SPACE LIFE SCIENCES SYMPOSIUM (A1)
Radiation Fields, Effects and Risks in Human Space Missions (5)

Author: Mr. Sergey Khulapko
Institute of Biomedical Problems (IBMP), Russian Academy of Sciences (RAS), Russian Federation

MAIN RESULTS ON THE NEUTRON CHARACTERISTICS MEASURED INSIDE THE RUSSIAN ORBITAL SPACE STATIONS

Abstract

Protection of crewmembers from radiation is a high priority for long-duration human spaceflight, including proposed exploration missions to the moon and Mars. In deep space, galactic cosmic rays (GCRs) and solar particle events create a mixed radiation field that is predominantly made up of protons and heavy ions. In low-Earth orbit (LEO), protons and electrons trapped in the Van Allen radiation belts also make a major contribution to the radiation field. Neutrons encountered in LEO are mainly produced by (i) nuclear interactions of GCRs and trapped protons with various elements in the walls and interior components of the spacecraft and (ii) by neutron albedo from GCRs incident on the Earth's atmosphere. Earlier investigations in LEO, including experiments using bubble detectors, have shown that neutrons contribute significantly to the total radiation dose received by crewmembers. Measurements on the International Space Station (ISS) aim to extend our understanding of space radiation in order to improve radiological protection of crewmembers, particularly on long-duration missions beyond LEO. Radiation measurements were started almost since the first manned spaceflight in 1957. Then, since the Russian long-term orbital stations "Salyut" and "Mir" were launched our scientists continued to measure radiation inside it. The brief history review of these measurements will be presented. Today, onboard the International Space Station (ISS) space radiation is measured by big international collaboration of the Russian, Canadian, Japanese and European scientists. To measure the neutron equivalent dose onboard the ISS in the framework of the "Matroshka-R" space experiment the scientific equipment "Bubble dosimeter" was made by Bubble Technology company. The Bubble dosimeter includes two dosimetric and six spectrometric detectors filled with the special gel and sensitive to neutrons with energies from 200 keV to 50 MeV, and the bubble reader for the bubble counting. As detecting media inside the detectors the special gel with superheated droplets is used. When neutron radiation passes through droplets they are boiling and bubbles are created (that is why such type of detectors called "bubble detectors"). One can determine the neutron dose measured by detectors by counting the bubbles. While using the bubble detectors on the ground there are various researches of their properties depending from conditions inside the ISS (temperature, radiation incident angle distribution etc.) that confirmed possibility to use the bubble detectors onboard the ISS. In current report the main results of the bubble detector measuring will also be presented.