

Recent Activities of the neutron standardization at KRISS

Neutron Spectrometry with BSS

KRISS extended Bonner sphere system

KRISS have constructed the multi-sphere system for the neutron spectrometry (Bonner Sphere spectrometer), manufactured by Centronic Ltd., UK. The Bonner Sphere set has 10 spheres of 3", 3.5", 4", 4.5", 5", 6", 7", 9", 10", and 12" diameter and originally designed by PTB, Braunschweig.⁽¹⁾

To extend the energy range for the neutron spectrometry, we designed and constructed the extended Bonner spheres with copper and lead shell included. The response matrix is calculated by using MCNPx.

	Inner PE sphere	Metalshell		Outer PE shell
	Diameter	material	Outer diameter	Outer diameter
C3P5S6	3"	Pb	5"	6"
C4P5S7	4"	Pb	5"	7"
C4U5S7	4"	Cu	5"	7"
C4P6S8	6"	Pb	6"	8"

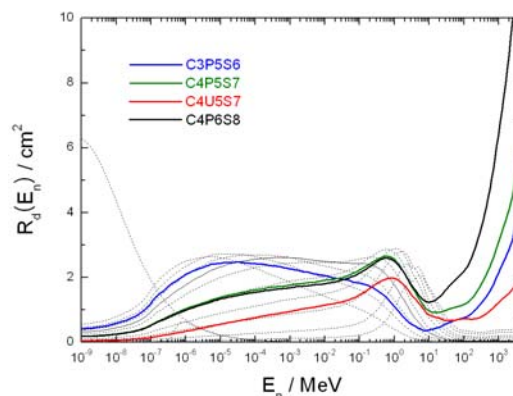


Figure 1 KRISS extended BSs and their response function

Neutron Spectrum Measurement at Nuclear Power Plant (PWR)

With BSS system, we continued the neutron spectrum measurement at the workplace of nuclear power plant in Korea. The reactor type is PWR(Pressurized Water Reactor).

Long counter for neutron fluence measurement

We designed and produced Long counter for neutron fluence measurement. Also, we calculated its response function and effective center. The calibration measurement for efficiency and the effective center will be performed in this year. Also, we have plans to monitor the stability and the reproducibility.

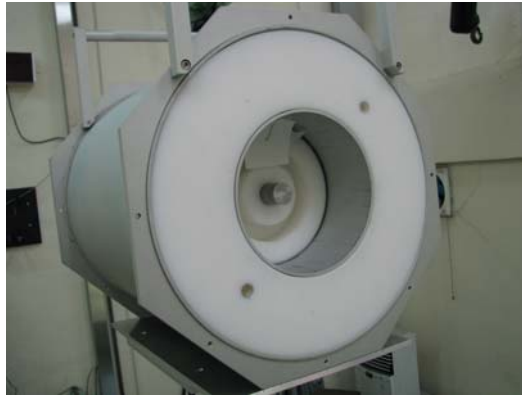


Figure 2 Long counter constructed by KRISS

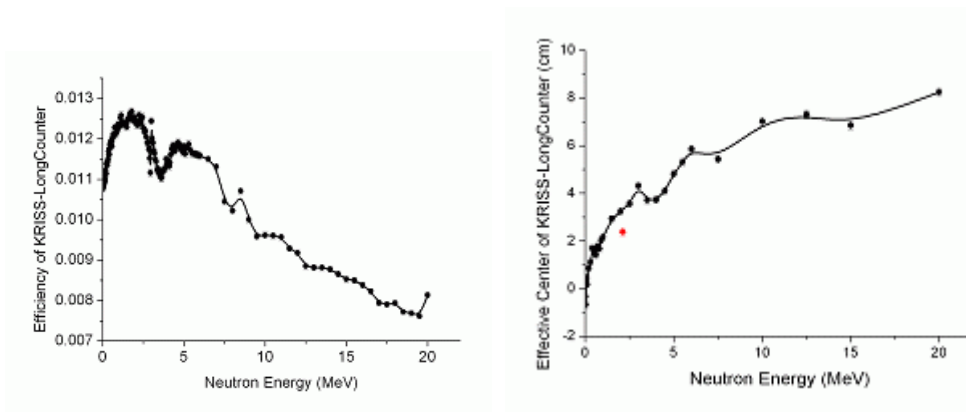


Figure 3 The efficiency(left) and effective center(right) for each incident neutron energy. The red point is measured value with Cf-252 source at KRISS.

- (1) B. Wiegel, A.V. Alevra, "NEMUS- the PTB Neutron Multisphere Spectrometer: Bonner spheres and more ", Nucl. Instrum. Meth. A447, pp 36-41, 2002.

Plans

1. Bonner Sphere Spectrometer

We plan to confirm the newly calculated response function of new extended BS set using Am-Be source and possibly accelerator produced neutrons. After that, we plan to measure the neutron spectrum at the ground level in KRISS, and also we

plan to measure the neutron spectrum at the underground laboratory for the dark matter search.

2. Neutron Spectrometry with LSC(Liquid Scintillation Counter)

Because the energy resolution of BSS is very much limited, we are preparing LSC (liquid scintillation counter) system for the high resolution neutron spectrometry. We planned to do this work 2 years ago, but could not start. We are planning to do this again. The gain stabilization system developed by PTB would be used if PTB provides.

3. Neutron fluence with Long Counter

We have constructed Long counter last year and calculated its response function. The calibration and the stability test will be performed.

Staff Members

Three research scientists are fully involved for the neutron standardization.

- Hyeonseo Park, ph.D in Nuclear Physics
- Jung Ho Kim, ph.D in Nuclear Physics
- Kil-oung Choi, master in Chemistry

Facilities

- **Radioactive neutron sources**
 - two ^{252}Cf source : the emission rates of 5.7×10^7 n/s and 5.4×10^5 n/s
 - two $^{241}\text{Am-Be}$ source : the emission rate of 1.229×10^7 n/s and 2.325×10^5 n/s
- **Low background neutron irradiation room** : size of $6.7 \times 7.6 \times 6.4 \text{ m}^3$
- **Manganese Sulphate Bath system for neutron emission rate measurement**
- **Bonner sphere system with 10 PE spheres**
- **4 extended Bonner spheres with Pb and Cu shells**
- **Neutron detectors**
 - Long counter with one He-3 proportional counter and one BF_3 proportional counter
 - two REM counter(EG&G Ortec LB123),
 - two H_2 proportional counter
 - Liquid scintillation detector (BC501a)
 - two BF_3 proportional counter

Publications and Communications

● International

- “The Determination of Neutron Dose for Accelerator-Produced Neutrons by Using a Bonner Sphere Spectrometer”, J.H. Kim, H. Park, K.O. Choi, *Journal of Nuclear Science and Technology*, Supp.5, pp294-297, 2008.
- “Neutron Spectrum Measurement at the Workplace of Nuclear Power Plant with Bonner Sphere Spectrometer”, H. Park, J.H. Kim, K.O. Choi, *Journal of Nuclear Science and Technology*, Supp.5, pp298-301, 2008.
- “Calibration Procedure for a neutron monitor at energies below 20MeV”, A. Ohrn, J. Blomgre, H. Park, S. Khurana, R. Nolte, D. Schmidt, K. Wilhelm, *Nuclear Instruments and Methods A592*, pp405-413, 2008..
- "A Monitor for Neutron Flux Measurements up to 20 MeV", , A. Ohrn, J. Blomgre, H. Park, S. Khurana, R. Nolte, D. Schmidt, *Radiation Protection Dosimetry*, 124, pp394-397, 2007.
- “Neutron Calibration Facility with Radioactive neutron Sources at KRISS”, H. Park, J.H. Kim, K.O. Choi, *Radiation Protection Dosimetry*, 124, pp159-162, 2007.
- “Neutron Dosimetry at the Workplace Field with Neutron Spectroscopy”, H. Park, J.H. Kim, K.O. Choi, *Proceedings of International symposium on radiation safety management*, November 7-9, 2007, Daejeon, Korea.
- “Calibration of neutron personal dosimeters in the realistic case”, J.H. Kim, J.H. Kim, K.O. Choi, *Proceedings of International symposium on radiation safety management*, November 7-9, 2007, Daejeon, Korea.

● Domestic

- “Neutron Spectrometry and its Application for Radiation Protection”, H. Park, J.H. Kim, K.O. Choi, *Bulletin of the Korean Physical Society*, 26/1, p67, 2008.
- “Neutron Spectrometry with Bonner sphere system at nuclear power plant”, J.H.Kim, H.Park, K.-O.Choi, *Bulletin of the Korean Physical Society*, 23/2, p404, 2005