

IAF SPACE EXPLORATION SYMPOSIUM (A3)  
Mars Exploration – missions current and future (3A)

Author: Dr. Marilena Amoroso  
Italian Space Agency (ASI), Italy

Dr. Eleonora Ammannito  
ASI - Italian Space Agency, Italy

Dr. Michelle Viotti  
United States

Dr. raffaele mugnuolo  
Italian Space Agency (ASI), Italy

Prof. Enrico Flamini  
Italian Space Agency (ASI), Italy

Mr. Timothy Haltigin  
McGill University, Canada

Dr. David M Hollibaugh Baker  
National Aeronautics and Space Administration (NASA), Goddard Space Flight Center, United States

Dr. Tomohiro Usui  
Japan Aerospace Exploration Agency (JAXA), ISAS, Japan

Dr. Richard Davis  
NASA Headquarters, United States

Mr. Michael Kelly  
SpaceWorks Engineering, Inc. (SEI), United States

Dr. Étienne Boulais  
Canadian Space Agency, Canada

Mr. Lane Painter  
NASA, United States

INTERNATIONAL MARS ICE MAPPER MISSION: A STEP FORWARD TO MAP THE  
SUBSURFACE WATER ICE AND PREPARE FUTURE HUMAN MARS EXPLORATION

**Abstract**

**Introduction:** The International Mars Ice Mapper (I-MIM) concept mission has been conceived by the Italian, Canadian, Japanese, and US space agencies partners (ASI, CSA, JAXA, and NASA) with the primary goal based on recognizing ice deposits and accessible water in the upper 0-10 m of the Martian subsurface and its overburden.

**I-MIM Measurement Definition Team (MDT):** The Agency Partners competitively selected the MDT to define the core measurements for the mission's primary payload, to suggest possible augmentations and to develop a concept of operations. The MDT released a Final Report [1], concluding that the mission's primary instrument, a polarimetric Synthetic Aperture Radar (SAR) centred at 930 MHz, would satisfy all the Reconnaissance Objectives (ROs) and also recommended that the concept team consider the inclusion of complementary payloads identified as highest priority: a Very High Frequency (VHF) radar sounder (100-200 MHz), a High-Resolution optical imager, and a sub-millimetre sounder for atmospheric profiling to expand the capabilities of I-MIM to undertake high-priority science investigations.

Mission Concept Architecture: The mission architecture is based on MDT inputs that consisting of three spacecraft: Element 1 – Ice -Mapping Orbiter provided by JAXA together with atmospheric sensor, in which a SAR provided by CSA and VHF sounder and Communication subsystem provided by ASI are accommodated Element 2 – Demonstration Lander: A JAXA-provided demonstration lander would piggyback on the main orbiter Element 3 – Free-flying Smallsat a NASA-provided, free-flying smallsat with a high-res imager

I-MIM Science and technology: The mission architecture has been designed to maximize the mission's return on investment and to provide high-value science. The ROs are connected to the origin of the ice and climatic implications. Mapping the unstudied near surface of Mars with the SAR and the VHF Sounder, enhanced by the High-resolution Imager, has the potential to fill a major data gap unmet before and addresses numerous scientific questions about the climatological and geological evolution. In addition, to characterize variability in the ionosphere both the SAR and the submillimetre sounder, further addresses key questions about the connections in Mars's dynamic climate regions and seasonal interactions of shallow subsurface volatiles with the atmospheric structure.

I-MIM to Enable Future Mars Exploration: The I-MIM mission concept fits within this future exploration strategy, specially I-MIM would address numerous cross-cutting themes and objectives of the Moon-to- Mars architecture, helping to pave the way for the future of human exploration.

**References:**[1]I-MIM MDT Final Report (2022)239pp.,online: <https://science.nasa.gov/researchers/icemapper-measurement-definition-team>