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A double-sided thin entrance window Si(Li) detector for the application in multilayer detector systems.

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Precise measurements of β-spectra are highly relevant for a number of physical areas. For the investigations of the neutrino processes at nuclear reactors, such as the reaction of inverse beta-decay, elastic neutrino scattering on an electron or coherent scattering on nuclei, an accurate quantitative determination of the electron antineutrinos spectrum is required. These electron antineutrinos are emitted during beta-decays of fission fragments of uranium and plutonium isotopes, as well as during beta decays of various nuclei that arise as a result of neutron capture, so their spectrum can be reconstructed from the measured beta-spectra. Our lab develops an experimental setup of beta-spectrometer based on silicon-lithium drift Si(Li) detectors designed to carry out the precise measurements of the beta spectra of various fissile isotopes of uranium and plutonium in the scheduled experiment at the PIK reactor after its launch. Individual Si(Li) detectors can be manufactured with a sensitive region thickness of up to 1 cm, which is sufficient to absorb electrons with an energy of up to 3.5 MeV. To register the electrons with higher energies the multilayer spectrometer consisting of several Si(Li) detectors is required. However, usual Si(Li) detectors manufactured using standard technology have an unacceptably thick entrance window from the n-contact side. We propose an alternative method for n-contact creation allowing to produce the Si(Li) detectors with a thin entrance window from both n- and p-sides. An assembly of three such thin-window Si(Li) detectors will make it possible to register the full energy of 10 MeV beta-electrons. At the Conference the detailed description of the spectrometric properties of individual double-sided thin-window Si(Li) detectors and the results of entrance windows thickness measurements will be presented and discussed. To suppress the accompanying gamma background a silicon transition detector with a thickness of 100–300 μm will be positioned in front of the first layer of Si(Li) detectors. Such configuration of the detectors effectively suppressed the background signals, but leads to a deterioration in the energy resolution of the spectra measured by the Si(Li) detector due to the passage of beta-electrons through the transition detector. The procedure of Si(Li) detector energy resolution restoration by the summation of pulse amplitudes of both detectors will also be discussed.

Primary author(s) : TRUSHIN, Maxim (PNPI)

Co-author(s) : DERBIN, Alexander (Petersburg Nuclear Physics Institute); DRACHNEV, ilia (PNPI NRC KI); IVANOV, Denis (NRC "Kurchatov Institute" - PNPI); MURATOVA, Valentina (Petersburg Nuclear Physics Institute NRC KI); UNZHAKOV, Evgeniy (Petersburg Nuclear Physics Institute); Dr. KOTINA, Irina (PNPI); Dr. KONKOV, Oleg (Ioffe Physical-Technical Institute)

Presenter(s) : TRUSHIN, Maxim (PNPI)

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