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Mars Exploration – missions current and future (3A)

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MARS SAMPLE RETURN AND THE CAPTURE, CONTAINMENT, AND RETURN SYSTEM NEW DESIGN AND PATH TO 2027 LAUNCH

Abstract

The Mars Sample Return (MSR) campaign is one of the most ambitious and complex exoplanet scientific exploration missions currently underway. With the participation of NASA, ESA, and a large number of industry partners, MSR aims to bring back Martian subsurface soil samples with the goal of answering key questions about Mars' biological evolution. To accomplish this ambitious goal, the campaign relies on three separate flight elements and a ground element, each fulfilling a fundamental role to safely bring the samples back to Earth. Notably, the Mars Perseverance rover landed safely on Mars on February 18, 2021, the first of the three missions, and has already acquired viable samples during the subsequent months, as well as completed a sample depot on the Martian surface. Among the next recovery and return missions that are currently in development, the Earth Return Orbiter (ERO) mission hosts the Capture, Containment, and Return System (CCRS), which performs the crucial roles of capturing the orbiting sample in low Mars orbit (launched into orbit by another mission), containing it to avoid any cross contamination with the Earth biosphere, and returning it to Earth, landing it safely at the Utah Test and Training Range. The ground element is the Sample Receiving Facility, where the samples would be transported to be analyzed.

The CCRS continues its development having passed NASA's Preliminary Design Review. Since then, a number of changes were adopted by the project. The most profound changes include (a) a new structural design that improves compliance with the host spacecraft and removes kickstands for the Mars jettison element, (b) a new containment system, which dramatically simplifies the containment process of Mars materials, and (c) a change in the cone angle of the sample return capsule, making it more robust to entry and landing loads. CCRS is currently on track to the next milestone, Critical Design Review, expected in early 2024. This paper will discuss the aforementioned design changes, how they contribute to a better mission baseline, and the next critical steps of the mission towards its 2027 launch.