Evaluation of Beam Quality Using an Optical Fiber-based Neutron Detector

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In order that BNCT is safely carried out, the quality assurance (QA) of neutron beam is essential. The thermal neutron distribution in a water phantom is one of the important measures for the QA. We are developing an optical fiber-based neutron detector [1] as a real-time neutron monitor for the beam quality evaluation of BNCT. The detector has the following advantages; a low gamma sensitivity, little perturbation to the measured field, etc. The detector consists of an optical fiber, a small piece of ^{6}Li-based scintillator crystal, a digital multichannel analyzer (MCA), and a photomultiplier tube (PMT). The LiF/Eu:CaF_2 eutectic crystal is used in the detector because it has some advantages, such as a high light yield of about 10,000 photons/neutron and a convenient emission wavelength of about 400 nm. In this study, the thermal neutron distribution in a water phantom was scanned by the detector. Here, the phantom was irradiated with neutrons generated from the accelerator-based neutron source in Nagoya University by using the detector. The gold foil activation method and the Monte-Carlo simulation by the particle and heavy ion transport code system (PHITS) were also conducted. The proton beam current and the proton energy were 0.5 mA and 2.8 MeV, respectively. The results obtained from each method showed good agreement within a range of uncertainty. In addition, we obtained the results with much smaller uncertainty in shorter measurement time compared with the gold foil activation method.

References

1. A. Ishikawa *et al*., Sensitivity and Linearity of Optical Fiber-Based Neutron Detectors Using Small ^{6}Li-Based Scintillators, Nuclear Inst. and Methods in Physics Research, A (2018).