

Investigation of the dependence of the time resolution of Si detectors on the bias voltage

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The aim of this work was to measure the parameters of Si detectors and study their dependences on the bias voltage. It was measured the amplitude and time resolution, signal-to-noise ratio in the fast and slow channels, the value of the signal front and surface temperature for each detector.

When studying reactions on light nuclei at the SINP accelerator we use a two-arm spectrometer [1]. It consists of an $\Delta E-E$ telescope of silicon surface-barrier detectors for charged particles and scintillation detectors in the other arm. The telescope determines the energy and type of charged particles, scintillation detectors separate neutron events from gamma by the pulse shape and determine the neutron energy by time of flight. In [1] a method for time calibration and measuring the time resolution of the detectors by using an accelerator is described. However, for the preliminary selection of detectors for experiment such a method is too expensive. To accomplish this task, we used the standard α - source RSAS Ra-226. We record simultaneous emitted alpha and gamma rays from the decays. The source was located near the detectors. The measurements were carried out using the same equipment used in the experiments [1]. Alpha particles were detected by a Si detector, gamma quanta were detected by scintillation detectors based on a Hamamatsu-2083 PMT and an EJ301 or EJ315 type liquid scintillator having pre-measured characteristics, in particular the time resolution, is obviously better than that of the our Si detectors. The measurements were carried out on a large number of detectors (mainly PIPS) with an area of 20 to 100 mm² and a working layer thickness of 23 to 1000 microns, made mainly 35-40 years ago in the USSR. CANBERRA 2003BT and ORTEC142 preamplifiers were used in the measurements.

As a result of the measurements sets of dependences of the time and amplitude characteristics on the bias voltage were obtained and recommendations were developed on its choice to achieve the best resolutions.

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1. S. V. Zuyev et al. // Bull. Russ. Acad Sci. : Phys. 2016. V. 80. P. 232.

Fig. 1. The y axis - the change in the value of the Si detector parameters (500 μm , S - 90 mm²) as a percentage of the point with a bias voltage of 40 V. a- the signal amplitude in the slow channel, b- the amplitude in the fast channel, c- is the amplitude resolution, d- time resolution, e- the fast signal front at the level of 0.1-0.9

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