SPACE-VEST PROJECT. A. Royce[1], E. Beltran[1], M. Conroy[1]; [1]University of Central Florida- Florida Space Institute

NASA's priority is to move human presence into the solar system. Currently, NASA aims to launch several components: landers, followed by rovers, building later on possible habitats, and creating a sustainable ecosystem to support a continued phase approach for Artemis with the goal to return humans to the Moon. The deep space environment is reasonably characterized, but radiation protection materials for human habitats and spacesuits has not been fully developed and characterized. Robotic missions will continue but human space exploration and EVA operations will be the method of choice for new and complex situations in space missions, as they allow for task flexibility and the implementation of real-time alternative and unique approaches to problems. The most immediate concern for these longer duration EVA missions is the risk of space radiation, in particular Galactic Cosmic Radiation (GCRs,). All space radiation, Solar Wind Particles, and Solar Energetic Particles (SPEs) will have an impact on mission operations and astronauts need to be well protected against those risks.

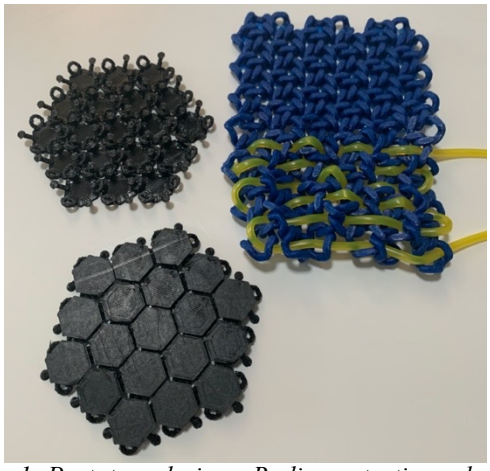

Fig. 1: Prototype designs. Radio-protective polymers will be added to 3D-printed design. Tubing will be incorporated into designs for temperature regulation.

The aim of our project is the assembly of a 3-D printed prototype scaffolding with radiation attenuation properties, made of thermoplastic polyurethane with radiation hardening characteristics. This prototype will be both strong and flexible, allowing it to be retrofitted to the existing spacesuits for use in radiation protection and better thermal regulation during human exploration of the deep space environment. We are testing and developing possible prototypes for space operations 1) human spacesuits, starting with the head and torso, and 2) equipment/life support systems (ECLSS) to protect equipment for crew surface operations. Our testing includes consideration of the best possible fitting for comfort, lightweight, and adaptation to many contours. Starting with the most radiation vulnerable organs and matching NASA's highest priorities, we aim to create a form-fitting prototype to protect central nervous system and cardiovascular large vessels. At a later stage this prototype will incorporate the radio-protective polymers produced by our partners at Georgia Tech, and we will then assemble them into different conformations if needed. Our focus is on reducing radiation damage, preventing common injuries, and minimizing contamination of regolith into spacesuits via a layered approach for crew safety operations. Tubing connected to the liquid cooling garment will be incorporated in the prototype for dual purpose: a) using the radiation protection properties of water and b) as a cooling system to avoid the overheating of astronauts.

Fig. 2: Cooling garment with tubing that will be used to incorporate our prototype with a layered approach.

The 3D-printing of the vest design allows for the *in-situ* modification, easy repair, and creation of the vest by the astronauts. In our future work, we aim to create the vest to form fit with previous 3D scanning of each astronaut's anatomical dimensions and produce adaptation to specific dimensions and requirements for the astronaut or any crew member. The current spacesuit for Artemis missions, xEMU, is developed for Moon surface operations, but there is still work to be done regarding space radiation control and mitigation for crew members wearing the xEMU. Our goal is to adapt our systems to fit any spacesuit for current or future missions.