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Degradation of Si-based detectors parameters under long-term irradiation by ^{252}Cf fission products at room and liquid nitrogen temperatures

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A compact calibration neutron source is highly required for a number of current and future nuclear and astrophysical experiments [1, 2]. An appropriate solution could be considered in a combination of ^{252}Cf radionuclide source which undergoes α-decay and spontaneous fission with a branching ratio of 97:3, whereas each spontaneous fission event liberates also a number of fast neutrons, with a semiconductor detector that detects the fission fragments and provides a time reference of the neutron production. However, performance of such neutron source could be considerably limited by the radiation defects formed in the semiconductor detector during the operation since the incoming fission fragments and α-particles would create the atomic displacement damage in the crystal lattice of the semiconductor [3].
This work will present the investigation results of Si-based detectors operating parameters degradation under irradiation with fission products of the ^{252}Cf nuclide. The irradiation of the detectors was performed at room and liquid nitrogen temperatures using the experimental setup specially designed for the simultaneous measurement of fission fragments spectrum and the determination of operational signs of the detector degradation (a decrease in the energy resolution, shift of the peaks positions, an increase in the reverse current, etc.). As a result of irradiation with 1-5×10^8 of fission fragments, a gradual shift of the energy positions of the fission fragments bumps towards the lower energies (i.e. the progressing pulse height defect [4]) was observed which proceeds nearly linear with the irradiation dose. Therefore, we were able to estimate the maximal exposure the detector could sustain before "degradation", which was considered to occur when the α-peak and the bump of the heavier fission fragments overlap. Preliminary results indicate that the investigated detectors can sustain exposure of up to 8×10^8 of fission fragments. More details about the obtained experimental results will be presented at the Conference.
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