National Aeronautics and Space Administration

Sample Capture and Orientation Technologies for Potential Mars Sample Return

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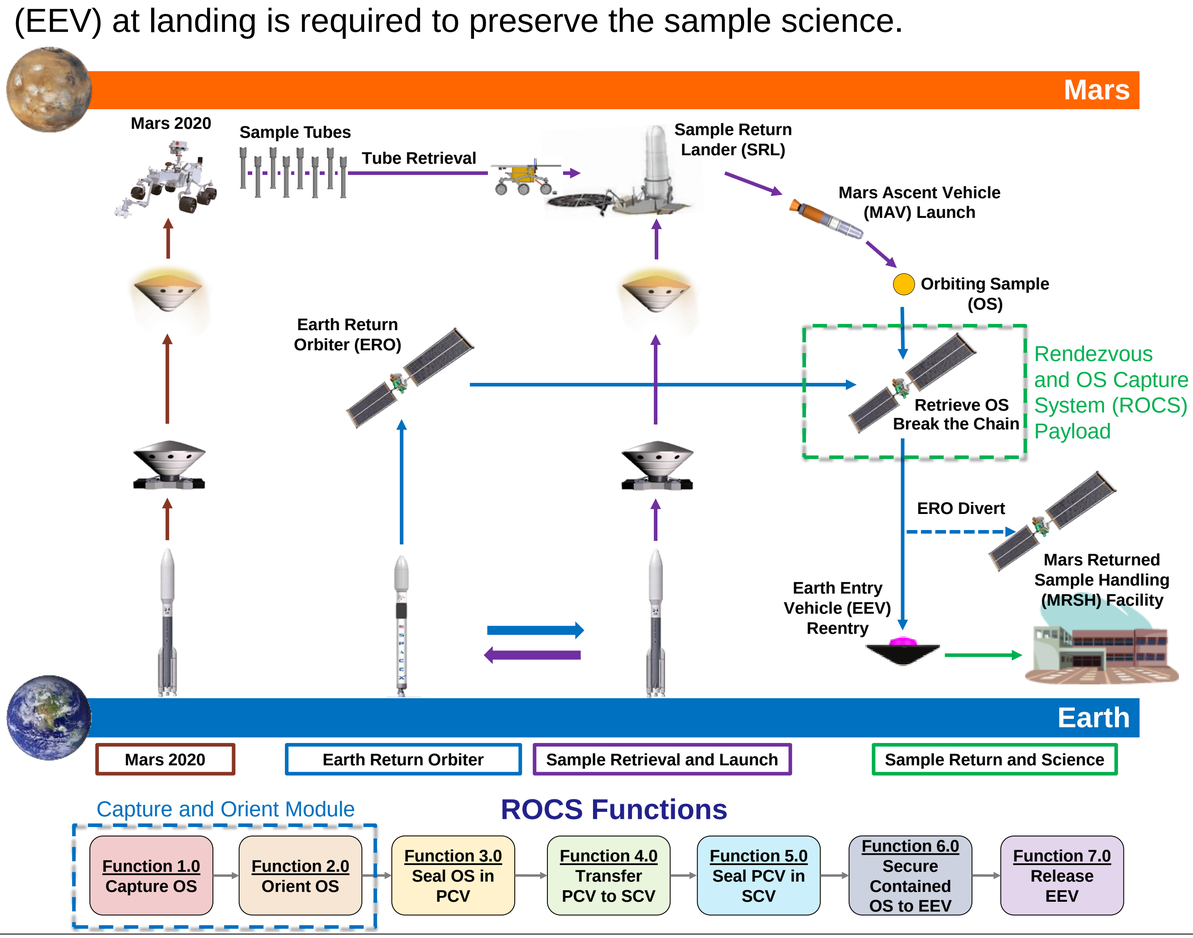
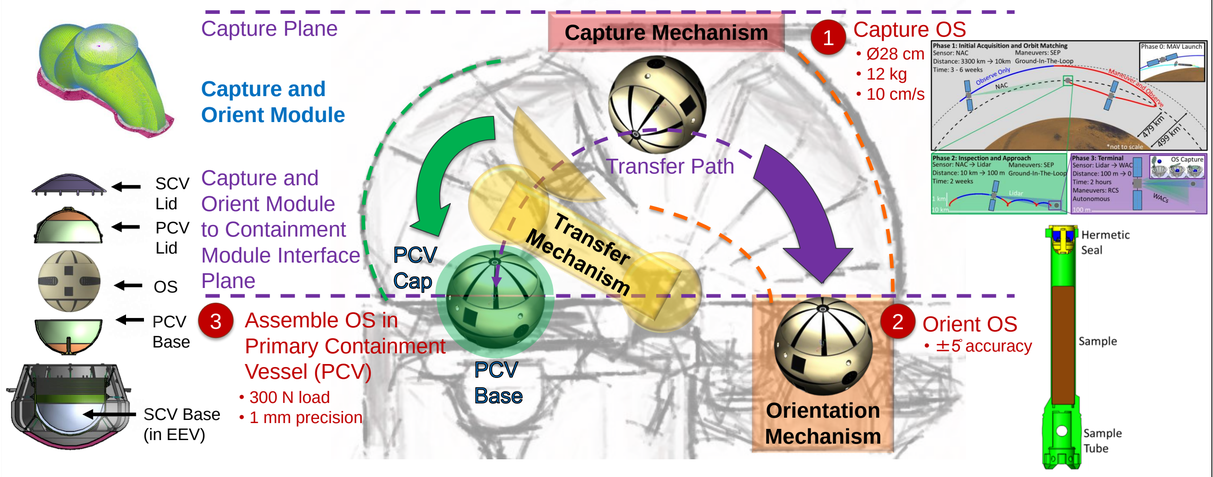
Notional MSR Mission Architecture

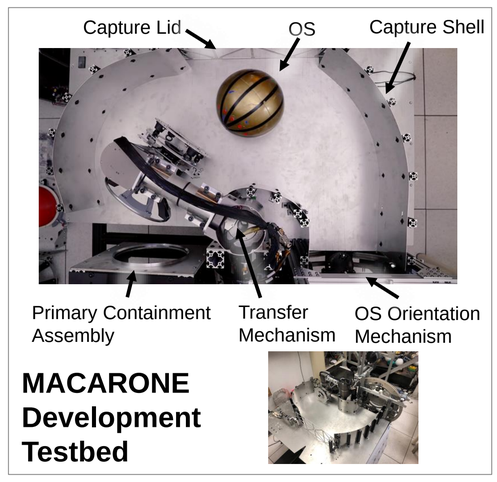
Making significant progress towards Mars Sample Return (MSR) was recommended as one of the highest-priority goals for the decade 2013-2022 by the 2011 Planetary Decadal Survey. This research focuses on assessing technologies applicable to the Orbiting Sample (OS) capture and orientation functions of the Earth Return Orbiter (ERO). On-orbit OS capture is required for ERO OS retrieval, and orientation of the OS relative to the Earth Entry Vehicle (EEV) at landing is required to preserve the sample science.



Capture and Orientation Module

The **MA**rs **CA**pture and **R**e**O**rientatio**N** for **E**arth return (**MACARONE** Concept) architecture would perform three primary functions: 1) OS capture from Mars orbit, 2) OS orientation to orient the sample tubes relative to the EEV landing orientation for sample science preservation, and 3) OS assembly in the Primary Containment Vessel (PCV) for bio-containment and break-the-chain operations.



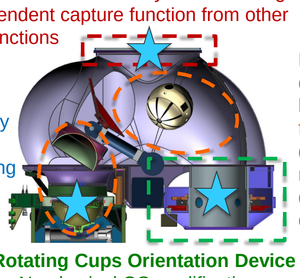


"Capture before Contact" Capture Lid

- Contains potential dust on OS prior to first contact to reduce spacecraft contamination risk
- Eliminates the need to simulate contact dynamics for capture verification and validation analysis and testing
- Separates time-dependent capture function from other time-independent functions

Subsystem modularity allows for development flexibility and technology flexibility with clean:

- Functional partitioning
- Spatial partitioning
- Interfaces



Mission-critical containment hardware isolated from dynamic OS during capture, reducing risk of damage from contact

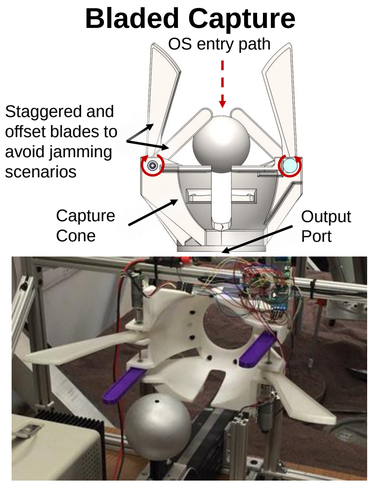
MACARONE Architecture Benefits

Rotating Cups Orientation Device

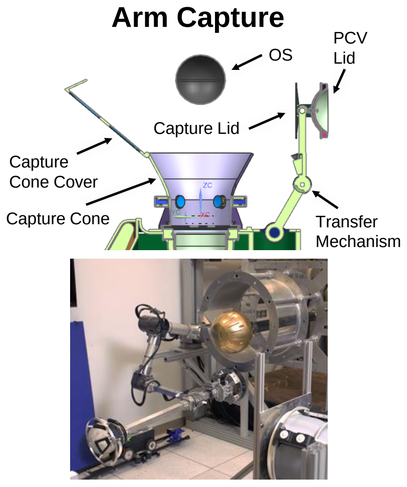
- No physical OS modification required
- Cups stow within structure during OS capture
- Deterministic, quasi-static operation, testable in 1 G

OS Capture and Orientation Technologies

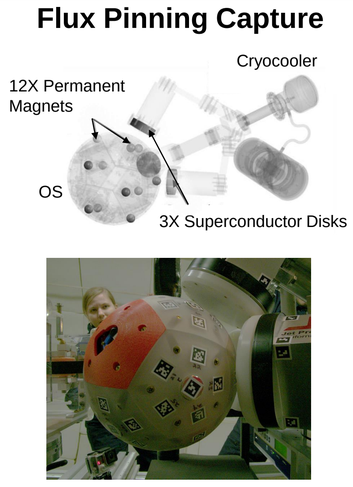
Bladed Capture



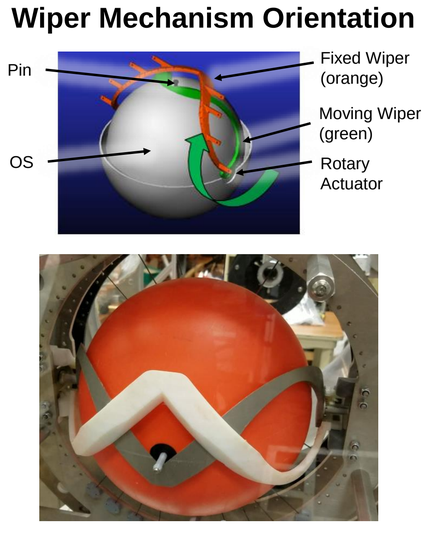
Arm Capture



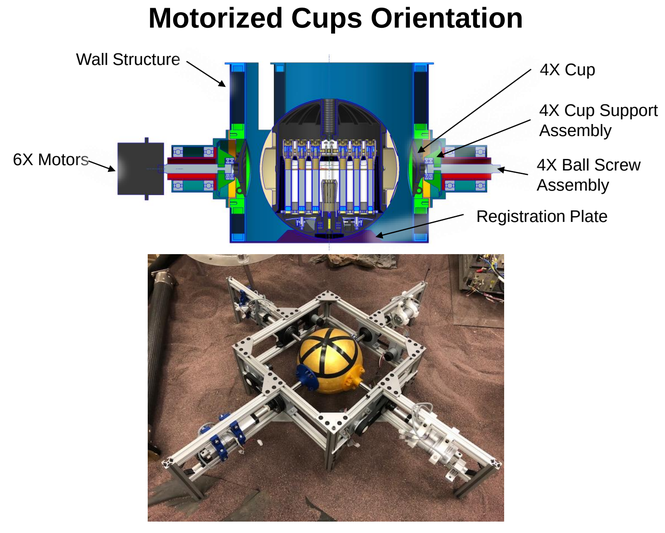
Flux Pinning Capture



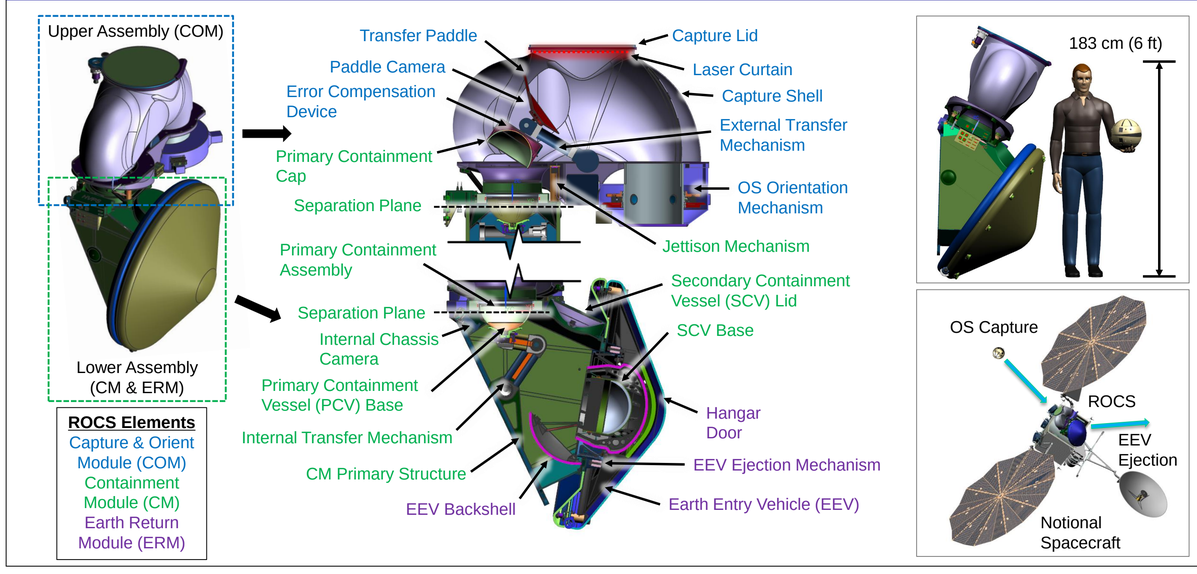
Wiper Mechanism Orientation



Motorized Cups Orientation



Rendezvous and OS Capture System Concept



Reference

Younse, P., J. Strahle, M. Dolci, P. Ohta, K. Lalla, and E. Olds, "An Orbiting Sample Capture and Orientation Element Architecture for Potential Mars Sample Return," IEEE Aerospace Conference, Big Sky, MT, Mar. 3-10, 2018.

Acknowledgements

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