6.3. The effect of scatter materials/ambient on the measured spectrum

In this experiment the effect of scattering materials such as plexiglass on photopeak/Compton ratio and Full Width at Tenth Maximum-FWTM ($(1/10^{th})$ value will be investigated. Compton edge is calculated from the Compton scattering equation. For the peak of a ^{60}Co source at 1332,5 keV energy, Compton edge is the spectral area between 1040 keV and 1096 keV, which is more probable in this energy range. To determine photopeak/Compton ratio, first of all the maximum count on the photopeak at 1332,5 keV energy shall be determined. Then the average count between 1040 keV and 1096 keV energies shall be determined. The photopeak/Compton ratio can then be easily found by dividing the max count on the photopeak center to the average count. Be aware that the method used to determine FWTM is the same with the method used to determine FWHM.

METHOD

1. Perform the energy calibration using at least two energies for example, use ^{60}Co source.
2. Preset the count time to 600 s.
3. Place ^{60}Co source in front of the detector and start the acquisition.
4. Write down the max count of the photopeak at 1332,5 keV energy.
5. Note the average count value between 1040 keV and 1096 keV energies.
6. Calculate $\frac{Photopeak}{Compton}$ ratio.
7. Note the FWTM value using the ROI covering the photopeak.
8. Add four layers of the used scattering material having a thickness of 2.3 mm between the source and the detector respectively.

Table 2

Scatter thickness (mm)	**Photopeak count**	**Compton count**	**Photopeak/Compton ratio**	**FWTM(keV)**
0				
9,2				
18,4				
27,6				
36,8				

EVALUATION

1. Plot the graph of Photopeak/Compton ratio versus scatter thickness.
2. Plot the graph of FWTM versus scatter thickness.
3. Interpret the measured and calculated results.
4. Calculate the energy of the Compton edge for ^{137}Cs isotope's 661.66 keV energy.

ANNEX 1 – Decay data of the interested isotopes used in the experiments for the gamma-ray energies, and their gamma emmision probabilities, and half-lives.

Isotope	Gamma energy (keV)	Half life	Gamma emission probability (%)
^{241}Am	59,537	432,2 year	35,9
^{57}Co	122,06	271,79 day	85,6
^{137}Cs	661,66	30,07 year	85,1
^{54}Mn	834,848	312,12 day	99,976
^{60}Co	1173,237	5,27 year	99,90
	1332,50		99,98
^{152}Eu	121,783	13,542 year	28,43
	244,699		7,49
	344,281		26,58
	411,115		2,23
	443,976		2,78
	778,903		12,96
	867,388		4,15
	964,131		14,34
	1085,914		9,91
	1089,70		1,71
	1112,116		13,54
	1408,011		20,87
^{65}Zn	1115,546	244,26 day	50,60

ANNEX 2. Mass attenuation coefficients of Pb

Photon energy (MeV)	**μ/ρ (cm^2/g) (ρ=11,35 g/cm^3)**
0,010	131,0
0,015	112,0
0,020	86,4
0,030	30,3
0,040	14,4
0,050	8,04
0,060	5,02
0,080	2,42
0,088*	1,91
0,088*	7,68
0,100	5,55
0,150	2,01
0,200	0,999
0,300	0,403
0,400	0,232
0,500	0,161
0,600	0,125
0,800	0,0887
1,000	0,0710
2,000	0,0461
4,000	0,0420
8,000	0,0467
10,000	0,0497
* indicates the K-absorption edge	