

Radiation Dosimetry for Microbial Experiments in the International Space Station

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The effects of the complex radiation field in space, consisting of neutrons, electrons and high-energy heavy charged particles, on biological samples are of high interest in the fields of radiobiology and exobiology. Radiation doses absorbed by biological samples must be quantified to be able to determine the relationship between observed biological effects and the radiation dose. For radiation protection purposes the effective doses to astronauts needs to be assessed, while in dosimetry for biological experiments the absorbed dose and the equivalent doses to the samples need to be known. Special techniques and correction methods combining luminescence detectors and track etched detectors are required due to the presence of particles with a wide range of LET (Linear Energy Transfer) values. These doses can be different from those to astronauts, due to different positions in the spacecraft, different compositions of the samples, and different shielding due to packaging materials.

The laboratory of Microbiology at SCK-CEN, in collaboration with different universities, participates in several ESA programs with bacterial experiments in space. The main objective of these programs is to study the effects of space conditions such as microgravity and cosmic radiation on board the ISS on metabolic processes in model bacteria. To measure the radiation doses received by the bacteria in the experiments, different detectors accompany the microbiological samples. These dosimetry experiments are a collaboration between different institutes, so that the doses can be estimated by different techniques. For the high LET doses (>10 keV/ μ m), two types of track etch detectors are flown. The low LET part of the spectrum is measured by three types of thermoluminescent detectors ($^7\text{LiF:Mg,Ti}$; $^7\text{LiF:Mg,Cu,P}$; Al_2O_3), and by the optically stimulated luminescence technique with $\text{Al}_2\text{O}_3\text{:C}$ detectors, both in continuous and pulsed mode. The high LET results were of the order of 23 $\mu\text{Gy/d}$ or 0.25 mSv/d and LET spectra were obtained. For the low LET radiation, small differences between different techniques and detectors were observed, ranging between 0.15 and 0.19 mGy/d, but the general agreement was good. The differences may be generally understood from the different efficiencies of the different methods for HCPs.