IN-SITU AND FLIGHT MICROBIAL STERILIZATION SYSTEM FOR FUTURE MISSIONS. E. P. Seto[1], N. Y. Bouey[1], D. Bergman[1], K. Bywaters[1], K. M. Ratliff [2], J. Wood[2], [1]Honeybee Robotics (Epseto@honeybeerobotics.com), [2]Environmental Protection Agency (wood.Joe@epa.gov).

Introduction: The Artemis program and upcoming sample return missions will require us to address the practice of Planetary Protection (PP) [1]. Our funded project aims to develop strategies to prevent re-contamination and cross-contamination which will be important for the following: 1) lunar missions near permanently shadowed regions (PSRs); 2) sample return missions; and 3) future approaches to manned missions on the Moon.

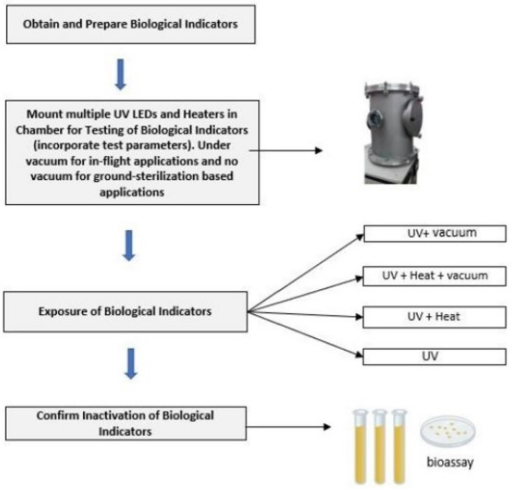
Background: Due to the presence of water-ice, PSR's have scientific value for studies for chemical evolution. With knowledge gaps regarding PP and PSRs, PSR missions have been temporarily assigned as Planetary Protection Category II-L with requirements (NASA Interim Directive 8715.218) [2]. Our funded work will further NASA's science objectives by investigating methods of sterilization and ensuring that contamination is minimized for future exploration.

The development of sterilization strategies is also critical for upcoming lander and sample return systems designed to investigate extant life (Planetary Protection Missions categories IVb, IVc, V (restricted)) that require a method of preventing re-contamination of the sterilized subsystem. In order to meet these challenges, the development and implementation of a sterilization strategy will be necessary to mitigate both recontamination and cross-contamination throughout the spacecraft lifecycle. The consensus from prior sample return working groups and reviews is that the existing sterilization technology typically used are insufficient for increasingly complex sample return missions and sensitive hardware [3].

Honeybee Robotics has been developing numerous geo-related tools for robotic exportation. By incorporating this UV sterilization and heat technology on drills and various sample collection tools, microbial contamination issues can be addressed even before the sample acquisition process. Additionally, this technology can be implemented as an in-situ sterilization system that can be utilized by Astronauts.

Research: Our funded research will examine new sterilization strategies for microbial reduction using synergistic effects of multiple Ultraviolet radiation (UV) wavelengths in combination with heat and without heat. Ultraviolet radiation is a well-known sterilant often used to inactivate microorganisms and kills mainly by direct effects; that is, the photon is absorbed by an important cellular component (like DNA), which is then altered and loses its functionality. The predominant usage of UV mercury lamps emits only one wavelength (254 nm) while UV-LEDs can be configured to emit certain target wavelengths.

Figure 1: Flow chart outlining technical approach for upcoming tests.



Broader contamination challenges lie ahead regarding a more sustained presence on the Moon (and eventually on Mars). The findings of this work will also be used to reduce complexity, cost, mass, and time associated with implementation of a sterilization system. These experiments will help guide future missions and approaches for sterilization.

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