

## Brief Summary

ILOA Human Service Mission to calibrate robotic lunar observatories at Moon South Pole / Malapert Mountain can utilize 15 years ILO technical research to achieve first Astronaut sortie astronomy observations of Galaxy / Stars from the lunar surface.

## Objective

The objective is to send a crew of two to the International Lunar Observatories (ILOs) location, where they would service, calibrate and upgrade the ~5-kg camera (and any other instruments on site) including characterizing and studying any degradation of the instrument from lunar dust, repositioning some of its lenses to make observations at different angles, and potentially deploy / mount other instruments for radio, optical and ultraviolet observations as well as communications.

Taking full advantage of communications with Astronauts on Earth or in cislunar space, the lunar crew could be the first to perform Galaxy First Light Imaging from the lunar surface, perform South Pole / Malapert Mountain local lunar landscape observations, help to establish a suite of instruments and infrastructure for lunar base build out for long-duration Earth observations (for climate change and precession), and additional applications for VLF, SETI, NEOs, and solar storm / weather studies.

## Background

International Lunar Observatory Association (ILOA) is a 501(c)(3) non-profit enterprise based in Hawaii since 2007 to expand human understanding of the cosmos through observation and communication from our Moon. Its five active lunar missions and a robust Galaxy 21st Century Education program will enable the international ILOA teams the opportunity to participate and observe the Galaxy / Stars, Earth with various wavelengths for differing durations and from various lunar locations, and local lunar landscape.

ILO-1 will conduct radio optical and UV astronomy, including Galaxy First Light Imaging Program and commercial communications, including Space Calendar Lunar Broadcasting, while serving as a catalyst for lunar base build-out.

The ILO-2 observatory will be built as back-up for ILO-1. It is planned to be nearly identical with potential advanced instruments, and able to be launched within ~6 months of ILO-1 to either the same location (Mons Malapert) or perhaps to another site (possibly Shackleton Rim) if ILO-1 landing is successful. With the success of ILO-1, the ILO-2 could be used in combination to conduct the first interferometry observations from the Moon.

Servicing and technical upgrades to Moon instruments will necessitate a Human Service Mission in the 2020s. Human Service Work has been discussed with Astrobotic Inc. and others, and would build on pioneering Lunar Lander research coordinated in 2011-2014 by Golden Spike Company with 8-10 other lunar technology enterprises, and conducted in 2005-2006 by visionary innovator Space Dev Inc.

**ILOA Studies of Human Moon Servicing Missions for ILOs at Malapert Mountain:**

We studied existing and proposed technology developed by NASA, other countries, or the private sector in time to be incorporated into the mission. The study combined those technical capabilities to arrive at an elegantly simple solution, which results in a task that is low in risk and low in cost. The studies made use of the following resources, among others:

1. Historical Lunar missions, both human-crewed and unmanned, including Surveyor, Apollo, and the Russian Moon landing attempt.
2. Lunar research, including the SMART-1 task and NASA's Artemis, return to the Moon.
3. Past SpaceDev Lunar mission studies, including Phase I and II studies for the International Lunar Observatory.
4. SpaceDev on-orbit experience in microsatellite design.
5. SpaceDev experience with hybrid propulsion systems, including Spaceship One and the Streaker Small Launch Vehicle currently being developed.
6. Input from the entire SpaceDev engineering team, through a brainstorming session and peer review of the final mission concept.

**Methodology of Human Servicing ILOs at Malapert Mountain**

Human Service Mission to the ILO explores ways for the crew members to move a few kilometers of their possible landing location or base camp, as well as move between the base camp to the location of ILOs and other instruments at Malapert Mountain.

SpaceDev 2005 Dream Chaser design concept includes adopting the Common Hybrid Propulsion Module (CHPM) concept and a CHPM based launch vehicle.

**Conclusion:**

We look forward to seeing the Artemis Human Return to the Moon and first Astronauts at the Moon South Pole to perform astronomy / observation and communications from the Moon, establish a lunar base and perform important work to service and calibrate science instruments on the surface. ILOA would be pleased to share all our available studies with NASA as we prepare for this work.