

The decision to implement the Europa Lander will not be made until NASA's completion of the National Environment Policy Act (NEPA) process. This document is being made available for information purposes only.

Design Considerations for a Europa Lander Mission

Europa Lander Pre-Project Team, Dr. Sam Thurman (presenter)

3 October 2018



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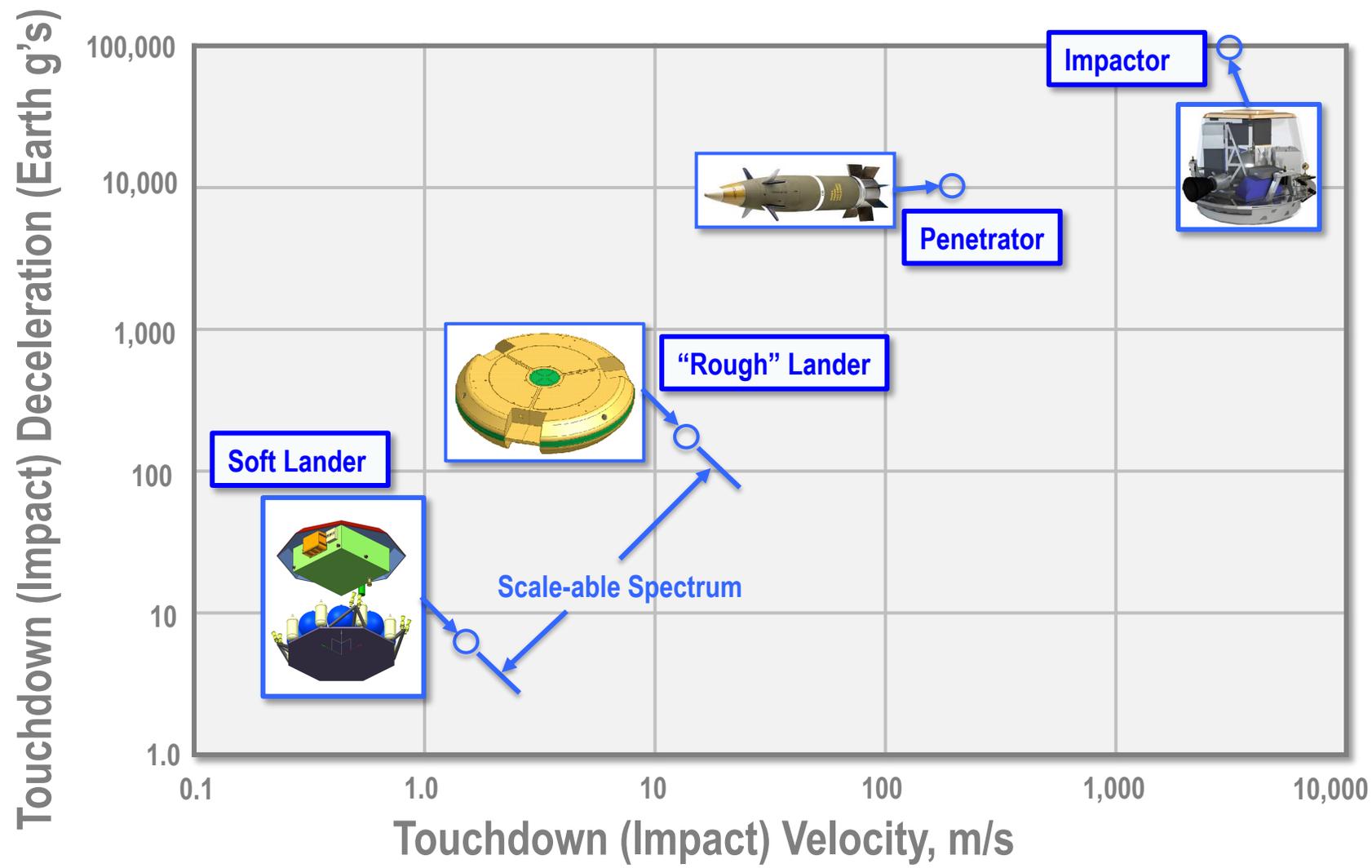


Background and Introduction

- NASA/JPL have been studying a potential landed mission to Europa over the past three years, with the following provisions:
 - Science objectives complementary to those of Europa Clipper
 - Wide range of options considered, starting with feasibility assessment
- After NASA review of an initial feasibility study in early 2016, option space has since focused on stand-alone mission concepts
 - Dedicated launch to Jupiter following Europa Clipper
 - Time of landing allowing for use of Europa Clipper data for landing site evaluation and selection
- This presentation summarizes some of the findings and results of these studies to date – keep in mind that this is a work in progress

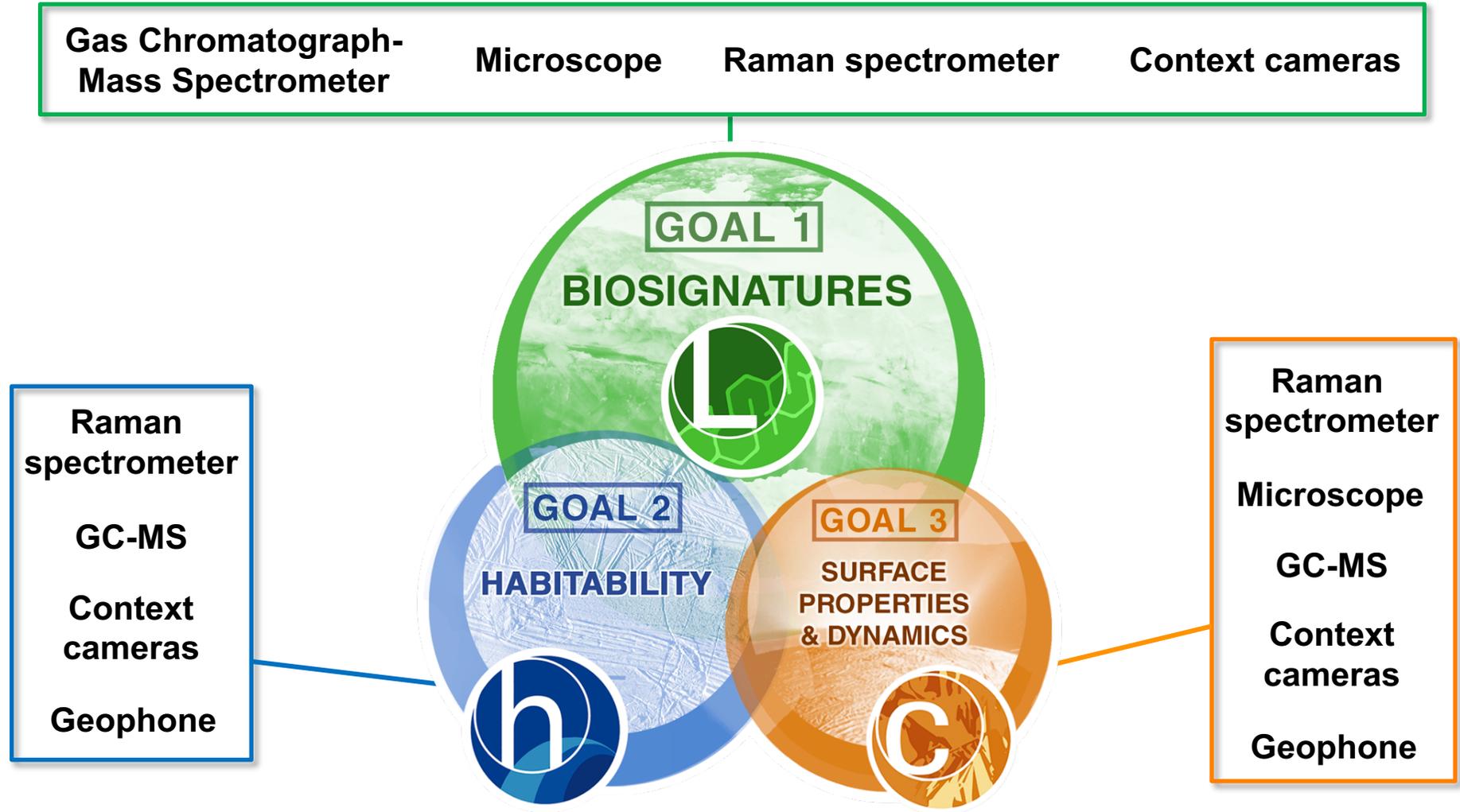


Initial Trade Space Exploration Led Towards Soft Landing as Preferred for Science Accommodation



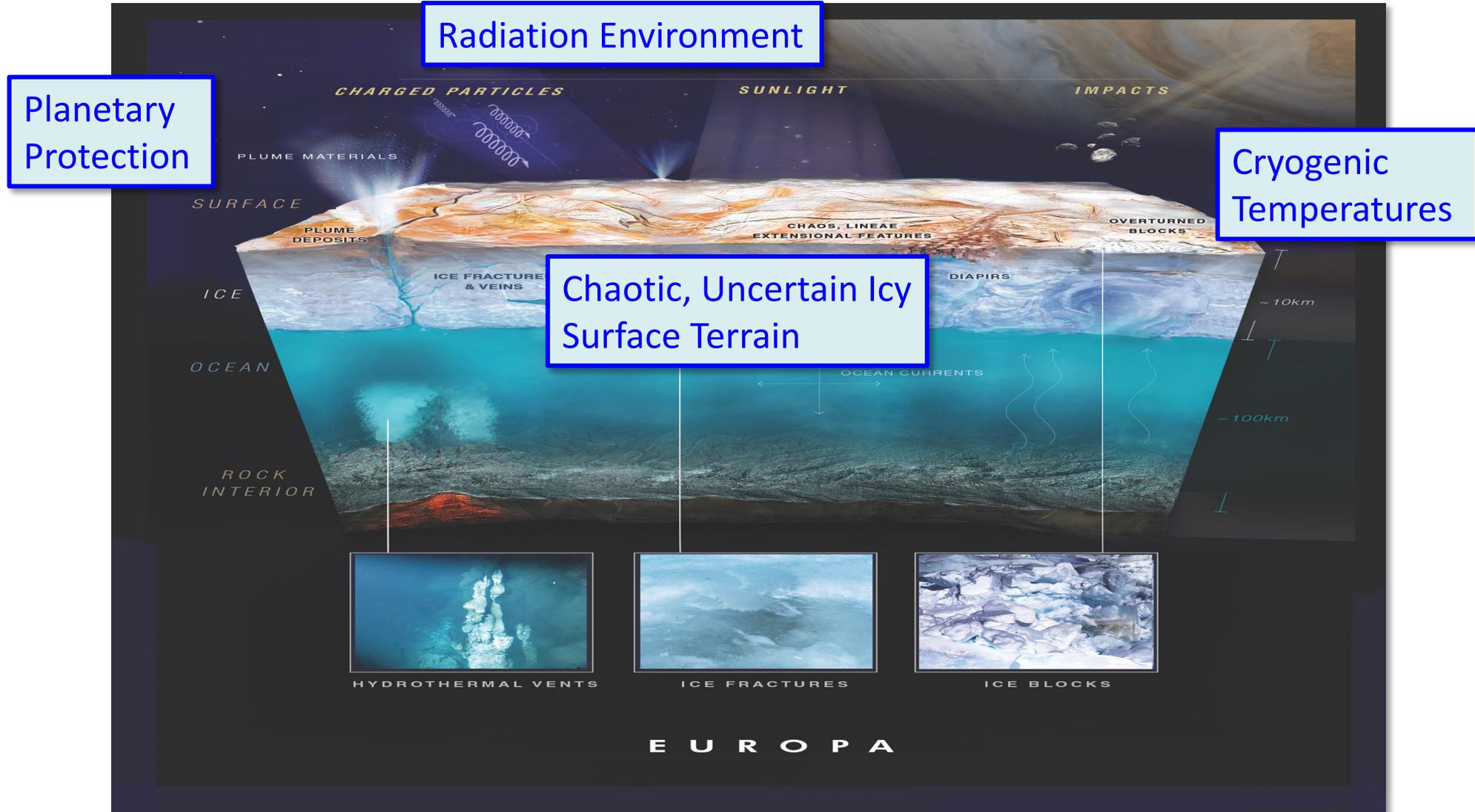


Science Definition Team Report: Model Payload Addresses A Connected Set of Goals and Objectives





Europa – Ocean World Environment and Its Challenges





Major Design Considerations

- Total Mission ΔV to Reach Europa's Surface
- Landing on Uncertain Terrain
- Science Payload Accommodation
 - Surface access for sampling
 - Power management and Earth communication
- Surface Operations
 - Power and thermal management
 - Use of automation
- Planetary Protection

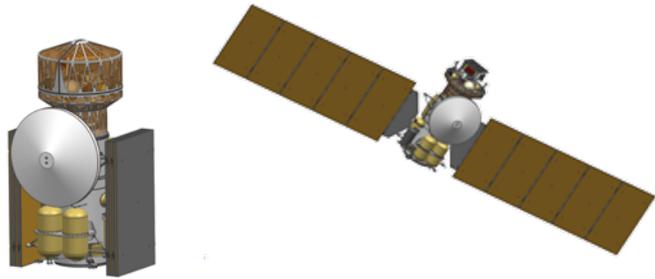


Current Working Baseline Concept



Launch

- SLS Block 1B
- Nov 2026



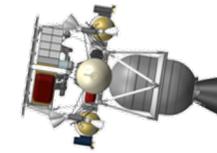
Cruise/Jovian Tour

- Jupiter Orbit Insertion: June 2031
- Europa Landing: 2033



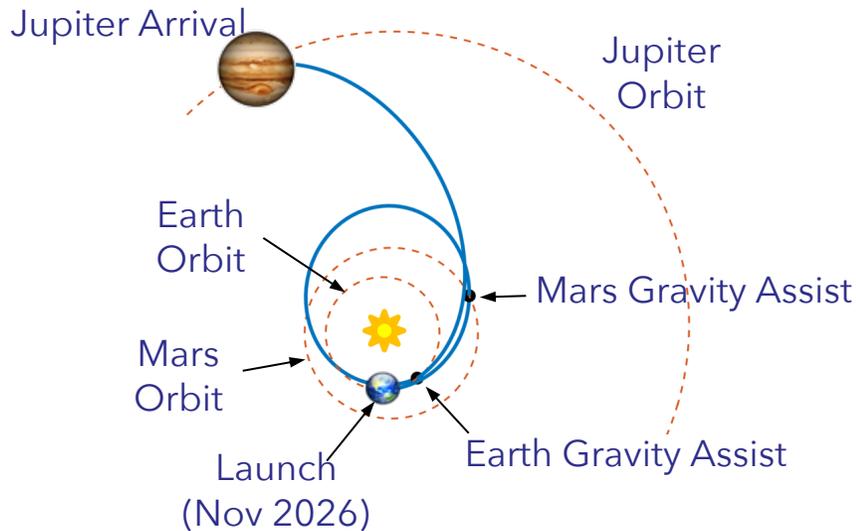
Carrier Stage

- 2.0 Mrad radiation exposure
- Elliptical disposal orbit



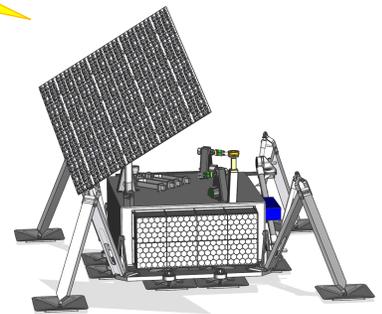
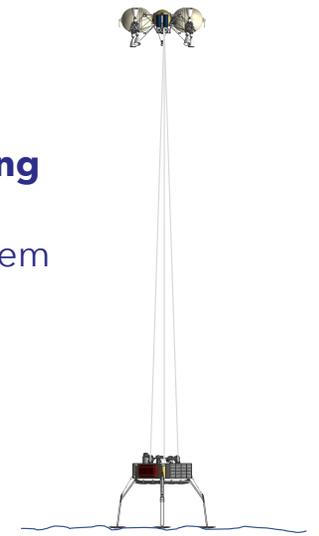
Deorbit, Descent, Landing

- 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 Communication or Clipper (backup)
- 1.5 Gbit data return
- 50 kWh battery stored energy
- 2.0 Mrad radiation exposure

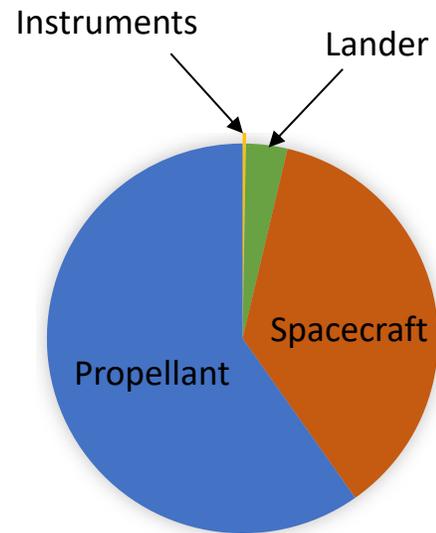
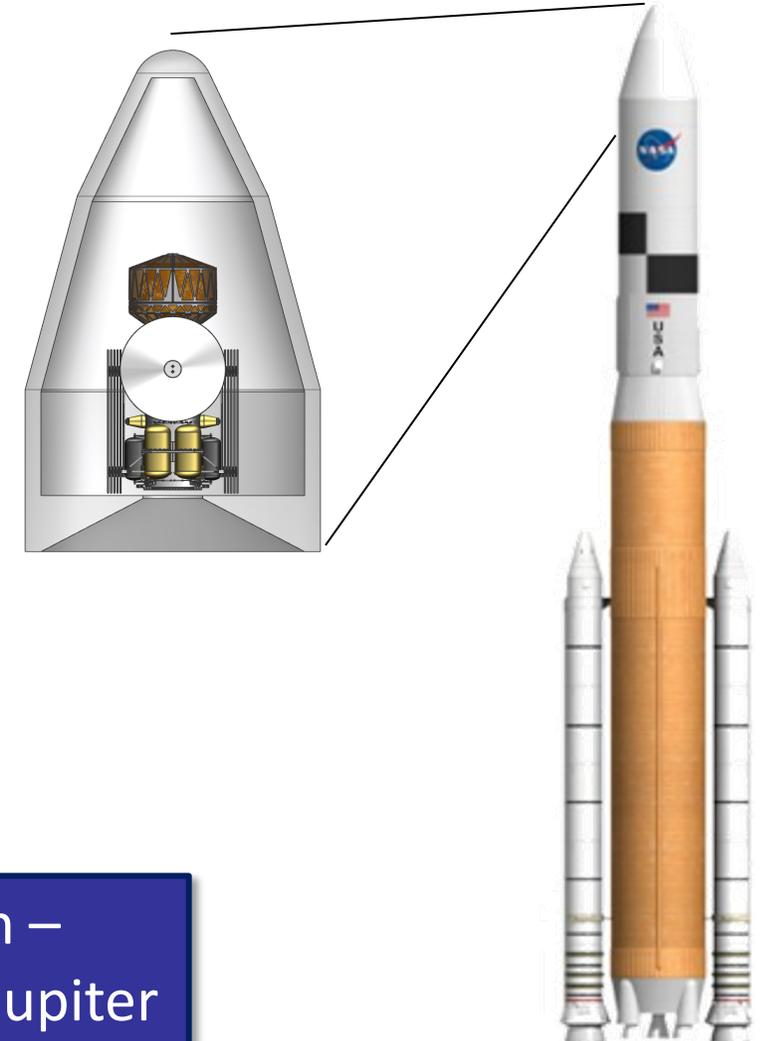


Leverage past flight experience and high-TRL tech development to reduce mission risk



Key Design Driver: Mission ΔV Requirement

- Large ΔV is required to reach Europa
 - 2 km/s to transfer to and enter into Jovian system, then achieve orbit around Europa
 - 2 km/s to de-orbit and land on Europa
- Results in over 15,000 kg launch mass

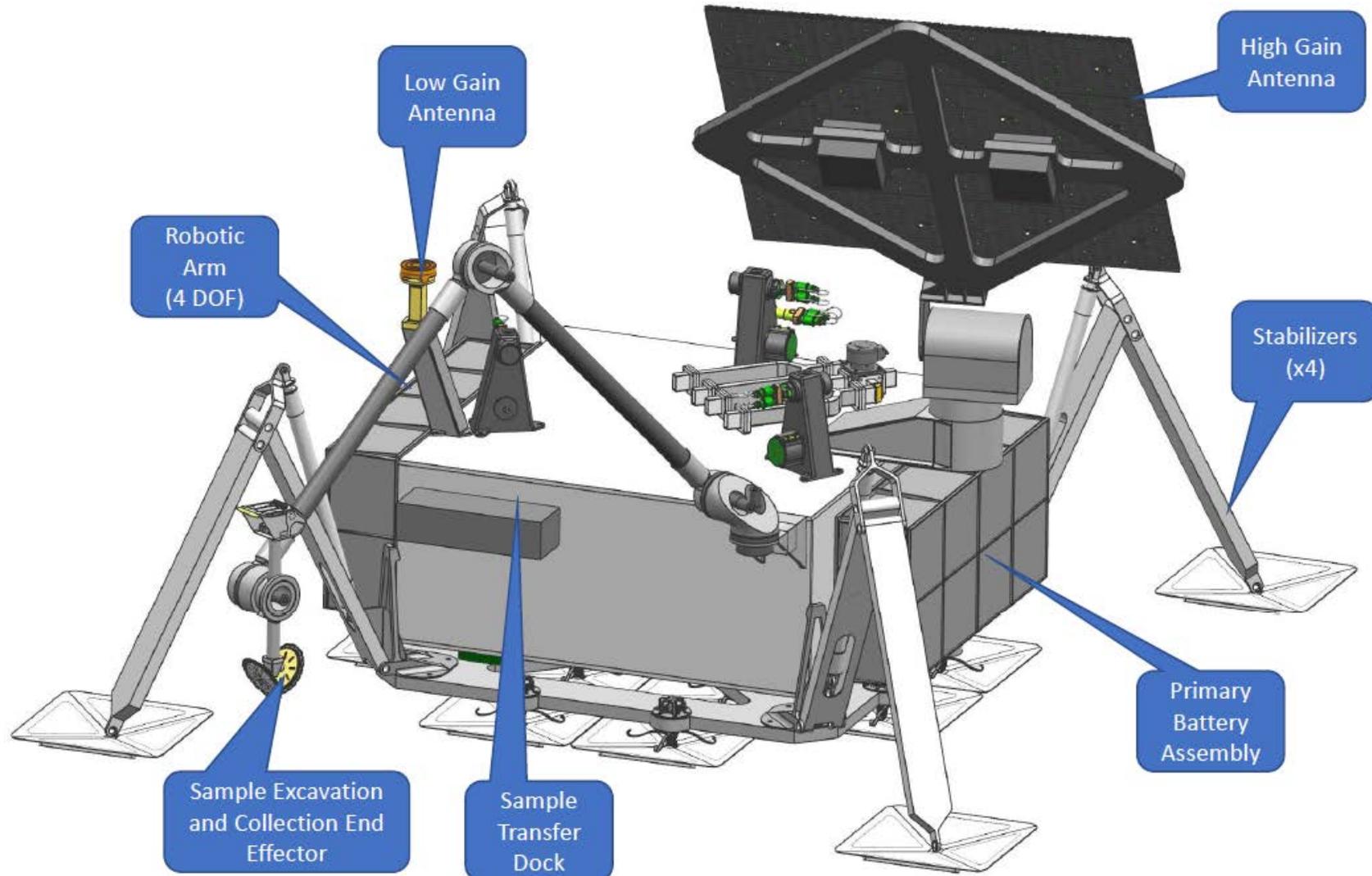


Launch Mass Breakdown

SLS Block 1B Launch System –
18,000 kg launch capability to Jupiter



Lander Deployed and Configured for Surface Operations (current baseline configuration)





Advanced Development: Sampling Arm

StORM: The fully instrumented Kuka Arm



**Blade feature refinement & comparison;
Fault behavior & response**

Mario: The Pipe Arm



Arm Configuration & Dynamics

Luigi: 5-DOF Manipulator

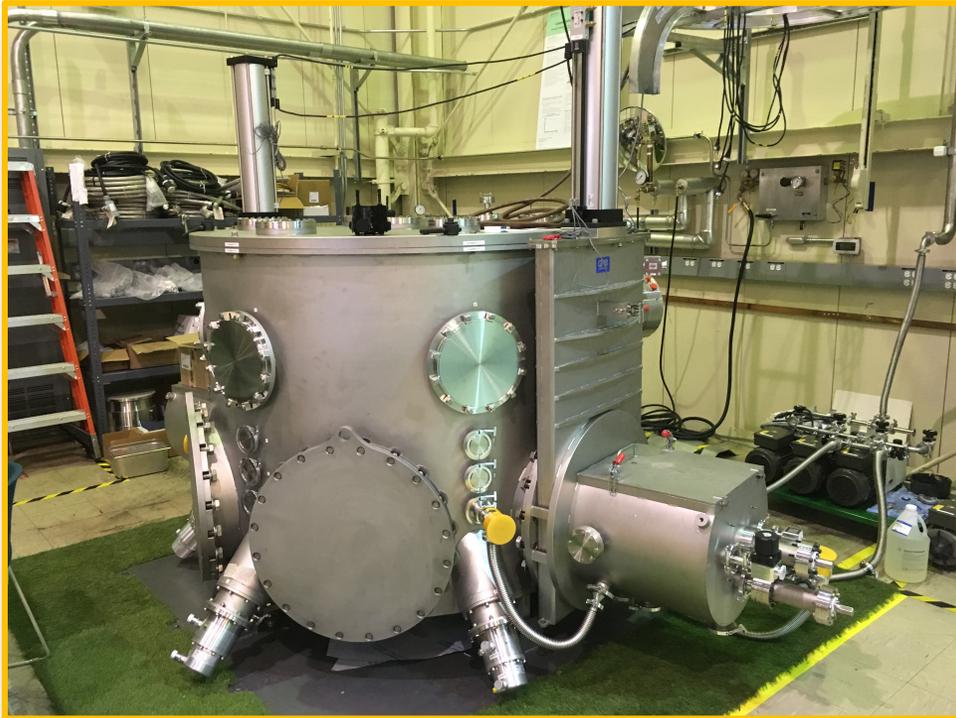


Sensing & Algorithm Development



Advanced Development: Recreating Europa's Environment

CITADEL Cryo-Vacuum Chamber

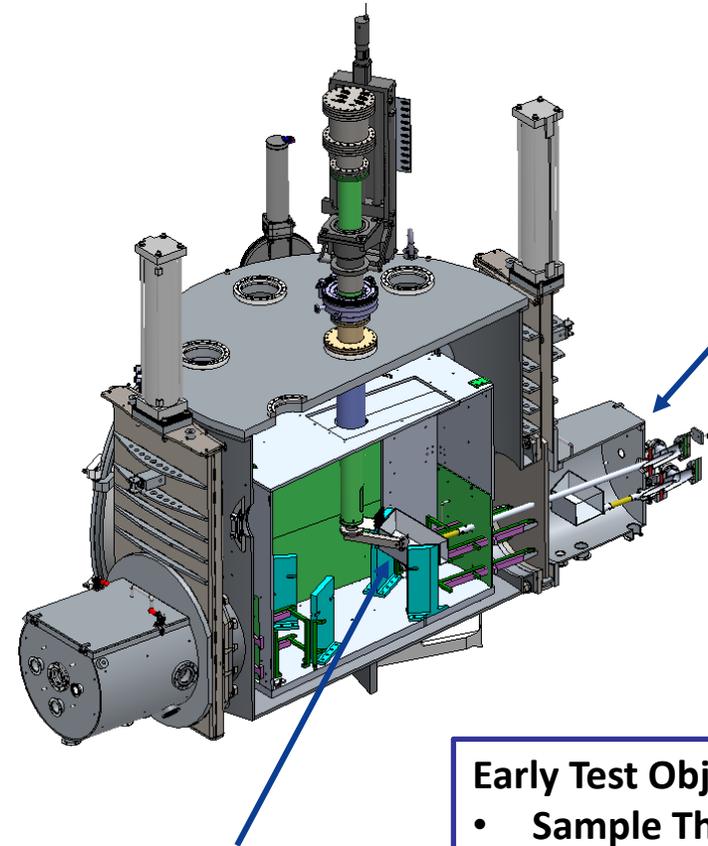


Europa relevant environment

T = 70-100K

P = 10^{-5} Torr

Robotic Manipulator for Tool-
Ice Interaction



4x Load Locks w/ Gate Valves
For Europa Simulant Change-out
& Inspection

Early Test Objectives:

- Sample Thermal Integrity Testing
- Collection Tool - Ice Interaction & Chip Dynamics
- Sample Handling Chain
- Initial material & component shakeout