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4π semiconductor beta-spectrometer for measurement of ^{144}Ce-^{144}Pr spectra

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Precision measurements of beta-spectra have always been and are still playing an important role in several fundamental physical problems, predominantly in neutrino physics. Magnetic and electrostatic spectrometers possess the superior energy resolution, but at the same time such devices appear to be very complex and large-scale setups. Since the electron free path at 3˜MeV (which is, basically, the maximum beta-transition energy for long-living isotopes) does not exceed 2˜g/cm^3, solid state scintillation and ionization detectors were effectively employed for detection of electron. In case of semiconductor detectors there is a significant probability of back-scattering from the detector surface that depends on the detector material. This issue could be overcome by constructing a beta-spectrometer with 4π geometry, fully covering the source and capable of detecting backscattered electrons. Here we present a technology allowing production of a beta-spectrometer based on silicon detectors and having 4π geometry. The spectrometer developed had been fitted with a ^{144}Ce-^{144}Pr radioactive source and has demonstrated capability of performing precision beta-spectrometry for this nuclides.

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