SESSION: NEW INSTRUMENTS/FUTURE ACTIVITIES

A Possible New Generation Personal Dosimeter TEPSC (Tissue Equivalent Plastic Scintillator Counter)

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The JSC (Johnson Space Center) - SRAG (Space Radiation Analysis Group) has been using the combined passive dosimeters - CR-39 plastic nuclear track detectors (PNTDs) sensitive to high LET (≥ 10 keV/μm water) + thermoluminescence dosimeters (TLDs)/optically stimulated luminescence dosimeters (OSLDs) sensitive to low LET (≤ 10 keV/μm water) to measure the space radiation experienced by astronauts and for the different monitored areas inside spacecraft. However the approach of TLD/OSLD + CR-39 cannot be used for on-site radiation monitoring which is necessary for future human space flights to the Moon and Mars.

A possible new generation active dosimeter which may satisfy NASA requirements for future human flights to the Moon and beyond is the TEPSC (Tissue Equivalent Plastic Scintillator Counter). This dosimeter is being developed by Radiation Monitoring Devices Inc. (RMD) with NASA's support. The new dosimeter is composed of a small area of tissue equivalent plastic scintillator (TEPS) and a solid-state photomultiplier (SSPM).

The light response of the plastic scintillator to relativistic nuclei (Z = 1- 26, E = 0.1 - 10 GeV/n) is the most important aspect of the TEPSC. The most recent and relevant research work in this area was carried out in the 1980s by researchers at the University of Chicago (UC) using their abundant experimental data obtained from high energy cosmic ray physics. UC researchers proved that the BTV (Birks-Tarle-Voltz) core-halo model for the light response of plastic scintillator to relativistic nuclei is the most successful and determined all the physical parameters in the BTV model.

A very important part of data analysis work for TEPSC is to look for a function to convert the light energy measured to the total energy loss in the plastic scintillator. This work was completed recently in SRAG through systematic calculation and research using the BTV core-halo model and the related parameters in the response formula.

This paper discusses the requirements for the new generation active dosimeters and the physical principles for the TEPSC and presents the conversion function to determine the total energy loss in the plastic scintillator using the light energy measured.