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

Author: Ms. Andrea Strádi
Centre for Energy Research, Hungarian Academy of Sciences, Hungary, stradi.andrea@energia.mta.hu

Dr. Julianna Szabó
Centre for Energy Research, Hungarian Academy of Sciences, Hungary, szabo.julianna@energia.mta.hu
Mr. József K. Pálfalvi
Centre for Energy Research, Hungarian Academy of Sciences, Hungary, palfalvi@aeki.kfki.hu
Dr. Tamas Pazmandi
MTA Centre for Energy Research, Hungary, pazmandi.tamas@energia.mta.hu

COSMIC RADIATION MEASUREMENTS ON THE FOTON-M4 SATELLITE BY PASSIVE DETECTORS

Abstract

The Russian Foton spacecraft was designed to deliver scientific experiments to low Earth orbit and return them safely to the ground for further analysis. The original programme started in 1985 and continues even today, as the vehicle has attracted considerable attention among the Western customers, as well. Since the 1990's the European Space Agency has been cooperating with the Russian Space Agency, creating a multi-user research program (Biopan) to investigate the effect of the space environment on biological materials. In 2002 the upgraded series of the vehicle was introduced under the name Foton-M. The first launch of the new spacecraft resulted in a disastrous explosion because of rocket failure, but after the unfortunate beginning three successful missions were completed in 2005 (Foton-M2), in 2007 (Foton-M3) and in 2014 (Foton-M4), with the participation of the Centre for Energy Research (till 2011 Atomic Energy Research Institute), Hungarian Academy of Sciences. On the Foton-M4 satellite several passive cosmic ray detectors were exposed outside and inside the recoverable capsule in different positions and locations to study the radiation field during the flight. Although the orbit-correction maneuver with the new liquid-propellant engine failed after the lauch from Baikonur in September, causing the interruption of the mission before the scheduled time, the 44-day flight provided useful data. With the combined detector stacks it was possible to measure the low and high linear energy transfer (LET) components of the cosmic radiation separately, which provides valuable information about the composition of the actual radiation filed inside and outside of the satellite. The applied thermoluminescent detectors (TLDs) are sensitive to the particles with LET under 10 keV/μm, while the solid state nuclear track detectors (SSNTDs) measure the particles having LET over this value. The results obtained from the evaluation of these passive detectors as LET spectra (above 10 keV/μm), absorbed doses in the low and the high LET range, dose equivalent and average quality factor values will be presented and the comparison with the previous missions will also be performed.