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Degradation of Si-based detectors parameters under the alpha-particle irradiation.

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The response function of the recoil nuclei in the detectors designed to detect neutrinos or dark matter particles can be determined only by using a neutron source with known energy spectrum. Therefore, the development and creation of a calibration neutron source is an important task for a number of current and future nuclear and astrophysical experiments [1, 2]. The neutron source has to be combined with a semiconductor detector that detects the moment of neutron appearance.
Silicon semiconductor detectors are widely used in various nuclear physics experiments and possess perfect operating parameters, such as thin window layer, sufficient temporal and good energy resolutions. However, their performance could be considerably limited by the radiation defects formed during the operation process. Since in the suggested experiments [1, 2] semiconductor detectors should operate under intense level of α-particles and fission fragments irradiation, which inevitably accompany the process of spontaneous fission of the nucleus, studies of the radiation hardness of Si detectors are of a significant importance for the successful implementations of the suggested nuclear physics experiments.
This work is devoted to the investigations of Si detectors parameters degradation during long-termed irradiation by α-particles. For these investigations an experimental setup for simultaneous measurement of α-particles spectrum and determination of the operational indications of the detector degradation (decrease of energy resolution and signal-to-noise ratio, growth of the reverse current, etc.) was developed by our group. Two types of Si detectors were under investigations - silicon-lithium Si (Li) p-i-n detectors and silicon surface barrier detectors. As a result of the measurements, the maximal permissible radiation doses for the correct operation of the detectors of both types and the correlation between the received radiation dose and the spectroscopic characteristics of the detectors were determined. Additional set of experiments was aimed to study the type and concentration of the radiation defects formed under irradiation. Detailed discussion of the obtained experimental results will be presented at the Conference.
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