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BACKGROUND SUPPRESSION IN GAMMA SPECTROMETRIC MEASUREMENTS

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Abstract: The contributions of the intrinsic activities of the scintillation and semiconductor detectors and their protection to the intensity of the background components of the γ spectra of natural objects are revealed.

Keywords: Radioactivity, spectrum, background, detector, efficiency, scintillation, semiconductor.

Introduction

The radioactivity of natural objects is mainly due to natural radionuclides of the uranium-thorium series and 40-potassium. In this case, the intensity of the γ-spectra of their samples, as a rule, is comparable to or lower than the intensity of the natural radiation background, which has the same spectral composition as that of natural objects [1, 2]. In this regard, in order to suppress the contribution of the background to the spectrum of the investigated sample, measurements of samples of natural objects are carried out using protective houses, in which the detector is placed together with the investigated sample.

In this work, we investigated the energy dependence of the attenuation of the γ-background by the lead protective houses of the scintillation and semiconductor detectors.

Research methodology.

The studies were carried out on γ-spectrometers with scintillation (NaI (Tl), Ø63 × 63 mm) and HPGe (relative registration efficiency $\varepsilon_{rel.} \approx 20\%$), placed in lead protective houses with wall thicknesses of 10 and 6 cm, respectively (Fig. 1), by measuring the spectra inside and outside the house.

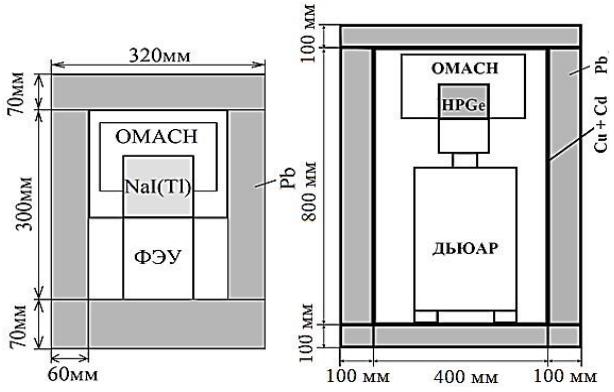

***Fig. 1**. Protective houses of HPGe and NaI (Tl) detectors.*

Research results and their discussion. Figure 2 shows the scintillation and semiconductor spectra outside - F and inside - F_0, the protective house and their ratios - F_0 / F.

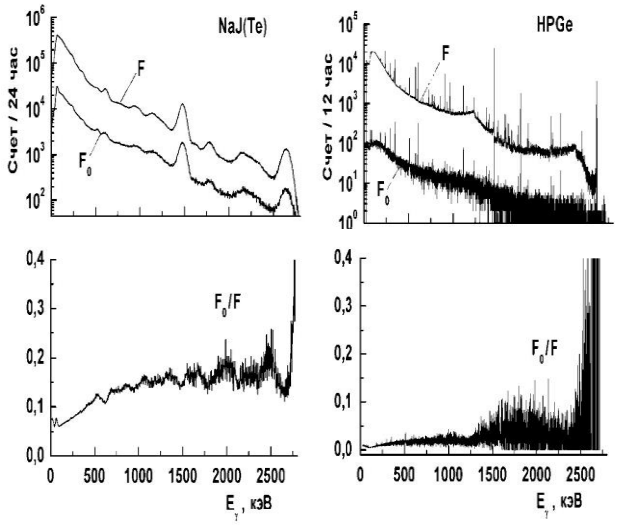

***Fig. 2**. Scintillation and semiconductor background spectra F - outside and F_0 - inside the house, F / F_0 - background suppression in protective houses.*

Consideration of the energy dependences of the background attenuation efficiency - F_0 / F made it possible to note the following circumstances:

- with an increase in the radiation energy, the amount of background attenuation decreases, for the scintillation spectrum - from $F_0 / F \approx 0.08$ at $\varepsilon_\gamma \sim 100$ keV to $F_0 / F \approx 0.2$ at $\varepsilon_\gamma \sim 2500$ keV, for a semiconductor, despite the fact that its thickness protection is noticeably less than that of scintillation, from $F_0 / F \approx 0.01$ at $\varepsilon_\gamma \sim 100$ keV to $F_0 / F \approx 0.8$ at $\varepsilon_\gamma \sim 2500$ keV,

- the dependence of the value of F0 / F on the radiation energy is not smooth, it shows maxima coinciding with the energies of the peaks of total absorption in the background spectra, this fact was noted by us for the first time.

Obviously, these circumstances are associated with the fact that the degree of background suppression, in addition to the material and thickness of the shield and the energy of the background radiation, depends on the intrinsic activities of the shield and detectors, and their radiation detection efficiency, while the activity and registration efficiency of a scintillation detector is much higher than that of a semiconductor detector.

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