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INVESTIGATION OF BACKGROUND GAMMA-RAY SPECTRUMS AS DEPENDING ON SUPPLY VOLTAGE OF PMT

To control the content of radionuclides, both in the general environment and in various products, what a person is created, one of the main methods is spectrometric. Examination of samples requires consideration of background radiation. Consequently, the quality of obtaining the background spectrum affects the final conclusions regarding the composition of the sample being investigated.

For registration γ -spectra typically use scintillation (SD) or a semiconductor detector (SCD). In terms of the quality of the spectra obtained, the SCD is better than the SD. However, the SCDs are more expensive, requires caution during slow on or off of high voltage supply, and also needs to be cooled by liquid nitrogen (to reduce thermal noise in a semiconductor), and it is also difficult or impossible to create large volume SCD crystals. Thus, the SD is still relevant for use in spectrometry.

In this work, an experimental study of background-spectrums from the voltage U applied to the photomultiplier tube (PMT) has been carried out. Measurement of the spectra carried out on a self-made device, where as a scintillator 40x40mm NaI(Tl) has been used. For the transformation of flashes into electrical impulses, the "FEU-19M" is involved. According to the technical passport of our PMT, its voltage supply may reach 1340 V. It has been experimentally established that individual pulses are already registered at a voltage of 650 V. Therefore, the research scenario consisted in obtaining background spectra with a voltage on the photomultiplier in the range from 700 V to 1200 V in increments of 100 V. As a source of high voltage a serial production unit BNV2-12 was used, which ensures its smooth regulation from 300 V to 2400 V.

For the construction of spectra, a digital oscilloscope BORDO-421M (production of Belarus) was used. The oscilloscope contains 10-bit ADC that allows us to digitize an analog signal with an accuracy of up to 1024 discretes. Maximum time resolution is 10 ns.

It is established that with the alternating voltage U, which occurs with amplitude pulses on the PMT, and the changed speed of the digit (c) on the interval 700-1200, it is possible to use practically linear function. In this case, the measurement error does not decrease by almost 4 times.

At a power supply of PMT U = 1200V, the noise level significantly increases (reaching 200mV), and the zero level becomes unstable. Thus, the operating point is better chosen at the power supply of the PMT from an interval of 1000V to 1100V.

The research of background-spectra has the advantage that it does not require the use of an ionizing radiationsources. However, there is a probable shortcoming of complete convergence – the delay of the speed corresponding to (by default, the spectrometer), and accordingly there is a small number of pulses registered for the time taken.

Preparation of the sensitivity of the spectrometer also requires control over the stability of the operation of its nodes: BNV2-12, PMT, ADC, programs. So, after turning on the digital oscilloscope Bordo-241M, which flows ~ 10min, there is a drift of its zero-level zero. Thus, the set of spectrum begins, which is necessary only after the elections, working with some time, necessary for stabilization [1]

Note that the characteristics of some elements used can significantly dependent on the temperature (for example PMT), so further study of such subjects is desirable to take into account.

References

1. Ivashkovska Yu.O., Spivak A.Ya. Investigation of background gamma spectra in the power supply of a photomultiplier. // p.164-169. In: Collection of articles on materials of student's scientific conference OSENU (Odesa, April 5-13, 2017) Kharkiv: FOP Panov AM, 2017.