

Phys 586 Laboratory

Lab 4

Goal: In this lab you will determine an energy scale and measure the energy resolution for the inorganic scintillators.

Reading: Knoll 326-332

Lab:

1. Choose either the LSO(Ce) (Wed groups) or NaI(Tl) (Mon, Tue groups) scintillator. Collect data using the following sources: ^{137}Cs , ^{60}Co , ^{22}Na , and ^{133}Ba . In this case we are interested in good measurements of the peak and width values, so running for 5 minutes or longer for each is recommended.
2. Using your data, construct an energy scale. Do this by fitting a line to a plot of channel number (y) versus energy (x). You can use the ROI feature in Maestro to determine the channel number of peaks though you may want to double check by looking at the raw data as well. You may want to make a rough plot before leaving the lab.
3. For the data taken with the ^{137}Cs and ^{22}Na sources, use your energy scale to determine the Compton edge and back scattering peak energies. Compare these with the expected values. Make sure you have enough data with these sources to see these features.
4. Using your data, make a plot of the log of the energy resolution (y) versus the log of the energy (x). You can use the ROI feature in Maestro to determine the FWHM though you may want to double check by looking at the raw data as well. Fit a line to this plot and determine the slope. Compare the slope to the expected value. Determine the energy resolution from ^{137}Cs and compare your result to a typical value for the scintillator you chose.

In your lab writeup, please include:

1. The inorganic scintillator used.

2. Spectra of the four sources. Please make sure the x-axis is in channels, not energy.
3. Result of the line fit determining the energy scale. Please show the data from the various photopeaks along with the resulting line. Comment on your results.
4. Using your scale, give the energy of the Compton edge and back scattering peaks for ^{137}Cs and ^{22}Na . Compare with the expected values. Comment on your results.
5. Result of the line fit determining the energy resolution. Please show data from the various photopeaks along with the resulting line. Compare the slope with the expected result. Give the energy resolution for ^{137}Cs . Comment on the results.

Also, please answer the following questions:

1. What is the main contribution to the energy resolution for your inorganic scintillator?
2. What factors can worsen the energy resolution for inorganic scintillators?