

2010 Exotic Beam Summer School

The basic idea of this activity is to determine the relative total cross sections for different materials by measuring the neutron flux from our ^{252}Cf source with a couple VANDLE modules. We will use the PIXIE digital signal processing data acquisition to record time-of-flight of neutrons from a trigger bar placed at the neutron source. Two groups of two will select and record two different materials. Comparisons can be made to all four materials.

1. Calculate the energy of the neutrons based on TOF and distance from the ^{252}Cf source.
 - a. Measure from center of trigger bar to center of VANDLE bar.
 - b. Look at sample TOF spectrum and pick a few energies to record for your comparison.
2. Pick a material and determine the number of atoms/cm² from thickness and density.
 - a. Use internet to find density of materials.
 - b. We have elemental ratios for the compound materials.
3. Record neutron data.
4. Analyze data and make cuts to project a TOF spectrum for the part of the bar that is masked by the material.
5. Account for differences in area and time of run and then normalize to background data.
6. Compare relative cross section to other materials.

List of Materials:

Bismuth
Tin
Lead
Cadmium
Aluminum
Stainless Steel
Brass
Graphite
Cement
Paraffin
Boron-doped Paraffin
Paper
Plastic
Water
Wood

Versatile Array Neutron Detectors at Low Energy (VANDLE)

VANDLE is a collection of large ($5 \times 5 \times 200 \text{ cm}^3$) and small ($3 \times 3 \times 60 \text{ cm}^3$) scintillating plastic modules. Neutrons scatter off the hydrogen in the plastic and the recoiling proton induces scintillation light in the bar. This light travels through the bar to the ends, getting internally reflecting at the sides, and is then collected and converted to an electric signal by a photomultiplier tube (PMT). Since the neutron can scatter off the proton at any angle, the energy of the neutron must be deduced from the time-of-flight and not the energy deposited by the scattered proton.

The raw signal is digitized by the XIA PIXIE 100 MHz 12-bit digitizer following a timing filter that amplifies the longer wavelengths. If any part of the digitized signal is above the threshold, that channel is flagged and sent to a logic mask that looks at all the channels to determine if the event is recorded. The events are sent to the computer where an analysis scan code processes the events to display amplitude, integrated signal, and timing spectra. The average timing signal from the left and right ends yields a position-independent TOF spectrum to deduce the energy of the reacted neutron.

Recording data:

Window 1

>pixie_ldf_c name

>shm

>go

To stop:

[ctrl^c]

>end

Window 2

>test16

To stop:

[ctrl^c]

Window3

>fdir /home/pixie16/SummerSchool2010

>ouf name.ldf

>trun boff

To stop:

[Return]

>tstop

>clo

Damm notes:

Input data

>in name.his

To open a saved file

>qf name.his

Note: For displaying data, the second value can be n or q for current or saved data.

View 2d spectrum neutron position vs. TOF (0.1 ns/bin)

>dd n 2550

Gate on 2d spectrum

>gx n 2500 1200 3000

or

>gy n 2500 130 300

Then display projection

>d m 1

Controlling the x-range of the display

>dl 1200 3000

To show default range for selected spectra

>dl

Rebin the data

>krud 2

or

>krud 25

Using the cursor on the histogram

>c

In histogram window

[c] will display the current x value of the cursor position

[q] will allow you to return to the DAMM window

