ORBATING SAMPLE CAPTURE AND ORIENTATION TECHNOLOGIES FOR POTENTIAL MAR
SAMPLE RETURN. P. Younse1, R. Adajian1, M. Dolci2, P. Ohta3, E. Olds4, K. Lalla5, and J. W. Strahle1. 1Jet
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Introduction: Making significant progress towards Mars Sample Return was recommended as one
of the highest-priority goals for the decade 2013-2022 by the 2011 Planetary Decadal Survey [1]. A notional
architecture for sample return is described in [2], which is composed of the Mars 2020 rover to acquire
the samples, a Sample Return Lander (SRL) to recover the samples and launch them into Mars orbit within an
Orbiting Sample (OS) container using a Mars Ascent Vehicle (MAV), and a Sample Return Orbiter (SRO)
to retrieve the OS from Mars orbit and deliver it to Earth within an Earth Entry Vehicle (EEV). This re-
search focuses on assessing technologies applicable to the OS capture and orientation functions of the SRO.
Effective on-orbit OS capture is required for SRO OS retrieval, and manipulation of the OS into an upright
orientation relative to the EEV at landing is needed to preserve the sample science. It should be recognized
that all studies described here are preliminary results of work in progress and that no decisions on the design
or implementation of a Mars Sample Return mission have been made by NASA.

Capture Technologies: Explored capture technologies include Bladed Capture, Capture Arm, and
Flux Pinning (from left to right in Fig. 1). Bladed Capture uses a twin sets of blades that rotate inward to
cage the OS within a capture cone. Capture Arm uses a three-degree-of-freedom robotic arm to cage the OS
within a capture cone. Flux Pinning uses cooled superconductors to pin the magnetic flux lines from magnets
on the OS at a fixed position and orientation.

Orientation Technologies: Explored orientation technologies include Wiper Mechanism and Motorized
Cups (from left to right in Fig. 2). The Wiper Mechanism orients the OS by rotating a moving wiper, which
guides a pin on the OS along a fixed wiper until it settles in a groove at the final orientation. The Motorized
Cups orients the OS by using contact friction between the OS and two sets of rotating cups arranged 90-degrees apart.

Figure 1: Capture technologies [2], [3], [4].

Figure 2: Orientation technologies [2], [3].

Integrated Capture and Orient Module MACARONE concept layout [2].

“Vision and Voyages for Planetary Science in the Decade 2013-2022”, National Research Council of the
F. et al. (2016) “Concept for Capturing and Docking Spacecraft with Flux-Pinned Interfaces,” 67th Interna-
tional Astronautical Congress.