



Prioritized Technology: Surface cryogenic ice sample acquisition and handling Europa Lander

Capability Description

Key Mission Requirements

Unknown surface topography
Unknown material properties

Sample temperature < 150K

Potential for sample adhesion

Limited command opportunities

Key Design Principles

Mechanically robust design

Thermally isolate and minimize handling

No gravity for sample handling

Sensing to enable autonomy

Mission Applications

- Europa Lander Pre-Project
 - Excavation to access unaltered subsurface material
 - Collection of material with wide-range of potential properties
 - Sample delivery with minimal alteration
- Surface sample acquisition missions, especially cold temperature (comet, asteroid, Enceladus, Mars, etc.)



Capability Status

- Extensive trade studies and testing resulted in conceptual baseline for Europa Lander:
 - Excavation: Counter Rotating Saw
 - Collection: Augmented Phoenix ISAD
 - Sample delivery: Individual Cup Concept
- Fielded key testbeds for higher fidelity testing
 - StORM (Stiff Operationally Flexible Robotic Manipulator) - KUKA
 - ELSA Dirty Mid-Size Chamber (TVAC) – [procured, not operating]
 - ELSA 5-DOF Ambient Arm - [in process]

Development Cost and Schedule