

Study on High Sensitivity Multi-layer Compton Camera For Clearance Applications in Decommissioning

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Abstract

High sensitivity multi-layer Compton camera is investigated to reduce nuclear power plants waste in decommissioning process. Compton camera has several advantages to produce image of radiation source distribution since it has high sensitivity for high energy gamma-rays in the range of MeV.

Keywords: High sensitivity, Compton Camera, Decommissioning

1. Introduction

Clearance activity is one part of decommissioning process. In this process nuclear waste is sorted and classified. If the activity is lower than the standard that has been approve by the authority it will be threat as an industrial waste. We study about high sensitivity multilayer Compton camera to reduce the NPPs waste, especially for the metal material from the reactor core which has activity of ^{60}Co .

2. Monte Carlo Simulation on Multilayer Compton camera

For Monte Carlo simulation, Geant4, a toolkit for simulating the passage of particles through matter was used[1]. Three layer Ce:GAGG scintillator which each layer has 8×8 voxel, where in first detector each pixel has size of $10 \times 10 \times 5\text{mm}$, and for the second and third detector the size is $10 \times 10 \times 10\text{mm}$. The 2D projection image from multilayer Compton camera simulation shows on figure 1.

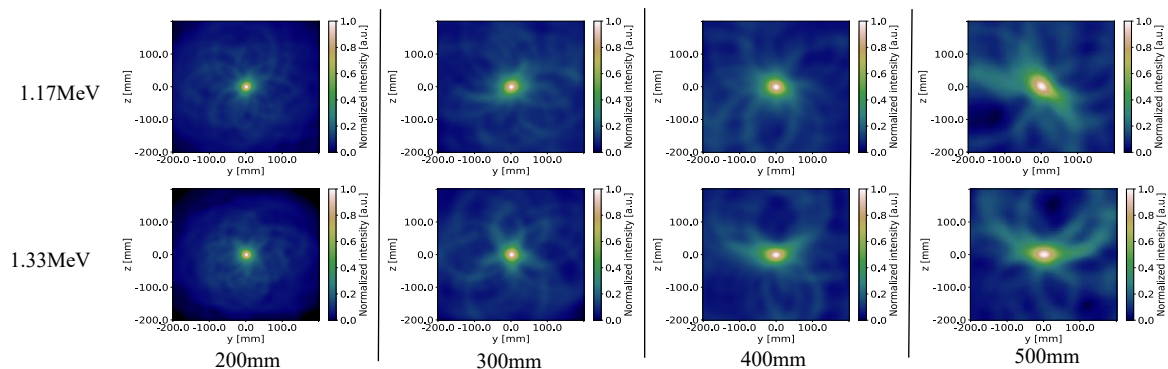


Fig.1 2D Back Projection of Multilayer Compton Camera

The absolute efficiency for the 200mm, 300mm, 400mm, and 500mm are respectively 7.28×10^{-4} , 2.24×10^{-4} , 1.22×10^{-4} , 6.77×10^{-5} , and 3.13×10^{-5} . The efficiency decreases in a line with increasing the distance of the source to the detector. The multiple hits in layers are also investigated.

3. Conclusion

From simulation, multilayer Compton camera can give good efficiency and image reconstruction. It can be beneficial for the clearance application in decommissioning.

References

- [1] Y. Yoshihara, K. Shimazoe, Y. Mizumachi, and H. Takahashi, "Evaluation of double photon coincidence Compton imaging method with GEANT4 simulation," Nucl. Instruments Methods Phys. Res. Sect. A Accel. Spectrometers, Detect. Assoc. Equip., vol. 873, pp. 51–55, 2017.