MODELING THE ACUTE HEALTH EFFECTS OF ASTRONAUTS FROM EXPOSURE TO LARGE SOLAR PARTICLE EVENTS

Shaowen Hu¹, Myung-Hee Y. Kim¹, and Francis A. Cucinotta²
¹Division of Space Life Sciences, USRA, Houston, TX, 77058.
²NASA Johnson Space Center, Houston, TX, 77058

In space exploration outside the Earth’s geomagnetic field, radiation exposure from solar particle events (SPE) presents a significant health concern for astronauts, which could impair their performance and result in possibility of failure of the mission. Acute risks are especially of concern during interplanetary trip because the long duration of such trip significantly increases the chance to encounter one or more large SPEs. Assessing the potential of early radiation effect under such adverse conditions is of prime importance. Here we present a biologic based mathematical model which describes the dose and time-dependent early human responses to various types of ionizing radiation. We examine the possible early effects on crew from exposure to some historical large SPEs on lunar and/or Mars missions. The doses and dose rates of specific organs were calculated using the BRYNTRN code [1] and CAM model [2], while the hazard of the early radiation effects and performance reduction were calculated using the RIPD code [3]. Based on model assumptions we show that exposure to these historical SPEs would cause moderate early health effects to crew members inside a typical spacecraft or during extra-vehicular activities (EVA), if effective shielding and medical countermeasure tactics were not provided. We also calculate some even worse cases (double intense, multiple occurrences in a short period of time, during EVA, etc.) to estimate the severity, onset and duration of various types of early illness. Uncertainties in the calculation due to limited data on relative biological effectiveness (RBE) factors for protons and secondary radiation, and the identification of sensitive sites in critical organs are discussed. Results from these types of calculations will be a guide in design of protection systems and medical response strategy for astronauts in case of exposure to high dose irradiation during future space missions.

REFERENCES: