

## Neutron spectrum measurement on the tandem accelerator for BNCT using a new time-of-flight method

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At BINP (Novosibirsk, Russia) it is constructed the prototype of the future accelerator-based neutron source to carry out boron neutron capture therapy at hospital. The tandem accelerator uses the reaction  ${}^7\text{Li}(\rho,n){}^7\text{Be}$  and generates neutrons since 2008 [1]. Up to date a lot of work has been done to upgrade the accelerator [2]. Thanks to this work the accelerator is currently able to operate daily and stable during several hours with 1-1.5 mA proton beam current, 2 MeV of proton energy and neutron flux respectively  $\sim 2 \cdot 10^{11}/\text{s}$ . The first *in vitro* experiments are already conducted and to continue the experiments we must know exactly the spectrum of generated neutrons. But so far we had only the Monte Carlo calculations of the spectrum and rough data from experiments with bubble detectors. Finally the reached parameters of the accelerator allowed us to carry out the neutron spectrum measurements using a new time-of-flight method, the idea of which was described by us in detail previously in [3]. Briefly the essence of the method is the following: the proton beam at the output of the accelerator has the energy of 1.88 MeV (below the neutron production threshold) and neutrons are not generated. But during 200 ns the energy of protons increases from 1.88 up to 1.92 MeV by supplying the square pulse of 40 kV on the lithium target, which is electrically isolated from facility body. During these 200 ns neutrons are generated. The spectrum is obtained by measuring the time of flight by a remote neutron detector. The proposed technical solution is implemented for the first time and has no analogues.

The present work contains the discussion of problems related to the new method, provides the detailed description of experiments and technical solutions and contains the experimental spectrum and its comparison with calculation. The measured neutron spectrum of the existing lithium target is in good agreement with the theoretical one. With the new TOF method it is planned also to measure the spectrum of the new lithium target.

[1] B. Bayanov, A. Burdakov, V. Chudaev, et al. *First neutron generation in the BINP accelerator based neutron source*. Appl. Radiat. Isot., 67, S285-S287 (2009).

[2] V. Aleynik, A. Bashkirtsev, B. Bayanov, et al. *VITA Based Neutron Source - Status and Prospects*. Proceedings of XXIII Russian Particle Accelerator Conference RUPAC2012, September, 24 - 28, 2012, Saint-Petersburg, Russia, p. 230-232.

[3] V. Aleynik, B. Bayanov, A. Burdakov, et al. *New technical solution for using the time-of-flight technique to measure neutron spectra*. Appl. Radiat. Isot., 69, 1639-1641 (2011).