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Radiation Fields, Effects and Risks in Human Space Missions (5)

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SPACE RADIATION MEASUREMENT FOR THE BIOLOGICAL RESEARCH ON SJ-10 SATELLITE

Abstract

On SJ-10 satellite developed under the CAS Strategic Priority Program, an experiment of space radiation systems biology research has been taken to study the biological effects induced with the various types of space radiation including electron, proton, heavy ion, x-ray end neutron.

The hardware for the experiment includes three bio-radiation boxes BRB-A, BRB-B and BRB-C, which has a look direction of -Y, -Z and + X of the satellite respectively. In each box, there are two modules: radiation detection module and model organism module. Three types of model organism module, sandwich-like bio-stack, seed bag and C. elegan container, were developed to provide adequate environment for the model organisms, which were rice seeds, arabidopsis thaliana seeds and C. elegan for this experiment.The radiation detection module is a combination of active and passive detectors. The active detectors includes the Slow Neutron Dose Equivalent (SNDE) detector and the Silicon Telescope (SITEL). The SNDE detector is designed to measure the neutron dose equivalent rate and SITEL measures the LET spectrum from 0.1keV/μm to 230keV/μm of charged particles. The passive detectors include thermoluminescent dosimeter (TLD) and CR-39 plastic nuclear track detectors, which were placed together with the model organisms to measure radiation total dose, LET spectrum and total dose equivalents. Moreover, the rice seeds and the arabidopsis thaliana seeds in the bio-stacks hit by heavy ions could be localized with the CR-39 detector.

As a result of the SITEL and CR-39 detectors, the LET spectrum from 0.1keV/μm to 1700keV/μm was detected in this experiment. The spectrum in the range of 10keV/μm to 230keV/μm from the SITEL active detector agrees well with those from CR-39 passive detectors. The averages of radiation absorbed dose rate and dose equivalent rate were 0.072 mGy/d and 0.162mSv/d respectively, which were lower than the absorbed dose rate of 0.2 0.3mGy/d and dose equivalent rate of 0.4 0.6mSv/d on the International Space Station (ISS). Among the 576 rice seeds in the bio-stacks, about 9.9% of rice seeds were not hit by heavy ions. About 18.2% of the seeds were hit once, 23.1% of the seeds were hit twice, and about 48.8% of the seeds were hit no less than three times.