

Introduction

- KEPCO NF (KNF) generates about 1000 radiowaste drums annually.
- The waste generated by KNF is contaminated by uranium.
- Drum scanning has efficient way to measure radioactivity but has large uncertainty.
- A large part of the uncertainty (-82%~325%) caused by the distribution of source position [1].

Objectivity

- We want to reduce uncertainty by suggesting index that estimate the distribution of sources and reflecting them in the measurement results

Methods and Results

- KNF analyzes radiowaste drum radioactivity by using KNF Integrated Drum Scanner (KIDS).
- This KIDS has detection system as follow.
 - A HPGe detector for low energy region gamma-ray analysis
 - NaI array for high density waste measurement (R&D ongoing)

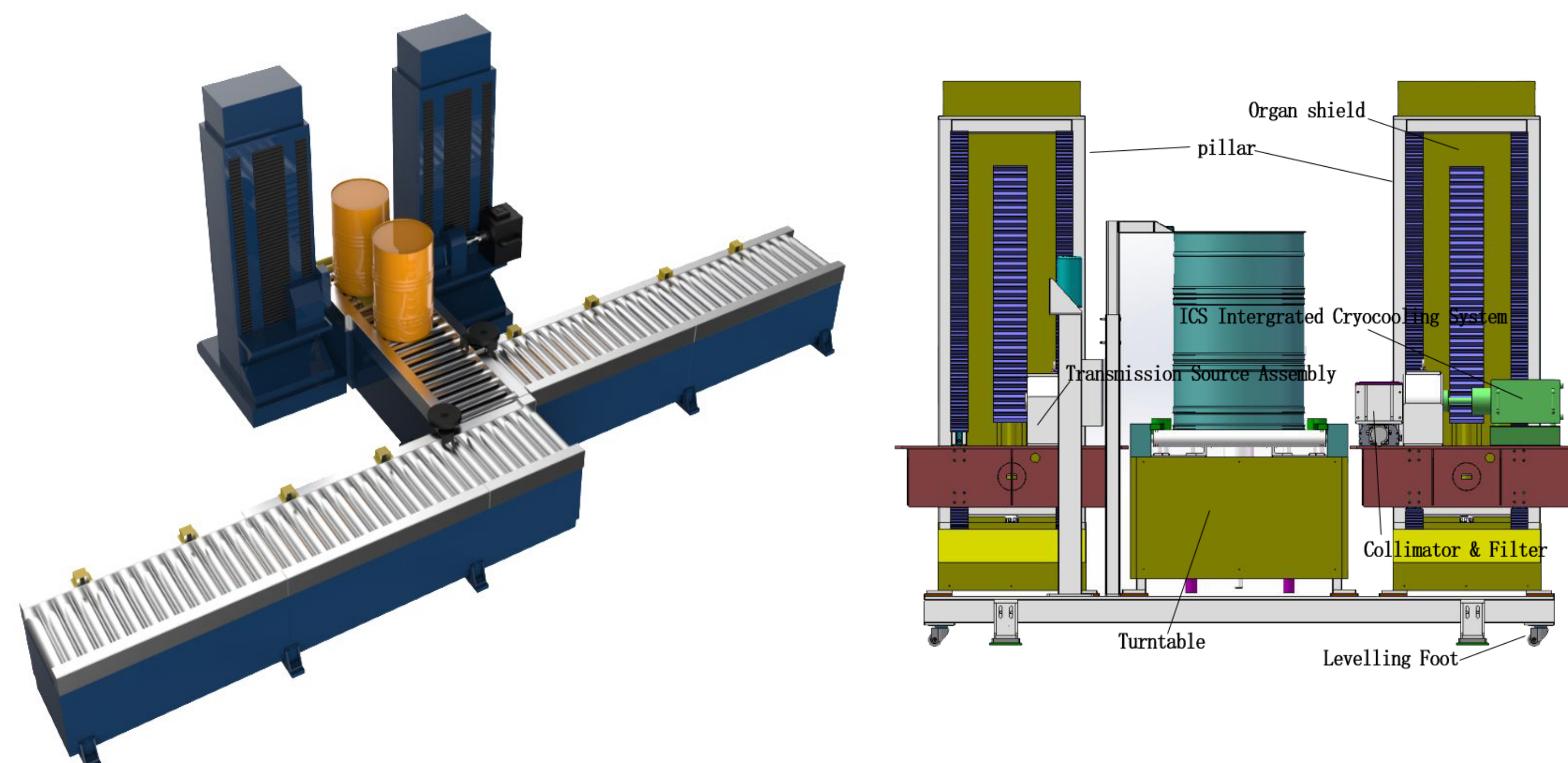


Fig. 1. A rendering image of KIDS and components of HPGe detection system

Methods and Results (cont'd)

- We suggested an index that determines the uniformity of radioactivity distribution in the drum through count ratio at 0 degrees and 180 degrees when rotating the drum.
- We call it as drum radioactivity uniformity index (DRUX).
- The method of estimating source location applied when DRUX is less than 0.6.
- To obtain depth information of sources in the drum, a list mode measurement waste used to record the change in the counts over time (185.7 keV peak area is used).

	DRUX
Uniform	1
Non-uniform	0 to 1
Extremely non-uniform (hotspot)	1

- The uranium powder(UO₂, 100g, enrichment 4.46%) is located at 5 cm, 10 cm, and 25 cm from the surface of the drum.

$$D = -12.53 \times PR^2 + 44.25 \times PR - 6.17$$

$$PE = 0.0679 \times e^{-0.036D}$$

- D is depth in radial direction of uranium, PR is peak ratio of 180 degrees to 0 degrees, and PE is peak efficiency of 185.7 keV.

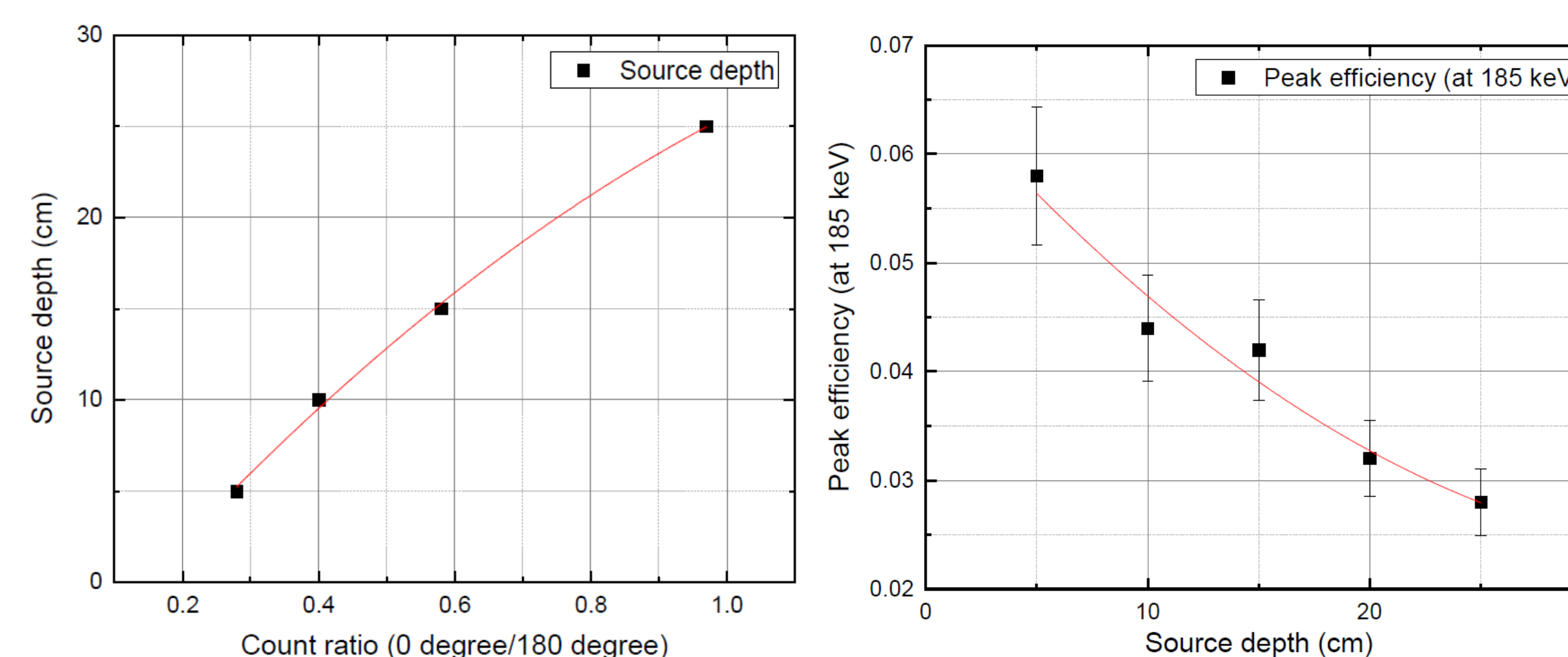


Fig. 3. A source depth estimation and a peak efficiency estimation function

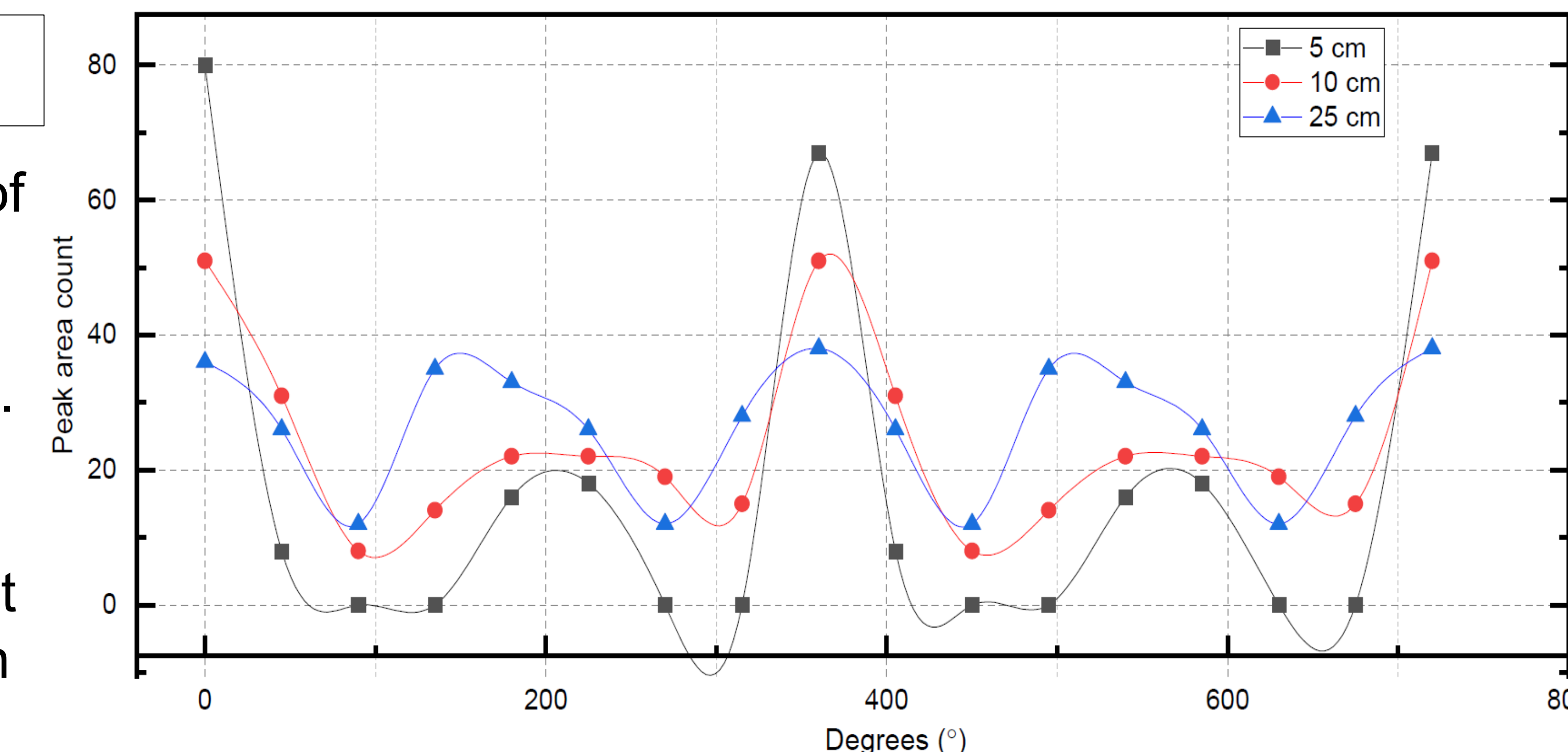


Fig. 4. List mode spectrum according to drum rotation angle

- DRUX was tested with uranium (75g) at any location and maintained an error of less than 10%.

Conclusion

- Radioactivity information in radiowaste drum is an important factor in the disposal of waste.
- We improve segment gamma scanning (SGS) method by suggesting DRUX that it applicable even in a hotspot situation.
- We will apply the DRUX concept to various contamination situations and various densities of waste.

References

- [1] Ministry of Trade, Industry and Energy Department, Study on radiation exposure optimization plans of nuclear power plants, 2002.
- [2] T. Krings and E. Mauerhofer, Reconstruction of the activity of point sources for the accurate characterization of nuclear waste drums by segmented gamma scanning, Appl. Radiat. Isot. 70, 880-889, 2011.
- [3] T. Krings and E. Mauerhofer, Reconstruction of the isotope activity content of heterogeneous nuclear waste drums, Appl. Radiat. Isot. 70, 1100-1103, 2012.