RESEARCH BUILDING GAMMA COMPTON SCATTERING MEASUREMENT SYSTEM AND RELATED EXERCISES FOR TRAINING NUCLEAR HUMAN RESOURCES

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ABSTRACT: In this subject we have designed and manufactured Compton scattering gamma measurement system based on the calculated optimal configuration as well as the conditions of protect radiation by using Monte - Carlo simulation program and fabrication with the optimal conditions were selected. Monte-Carlo simulation calculation of Compton scattering gamma follow different angles on copper, surveying gamma radiation attenuation characteristics of materials: lead, iron, aluminum, and compared with the experimental results performed on the same measurement system has been built and given for evaluation, comments.

I. INTRODUCTION

Training Center of Nuclear Research Institute is one of the basis by the Ministry of Education tasked to participate in the training of human resources in the nuclear field. Therefore, the study design and manufacture a Compton scattering measurement system using Detector NaI(Tl) scintillator with gamma sources and exercise related construction service training is essential.

Compton scattering gamma measurement system is made at the Training Center, Nuclear Research Institute will facilitate the university students as well as graduate students to experiment and verify theory has been studied.

II. EXPERIMENTS

II.1. Equipments

- Compton scattering gamma measurement system, the materials survey intensity of gamma-ray scattering angle and materials survey attenuation of gamma radiation: Copper, aluminum, iron, lead.

- Detector Nai (Tl) scintillator connected to the multi-channel analysis system using the Phast PC - 8K MCA type MC 1008 of Indian.

Figure 1: Compton scattering gamma measurement system at the Training Center, Nuclear Research Institute.

II.2. Experimental procedures

- Monte Carlo simulations using MCNP program to calculate the scattering gamma intensity follow different angles on copper target and determine the characteristic attenuation of gamma radiation in the material: aluminum, iron, lead.

- Experimental measurements based on Compton scattering gamma measurement system have been built to calculate the scattering gamma intensity follow different angles on copper target and determine the characteristic attenuation of gamma radiation in the material above.

- Comparison between simulation and experimental results, verification of theoretical laws.

III. RESULTS AND DISCUSSION

The results showed that the difference between the Monte Carlo simulations using MCNP program and experimental measurement is negligible.

Gamma scattering energy follow angles (0^o, 30^o, 60^o, 90^o, 120^o) as measured on the Compton scattering gamma measurement system was fabricated completely follow the rules of Compton scattering, the results from simulation calculations also for the same results.

Table 1: Gamma scattering energy at different angles.

Scattering angles	0^o	30^o	60^o	90^o	120^o
E'_γ theory (KeV)	662	564	402	288.5	225
E'_γ simulation (KeV)	662	564	402	288	225
E'_γ experiment (KeV)	660	570	401	286	215

When surveying gamma radiation attenuation characteristics of materials: aluminum, iron, lead by the two methods is the simulation and experimental measurements obtained results quite similar, here we see only a very small difference between the calculated parameters such as: the linear attenuation coefficient (μ), the mass attenuation coefficient (μ_m), half value thickness (HVT), tenth value thickness (TVT).

So, you can use the results from simulation calculations for comparison and verification with experiments.

Table 2: The parameterst from the simulation calculations and experimental measurements.

Parameters		μ (cm^{-1})	μ_m (cm^2/g)	HVT(cm)	TVT(cm)
Simulation	Aluminum	0.202	0.075	3.4	11.4
	Iron	0.569	0.072	1.2	4.0
	Lead	1.170	0.103	0.59	1.97
Experiment	Aluminum	0.201	0.074	3.45	11.46
	Iron	0.559	0.071	1.24	4.12
	Lead	1.146	0.103	0.604	2.011

IV. CONCLUSIONS

Have completed the following objectives:

- Calculate the optimal design Container containing Cs-137 source activity 22.7 mCi by Monte Carlo simulations using MCNP program.

- Designing and manufacturing Compton scattering gamma measurement system and complete installation on the lab table.

- Calculate the simulated gamma scattering intensity in copper follow different angles using MCNP program and identify attenuation characteristics of gamma radiation in the material: aluminum, iron, lead.

- Measurement of experiments to determine the gamma scattering intensity in different angles on copper and determine the attenuation characteristics of gamma radiation in the material: aluminum, iron, lead on the system has already been made.

- Compare and evaluate the results between simulation and experimental measurements.

System has been completely made for the survey results consistent with theoretical calculations and simulations.

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