



dosimetry

Prompt Gamma-ray Spectroscopy for Boron Dose Measurement

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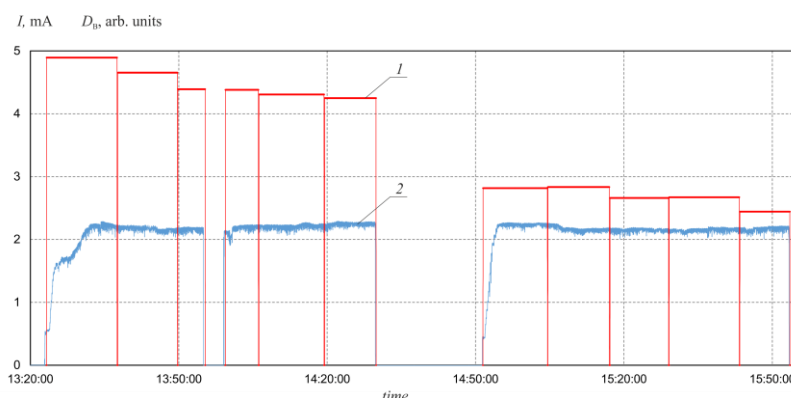
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The $^{10}\text{B}(n,\alpha)^7\text{Li}$ reaction itself provides a direct way to measure the boron dose, since one of the products of this nuclear reaction, the lithium nucleus, emits a photon with an energy of 478 keV in 93.9% of cases. Registration of such photons provides direct information about the number of nuclear reactions, i.e. about boron dose. Of course, this method of prompt γ -spectroscopy is well known [1], but has not been implemented for practical use in therapy.

The difficulty of implementation is that the γ -radiation spectrometer must be located in a neutron flux and have good energy resolution. It should be taken into account that photons with the same energy are emitted from the lithium target as a result of inelastic scattering of protons on lithium atomic nuclei. If we use a γ -spectrometer, which is relatively stable in a neutron flux, then the energy resolution does not allow us to separate the 478 keV line from the more powerful 511 keV line. The HPGe γ -spectrometer separates these lines, but it is not resistant to neutrons.

The report presents the results of a study that made it possible to measure the time dependence of boron dose in the treatment of a pet cat with adenocarcinoma in the nasal cavity. The study was carried out at the accelerator based neutron source VITA [2]. The figure shows the measured dependence of boron dose (1) and proton beam current (2). The results obtained made it possible to determine the absolute value of the absorbed dose, which is important for assessing the result of therapy.



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References:

1. T. Kobayashi, K. Kanda. Microanalysis system of ppm order B-10 concentrations in tissue for neutron capture therapy by prompt gamma-ray spectrometry. *Nucl. Instrum. Methods Phys. Res.* 204 (1983) 525–531.
2. S. Taskaev, *et al.* Neutron Source Based on Vacuum Insulated Tandem Accelerator and Lithium Target. *Biology* 10 (2021) 350.