Investigation on the development of the intelligent radiation detection techniques in extreme environment

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The change and problems of the radiation detector material and the detector electronics faced in the typical extreme environment(such as space, nuclear accidents, deep sea nuclear detection, oil/gas deep well logging engineering and nuclear facilities, etc.) are sketched in the present report. The radiation resistance properties of the typical semiconductor material and scintillator material are simply introduced and compared. The research development and applications of the miniaturized detectors based on some typical semiconductor(such as Si SOI, Si PM，4H-SiC and Ga2O3, etc) and scintillator material (CLYC, perovskite) were reviewed. Finally, the future development trends of the intelligent detection techniques in extreme radiation environment are summarized and discussed.

Key Words：Radiation detector; Intelligent radiation detection; Extreme environment

[Ref abstract]

Neutron Fields Measurements at IREN Facility behind Biological Shielding

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The radiation fields behind the shields of the JINR nuclear facilities are formed mainly by neutrons of a wide energy spectrum. Radiation control in the fields of mixed (neutrons and gamma rays) and scattered radiation is a difficult task, especially in cases where the upper neutron energy exceeds 15–20 MeV. This is due to the fact that the mechanisms of interaction of neutrons with matter (and, accordingly, the sensitivity of neutron dosimeters) change strongly with an increase in their energies from thermal to tens and hundreds of MeV. The most adequate technique for determining the values of the effective dose of neutrons is associated with the measurement of their energy distribution and the use of calculated fluence-effective dose conversion factors in the geometry of human irradiation typical for the measurement site. To measure the spectrum of scattered neutrons in a wide energy range, a multisphere spectrometer is used, according to the readings of which the neutron spectrum at the measurement point is then restored.

This paper describes the results of measuring neutron spectra at two points at the Resonance Neutron Source (IREN) of the Laboratory of Neutron Physics, JINR. To obtain powerful neutron fluxes, this source uses an electron gun and a thick tungsten target, in which photoneutrons are produced from the bremsstrahlung of electrons in the target. Based on the obtained spectra, the effective neutron dose rates at the measurement points were determined, which is important both for assessing the radiation situation at IREN and for comparison with the readings of neutron dosimeters of the automated radiation monitoring system.