Development of Large Volume Neutron Detector

著者	Ito S., Konno O., Takeya M., Terasawa T., Maeda K., Suda T., Fukuda T.
journal or publication title	CYRIC annual report
volume	1992
page range	77-78
year	1992
URL	http://hdl.handle.net/10097/49698

I. 18. Development of Large Volume Neutron Detector

Ito S., Konno O., Takeya M., Terasawa T., Maeda K., Suda T.*, and Fukuda T.***

Laboratory of Nuclear Science, Tohoku University
** College of General Education, Tohoku University*
***Institute for Nuclear Study, University of Tokyo*

We have developed a Large Volume Neutron Detector (LAND) to study various kinds of (γ,n) reactions. The requirements for LAND were the following: (1) n-γ separation by the Pulse Shape Discrimination (PSD) method [1], (2) good time resolution for the Time-of-Flight (TOF) measurement, (3) easy fabrication and handling, (4) large volume to reduce the number of electronics, and (5) efficient light collection capability. To satisfy these requirements, we have selected a large volume NE213 liquid scintillation detector.

A schematic drawing of LAND is shown in Fig.1. It is made of a cylindrical aluminum tube whose dimension is 1000 mm long and 130 mm ø in diameter. The total volume of NE213 is 13.3 litters. Two R1250 (HAMAMATSU) photomultipliers view inside from the both ends of the container through Pylex glass plates of 10 mm in thickness. A reservoir of the NE213 is placed at the top end of the container. The aluminum tube of 12 mm ø is connected at the bottom end. This tube is used for de-oxygenation of NE213 by bubbling argon. The computer code GUIDE7 [2] was employed to simulate the light propagation, in order to search the best condition of the reflector. The Aluminized-Plastic film (TS-100, Toyo Metalyzing Corporation, 100 μm thick), which was selected from 29 materials by measuring their reflectivities.

The response functions of LAND for the neutrons were measured at the Cyclotron laboratory, Tohoku University (CYRIC). The neutrons were obtained by using the (p,n) reactions at E_p = 35 MeV. Mono-energetic neutrons (E_n = 33.2, 33.4 MeV) were obtained with the ^{7}Li (10 mg/cm^2) and the thin ^{9}Be (22 mg/cm^2) targets,and continuous energy neutrons ($E_n \leq 33.4$ MeV) were obtained with the thick ^{9}Be (1.8 g/cm ^{2}) target. A reference detector,whose response function and detection efficiency were well determined, was used simultenuously for the absolute normalization. LAND and the reference detector were placed at 21.9 m and 43.2 m from the target, respectively. The relations between E_n and the maximum light output in corresponding E_e for LAND and the reference detector were consistent with the result by Verbinski et al. [3] as shown in Fig.2.

The neutron detection efficiency for LAND was obtained by comparing the total yield of neutrons with that of the reference detector. The neutron detection efficiency for $E_n = 33$ MeV was found to be 10 % for 10 MeV threshold which is corresponding to 6 MeV in electron energy. The obtained efficiency is shown in Fig.3.

In summary, we have constructed a large volume neutron detector, which has the large and long cylindrical shape (130 mm ø x 1000 mm) with a mirror refletor. The test using a neutron beam from CYRIC showed its performances concerning the timing resolution, n-γ separation and detection efficiency as good as those of a small detector.

References

1) Schery S. D et al., Nucl. Instrum. and Methods, **147** (1977) 399.
2) Massam T., CERN 76-21,Experimental Physics Division, 10 December197.
3) Verbinski V. V. et al., Nucl. Instrum. and Methods, **65** (1968) 8.

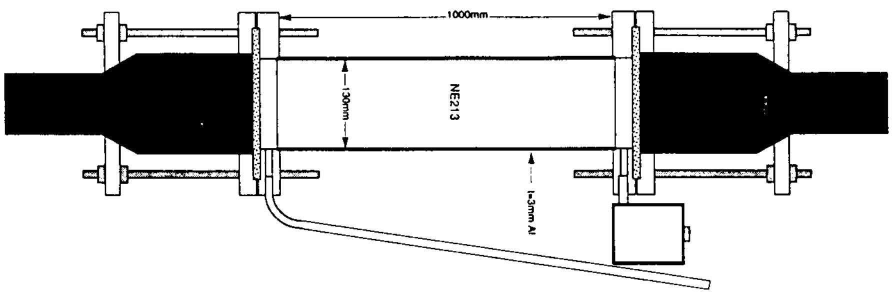

Fig. 1. Schematic drawing of the LAND.

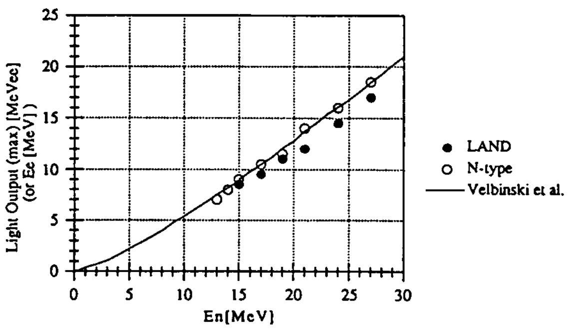

Fig. 2. LAND's maximum light output versus E_n.

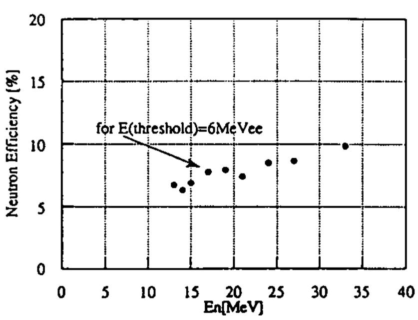

Fig. 3. LAND's detection efficiencies for neutrons.