RADIATION SAFETY SYSTEMS INTEGRATION FOR EVA AND SURFACE OPERATIONS IN HUMAN SPACE EXPLORATION

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Crew safety is paramount in long-duration deep-space missions, and a primary risk to astronaut health is radiation. NASA research traditionally supports assessments and mitigation of Radiation Exposure Induced Death (REID) attributable to a crew member's time in space. REID probability increases with length of mission and is cumulative throughout the career of an astronaut, and these risks are long-term and persist throughout their lifetime.

REVEALS (Radiation Effects on Volatiles and Exploration of Asteroids and Lunar Surfaces) focuses on radiation protection and establishing radiation risk mitigation strategies. The development and testing of new materials and active dosimetry, resulting in the practical operational integration of radiation shielding in spacesuits and crew surface mobility, will decrease the probability of radiation exposure. With the development of new materials and by assessing the viability, durability, and performance for surface-mobility suits and vehicles, we can suggest sub-systems integration could be made more reliable, and therefore reduce human space exploration risks.

New materials to facilitate and improve EVAs will be an essential component working and living in space environments safely. Special attention is now on radiation exposure to the human central nervous system because of its effects on human performance, cognitive effects, and late degenerative tissue processes which can significantly affect missions. Therefore, strategic placement of these new materials and of real-time radiation detection devices is crucial. It will enable crew members to become active participants in decision-making process regarding radiation risk and human operations.

Preliminary results at REVEALS are helping prioritize risks and create options for determining operational risk mitigation strategies leading to safer human exploration missions.

Polymers:

The polymer samples investigated by the REVEALS team are manufactured through melt compounding and casting of two materials: a) high-density polyethylene (HDPE), historically used for radiation resistance because of its high hydrogen content, and with tunable properties; b) graphene, which has excellent mechanical and electrical conductivity properties, but is not easily miscible, unless its chemistry is carefully modified. Before the incorporation of any fiber reinforcement, we are planning to test the polymers under Solar Particle Events (SPE) irradiation doses to identify the configuration of lightweight graphene-modified HDPE with the best synergy of residual mechanical, chemical and electrical properties,. These tests are essential first steps towards proper integration of materials and create appropriate risk mitigation strategies.

REFERENCES

[1] Orlando, T. M., Jones, B., Paty, C., Schaible, M. J., Reynolds, J. R., First, P. N., Robinson, S. R., La Saponara V., Beltran, E., "Catalyst: Radiation Effects on Volátiles and Exploration of Asteroids and the Lunar Surface", 2018, *Chem*, 4, pp. 1-4