

## Characterization of New Intense ${}^7\text{Li}(p,n)$ Neutron Source at CYRIC

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## II. 2. Characterization of New Intense ${}^7\text{Li}(p,n)$ Neutron Source at CYRIC

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A new  ${}^7\text{Li}(p,n)$  neutron source has been installed at The Cyclotron and Radioisotope center, Tohoku University. Figure 1 shows a schematic view of the new neutron source. It was designed to provide intense neutron flux ( $> 10^6/(\text{cm}^2\cdot\text{s})$ ) at a sample position by enabling short target-sample distance. It will be used extensively for cross section measurement, nuclear physics, and testing of semiconductors for single-event effects, and dosimetry development. Prior to the experiment, it is necessary to confirm the property of the source intensity and background level, because of narrow experimental room, and relatively thin shielding for the lithium target and the beam dump.

For the reason, we have characterized the new neutron source for 3 aspects; 1) the neutron intensity and energy spectra, 2) backgrounds and 3) neutron beamprofile. We have measured the neutron intensity and energy spectra with a TOF (Time Of Flight) method having good energy resolution. These results have confirmed that the intensity of neutron flux is close to the design. Figure 2 shows the measured neutron energy spectra. Figure 2 indicates the energy spectra consist of intense peak component around 880 ch. and continuum spectrum as expected. The peak around 950 ch is attributed to the flame overlap. Table 1 summarizes the main features of the measured spectra and the achieved neutron fluence, and shows the present source realizes the expected source intensity.

We have measured the fast neutron backgrounds from the lithium target and the beam dump, and the distribution of thermal neutrons in the room. The fast neutron backgrounds have been derived from the TOF spectrum with shadowing of primary neutron and in off-axis position. Figure 3 shows the measured TOF spectra which consist of foreground neutron, neutron spectrum shadowed of primary neutron, and neutron from the beam dump. These measurements proved that the TOF spectra of fast neutron backgrounds are flat and low ( $\sim 10^{-3}$  relative to the peak).

The measurement of the thermal neutron distribution in the irradiation room has used foil activation method combined with imaging plate<sup>1)</sup>. This method enables to measure the thermal neutron distribution without  $\gamma$ -rays backgrounds. We concluded that thermal neutron flux was low in the experimental region, while it was  $1.0 \times 10^5 /(\text{cm}^2\text{s})$  around the Li-target. These results proved that the new neutron source can be used for practical applications.

The beam-profile was measured by a combination of foil activation and imaging plate<sup>2)</sup>. We have measured the signal-to-noise ratio of collimated beam through the comparison between measurements in on-axis and off-axis position. The signal-to-noise ratio was 8:1 for a thin collimator(25 cm thick). It has been measured with TOF method in on-axis and in off-axis position. From these result, we have determined that the signal-to-noise ratio is about 100:1

#### References

- 1) Masumoto K., et al., Rad. Safe. Manage, **1** (2002) 12.
- 2) Hagiwara M., et al., J. Nucl. Sci. Tech. **Sup. 4** (2004) 267.

Table 1. Summarizes the main features of the measured spectra and achieved neutron fluence.

| target thickness [mm] | peak energy [MeV] | beam current [nA] | peak fluence [#/(MeV·Sr· $\mu\text{C}$ )] |
|-----------------------|-------------------|-------------------|---|
| 4.69                  | 64                | 15                | $4.10 \times 10^9$                        |

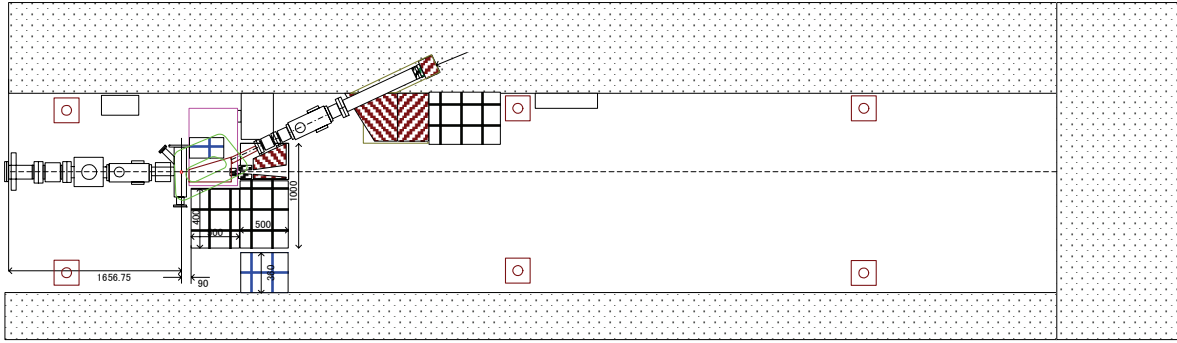


Fig. 1. Schematic view of new  ${}^7\text{Li}(p,n)$  source.

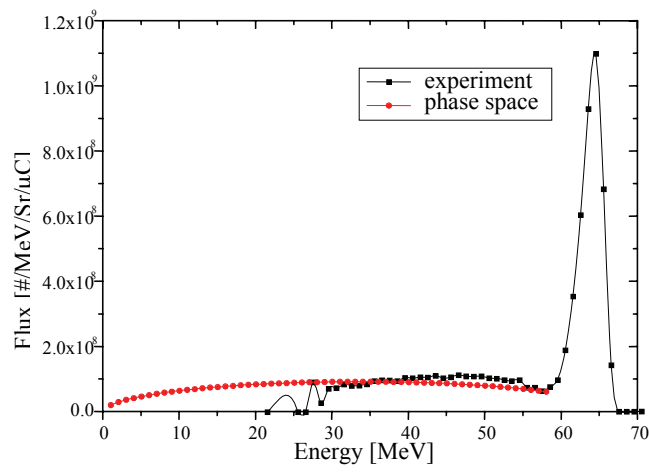


Fig. 2. Energy spectrum of new  ${}^7\text{Li}(p,n)$  neutron source.

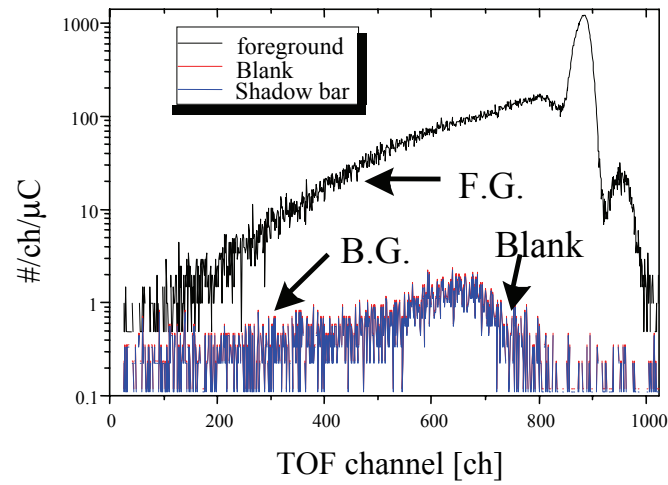


Fig. 3. Energy spectrum of new  ${}^7\text{Li}(p,n)$  neutron source.