A NEW METHOD FOR GENERATING MONOENERGETIC NEUTRONS USING ACCELERATOR

S. Taskaev

Budker Institute of Nuclear Physics SB RAS,
11 Lavrentiev ave., 630090 Novosibirsk, Russia;
Novosibirsk State University

Monoenergetic neutron beams with neutron energy from 8 keV to 390 MeV have been obtained today for metrology purposes [1, 2]. In the low-energy area, they use mainly two reactions, $^{7}Li(p,n)^{7}Be$ and $^{45}Sc(p,n)^{45}Ti$, and receive beams with energies of 2, 8, 24, 27, 70 and 144 keV [3-5].

In this paper, we propose and discuss a new method for the generation of monoenergetic neutrons of any energy. Generation of neutrons is implemented by using a proton beam produced by an accelerator and neutron-generating target. The method is based on the use of threshold reaction of neutron generation and the use of a thin neutron-generating layer. Monoenergetic neutron beam is formed of neutrons emitted in the direction opposite to the direction of the protons. The neutron energy is uniquely determined by the energy of the protons and the angle of emission. Monochromaticity of the beam is determined by the proton energy, the solid angle, and thickness of neutron-generating layer.

An implementation of the proposed method for 77 keV neutrons using reaction $^{7}Li(p,n)^{7}Be$ in the facility made in the Institute for the development of boron neutron capture therapy [6] is shown in detail in the present report. These neutrons are required to measure the quench factor of liquid argon, used as detection media at the dark matter detector.

References

[1] HARANO, H., MATSUMOTO, TANIMURA, Y, et al.: *Monoenergetic and quasi-monoenergetic neutron reference fields in Japan.* Radiat. Meas. 10, **45**, 1076-1082, 2010.

[2] LACOSTE, V.: *Review of radiation sources, calibration facilities and simulated workplace fields.* Radiat. Meas. 10, **45**, 1083-1089, 2010.

[3] MATSUMOTO, T., HARANO, H., NISHIYAMA, J, et al.: *Novel generation method of 24-keV monoenergetic neutrons using accelerators.* Proc. of the 20th International Conference on the Application of Accelerator in Research and Industry, Fort Worth, Texas, USA, Aug. 10-15, 2008, AIP Conf. Proc. **1099**, 924-927, 2009.

[4] MATSUMOTO, T., HARANO, H., SHIMOYAMA, T., et al.: *Characterisation of kilo electron volt neutron fluence standard with the $^{45}Sc(p,n)^{45}Ti$ reaction at NMIJ.* Prot. Dosim. **126**, 155-158, 2007.

[5] YOSHIZAWA, M., SHIMIZU, S., KAJIMOTOET, Y., et al.: *Present Status of Calibration Facility of JAERI, Facility of Radiation Standards.* Proc. Symposium – IRPA-11, Madrid, May 2004. 3b46, 2004.

[6] ALEYNIK, V., BURDAKOV, A., DAVYDENKO, V., et al.: *BINP accelerator based epithermal neutron source.* Appl. Radiat. Isot. **69**, 1635-1638, 2011.

E-mail: taskaev@inp.nsk.su
Session number: INSTRUMENTATION AND TECHNIQUES