# Radiation Shielding of Lunar Regolith/Polyethylene Composites and Lunar Regolith/Water Mixtures

Johnson, Q.[1, 2], Gersey, B.[1], Wilkins, R.[1, 3], and Zhou, J.[1, 2]

[1]NASA Center for Radiation Engineering and Science for Space Exploration
[2]Department of Mechanical Engineering
[3]Department of Electrical & Computer Engineering
Prairie View A&M University, Prairie View, Texas, USA

Space radiation is a complex mixed field of ionizing radiation that can pose hazardous risks to sophisticated electronics and humans. Mission planning for lunar exploration and long duration habitat construction will face tremendous challenges of shielding against various types of space radiation in an attempt to minimize the detrimental effects it may have on materials, electronics, and humans. In late 2009, the Lunar Crater Observation and Sensing Satellite (LCROSS) discovered that water content in lunar regolith found in certain areas on the moon can be up to 5.6 +/-2.8 weight percent (wt%) [A. Colaprete, et. al., Science, Vol. 330, 463 (2010). ]. In this work, shielding studies were performed utilizing ultra high molecular weight polyethylene (UHMWPE) and aluminum, both being standard space shielding materials, simulated lunar regolith/ polyethylene composites, and simulated lunar regolith mixed with UHMWPE particles and water. Based on the LCROSS findings, radiation shielding experiments were conducted to test for shielding efficiency of regolith/UHMWPE/water mixtures with various percentages of water to compare relative shielding characteristics of these materials. One set of radiation studies were performed using the proton synchrotron at the Loma Linda Medical University where high energy protons similar to those found on the surface of the moon can be generated. A similar experimental protocol was also used at a high energy spalation neutron source at Los Alamos Neutron Science Center (LANSCE). These experiments studied the shielding efficiency against secondary neutrons, another major component of space radiation field. In both the proton and neutron studies, shielding efficiency was determined by utilizing a tissue equivalent proportional counter (TEPC) behind various thicknesses of shielding composite panels or mixture materials. Preliminary results from these studies indicated that adding 2 wt% water to regolith particles could increase shielding of the regolith materials by about 6%. The findings may be utilized to extend the possibilities of potential candidate materials for lunar habitat structures, will potentially impact the design criteria of future human bases on the moon, and provide some guidelines for future space mission planning with respect to radiation exposure and risks posed on astronauts.