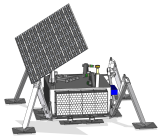
Europa Lander Concept Video



- URS 272524

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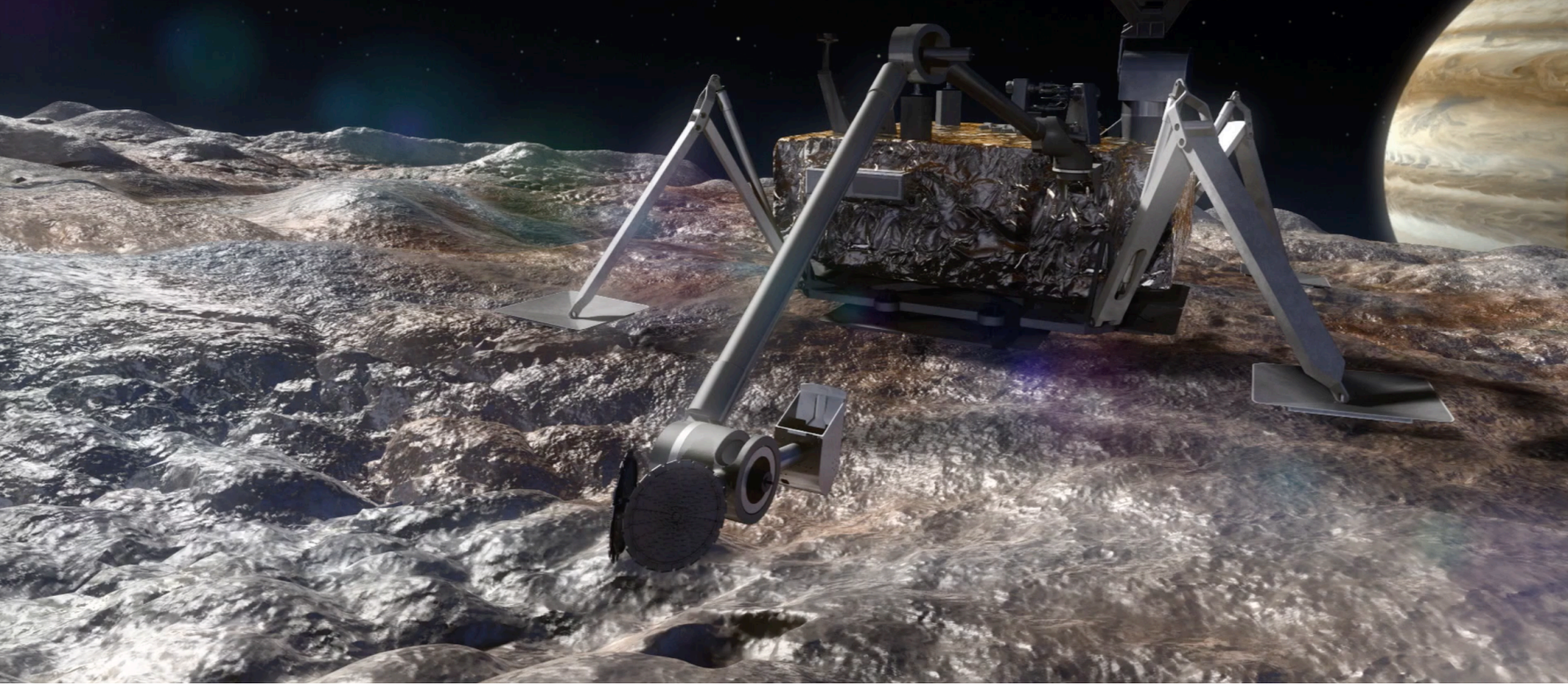


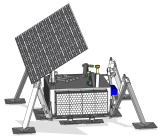
Europa Lander Mission Concept - Science & Engineering

Roger Gibbs

Jet Propulsion Laboratory
California Institute of Technology

Pre-Decisional Information – For Planning and Discussion Purposes Only. © 2018 California Institute of Technology. Government sponsorship acknowledged.

Outline

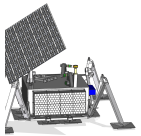


- Introductions
- Science
- Mission Architecture
- Technology Maturation
- Programmatics

National Aeronautics and Space Administration

EUROPA LANDER STUDY 2016 REPORT

EUROPA LANDER MISSION CONCEPT TEAM



Science Definition Team *(affiliations provided in Chapter 1)*

Co-Chairs: Dr. K. P. Hand, Prof. A. E. Murray, Dr. J. B. Garvin,

Dr. W. B. Brinckerhoff	Dr. T. M. Hoehler	Dr. D. E. Smith
Prof. B. C. Christner	Prof. S. M. Horst	Prof. A. R. Rhoden
Dr. K. S. Edgett	Prof. J. I. Lunine	Dr. M. J. Russell
Prof. B. L. Ehlmann	Prof. K. H. Nealson	Prof. A. S. Templeton
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Prof. A. G. Hayes	Prof. B. E. Schmidt	Dr. R. A. Yingst

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Project – Engineering

Jet Propulsion Laboratory, California Institute of Technology

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Boykins, K. T.	Harris, J. R.	McElrath, T. P.	Stehly, J. S.
Brandon, E. J.	Heverly, M. C.	Montgomery, R. H.	Tan-Wang, G. H.
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Burns, B.	Johnson, B. A.	Park, E. L.	Truong, H. D.
Carr, G. A.	Jun, I.	Parker, J. M.	Warner, N. Z.
Chen, Y.	Kawata, J. M.	Ratliff, J. M.	Yahnker, C. R.
Cook, B. T.	Kipp, D. M.	Reeves, G. E.	Young, M. E.
Davis, G. L.	Klesh, A. T.	Reiz, J. M.	Zimmer, A. K.
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Davis, A.	Hong, A.	Norkus, M.	
Ensor, S.	Hunt, J.	Pfisterer, R.	
Gannon, M.	Iskow, J.	Porter, J.	

Goddard Space Flight Center

Cardiff, E. H.	Davis, A.	Grob, E. W.

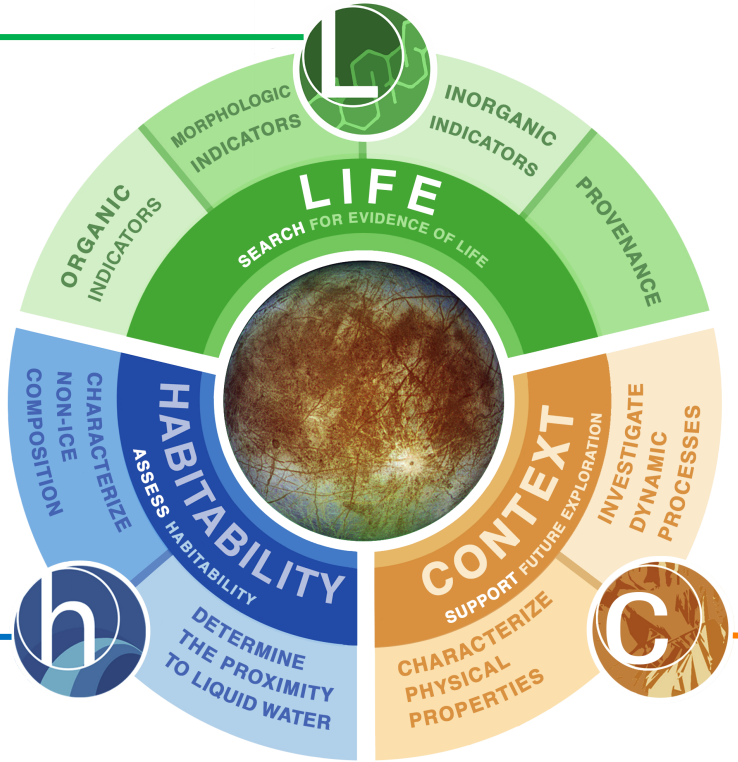
Marshall Space Flight Center

Adam, J. R.	Betts, E.	Norwood, J.

Science Definition Team Recommendations

A connected set of goals and objectives addressed with a focused model payload

GC-MS
Microscope
Raman spectrometer
Context cameras



Raman spectrometer
Microscope
GC-MS
Context cameras
Geophone

20+ day surface lifetime
42.5 kg allocation for payload
3 sample analyses for biosignature science
7 cubic centimeters
10 cm depth or deeper

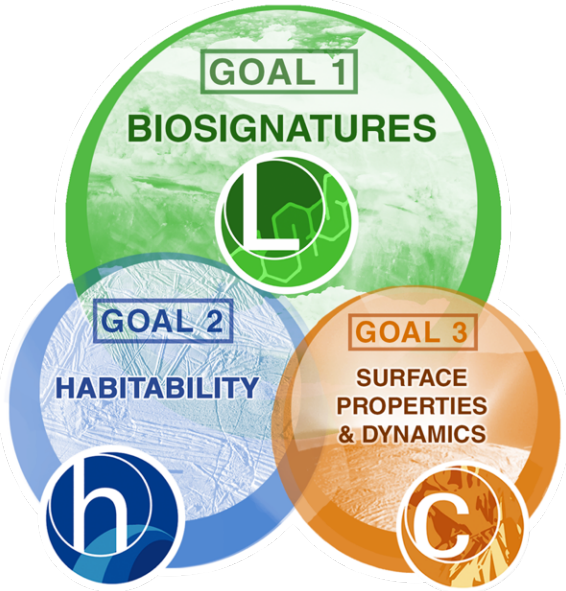
Raman spectrometer
Microscope
GC-MS
Context cameras
Geophone

Pre-Decisional Information – For Planning and Discussion Purposes Only

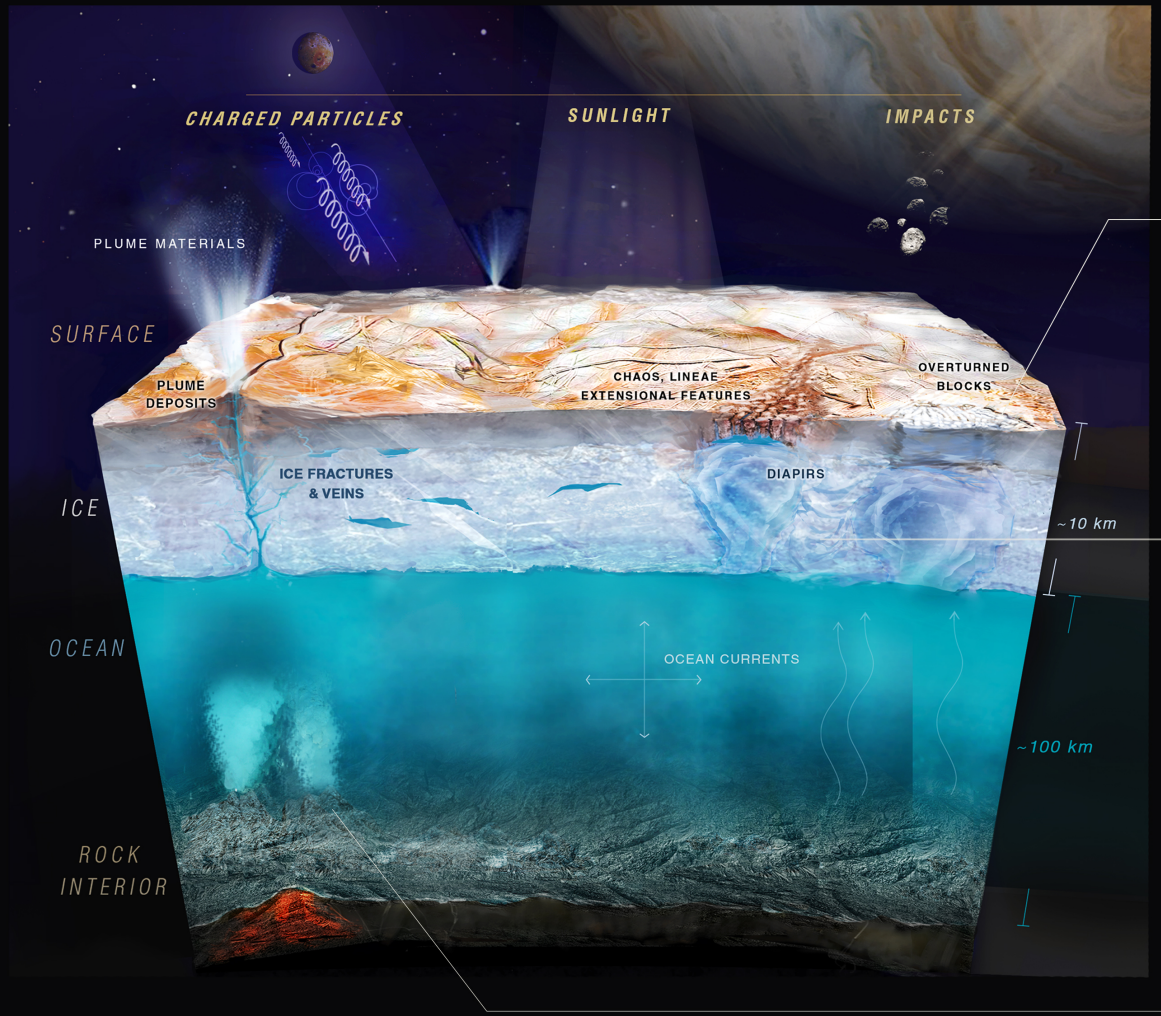
Science Goal: *Search for Biosignatures*

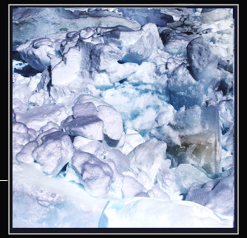
- SDT Report Definition of 'Biosignature':
  - **'A feature or measurement interpreted as evidence of life.'**

- Focusing on 'Searching for Biosignatures' as opposed to 'Life Detection' enables several significant operational changes, e.g., reduction in number of samples, trenches, and ground-in-the-loop opportunities.
- This change is directly in line with the SDT Report and is also consistent with Town Hall and community feedback (e.g. OPAG).

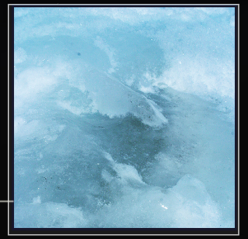


EUROPA

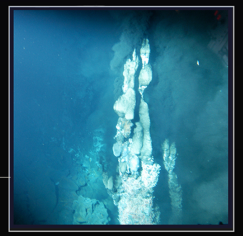




ICE BLOCKS

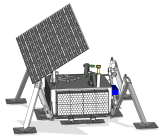


ICE FRACTURES

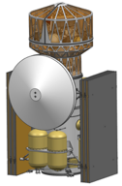


HYDROTHERMAL VENTS

Europa Lander Mission Concept

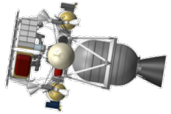


Launch
- SLS Block 1B
- Nov 2026

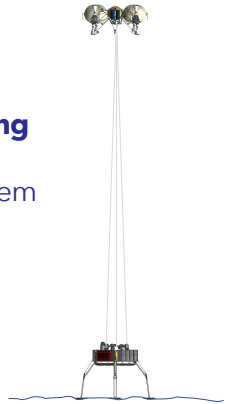


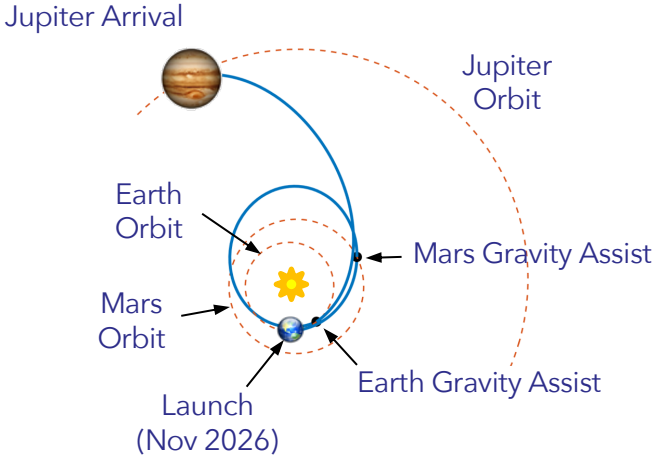
Cruise/Jovian Tour
- Jupiter Orbit Insertion: June 2031
- Europa Landing: 2033

Carrier Stage
- 1.5 Mrad radiation exposure
- **Elliptical disposal orbit**

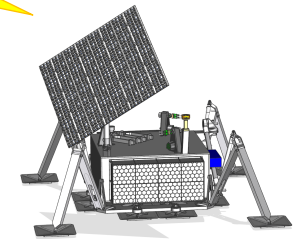


Deorbit, Descent, Landing
- Guided deorbit burn
- Sky Crane landing system
- 100-m accuracy
- **DTE tones only**

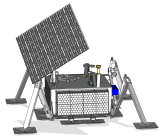


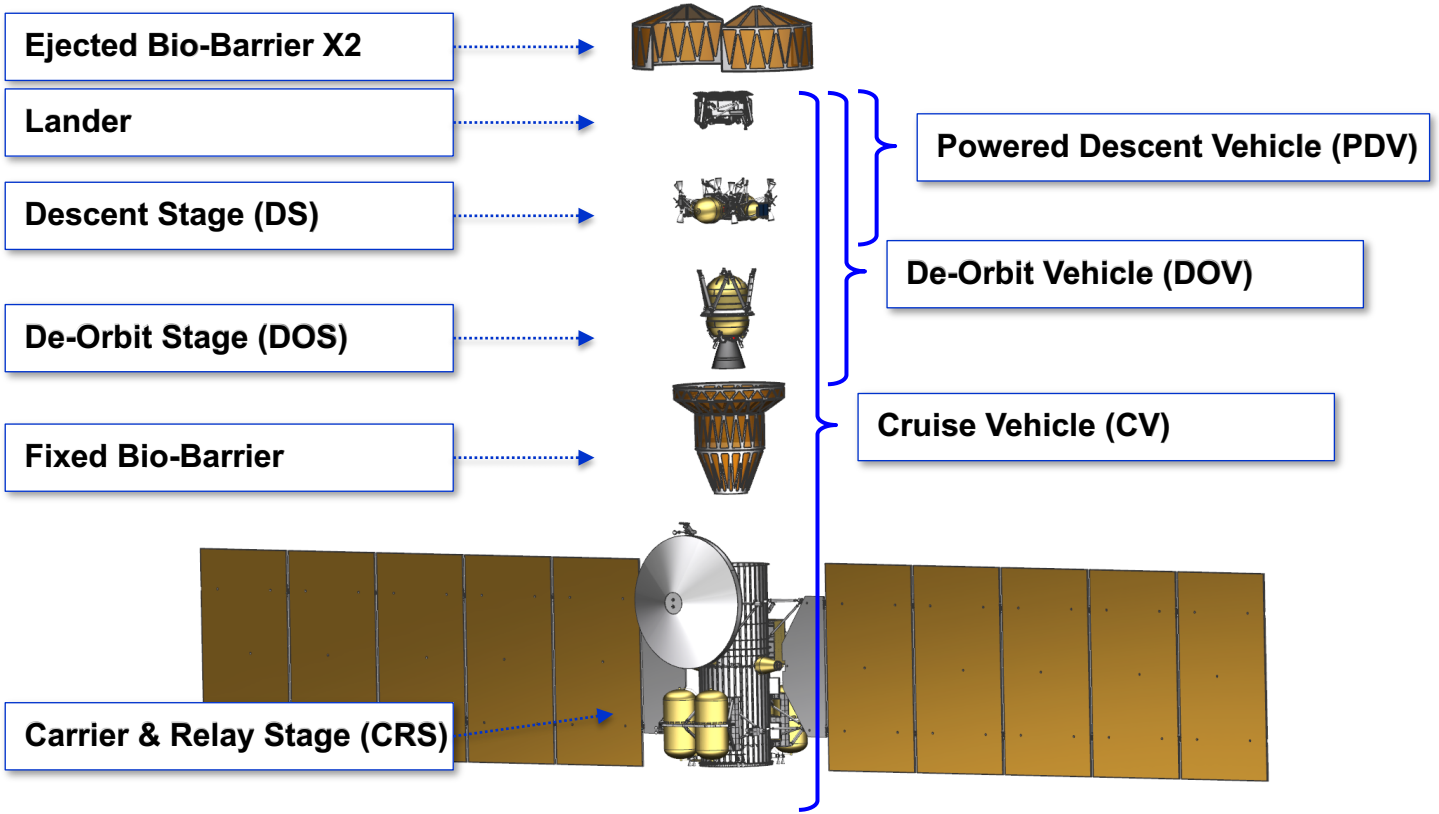


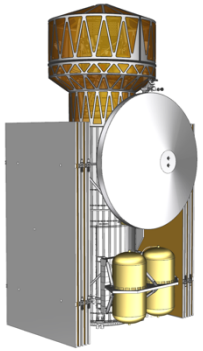
Surface Mission
- **Biosignature Science**
- 20+ days
- **3 samples from 1 trench**
- **Direct to Earth Comm or Clipper (backup)**
- **1.5 Gbit data return**
- 50 kWh battery
- 2.0 Mrad radiation exposure



Baseline Launch Assembly

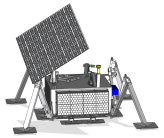


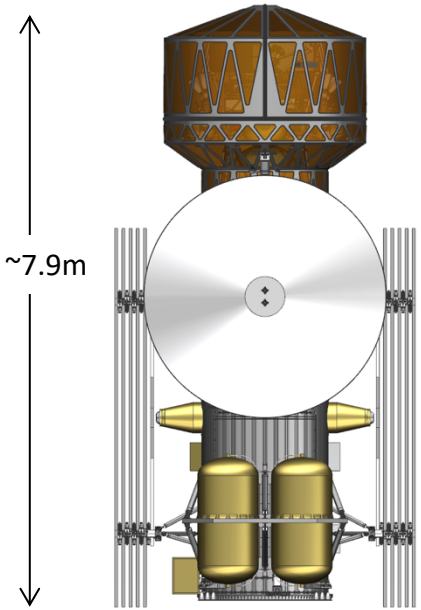




Artist's Concepts

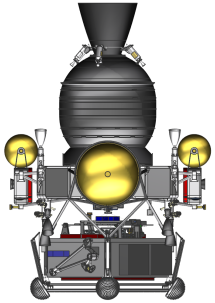
Baseline System Vehicles





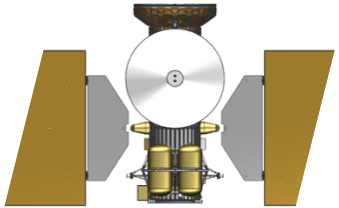
Cruise Vehicle (CV)

Launch Mass: 15 mt

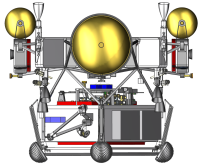


Deorbit Vehicle (DOV)

+



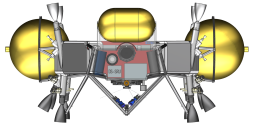
Carrier Stage (CS)



Powered Descent Vehicle (PDV)

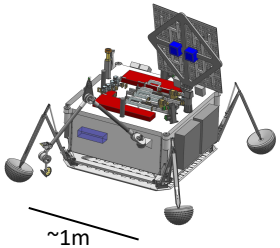
+

Deorbit Stage (DOS)



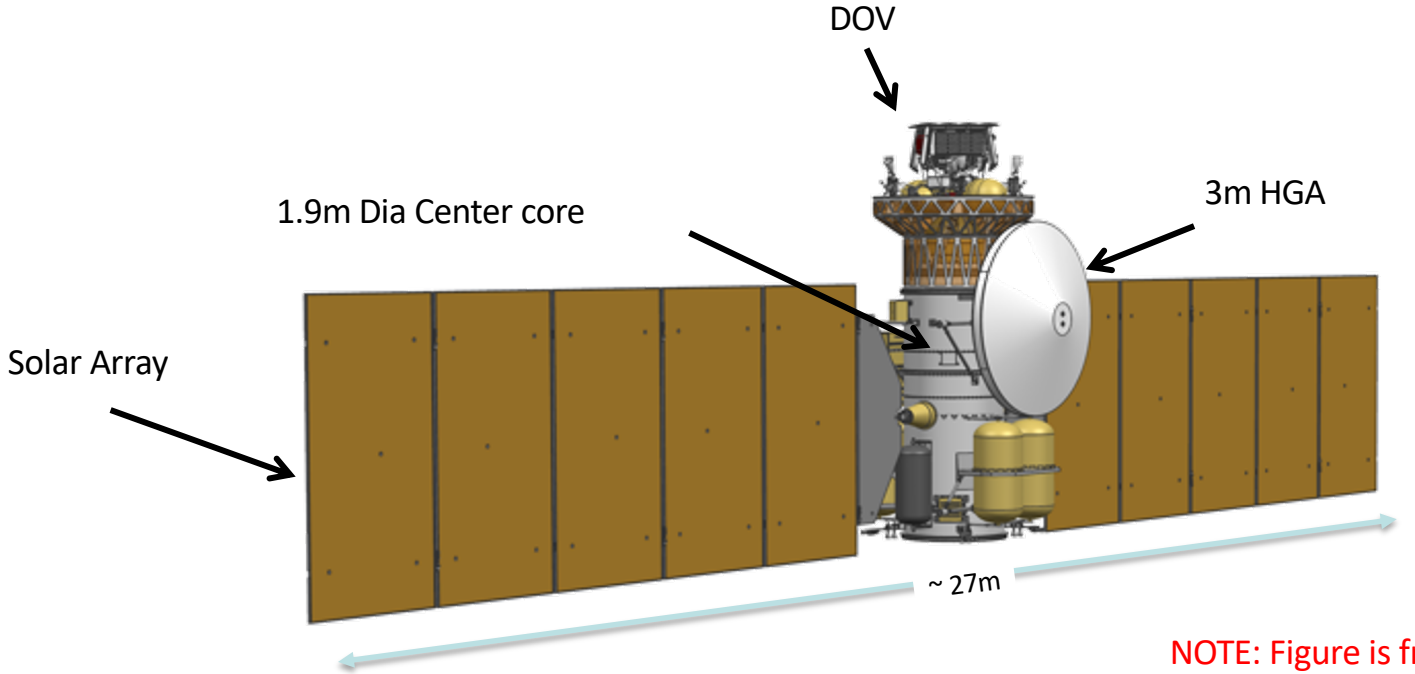
Descent Stage (DS)

+



Lander (500 kg)

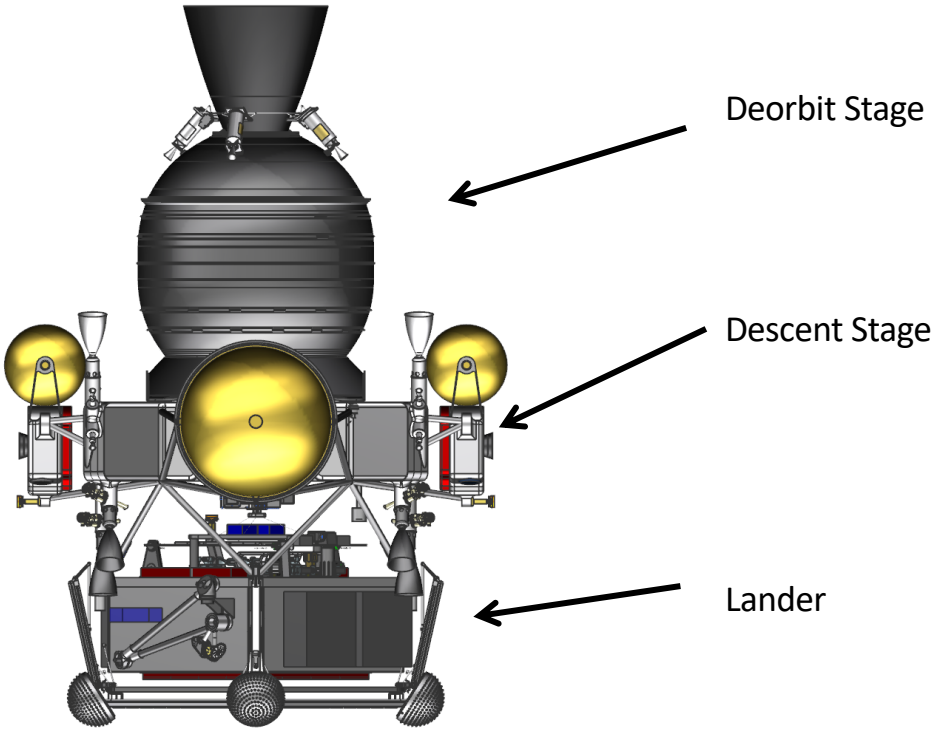
Carrier Stage



Baseline Configuration

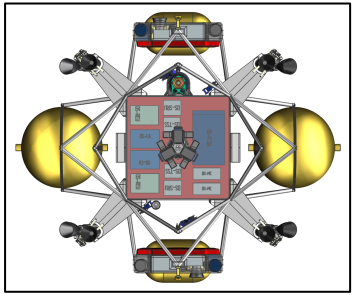
NOTE: Figure is from MCR
In June 2017 (update pending)

Deorbit Vehicle



Baseline Configuration

Descent Stage



He Tanks (2)

MR-104 TVC Engines (4)

ACS Engines (8)

MR-104 Descent Engines (8)

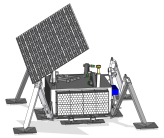
H2N4 Tanks (2)

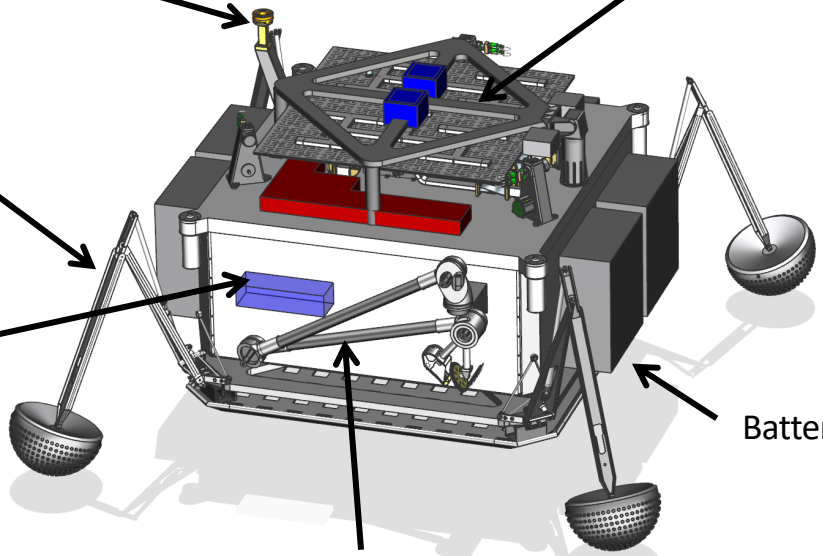
Avionics Vault

GNC Sensor Pods (2)
- IMU
- Camera
- Star Tracker
- LIDAR

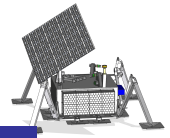
Baseline Configuration

Lander



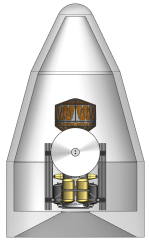

Low Gain Antenna
High Gain Antenna
Adaptive Stabilizers
Sample Dock
Battery Modules (4)
Sampling and Excavating Arm

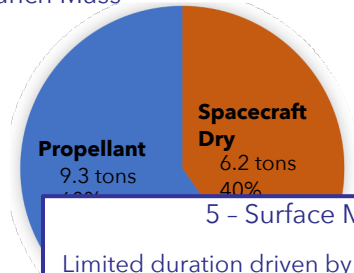
Five Driving Challenges



What makes the Europa Lander Concept more challenging than Mars or Lunar landers

1 - Launch Mass

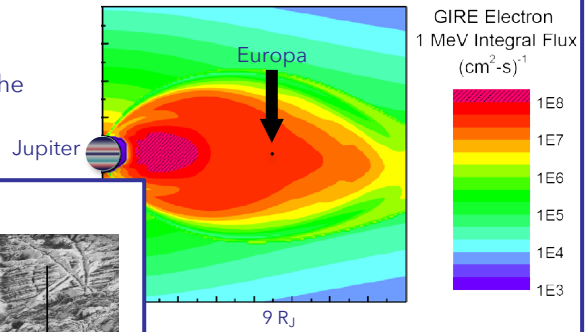




SLS BLOCK-1B LAUNCH CAPABILITY:
18.5 tons, 4.6 Year Transit

3 - Jovian Radiation Environment

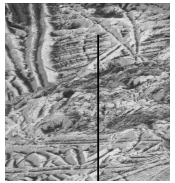
- ~3 Mrad TID accumulation in the last months of approach and surface mission

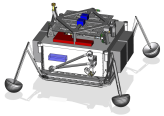


5 – Surface Mission Duration and Automation

Limited duration driven by energy storage capacity

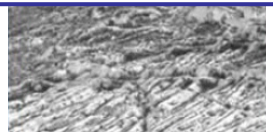
- Lander must be highly automated and ready for an uncertain surface topography and materials
- Lander will manage communication, thermal control, and activity execution (similar to Mars heritage) for overall efficiency
- Sampling location can be selected by science team <u>and</u> onboard behavior will be capable of full sample acquisition and analysis processing





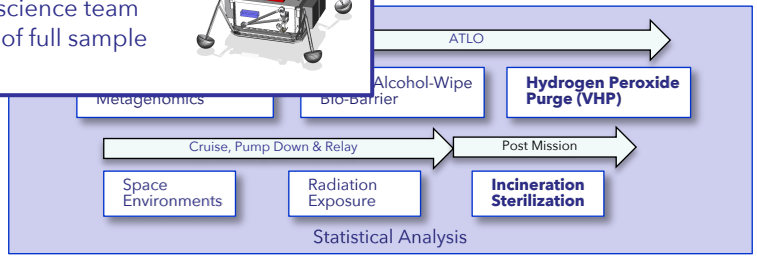
2 – Landing on Un

- Clipper Reconnaissance
- Pin Point Landing with TRN
- Hazard Detection & Avoidance
- Soft Landing
- Adaptive Stabilizers

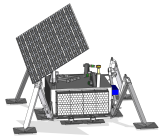


ary Protection

robability of introducing a single "Viable
s – Drives ATLO



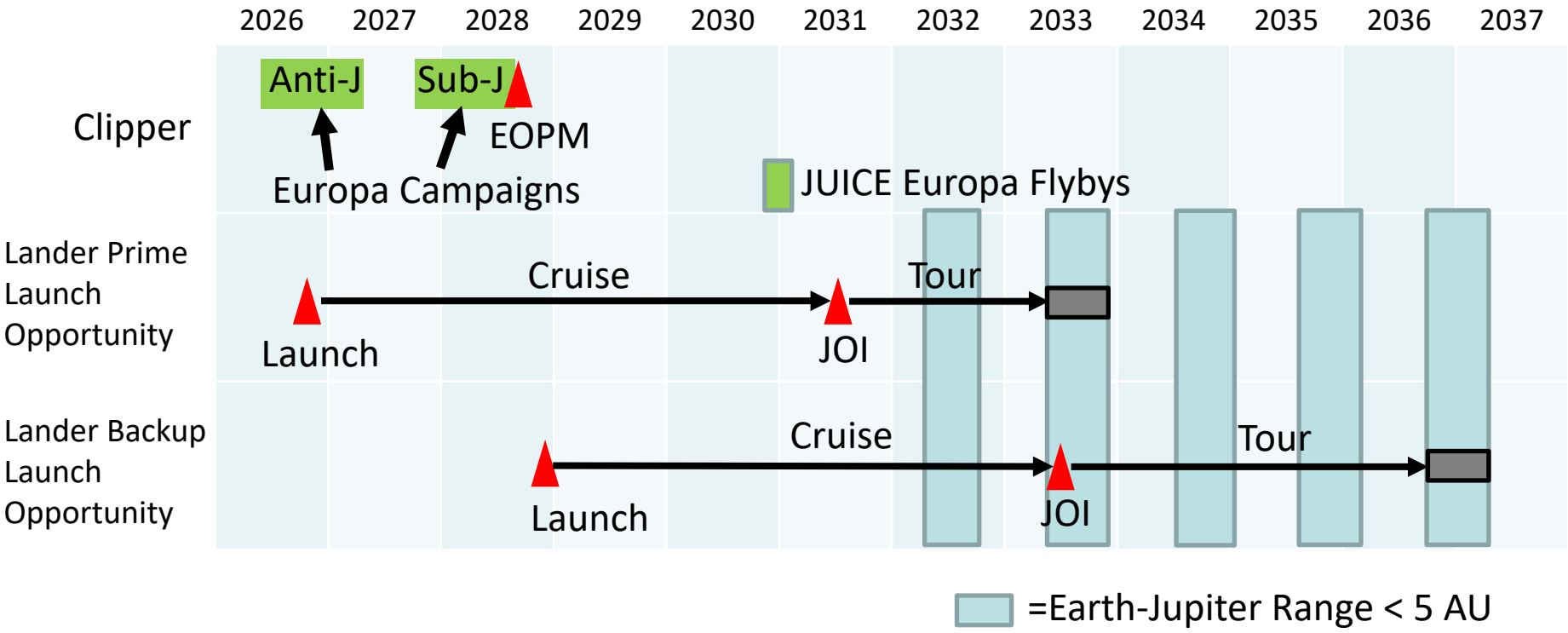
Europa Lander Technology Development



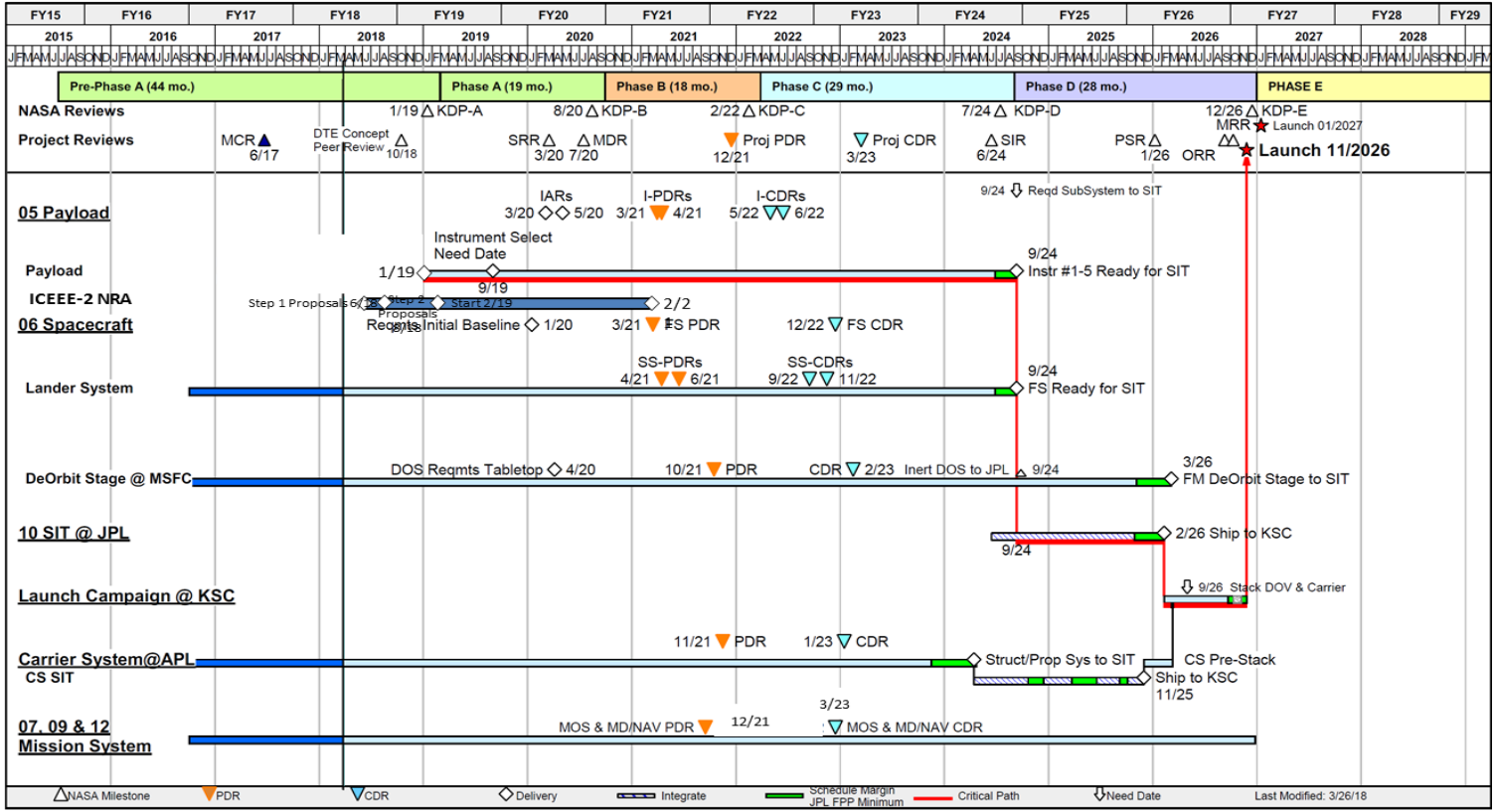
- Energy Storage
- Planetary Protection
- Sample Acquisition and Handling
- Compact Motor Control with Low Temperature Actuators
- Intelligent Landing System
- High Efficiency Antenna Array

Sufficient early funding for technology maturation has been instrumental in preserving the earliest possible launch date.

Clipper Campaigns vs Lander Notional Timeline



Europa Lander Tier 1 Schedule
From Lander Planning Guidelines July 2018



Pre-Decisional Information – For Planning and Discussion Purposes Only