THESIS TOPIC:

Computational Design and Topology Optimization of Active Radiation Shielding Sytems for Lunar Settlements

Thesis duration: 6-12 months

Advisors: Valentina Sumini, Claudio Chesi, Elena D'Onghia

Preferred skills: Form-finding, computational design, space architecture, structural analysis

Software: Rhinoceros3D, Karamba3D, Kangaroo, Ameba

The candidate will explore different computational design tools in order to design an optimized structure that could support an active radiation shielding to protect a Lunar settlement against solar flares and Galactic Cosmic Rays.

The research will be developed in collaboration with the University of Wisconsin-Madison.

Research framework

As space travel becomes more prevalent the long-term implications of space travel and the effects of prolonged time outside of Earth's environment have become more relevant for astronauts than in the past. One of the most significant concerns as astronauts leave the protection of Earth's magnetic field, is exposure to an increased amount radiation which permeates space. Extended exposure to radiation can have significant health effects and as a result needs to be properly mitigated against for extended space travel. Currently, NASA has begun work on a lunar station referred to as the Lunar Gateway's Habitation and Logistics Outpost (HALO) as a part of their Artemis program and is envisioning a permanent outpost at the South Pole of the Moon by 2030.

In the past, a method known as passive shielding has been used to minimize the amount of radiation that astronauts are exposed to when outside of Earth's magnetic field by insulating the walls of spacefaring vessels or envisioning shell structures built using in situ resources (lunar regolith or water). Researchers at University of Wisconsin-Madison demonstrated the possibility of using active shielding in order to generate a magnetic field around the habitats, mimicking the Earth's own magnetic field and protecting astronauts.

Indeed, this research will explore the synergy of using both passive and active radiation shielding systems, unveiling new architectural design concepts to sustain human space exploration, on the Moon and beyond.