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MILAB, A BIOMEDICAL PLATFORM FOR THE ISS

Abstract

MiLab is a comprehensive, versatile life sciences laboratory which promises to position Canada at the forefront of bio-analysis in space. While MiLab builds on successful technology elements of Microflow1 (demonstrated onboard ISS in early 2013), it represents a completely new technological advancement that would provide the first operational flow cytometer laboratory in space with permanent infrastructure for conducting versatile science and medical biomarker detection. This novel biomedical platform can be used for a broad range of research including cardiovascular dysregulation, bone loss, muscle atrophy, hematology, and immune response under stressful and radiation conditions, as well as supporting ongoing astronaut health bioanalysis and monitoring. This autonomous bio-diagnostic laboratory brings to the ISS two unique technologies that enable in situ bio-analysis: enhanced flow cytometry technology with improved biomarker detection and an integrated, self-contained sample processing feature which allows users to conduct and customize research directly in MiLab with personalized assay boxes (MiPAC) – for both cellular and molecular protocols or via other scientific research equipment (e.g. microscopes) on the station.

MiLab offers significant innovations in a number of areas which enable cytometric life sciences and medical research:

- New ISS strategic space health infrastructure, driving the miniaturizing of the flow cytometer and sample processor, thereby allowing flow cytometry to be a continuously available on-board capability for in-situ crew testing of biomarkers for health monitoring and a necessary toolbox for longitudinal space health research interfacing with ISS infrastructure.
- Minimizes crew time operating MiLab by maximizing system autonomy through automation and ground control.
- Versatile, upgradeable MiPAC design that enables modularity to support future breakthrough enhancements (e.g. microfluidics).
- Leverages capabilities of complementary life sciences tools on ISS.

The MiLab bio-analysis platform addresses multiple risk areas in crew health during human spaceflight and provides an essential biomarker monitoring tool to enable deep space exploration. It has particular relevance to musculoskeletal and behavioral health and performance research, such as assessing the biological mechanisms associated with the effect of prolonged zero-g on immune response, musculoskeletal

status, and cardiovascular function, and a number of respected Canadian and international researchers support the proposed concept development.

The unique environment of the ISS and MiLab's capabilities, as discussed in this paper, present an opportunity to help better understand the universal aging process and answer questions about human diseases and aging and dysregulations of the immune system through space research. MiLab promises to be a key element of that research.