Phys 586 Laboratory

Lab 3

Goal: In this lab you will measure several pulse height spectra with two inorganic scintillators.

Reading: Knoll 307-327 and short tutorial on MAESTRO-32.

Lab:

1. There are two inorganic scintillators: NaI(Tl) and Lu_2SiO_5(Ce). Using the ^{137}Cs source, make a sketch of the PMT output for each of the two counters. Note the rise and fall time of the signal as well as the pulse height scale. Also, note any particular bright lines in the spectra.

2. Sketch the PMT output for the no source condition for each of the two scintillators.

3. Connect the shaper and multichannel buffer card to the PMT. Here we are using an ADC (multichannel buffer card) with integrated software (MAESTRO-32) to form a multichannel analyzer (MCA). An MCA is an instrument that counts and sorts events in real time. In this case, the events are sorted according to the pulse height of the signal, which is proportional to the energy deposited.

4. Collect the following data for crystals and sources. A 5 minute run generally gives good statistics.

   - NaI with ^{137}Cs source.
   - NaI with ^{60}Co source.
   - NaI with ^{22}Na source.
   - LSO with no source.
   - LSO with ^{60}Co source.

5. Finally, collect data at several different distances between source and detector. Take enough data to show that the falloff in intensity (or dose) agrees with your expectations.

In your lab writeup, please include:

1. Sketches of the PMT output for each of the scintillors with and without a source.
2. Plots and explanations of features seen in the plots for the NaI crystal. Label the energies of the photopeaks. There are more features than just the photopeaks in the plots.
3. Plots and explanations of features seen in the plots for the LSO crystal.
4. Plot the number of counts or count rate as a function of the distance between source and detector. Show or fit that this curve agrees with your expectations.

Also, please answer the following questions:

1. What is the radioactive component in the LSO detector?
2. What is the decay scheme for this radioactive component?