Addressing Future Challenges for Planetary Science and Astrobiology

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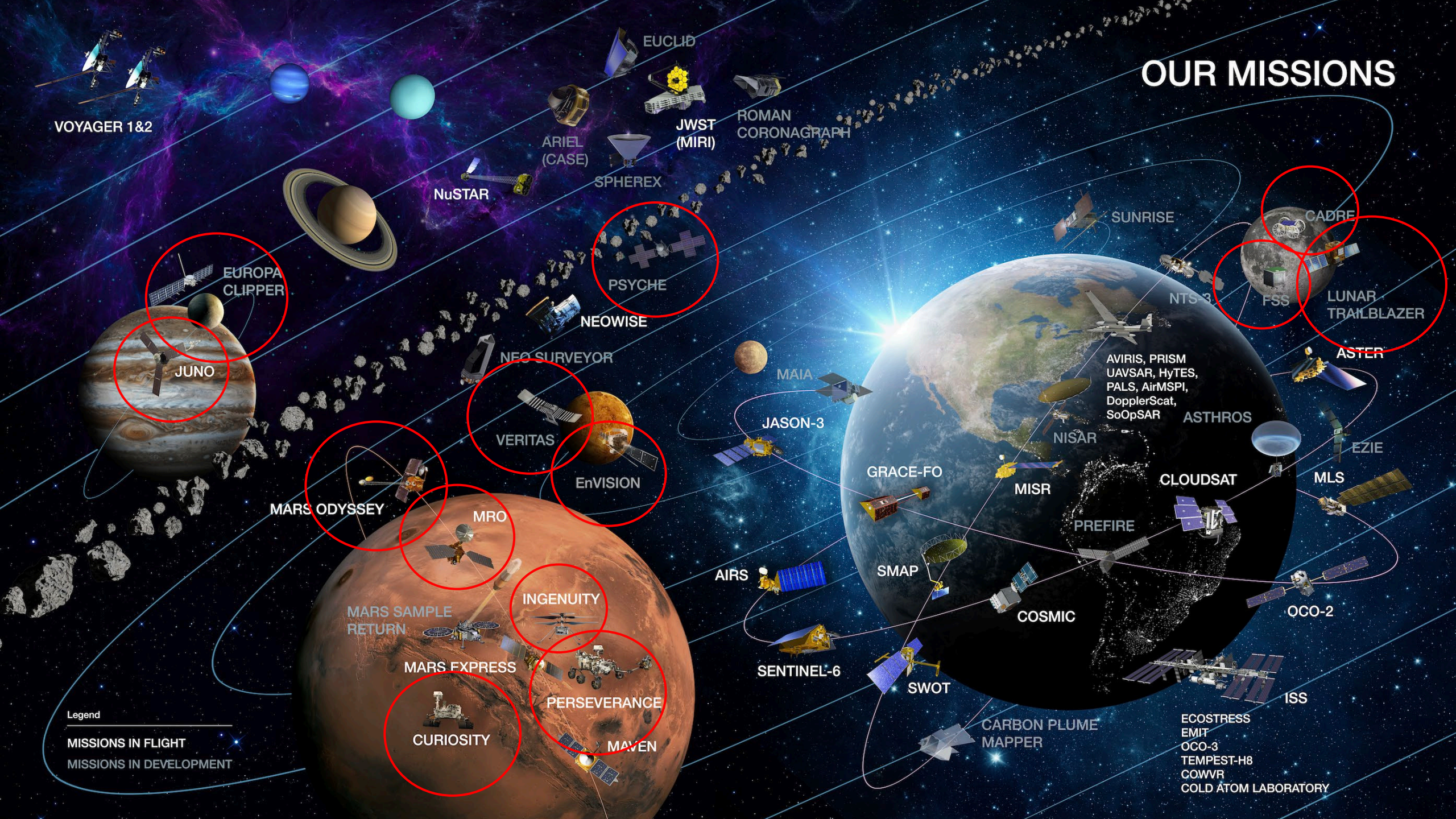
JPL / California Institute of Technology

Presentation to CAPS

October 24, 2023


OUR MISSIONS
VOYAGER 1&2
EUCLID
ARIEL (CASE)
JWST (MIRI)
ROMAN CORONAGRAPH
SPHEREX
NuSTAR
EUROPA CLIPPER
JUNO
PSYCHE
NEOWISE
NEO SURVEYOR
VERITAS
EnVISION
MARS ODYSSEY
MRO
INGENUITY
MARS SAMPLE RETURN
MARS EXPRESS
PERSEVERANCE
CURIOSITY
MAVEN
SUNRISE
CADRE
FSS
LUNAR TRAILBLAZER
NTS-3
ASTER
AVIRIS, PRISM
UAVSAR, HyTES,
PALS, AirMSPI,
DopplerScat,
SoOpSAR
ASTHROS
MAIA
JASON-3
NISAR
EZIE
GRACE-FO
MISR
CLOUDSAT
MLS
PREFIRE
AIRS
SMAP
COSMIC
OCO-2
SENTINEL-6
SWOT
ISS
CARBON PLUME MAPPER
ECOSTRESS
EMIT
OCO-3
TEMPEST-H8
COWVR
COLD ATOM LABORATORY
Legend
MISSIONS IN FLIGHT
MISSIONS IN DEVELOPMENT

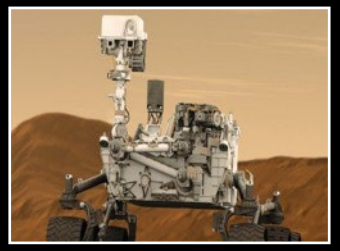
Planetary Science @JPL: Position Our Community to Execute the Planetary Science Missions of the Coming Decade

In Operations:

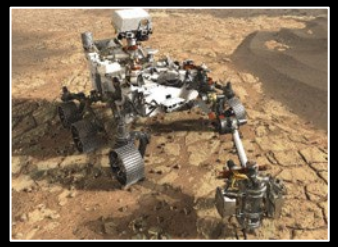
Mars Odyssey (2001)

Mars Reconnaissance Orbiter (2005)

Juno (2011)



Curiosity (2012)

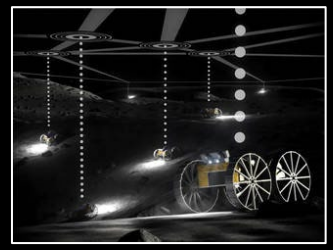


Perseverance and Ingenuity (2020)

Psyche (2023)

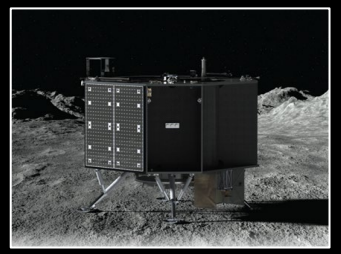
In Development:

Europa Clipper (2024)

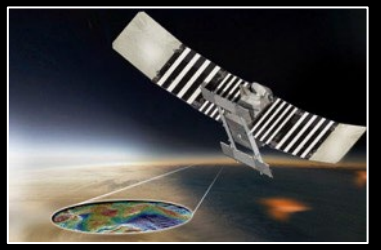


CADRE Rovers (2024)

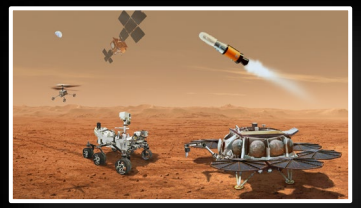
Lunar Trailblazer (2024)



FSS (2025)



VERITAS (TBD)

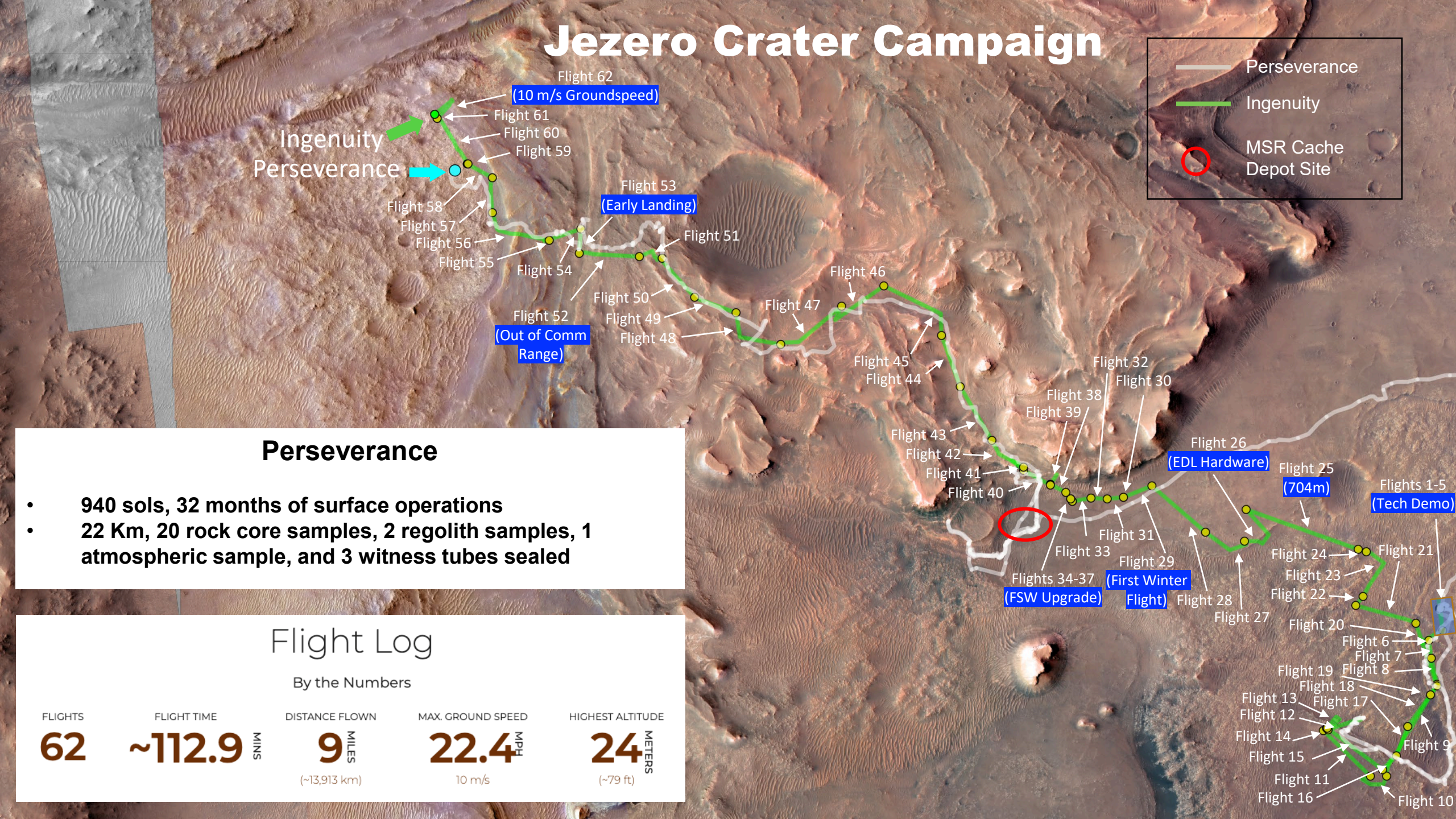


Mars Sample Return

Mars 2020
Perseverance and Ingenuity

- Crater Floor and Fan Front Science Campaigns complete
- Three Forks Sample Depot Generated
- Fan Top Campaign in progress

Jezero Crater Campaign



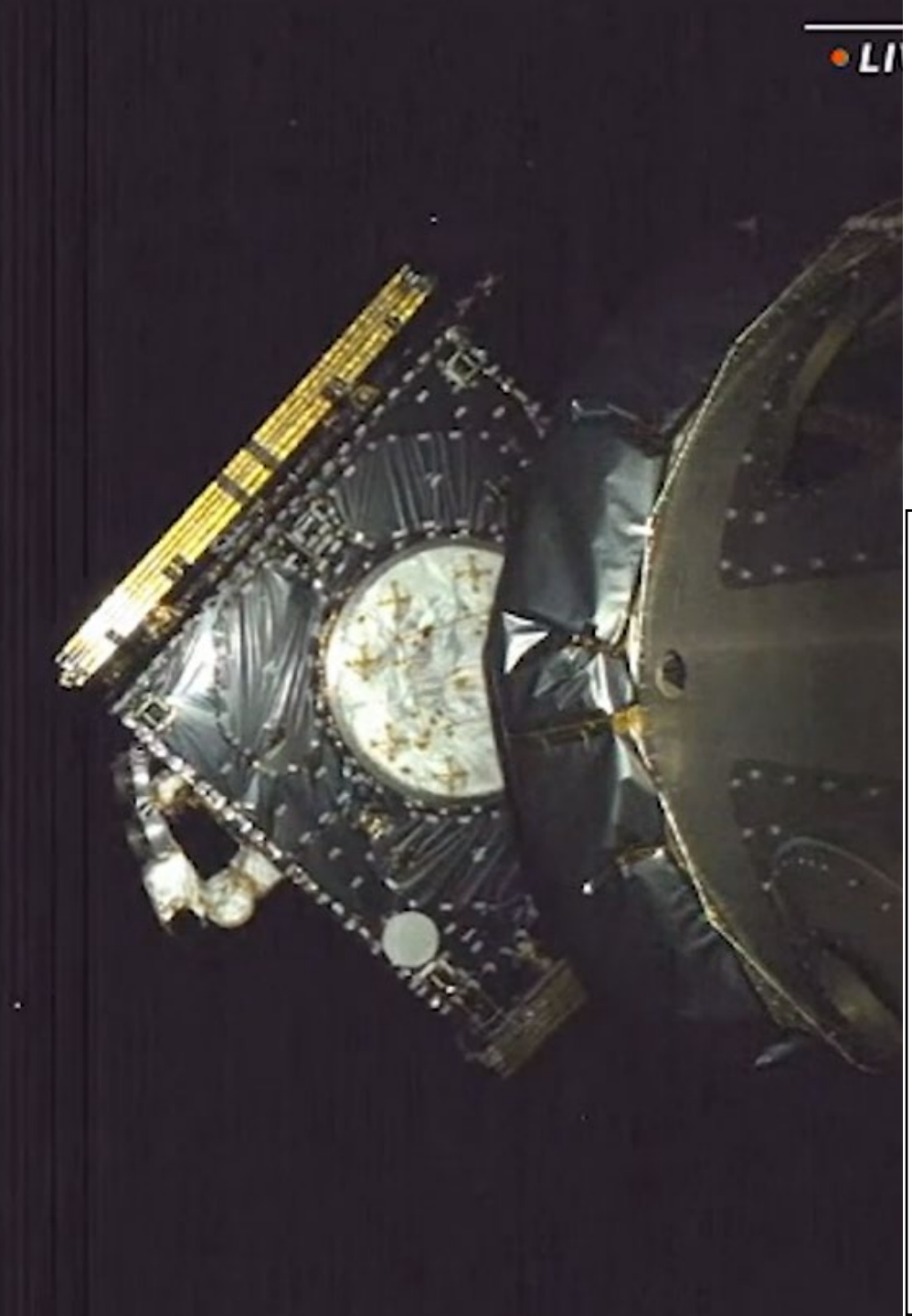
Perseverance

- 940 sols, 32 months of surface operations
- 22 Km, 20 rock core samples, 2 regolith samples, 1 atmospheric sample, and 3 witness tubes sealed

Flight Log

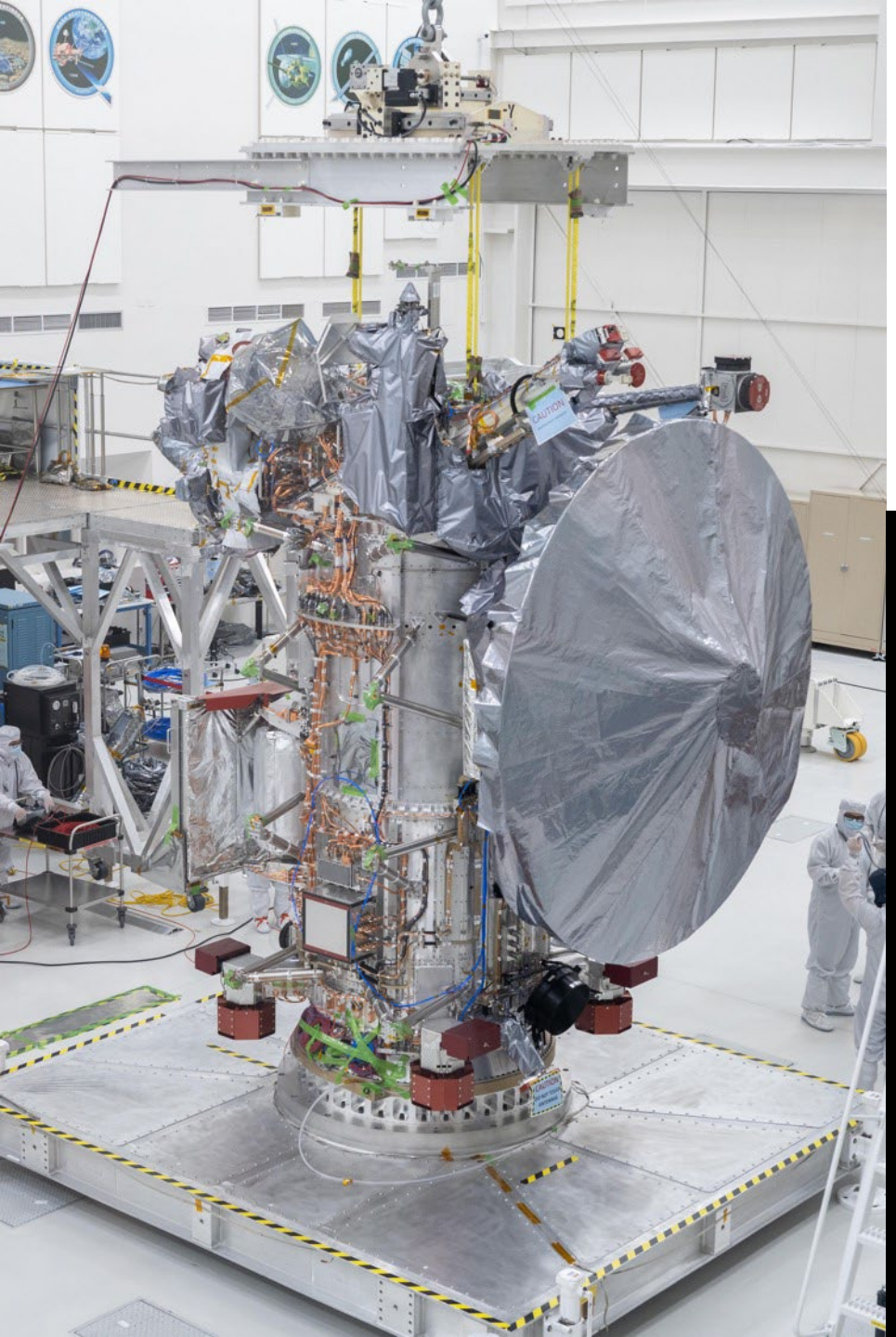
By the Numbers

FLIGHTS	FLIGHT TIME	DISTANCE FLOWN	MAX. GROUND SPEED	HIGHEST ALTITUDE
62	~112.9 MINS	9 MILES (~13,913 km)	22.4 MPH 10 m/s	24 METERS (~79 ft)



Psyche

- Oct 13 — Successfully launched on Falcon Heavy!
- Jan 2024 — Complete Initial Checkout
- Mar 2024 — Initiate sustained EP thrusting
- May 2026 — Mars gravity assist
- Aug 2029 — Arrive at Psyche, begin science mission



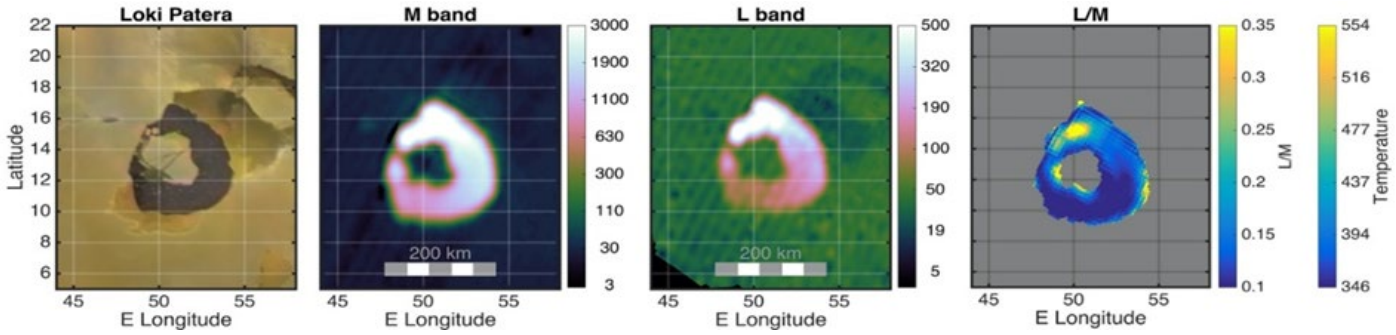
Europa Clipper

- Now — Fully assembled. Initial system testing.
- Nov 2023 — Spacecraft Dynamics Testing
- Dec 2023 — Spacecraft Thermal Vacuum
- May 2024 — Ship to KSC
- Oct 2024 — Launch

Juno

- **Juno is on the third year of its extended mission, has performed 55 orbits of Jupiter and obtained data on Europa, Ganymede, and Io.**

- **Oct 15 Io flyby at 11,700 km altitude**
- **Dec / Feb Io flyby at ~1,500 km altitude**



JIRAM images of Loki patera from May 2023. From the left: i) USGS reference image; ii) M-band (4.5 to 5 μm) radiance map; iii) L-band (3.3 to 3.6 μm) radiance map (band radiance is integrated by the bandpass filter and it is in mW sr^{-1} m^{-2}); iv) L/M ratio, and an estimation of the temperature (Mura et al., AOGS and in prep.)

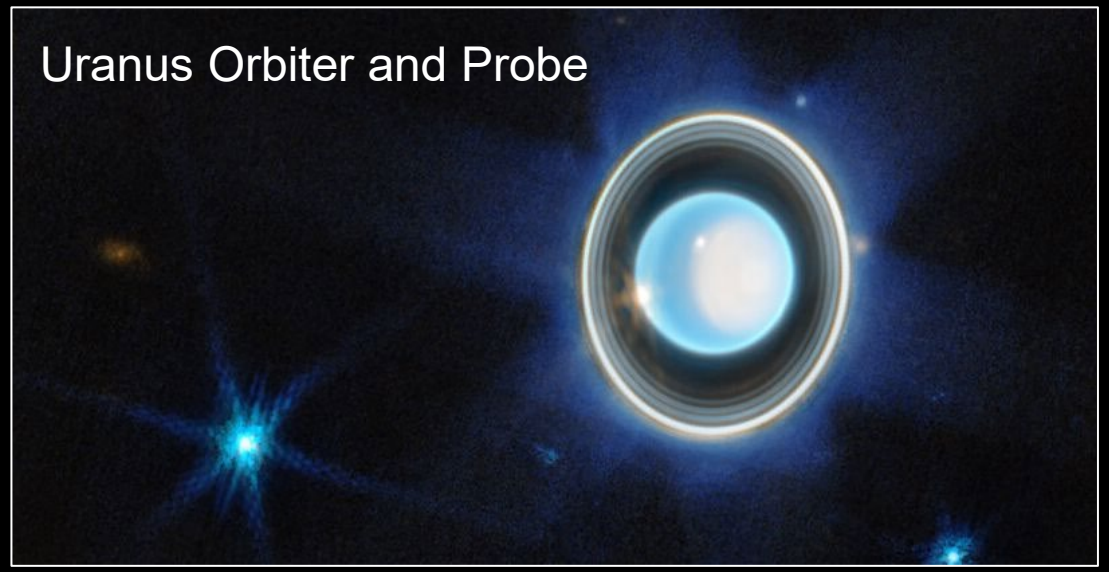
Questions from the Committee

1. Is JPL positioned to meet the demands of the high-priority science missions in the near and mid-term?

2. What impacts have there been / will there be from the issues identified in the Psyche and MSR IRBs?

3. How will JPL respond to the challenges of constrained budgets and growing demand for talent in the commercial aerospace industry?

Planetary Science and Astrobiology Decadal Survey (2023-2032)



New Frontiers-5 Targets:

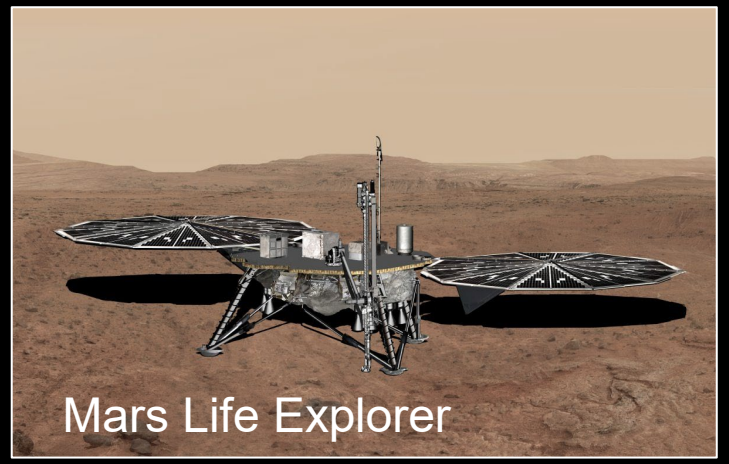
- Comet Surface Sample Return
- Lunar South Pole-Aitken Basin Sample Return
- Ocean Worlds (only Enceladus)
- Saturn Probe
- Io Observer
- Lunar Geophysical Network

New Frontiers-6 Targets:

- Centaur Orbiter & Lander
- Ceres Sample Return
- Comet Sample Return
- Enceladus Flyby
- Lunar Geophysical Network
- Saturn Probe
- Titan Orbiter
- Venus Insitu Explorer

NF-7 additional Target:

- Triton Ocean World Surveyor



A Plan for JPL | Seven ***Strategic Imperatives*** to Support the NASA Mission

SUCCEED

Advance science and exploration by delivering on our commitments

SI 1: World Class Workforce

SI 2: Position for Performance

SEED

Grow our capabilities to enable the future of scientific exploration from space

SI 3: Transformative Science and Technology

SI 4: Lab-wide Planning and Prioritization

LEAD

Be an inspiring role model and industry leader

SI 5: Industry Leading Workplace Culture

SI 6: Global Inspiration

SI 7: 2036 and Beyond – Launching JPL's Next Century

JPL

Psyche IRB Final Report

Psyche Project Summary and Conclusions

- The judgement of the IRB is that the response to the IRB recommendations and work-to-go is outstanding and exceeded the board's high expectations.
- The Principal Investigator, ~~Psyche Project, JPL senior leadership,~~ and JPL Line organization are to be commended for their exceptional contributions.
- A credible plan has been developed for the remaining work to be accomplished to support an October 2023 launch. Initial operations planning is viewed by the IRB to be positive; however, this area has a significant amount of work yet to be accomplished.
- The IRB believes the October 2023 LRD is credible and the overall probability of mission success high.
- It is the judgement of the IRB that the positive actions observed validate NASA's decision to continue the Psyche Project.

JPL Institution Summary and Conclusions

- The IRB recognizes that the board's findings and recommendations were challenging, necessary, and would ultimately require considerable time to complete the corrective actions.
- The IRB's assessment includes the work accomplished to date and the plans to complete the remaining actions.
- The IRB assesses that the response to all the findings and recommendations are appropriate. The IRB is extraordinarily impressed by the accomplishments of the total JPL organization and Caltech.
- Engagement in and leadership of the overall response process by the JPL Director and senior leadership is deemed "world class."
- The amount of work-to-go is extensive and will require continued engagement, commitment, and leadership. The IRB is confident this will occur.

Ref: https://www.nasa.gov/wp-content/uploads/2023/09/psyche-irb-assessment-report-with-nasa-response-may-2023-508.pdf

MSR IRB – Initial Reactions

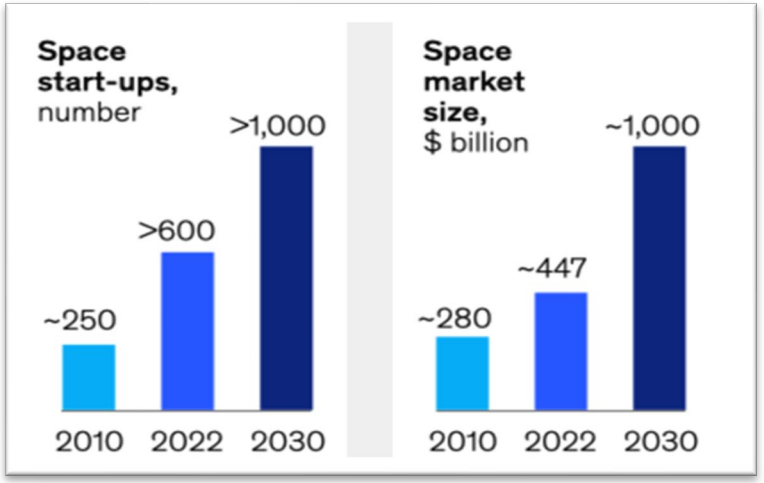
- Fully appreciate and concur with emphasis in the IRB report on the fundamental importance of the return sample science

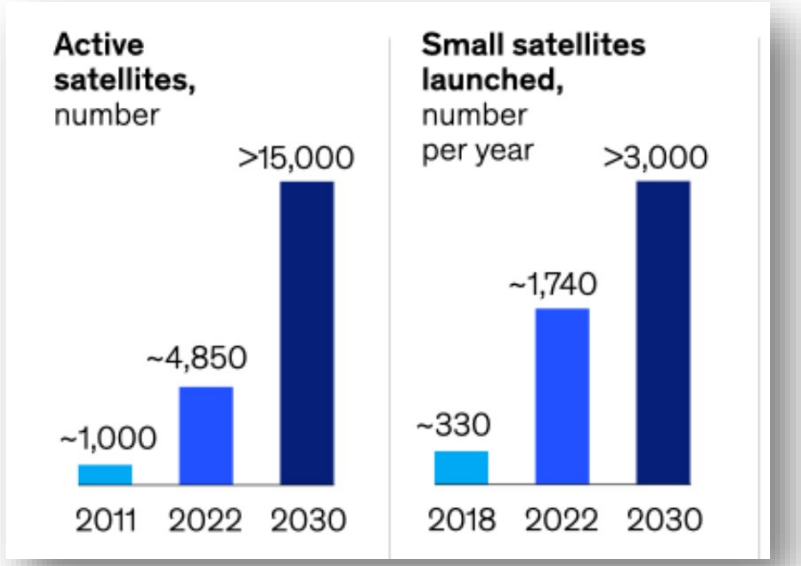
- Institutional leadership is committed to supporting SMD/NASA in addressing the report concerns and findings fully and transparently, as was done with the Psyche IRB report.

- Architectural work is underway to achieve a programmatically feasible path forward that will meet the highest priority objectives of the Decadal Survey within an appropriately balanced planetary science portfolio.

Demand for Talent

- Continuing growth in space industry
- Workforce metrics are strong (retention rates, employee satisfaction, …)
- Leadership/training/mentorship remain a focus
  - Science/Mission Interface Workshop (for early career scientists)
- Key Challenges.
  - Maintaining Tier 1 & 2 capabilities
  - Build on successful efforts in work-place diversity





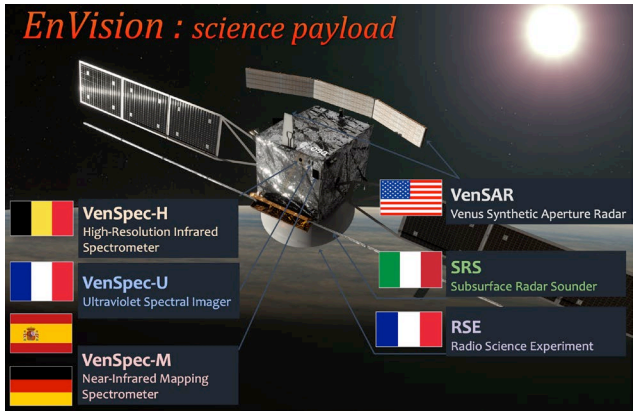
Source: McKinsey & co

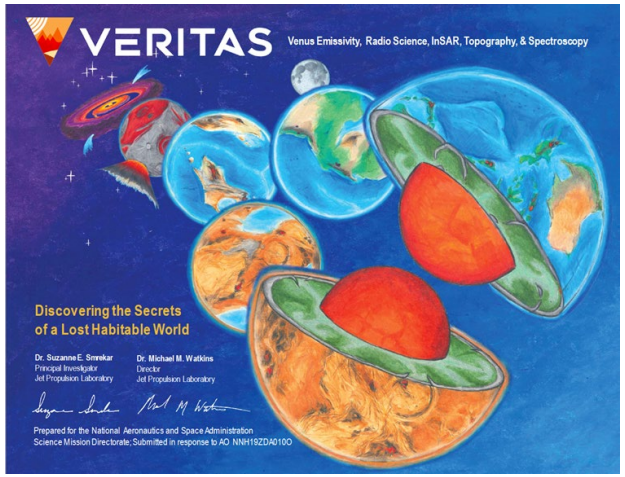
Tier 1

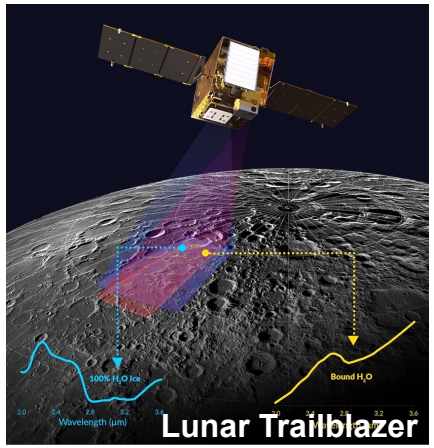
1. Formulate and execute complex missions, including systems engineering
2. Deep Space Network operations and evolution
3. Microwave and radar measurements, including SAR and ocean altimetry
4. High-contrast imaging technologies and associated testbeds and laboratories, including applications to exoplanet detection and characterization
5. Autonomous planetary in situ robotic systems

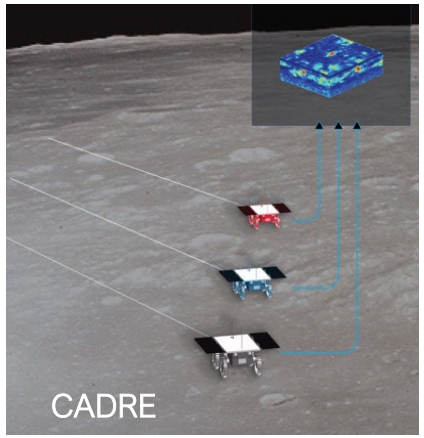
Constrained Budgets - 1

- Diverse portfolio
  - Flagship, NF, Discovery, Type II
  - Outer planets, Mars, Venus, small body, lunar
  - Missions, instruments, systems engineering
- Leverage Partnerships
  - International, cross-directorate, non-NASA



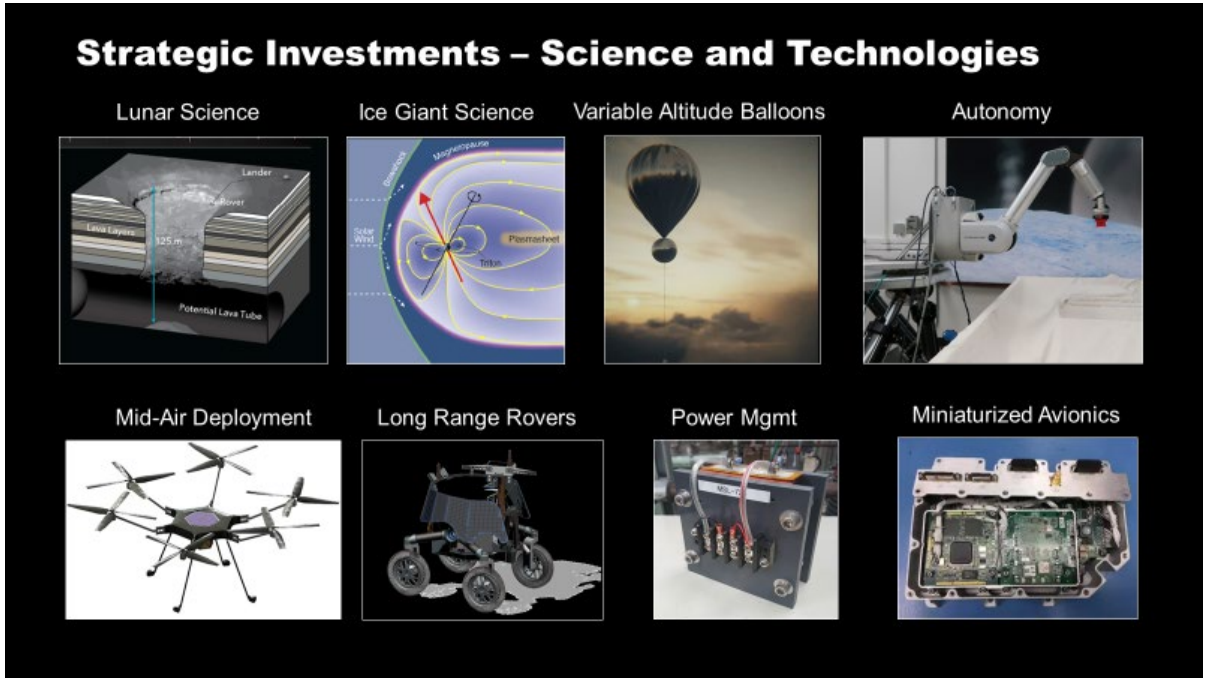


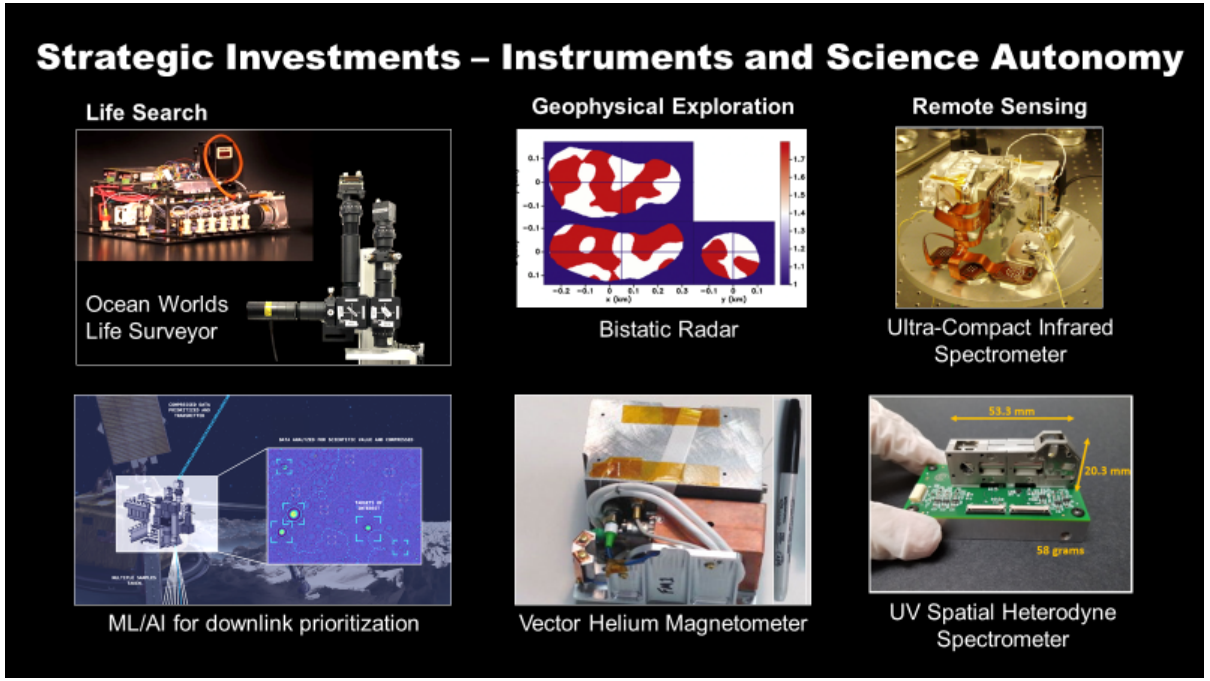




Constrained Budgets - 2

- Maintain Internal R&D

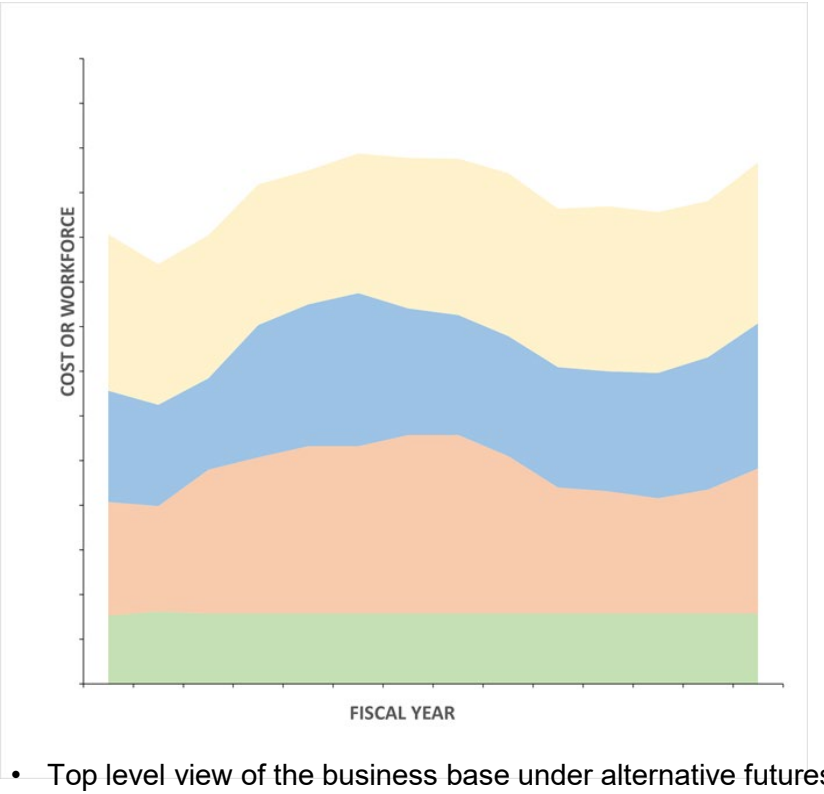




Constrained Budgets - 3

- Lean forward into cost-efficiencies
  - Mission operations
  - Institutional efficiencies (Snowplow)
  - Commercial capabilities
  - Reduced launch costs
- Improve programmatic assessment and tracking tools
- Key Challenges
  - Same-year / near-year budgetary instability
  - Supporting DSN and Laboratory Infrastructure

Strategic Portfolio Tool (SPoT)



- Top level view of the business base under alternative futures
- Rapid synthesis & visualization of potential work portfolios ~10 yrs
- Integrates current commitments w/ future mission scenarios
- Data can be sliced by projects and programs, engineering and program office organizations, and other items of interest

Conclusions

- JPL is deeply committed to supporting the world-class science and planetary missions identified by CAPS
- JPL is focused on maintaining and expanding our deep technical capabilities to formulate and execute one of-a-kind NASA planetary science missions
- We recognize there will be budgetary challenges ahead that we must collectively address and mitigate to maintain a national leadership role in planetary exploration

“Far better it is to

dare mighty things,

to win glorious triumphs,

even though checkered by

failure, than to take rank with

those poor spirits who neither

enjoy much nor suffer much,

because they live in the gray

twilight that knows neither

victory nor defeat.”

- T. Roosevelt

Together!


Thank you
JPL