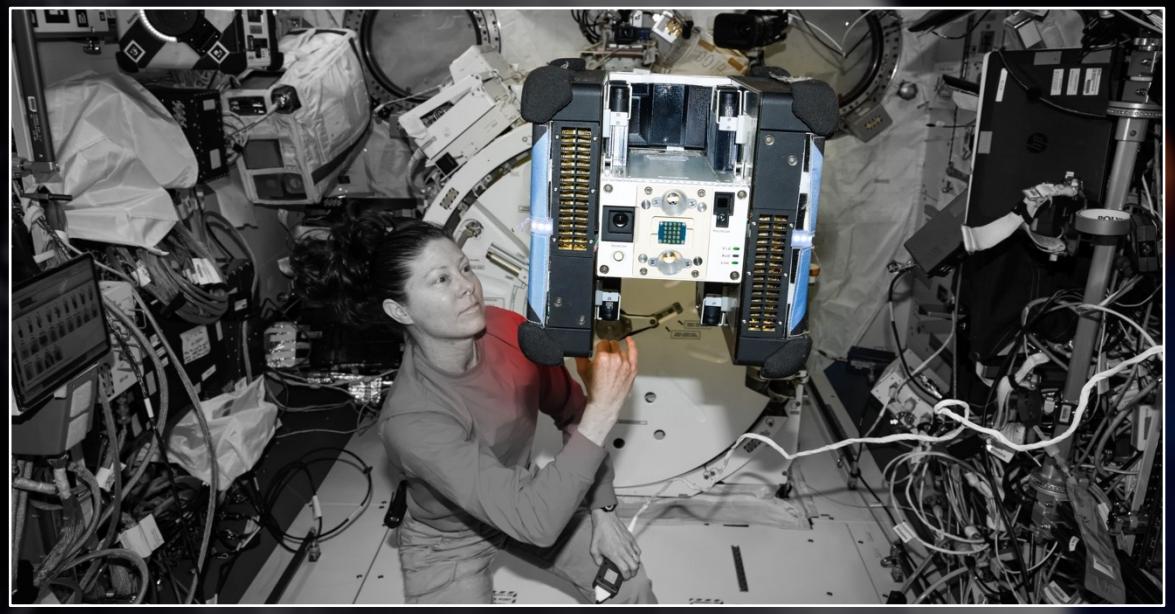


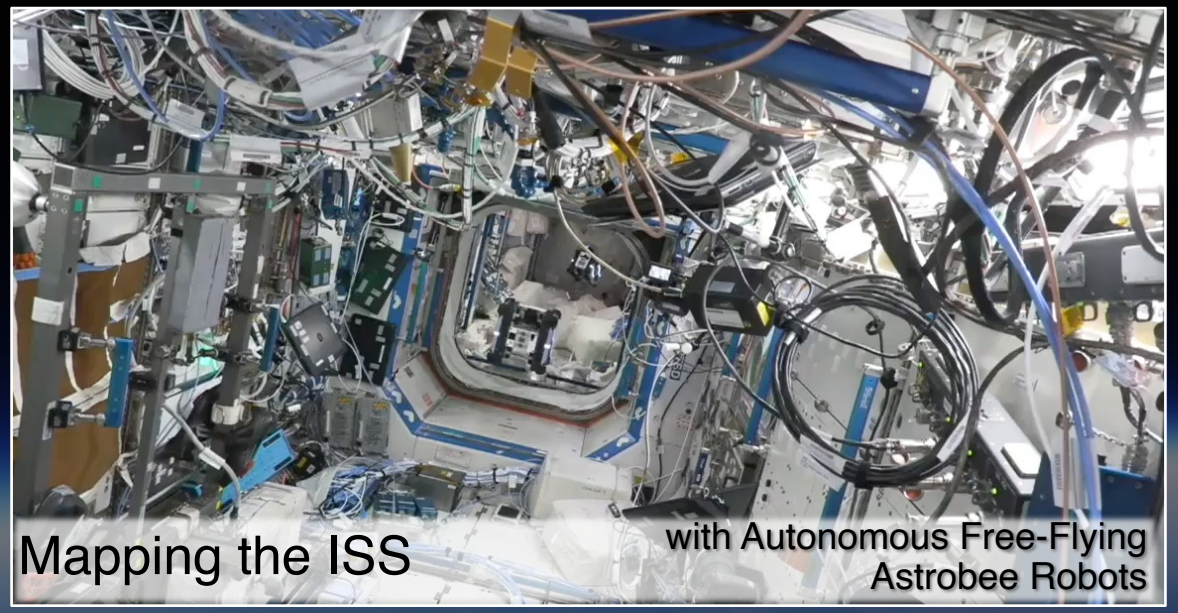
ARMADAS — Automated Reconfigurable Mission Adaptive Digital Assembly Systems

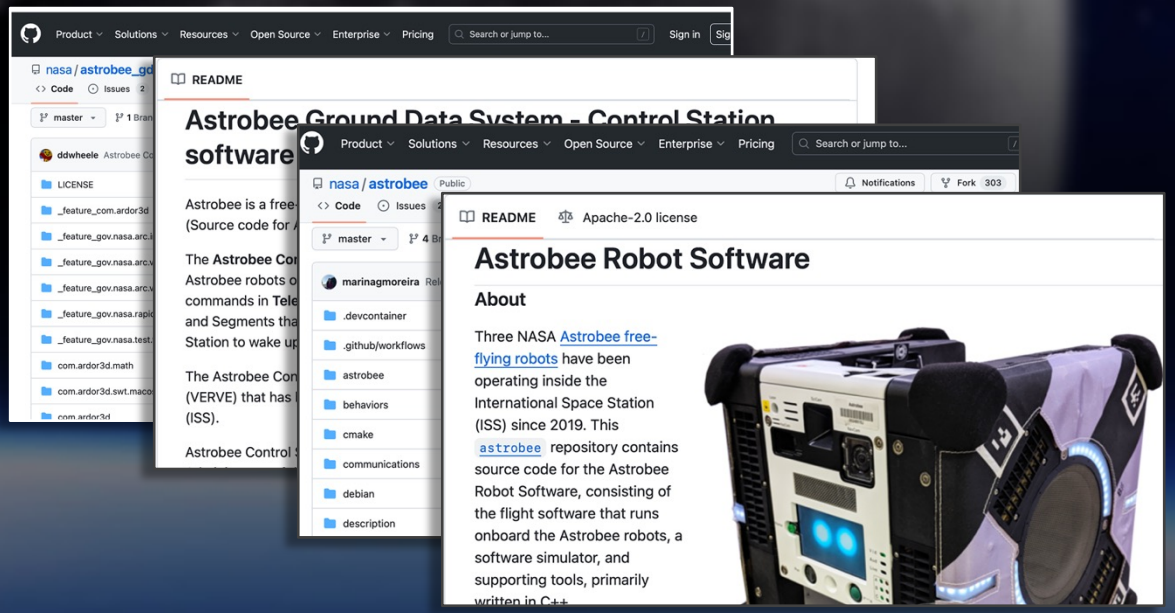
Astrobee

A free-flying robotic system helping with routine duties, leaving astronauts to focus more on high priority tasks only humans can do









Starling

Advancing The Readiness Of Various Technologies For Cooperative Groups Of Spacecraft – Also Known As Distributed Missions, Clusters, Or Swarms

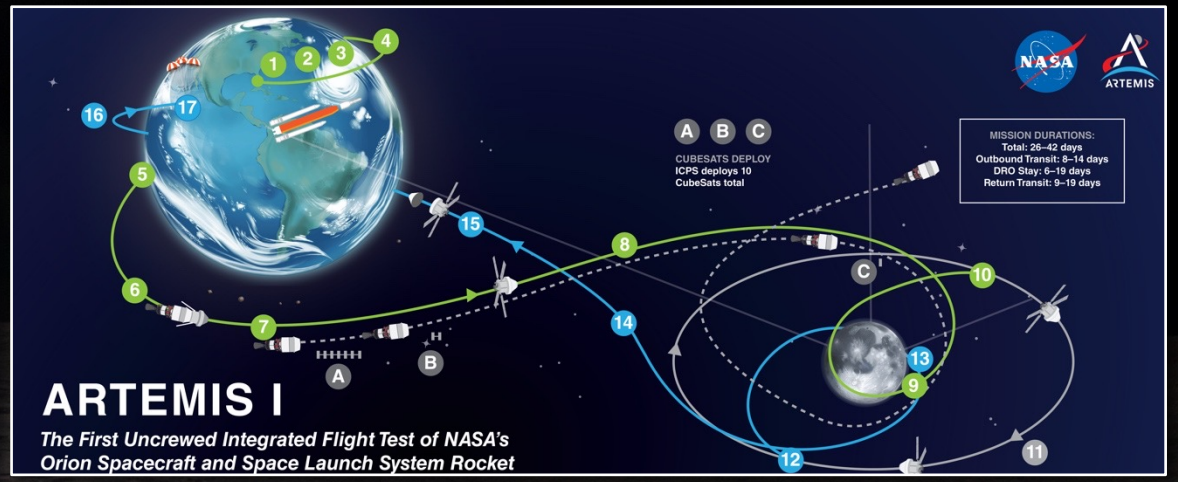


Artemis I – Back to the Moon


Sea of Tranquility (July 21, 1969)

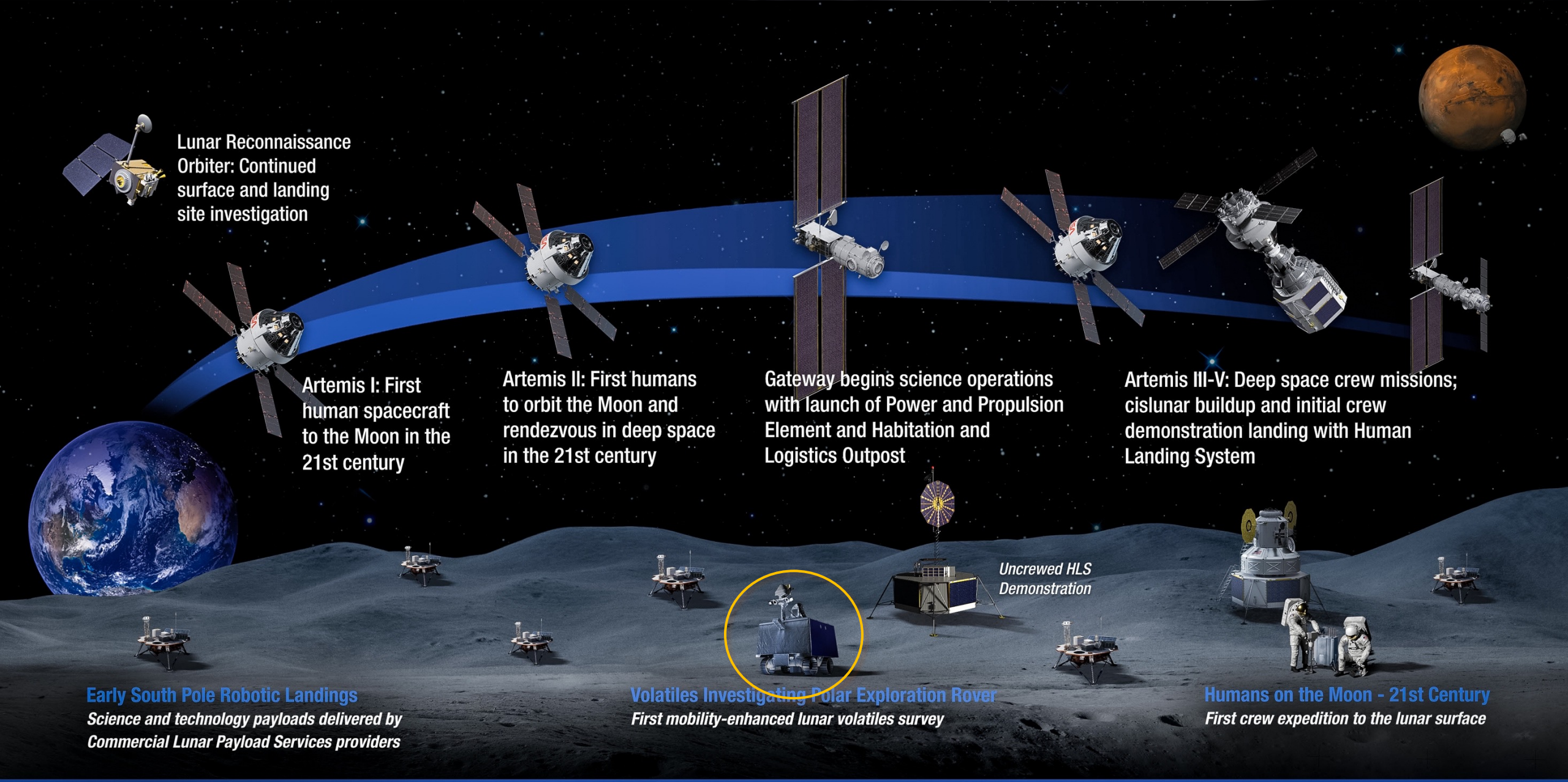

Pad 39A, KSC (July 16, 1969)


Mission Control, JSC
(July 24, 1969)



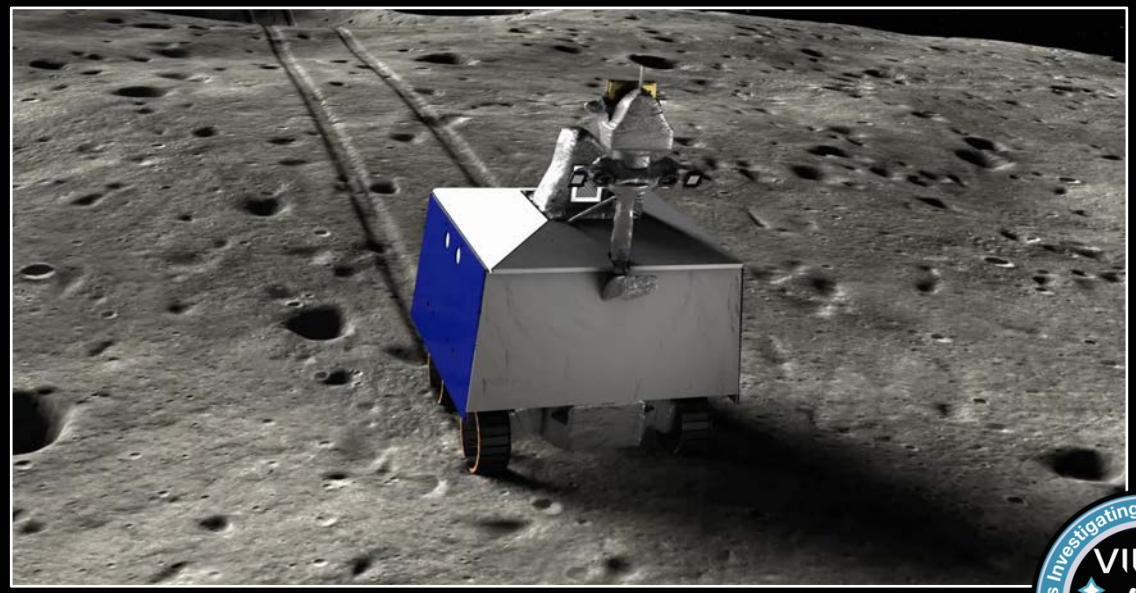


Launch Pad 39B, KSC
(August 29, 2022)

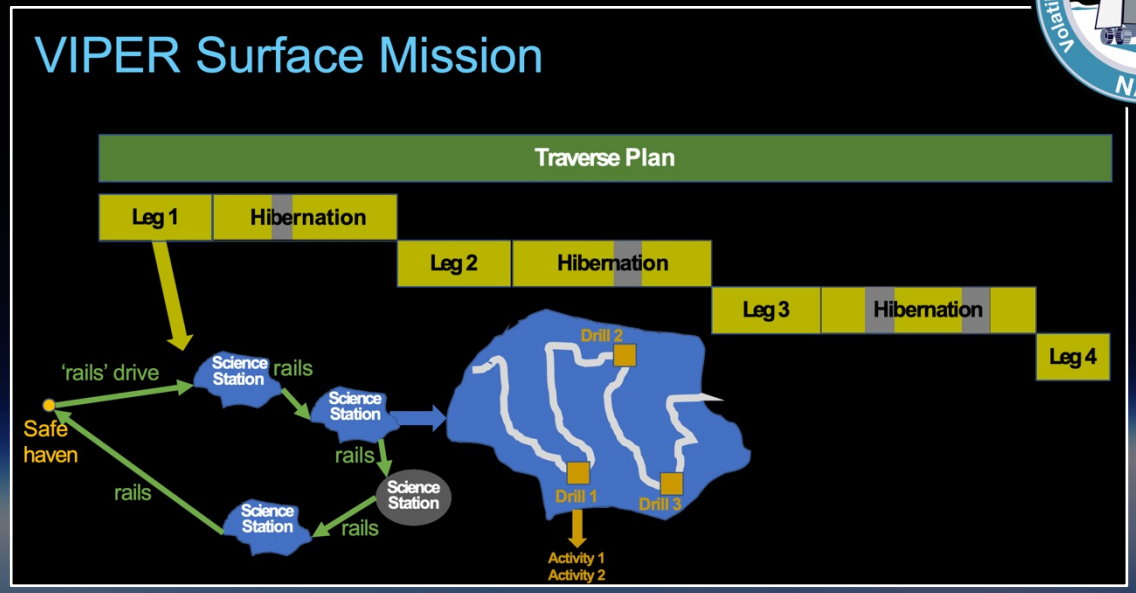


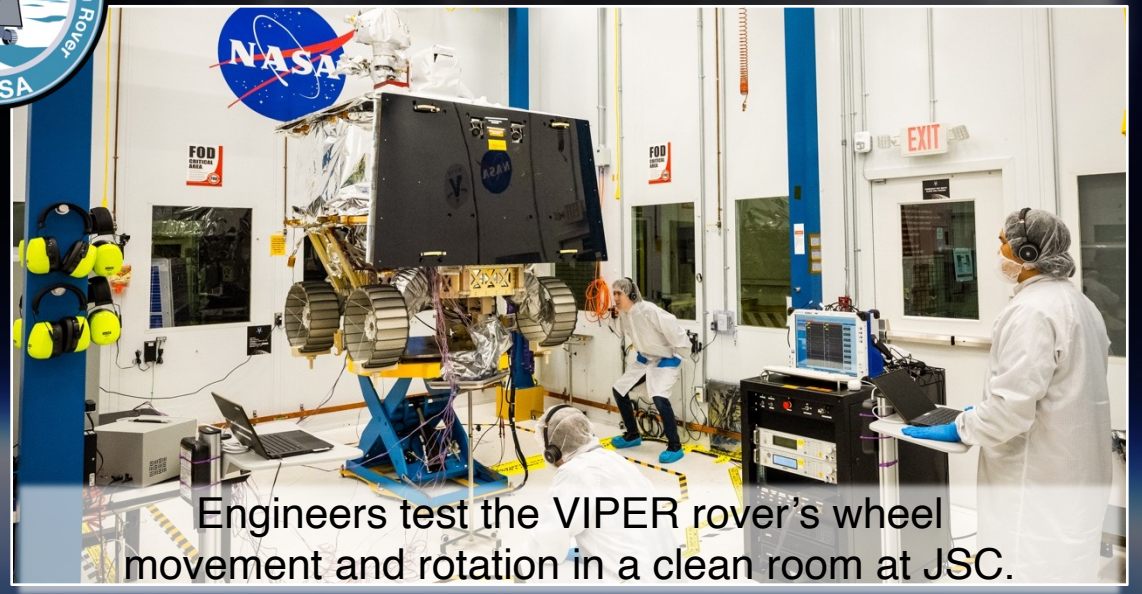
LUNAR SOUTH POLE TARGET SITE

Volatiles Investigating Polar Exploration Rover









Engineers test the VIPER rover's wheel movement and rotation in a clean room at JSC.



Mission Planning And Operation

SHERPA: System Health Enabled Realtime Planning Advisor

AEROSPACE ★★★ AMERICA

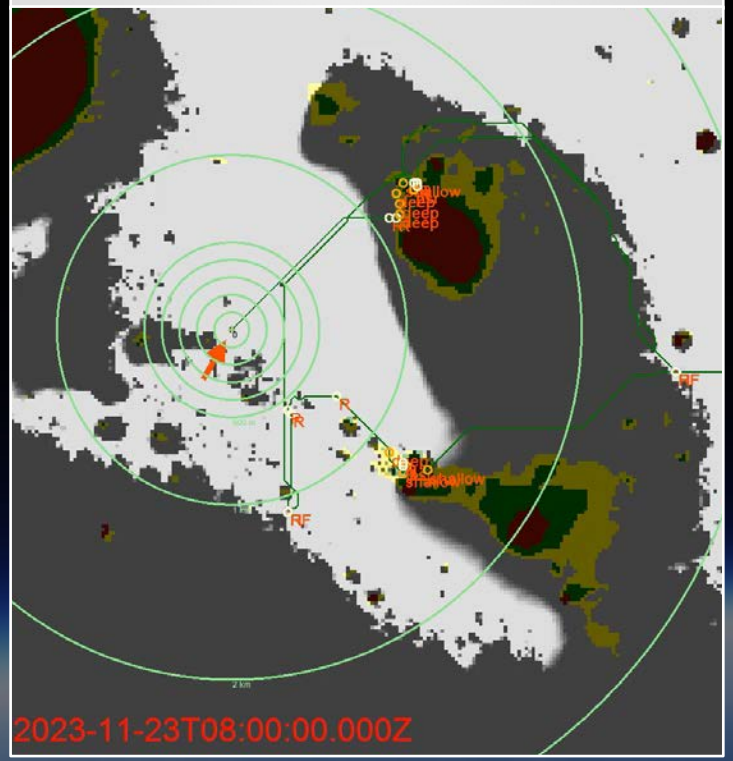
SEARCH | LOGIN | MENU

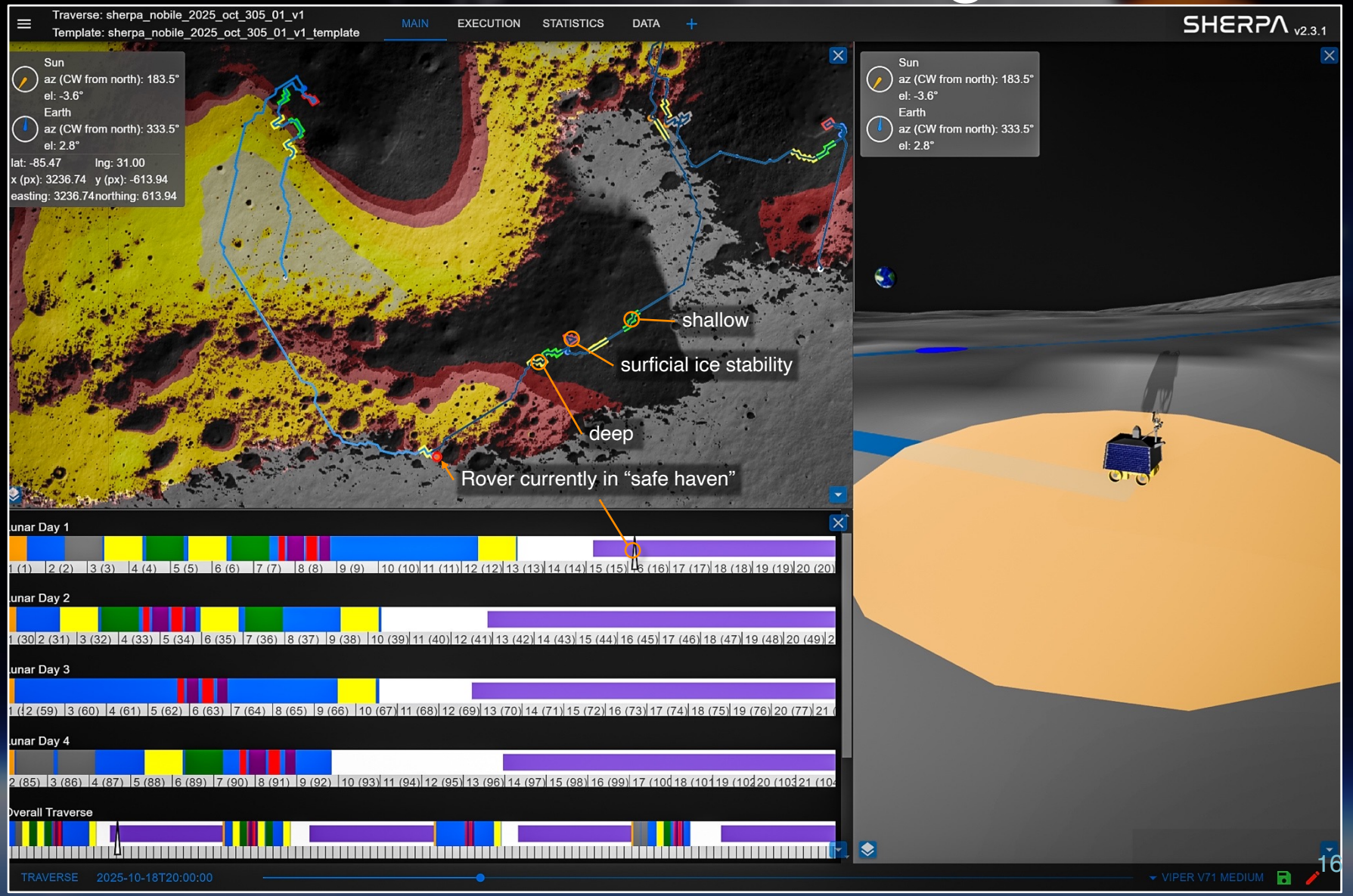
Engineering Notebook

VIPER's AI assistant

BY KEITH BUTTON | JUNE 2024

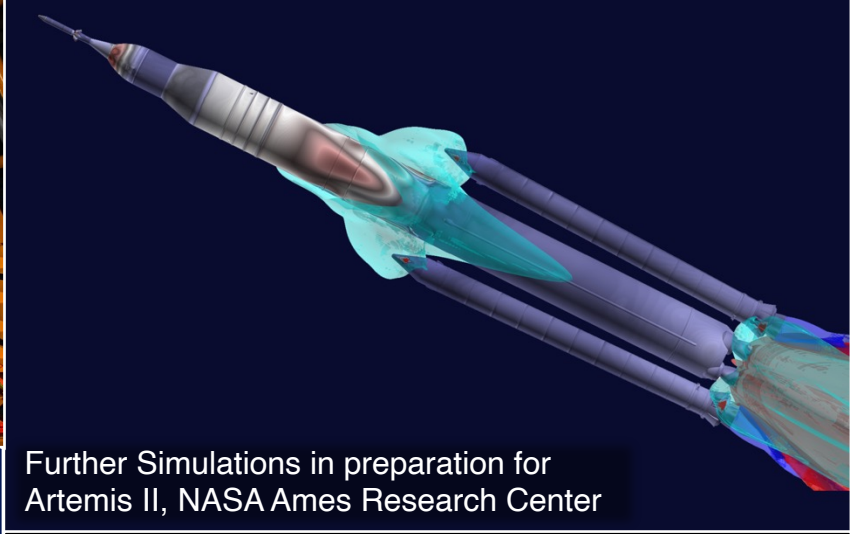
If NASA's VIPER rover safely arrives at the lunar south pole next year as planned, the race will be on to find water and hydrogen ice before the moon's winter stops the rover in its tracks. Pausing to debate each leg of its journey would be a terrible waste of time, so operators have turned to artificial intelligence. Keith Button has the story.











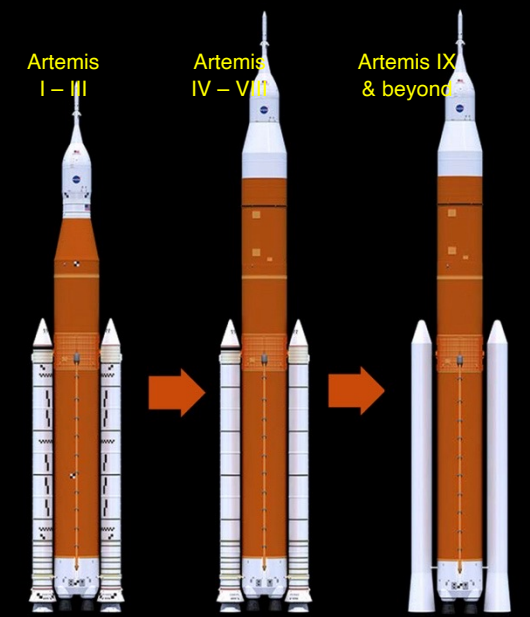


	Artemis I – III	Artemis IV – VIII	Artemis IX & beyond*
Payload to TLI/Moon	> 26 t (57k lbs)	34–37 t (74k–81k lbs)	> 45 t (99k lbs)
Payload Volume	N/A**	10,100 ft³ (286m³)**	10,100 ft³ (286m³)**
Maximum Thrust	8.8M lbs	8.8M lbs	11.9M lbs

Trans-Lunar Injection (TLI) is a propulsive maneuver used to set a spacecraft on a trajectory that will cause it to arrive at the Moon. A spacecraft performs **TLI** to begin a lunar transfer from a low circular parking orbit around Earth.

The numbers depicted here indicate the mass capability at the Trans-Lunar Injection point.

** Not including Orion/Service Module volume



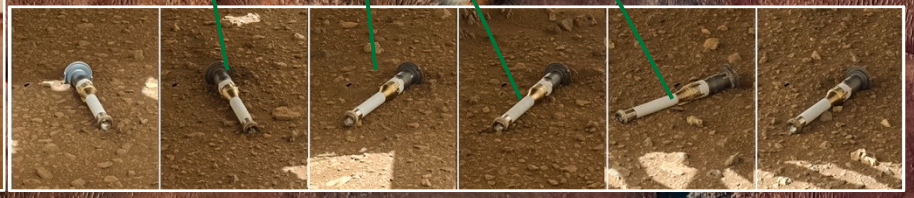
Mars Rover Sample Return



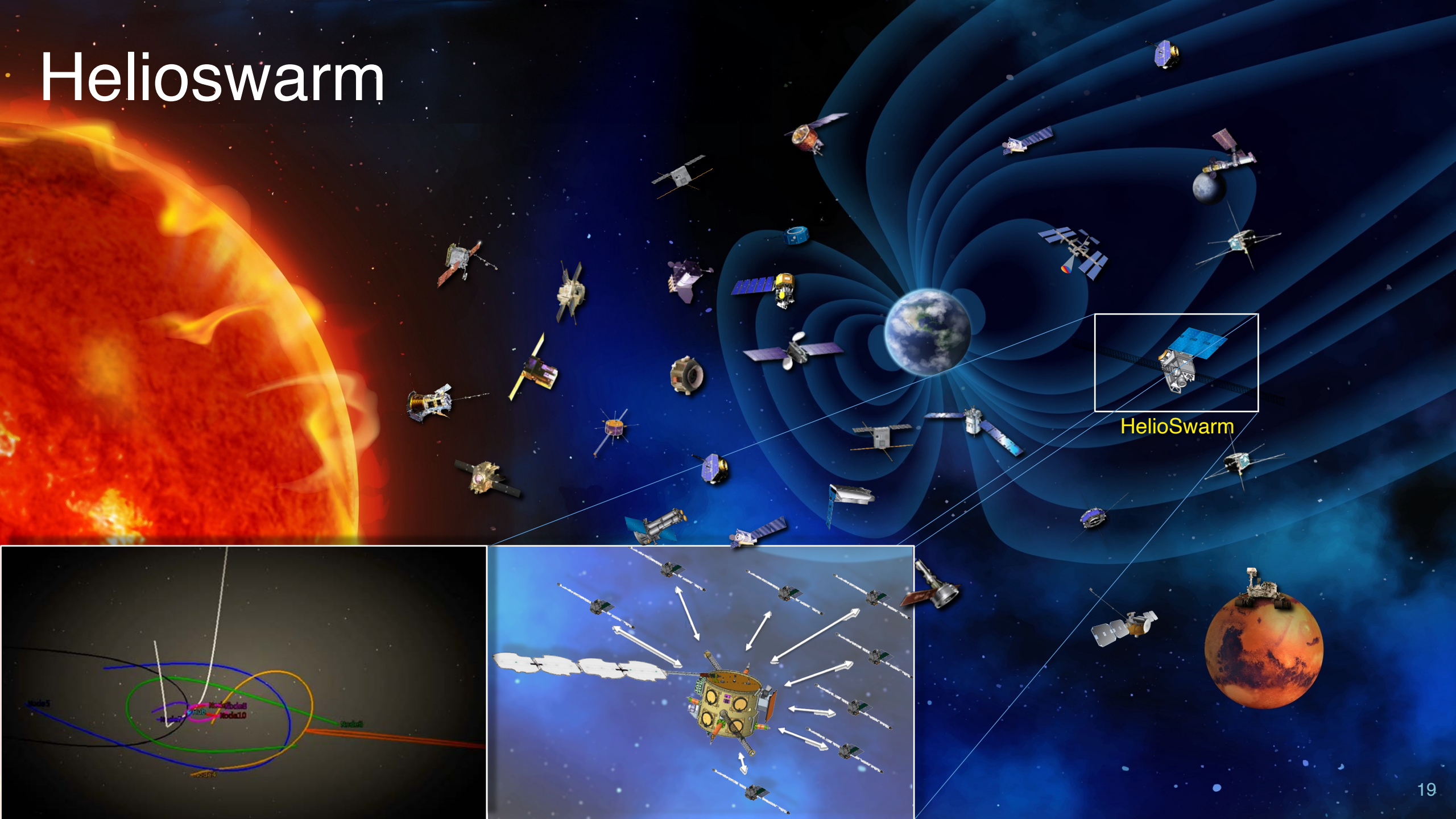




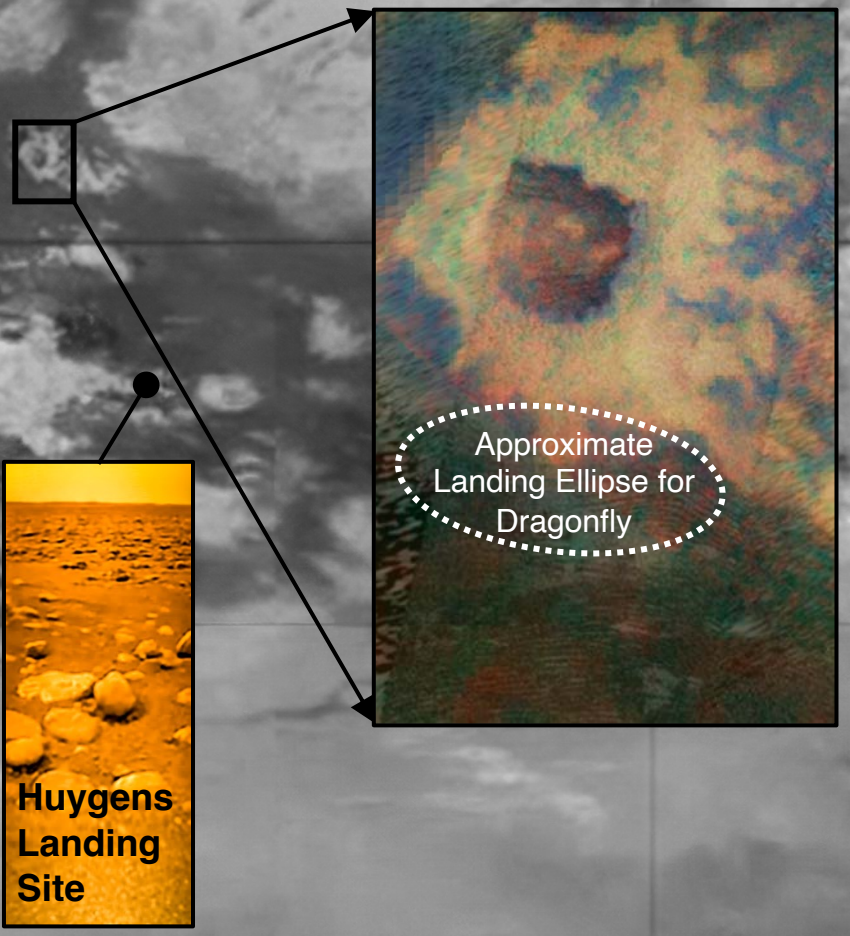
Ingenuity's Second Flight As Seen by Perseverance
April 22, 2022

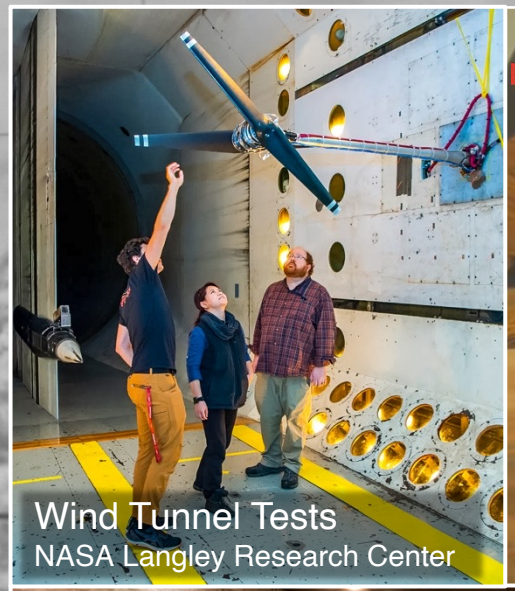


Helioswarm



Dragonfly – Mission to Titan




Wind Tunnel Tests
NASA Langley Research Center




Wind Tunnel Tests
NASA Ames Research Center




Arc Jet Tests
NASA Ames Research Center

NASA Ames Development Plan Today



- To advance NASA's overall mission
  - Helping NASA expedite its return to the Moon & the exploration of Mars
  - Helping NASA meet programmatic objectives
  - Providing positive financial returns
  - Keeping the Ames property useful to NASA goals
  - Helping NASA expand its base of support

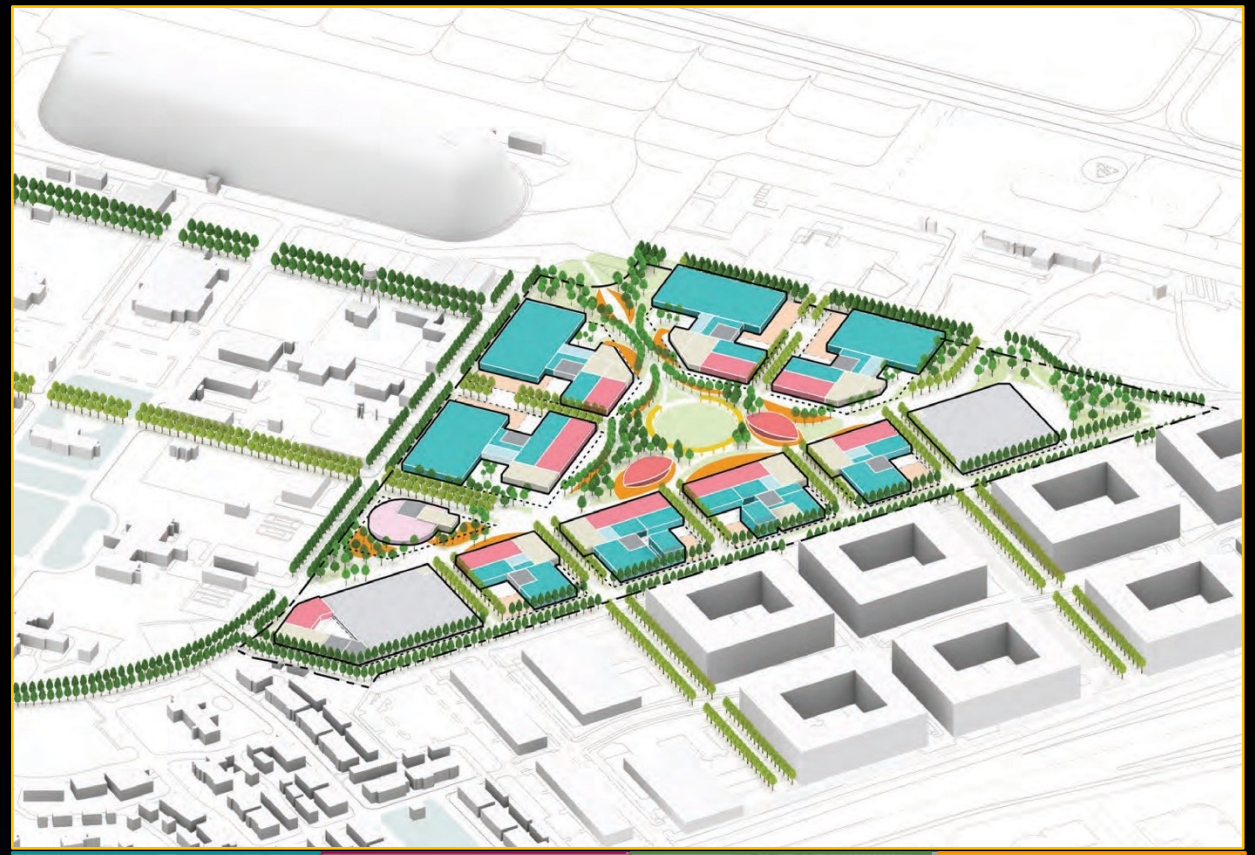
- NASA Ames Campus, 406 Acres
- Eastside Airfield
  - Planetary Ventures, 1,000 Acres
  - California ANG (CAANG), 111 Acres
- NASA Research Park
  - Shenandoah Plaza Historic District, 64 Acres
  - University of California, 36 Acres
  - Mountain View Housing Ventures, 46 Acres
- Bay View – Planetary Ventures R&D, 42 Acres

NASA Research Park



Berkeley Space Center

at NASA Ames Research Center



RESEARCH	SITE & OPEN SPACE	ACTIVE USES	RESIDENTIAL
1.75M PROPOSED OFFICE AND LAB R&D AREA (SF)	34.9 SITE AREA (AC)	91K ACTIVE USE AREA (SF)	140 STUDENT AND FACULTY UNITS
260K ACADEMIC AREA (SF)	13 OPEN SPACE (AC)	20K CONFERENCE CENTER AREA (SF)	100 SHORT TERM STAY UNITS
6K TOTAL JOBS	5 FUNCTIONAL LANDSCAPE (AC)		550 RESIDENTS





Questions?

Eugene.L.Tu@nasa.gov