SPACE LIFE SCIENCES SYMPOSIUM (A1)
Radiation Fields, Effects and Risks in Human Space Missions (4)

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RADIATION OF COSMIC RAYS IN LEO IN RECENT SOLAR CYCLE

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Abstract

Radiation in LEO (Low Earth Orbit) is mainly composed of primary particles: GCR (Galactic Cosmic Rays), SEP (Solar Energetic Particles), SAA (South Atlantic Anomaly) particles and albedo neutrons and protons from the atmosphere of the Earth. When the primary particles enter/pass through the space vehicle shielding and the internal instruments/equipment/detectors, the secondary particles (charged and neutrons) are produced and then a very complicated radiation environment is generated.

One of the remarkable characteristics of space radiation is that the radiation varies with the solar activities, in the solar minimum period the radiation is maximum and vice versa. The recent solar minimum was between 2008 and 2010. ISS-Expedition 18-19/ULF2 was conducted in this solar minimum (15 Nov. 2008 - 31 July 2009, total 258.6 days).

NASA-SRAG (Space Radiation Analysis Group) has been using both active dosimeters TEPC (Tissue Equivalent Proportional Counter) sensitive to all LET (Linear Energy Transfer) and passive dosimeters TLDs (Thermo Luminescent Dosimeters)/OSLDs (Optically Stimulated Luminescent Dosimeters) sensitive to low LET (<=10 keV/μm water) and CR-39 PNTDs (Plastic Nuclear Track Dosimeters) sensitive to high LET (>=10 keV/μm water) to measure radiation for astronauts and for the selected locations inside the ISS (International Space Station). For the passive methods, the total radiation quantities for all LET can be obtained by combining the results measured with TLDs/OSLDs and CR-39 PNTDs.

This paper introduces the methods of radiation measurements using TEPC, TLDs/OSLDs and CR-39 PNTDs and the LET spectrum method for CR-39 detectors; presents the radiation LET spectra measured with TEPC and CR-39 detectors and the radiation quantities measured with TEPC, TLDs/OSLDs and CR-39 PNTDs for the ISS-Expedition 18-19/ULF2 (near the recent solar minimum) and ISS-Expedition 12 (after the last solar maximum); and compares the radiation quantities measured with the active and passive dosimeters in the different stage of solar activities.

Key words: Solar activity, cosmic-ray radiation, active and passive dosimeters, LET spectra