

PHYSICS 360/371 INTERMEDIATE LABORATORY

EXPERIMENT #15 - GAMMA RAY SPECTROSCOPY

References: B. Brown: Experimental Nucleonics
D. Halliday: Introductory Nuclear Physics

The apparatus consists of a sodium iodide scintillation detector, which is connected to a multichannel analyser (MCA). The operation of the MCA is handled by a windows based software package which will load when the computer is switched on. For the most part, the software will not need to be configured much beyond the default settings. On power up the Amp/HV window will appear, and you must switch the HV on. A setting of 450V provides a nice linear response of the scintillation detector and photo multiplier combination. There are many different utilities within the software which you can use to calibrate the instrument, select regions of interest (ROI's), plot spectra and obtain counts vs energy data

- 1) Using the Cs¹³⁷ and Co⁶⁰ sources, you should first calibrate the MCA. You can do this by plotting the known* Gamma ray energy vs the channel # for each peak observed in the two spectra. Alternatively, you can use the calibrate function (found by right clicking on the spectrum) to calibrate the x-axis directly. To do a three point calibration, you will have to acquire sequential data from both sources. However, you must plot and analyse both spectra individually.
- 2) Record as well, the γ -spectra of Na²² and identify all of the main features in terms of energy and origin. The range of energies here may be greater than that of Part 1. Note that Na²² emits positrons as well as γ photons.
- 3) Repeat part 2) for the other sources provided. (Ba¹³³ and Bi²⁰⁷) The bismuth source is in a steel can, and should not be removed from it. Simply place the can as close to the scintillation detector as possible.

In your report, include descriptions of the principles of operation of the NaI(Tl) scintillation detector and photo multiplier combination. Include as well a summary of the three ways in which a γ -ray may lose energy in the crystal. Identify the origin of all peaks in your spectra, and compare the energies of observed Compton Edges with those predicted by theory.

* The actual values of the γ - ray energies can be obtained by consulting the "Chart of the Nuclides" which is attached to the wall in the vestibule area of the laboratory entrance.