A Canadian Science Maturation Study for the Precursor to Human And Scientific Rover (PHASR) as part of the HERACLES Mission Concept

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INTRODUCTION

Human Enabled Robotic Architecture and Capability for Lunar Exploration and Science (HERACLES) is an international mission concept being developed between the European Space Agency (ESA), the Japanese Aerospace Exploration Agency (JAXA) and the Canadian Space Agency (CSA) to prepare for crewed missions to the lunar surface and gain knowledge in science and exploration. A component of HERACLES is the Precursor to Human and Scientific Rover (PHASR) which would demonstrate key technology necessary for future human lunar missions and perform robotic lunar sample return via the Lunar Gateway. To prepare for the international science team discussions for HERACLES, CSA awarded a contract to perform a Science Maturation Study to our team at the University of Western Ontario.

This study focused on maturing the science requirements PHASR and to develop a science investigation which involved identifying the science goals/objectives, proposing a suite of science instruments for the rover, developing the concept of operations, designing a nominal traverse plan [Abstract 2886]. An analogue mission to test the science investigation and operations concept was developed as part of this contract. The study also involved recommending an instrument to CSA that could be Canadian contribution to the mission and creating a science plan for the corresponding instrument team [Abstract 2062].

MISSION CONCEPT

PHASR is tentatively planned to land in Schrödinger Basin on the lunar far side and collect samples over a 70-day period. The samples are then returned to the ascent vehicle which would rendezvous with the Lunar Gateway and eventually return to Earth. After the ascent vehicle has left the lunar surface, the rover would continue to explore Schrödinger Basin for another year to perform follow-up science.

SCIENCE GOALS AND OBJECTIVES

Lunar Chronology

- Acquire chemical data and return samples of:
  - Clast-poor and ejected impact melt rock
  - Peak ring material
  - Material from secondary craters

Impact Cratering

- Acquire mineralogical/chemical data and return samples of:
  - Impactites, peak ring, and impact melt
- Investigate shock effects
- Characterize geology of secondary craters

Lunar Volcanism

- Acquire chemical data and return samples of:
  - Mare deposits
  - Pyroclastic deposits

Human Lunar Exploration

- Measure radiation environment
- Measure surface temperature
- Create geologic and terrain maps of area

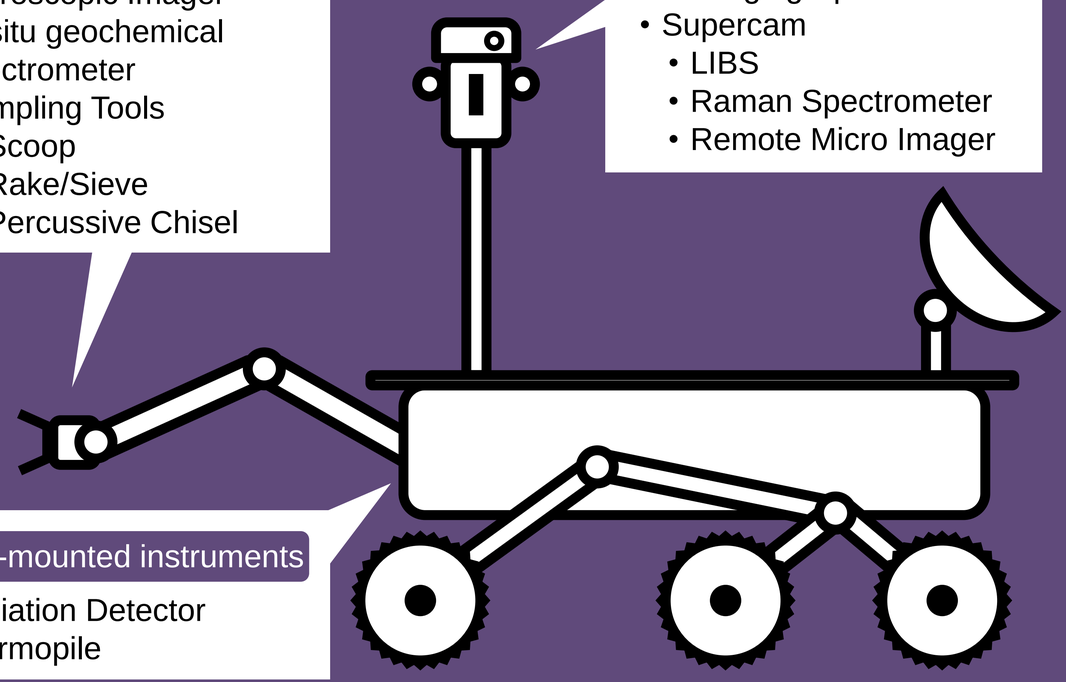
SCIENCE INSTRUMENTS

Arm-mounted instruments

- Microscopic Imager
- In-situ geochemical spectrometer
- Sampling Tools
  - Scoop
  - Rake/Sieve
  - Percussive Chisel

Mast-mounted instruments

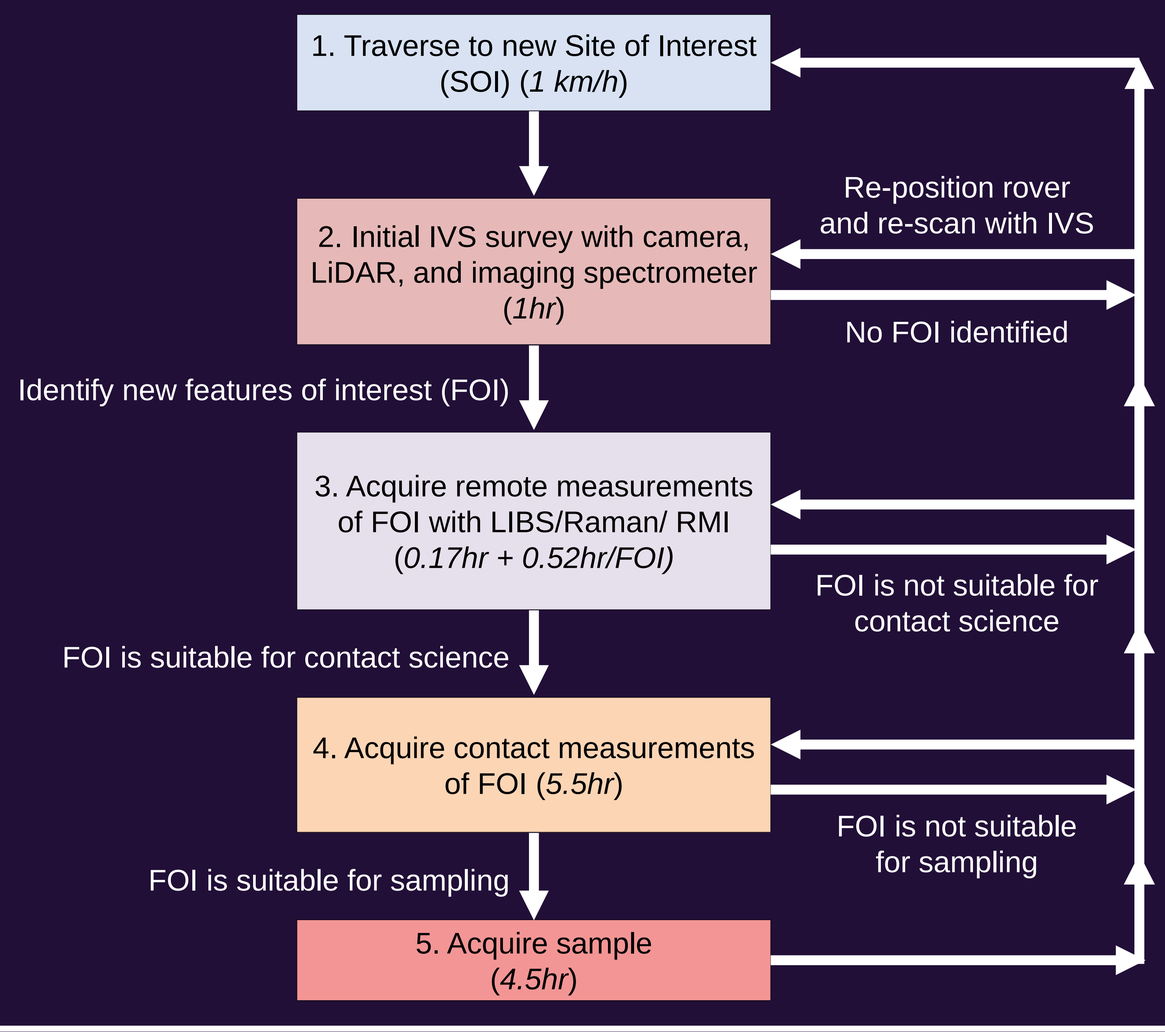
- Integrated Vision System
  - Science Camera
  - LiDAR
  - Imaging Spectrometer
- Supercam
  - LIBS
  - Raman Spectrometer
  - Remote Micro Imager



Body-mounted instruments

- Radiation Detector
- Thermopile

CONCEPT OF OPERATIONS



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