Mars Campaign Office

Polaris Project: Spaceflight Autonomous Multigenerational Microbial Sequencer (SAMMS)

Active Technology Project (2021 - 2025)

Project Description

Enabling Capabilities special project series: Polaris Project, small flight experiments or risk reduction projects to fulfill high-priority capabilities gaps.

Project Description & Objectives

In the SAMMS project we **automated an Oxford Nanopore library preparation and sequencing method to a CubeSat payload system.**

We **developed and demonstrated a breadboard system in a 4U CubeSat payload form factor** consisting of 3 modular components:

1. a multigeneration microbiological culture chamber,
2. a microfluidic charged info-storage polymer prep system (ChIPPS) sample extraction and purification device,
3. a microfluidic library prep device that interfaces with an Oxford Nanopore MinION sequencing device (COTS).

We aim to achieve full automation of the hardware to support a crew-free *in situ* sequencing capability for exploration.

Why this project is important & Tier 1 gap addressed.

The SAMMS capability can provide across-generation monitoring of microbes relevant to plant production, water purification processes or in-situ resource utilization under spaceflight conditions, including increased radiation and reduced gravity and is amenable to the spaceflight form factor (small, light and automated).

Anticipated Benefits

Four Tier 1 HEOMD Capability Gaps can be addressed:

06-117, Storing, processing, and analyzing of in-situ biological samples during Earth-independent operations;

06-118, Earth-independent food system;

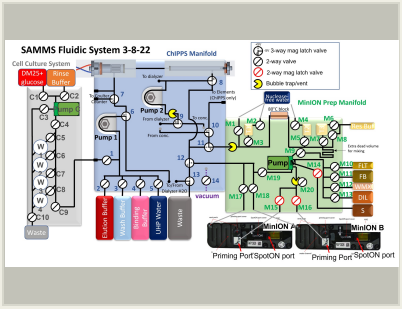
06-08, In-flight water Quality Monitoring for Quantification and Identification;

06-29, Safe, Acceptable, and Nutritious Food System.

Major Milestones

- Build/procure and test the three modular components of the device in isolation.
- Combine the three modular components for in-line operation.
- Demonstrate autonomous operation of the complete system.

Technology infusion & innovation approach



SAMMS Fluidic System

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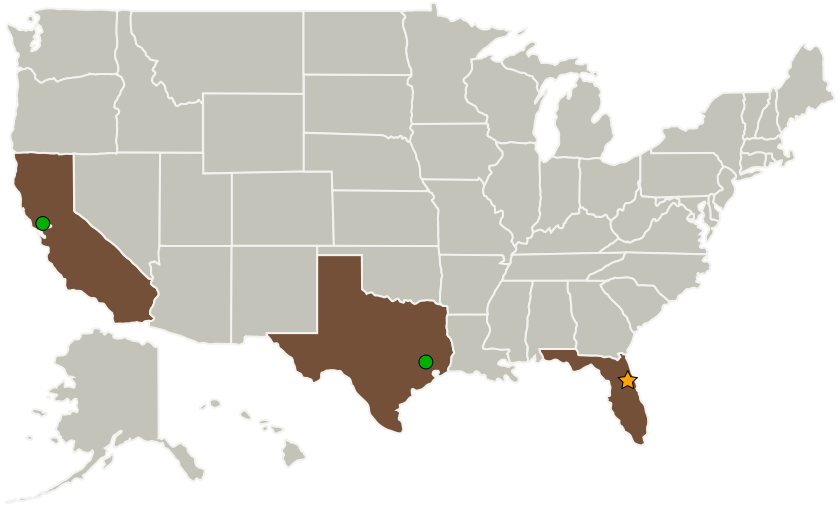
We will target one or more of several technology-infusion mission opportunities for the 4U SAMMS payload:

- With a 2U lander-interface module, it can be delivered as a self-contained 6U system suitable for operation on a commercial lunar lander, Gateway, or the ISS;
- With a 2U bus and spacecraft it can be deployed as a free-flying satellite in or beyond LEO, as a future *Artemis* secondary payload. SAMMS also will be adaptable to multiple flight-module habitats, including future space crop production hardware.

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
★Kennedy Space Center(KSC)	Lead Organization	NASA Center	Kennedy Space Center, Florida
●Ames Research Center(ARC)	Supporting Organization	NASA Center	Moffett Field, California
●Johnson Space Center(JSC)	Supporting Organization	NASA Center	Houston, Texas

Organizational Responsibility

Responsible Mission Directorate:

Exploration Systems Development Mission Directorate (ESDMD)

Lead Center / Facility:

Kennedy Space Center (KSC)

Responsible Program:

Mars Campaign Office

Project Management

Program Directors:

Lindsay T Aitchison
Dayna S Ise

Principal Investigator:

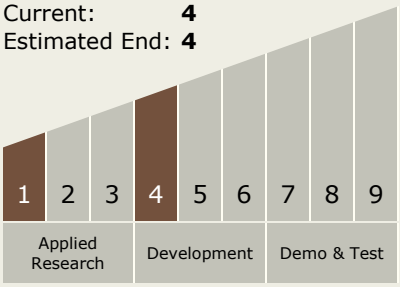
Aubrie E Orourke

Co-Investigators:

Sarah L Wallace
Antonio J Ricco

Technology Maturity (TRL)

Start: **1**
Current: **4**
Estimated End: **4**



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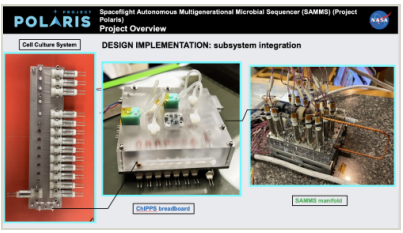
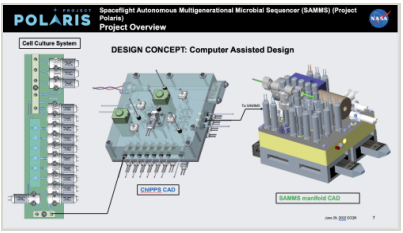
Primary U.S. Work Locations	
California	Florida
Texas	

Images



Builds of the three modular subcomponents
https://techport.nasa.gov/image/314614

Builds of the three modular subcomponents



CAD of the three modular subcomponents of SAMMS
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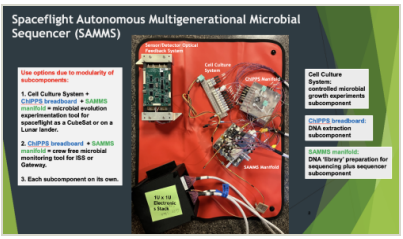
CAD of the three modular subcomponents of SA MMS



In-line assembly of the three modular components and use cases
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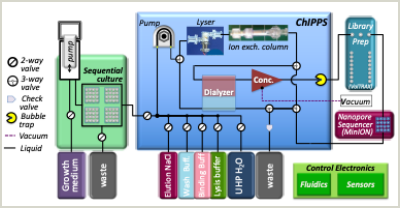
In-line assembly of the three modular compone nts and use cases



SAMMS FLAT-SAT fluidics schematic
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SAMMS FLAT-SAT fluidics schematic

Technology Areas

Primary:

- TX06 Human Health, Life Support, and Habitation Systems

Target Destinations

Mars, Foundational Knowledge, Moon and Cislunar

Views on TechPort

15 views

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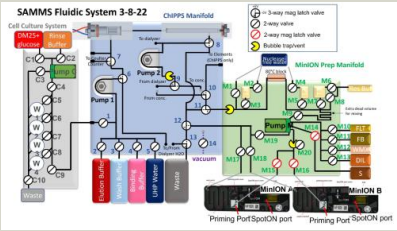

SAMMS Fluidic System

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SAMMS Fluidic System