Jet Propulsion Laboratory
California Institute of Technology

Mars Orbiting Sample (OS) Capture and Containment Technology Development

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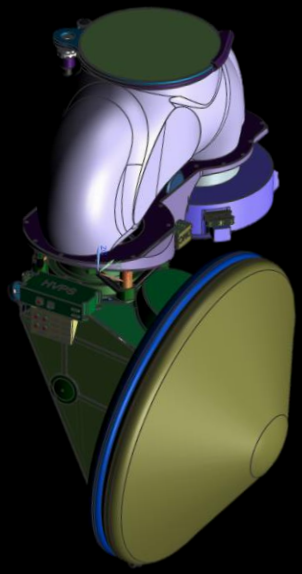
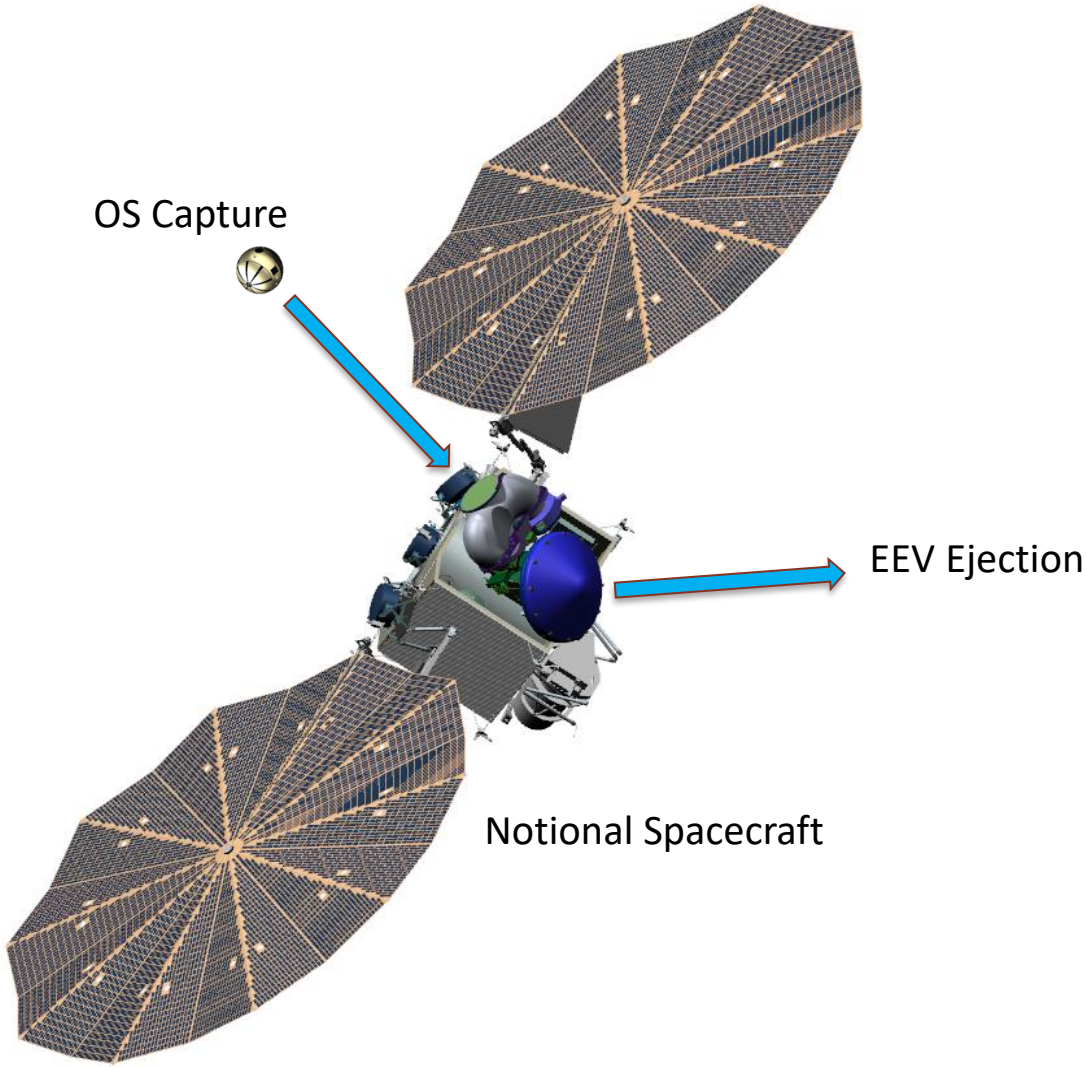
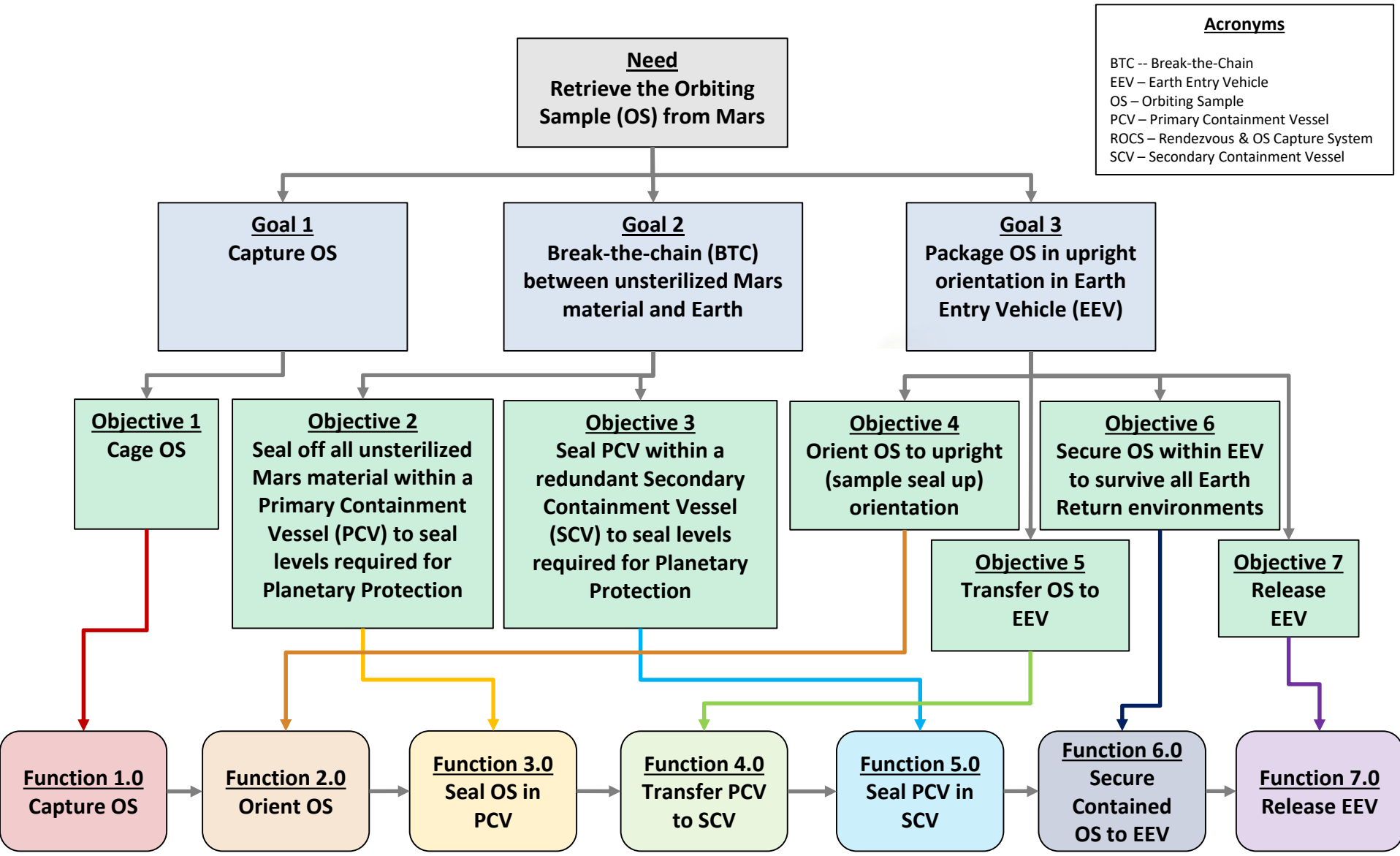


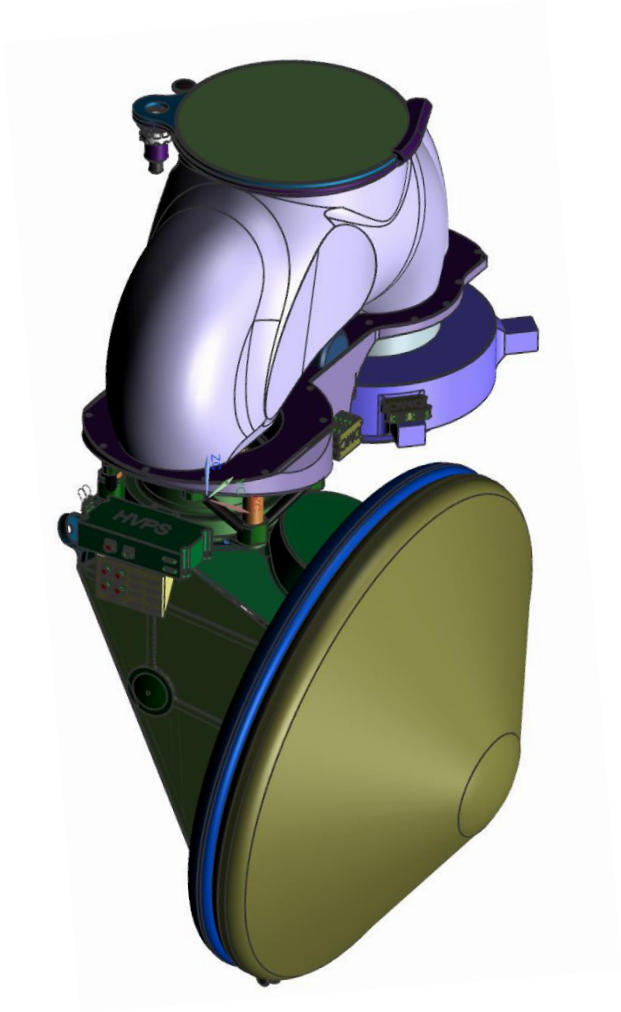
ROCS on a Notional ERO spacecraft

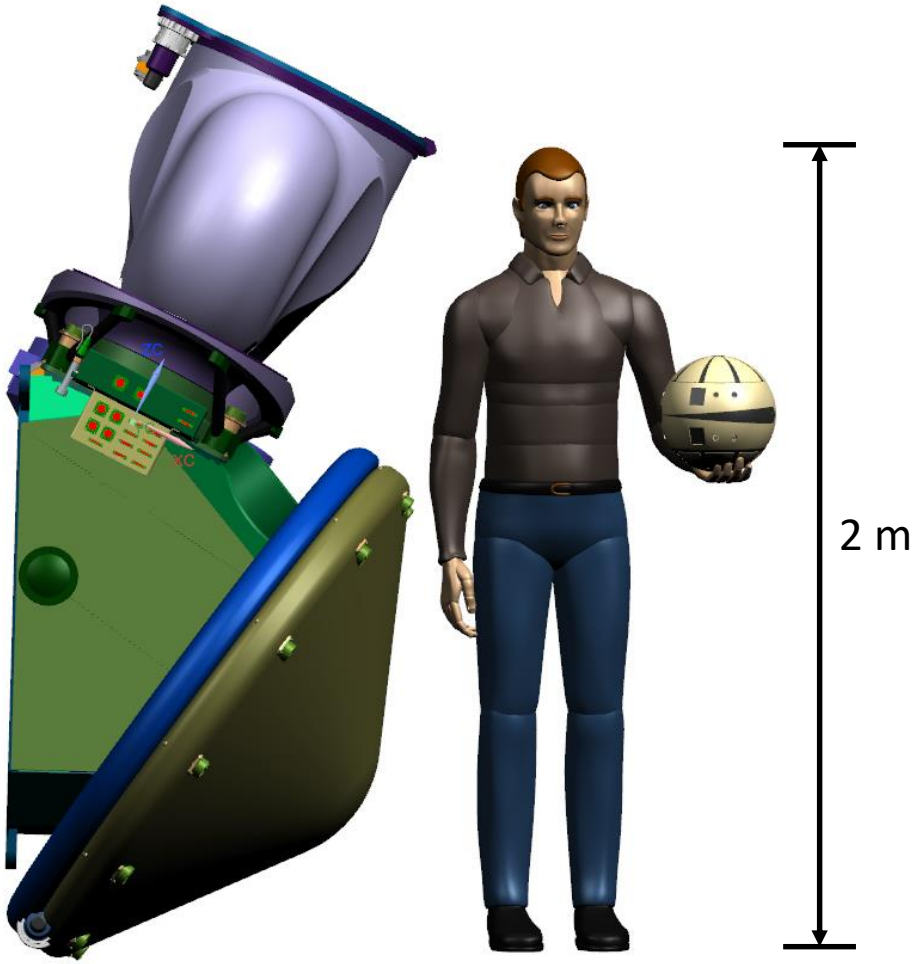


ROCS Need, Goals, Objectives, Functions



ROCS Payload

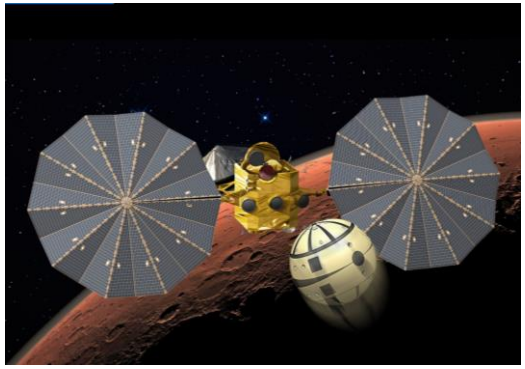


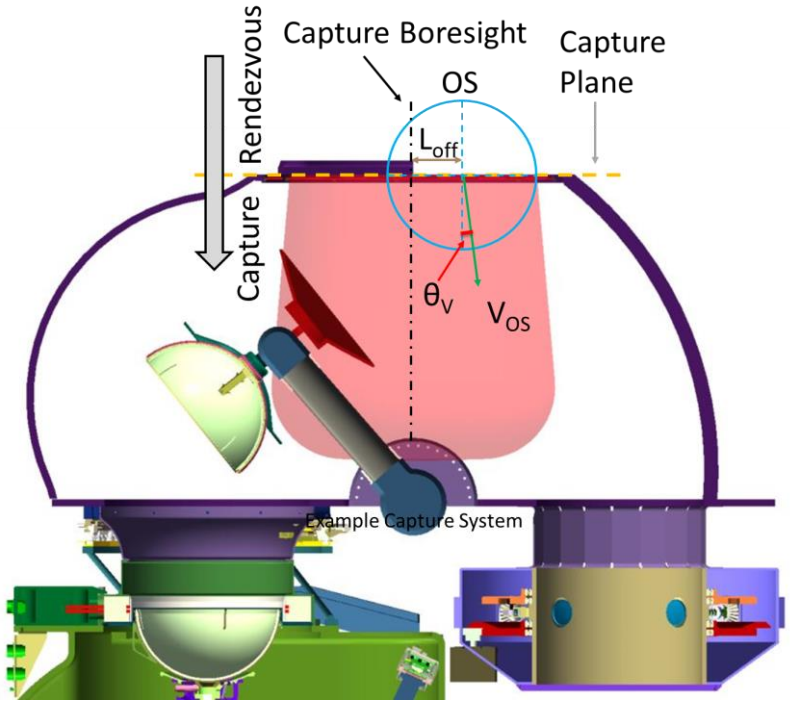


"Wizard"

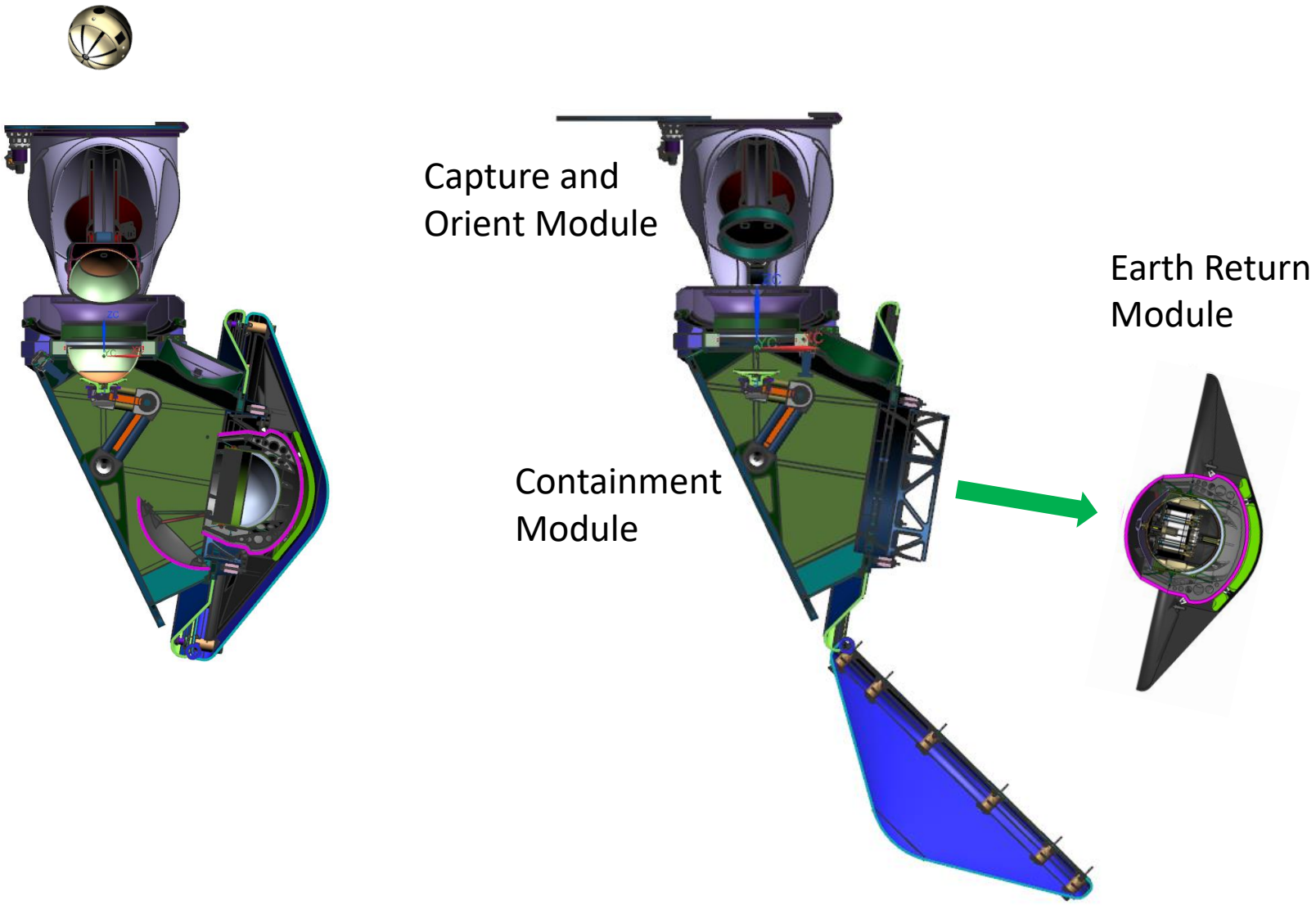
OS Assumptions for Capture

- Diameter = Maximum [28 cm]
- Mass = Maximum [12 kg]
- Center-of-mass offset = Maximum [1 cm]
- Moment of inertia = Maximum [0.15 kg-m^2]
- Albedo = [>0.37] in visible
- L_{off} = [10] cm
- V_{OS} = [2] to [10] cm/s
- θ_V = 5°

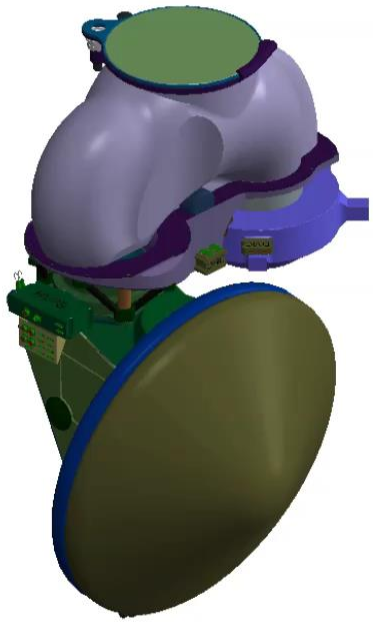




ROCS Payload Modules



ROCS CONOPS - Animation

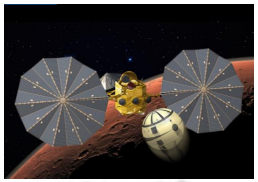


Capture and Orient Module Architecture

Capture Plane

1 Capture OS

- Ø28 cm
- 12 kg
- 10 cm/s



Capture and Orient Module

Capture and Orient Module to Containment Module Interface Plane

Capture Mechanism

Transfer Path

Transfer Mechanism

Cap

Base

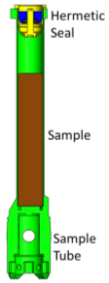
3 Assemble OS in Primary Containment Vessel (PCV)

- 200 N load
- 1 mm precision

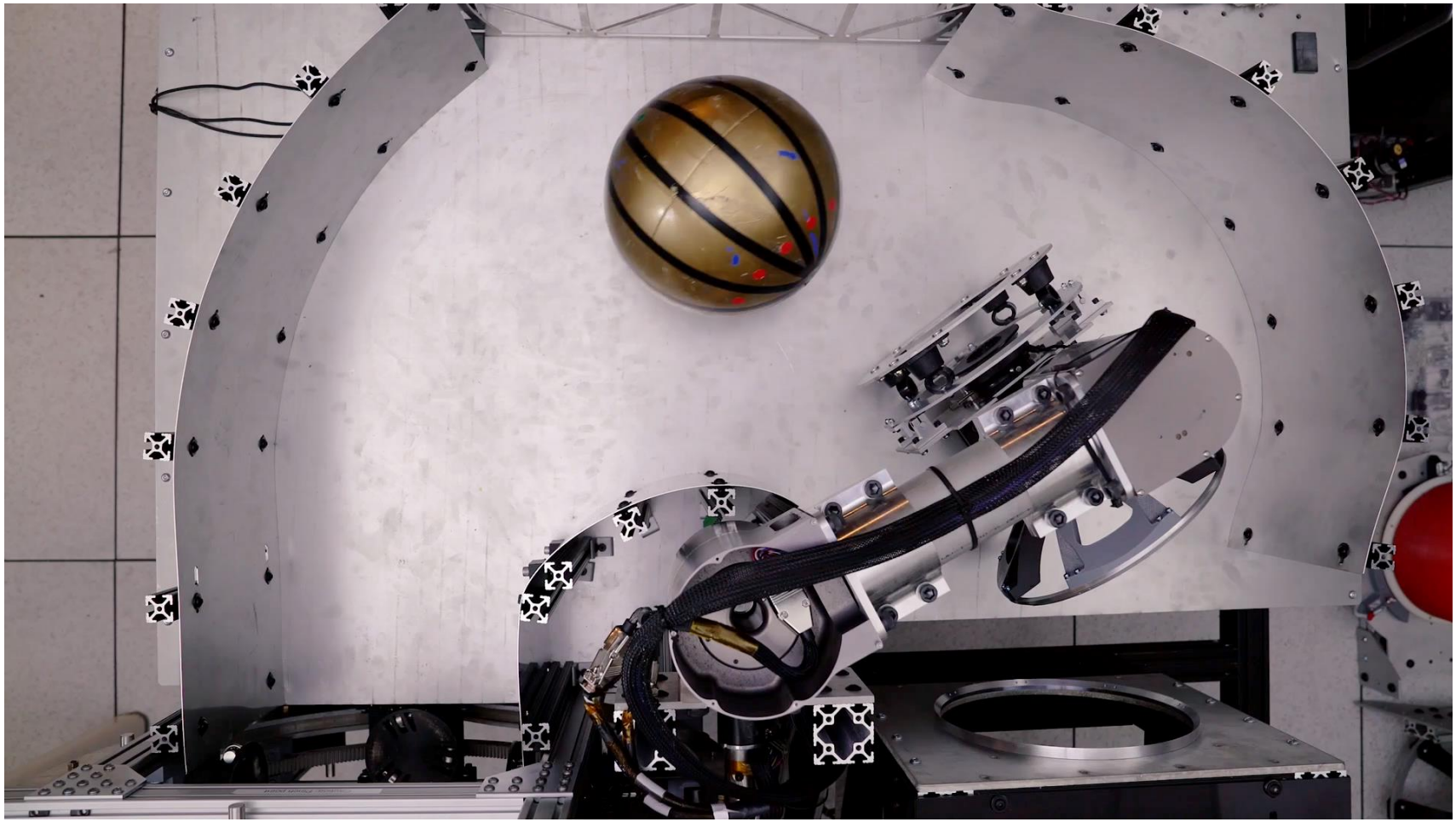
2 Orient OS

- ±5° vertical

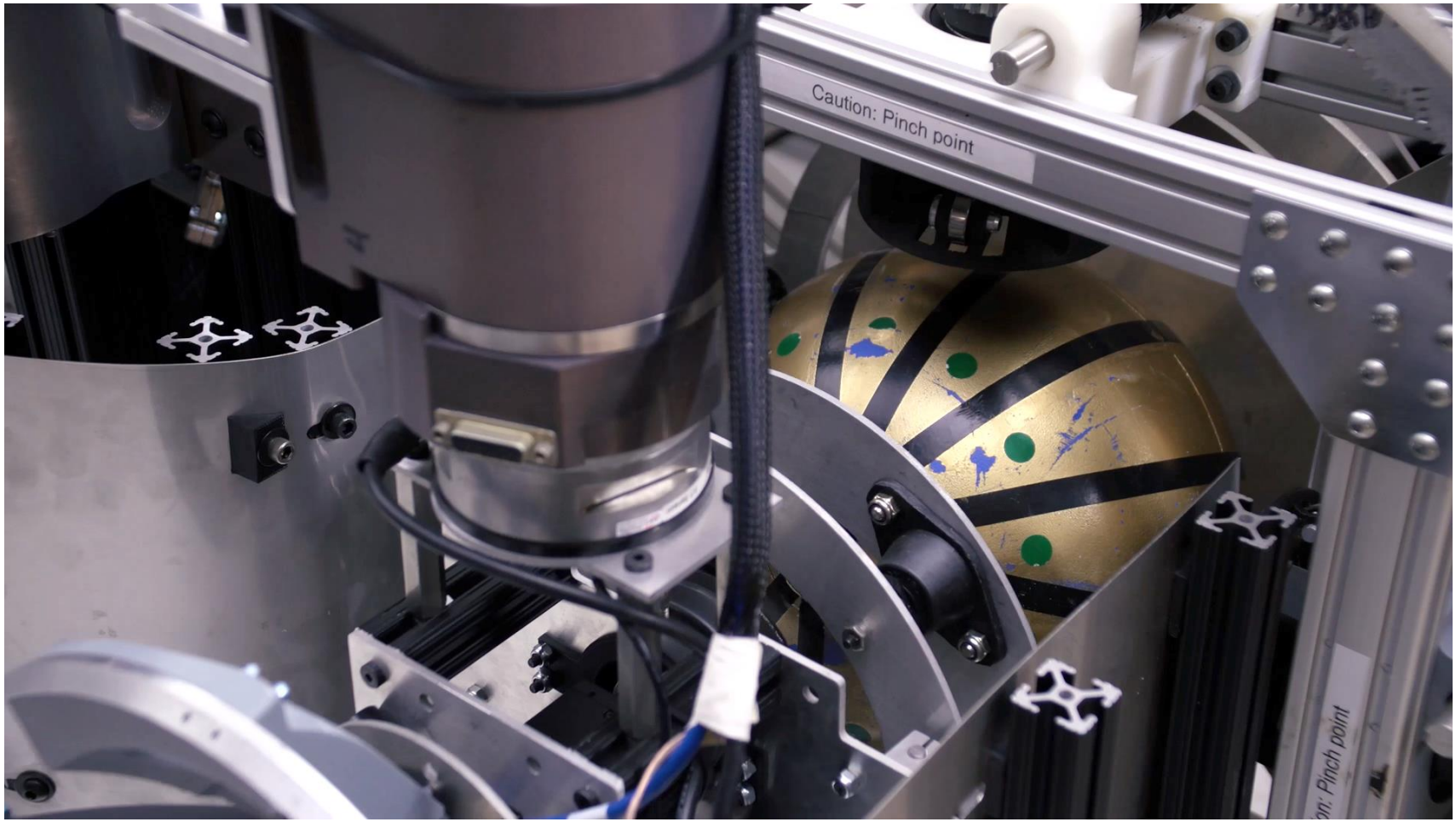
Orientation Mechanism



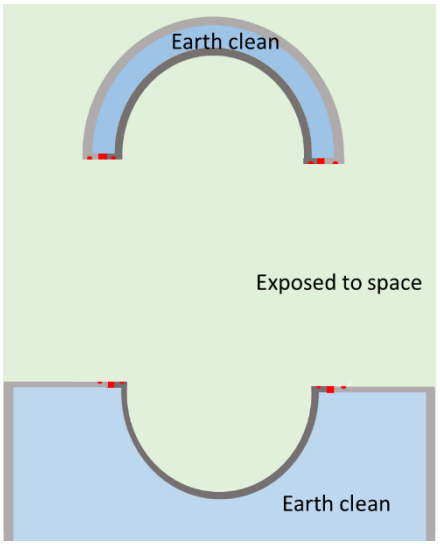
Prototype Testing: Capture and Transfer



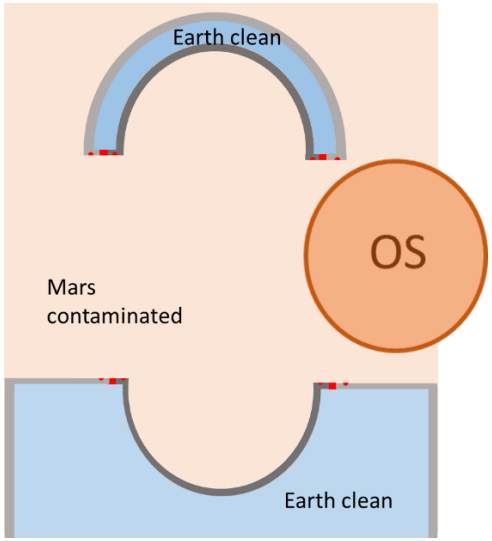
Prototype Testing: Orientation



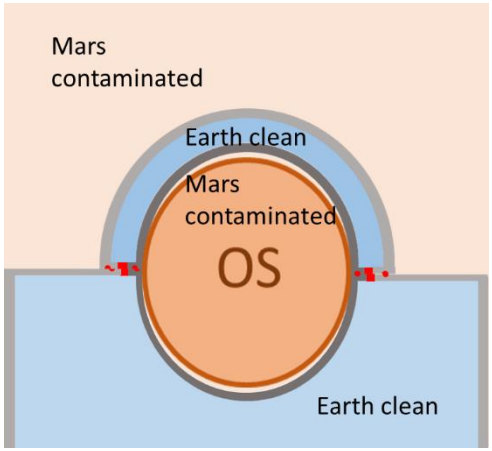
Breaking the Chain of Contact Using Brazing



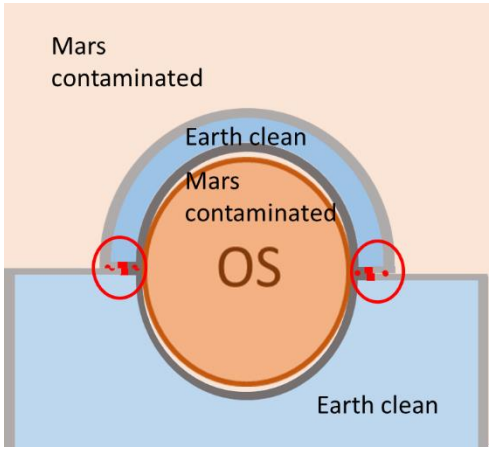
In space



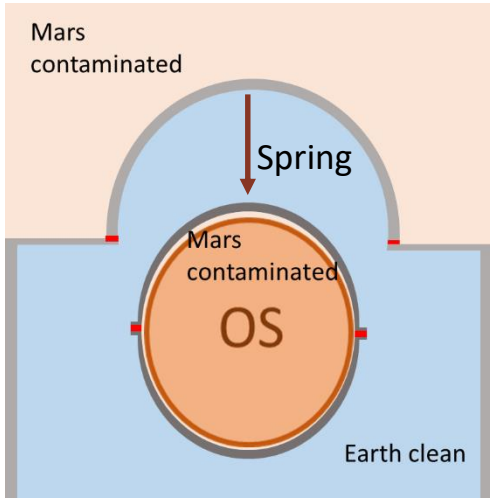
OS capture



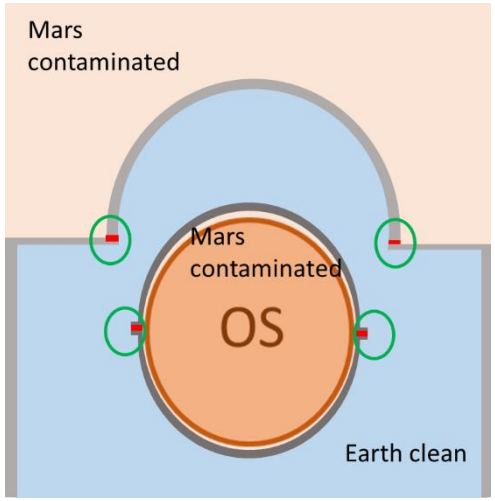
Enclose OS



Activated heating
(Sterilizing and Sealing)



Separation

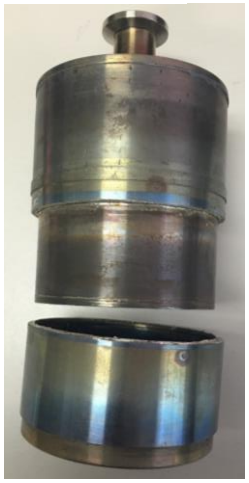


Passive cooling (Seaming)

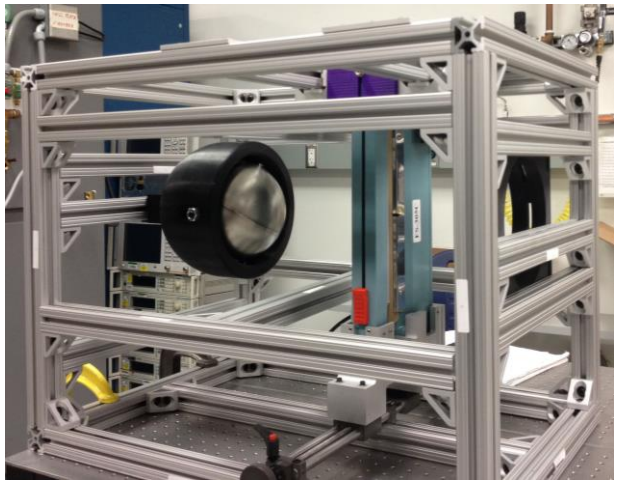
Break-the-Chain Technology Development

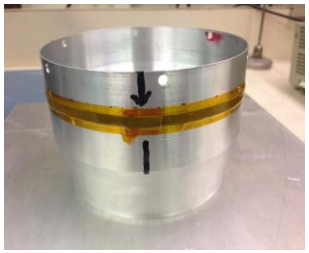
- Several technologies evaluated:
- Sealing modalities for inflight BTC (provides clean container and separated segments)
  - Brazing
  - Bagging
  - Explosive welding
- Sterilization modalities
  - Plasma
  - Hot gas or electric oven
  - Pyrotechnic surface treatments
  - Laser ablation
- Sealing modalities for secondary container
  - Knife-edge
  - Elastomeric o-ring

Brazing



Bagging





Explosive Welding

Status and Future Work

- Technology development (2014-present)
  - Capture/orient strategies (mechanical, magnetic, etc.)
  - Containment assurance/break-the-chain (brazing, explosive welding, bagging, etc.)
  - EEV technologies (TPS, impact attenuation)
- System architecting and concept development (2015-present)
  - Numerous concepts developed under auspices of NASA Mars Program Formulation Office
  - Today's end-to-end system concept for reference
- System engineering (2017-present)
  - CAD drawings
  - MEL and other system resources
  - Interface definition documentation beginning soon

Our major focus for the next 1-2 years is continuing maturing the technology and system concept, preparing for future flight system development