Appendix XXIV: Quick Start – the NaI:Tl scintillator and the high purity Ge detector

Two different detectors will be used to measure the energy spectrum of gamma ray sources.

For each type of detector

Set up electronics (refer to **Electronics setup and connections** sections)

With a sample such as ^{60}Co in front of the detector, adjust the FINE GAIN 2.5-12.5 dial on the panel of 575A AMPLIFIER to reach the peak amplitude (so that energy range you are interested in is within channels 1-4000. Use the Maestro program of the multichannel analyzer (MCA) plug-in card in the computer to monitor the gain. Note that the ADC of the MCA has a nominal conversion gain of +10V to channel 4000.

Remove the sample and collect data for background radiation (refer to **Data collection**.). Collect background radiation data for the same time as you going to use for the samples. Save the data for background (see **To save data to the diskette**).

Collect and Save Data for each sample (refer to **Data collection** and see **To save data to the diskette**). Strip the background data from the sample data, for each sample (see **To load data to BUFFER** and **To strip background from buffer**). Save again using different filenames (see **To save data to the diskette**).

Convert each data file from binary (".chn") to ascii or text (see **To convert data**).

Electronics setup and connections

A. The HPGe detector together with its preamplifier is enclosed in a metal cylinder and has to be cooled down with liquid nitrogen for several hours before using. (The application of the 1.5kV reverse bias will cause drift of the Li dopants at room temperature, which will eventually destroy the detector.)

Connect OUTPUT1 of the HPGe detector to the INPUT on the front panel of 575A amplifier.

Connect the BIAS SHUTDOWN from the HPGe detector to the BIAS SHUTDOWN on the back of 659 5Kv bias supply

Connect the HIGH VOLTAGE input (thick black coaxial cable) of the HPGe detector to 0-5kV OUTPUT on the back of 659 5kV bias supply

Connect the PREAMPLIFIER POWER input (gray cable) of the HPGe detector to 9-pin POWER PREAMP connector on the back of 575A amplifier

Connect BI OUT (bipolar output) on the panel of 575A amplifier to INPUT 1 or 2 of the oscilloscope. Set the scope for internal trigger on the appropriate signal.

Connect UNI OUT (unipolar output) on the panel of 575A amplifier to ADC input of the ADC card on the back of the computer.

Turn the power on setting ON/OFF switch on the panel of NIM 2100 power supply to ON.

POS and SHUTDOWN indicators on the panel of 659 5Kv bias supply should be on. Push the RESET button on the panel of 659 5kV bias supply once. The SHUTDOWN indicator should go off indicating that the detector temperature is cool enough. **If at this step the SHUTDOWN indicator is still on, STOP and ask for instructor's help immediately. (Note: the 9-pin preamp power cable must be plugged in for the SHUTDOWN interlock to be satisfied.)** Turn on the HV switch and push RESET button on the panel of 659 5Kv bias supply one more time, the ON indicator LED should turn on (so that both ON and POS indicators are now on).

Apply approximately 1.5kV of bias voltage to HPGe detector by rotating the 0-5kV dial on the panel of the 659 5kV bias supply (approximately 1.5 rotations of the dial, two LED bars in the indicator window will turn on).

On the panel of the 575A amplifier, set INPUT to POS and the COARSE GAIN dial to 10 then using FINE GAIN dial, adjust the amplification so that the majority of the output pulses have tops of their positive polarity peaks below +10 Volts. Use the oscilloscope to observe the amplitude and polarity of the output signal and use the MCA to check the ADC conversion gain.

To turn off, using 0-5kV dial on the panel of 659 HV supply, decrease the HV to zero. On the same unit turn off the high voltage by setting the HV switch to OFF. Turn OFF the NIMBIN 2100 power supply.

B. Scintillator, photomultiplier detector, and 113 preamplifier in a separate unit.

Connect the OUTPUT of the photomultiplier through 1MOhm-1μF RC network to the INPUT on the panel of the 113 preamplifier.

Connect POWER (gray) cord from the back of 113 preamplifier to the 9-pin POWER PREAMP socket on the back of the 575A amplifier.

Connect OUTPUT on the back of 113 preamplifier to INPUT on the back of 575A amplifier.

Connect HIGH VOLTAGE input of the photomultiplier to HV OUT on the back of the Mech-Tronics Model 225 HV SUPPLY.

Connect BI OUT (bipolar output) on the panel of 575A amplifier to INPUT 1 or 2 of the oscilloscope. Set the scope for internal trigger on the appropriate signal.

Connect UNI OUT (unipolar output) on the panel of 575A amplifier to ADC input of the ADC card on the back of the computer.

Turn the power on setting ON/OFF switch on the panel of NIM 2100 power supply to ON.

Apply +800 volts of high voltage to the photomultiplier by rotating 0-2kV dial on the panel of 255 2kV HV supply (4 rotations of the dial (200 V per rotation)). Use the analog voltmeter on the panel of the same unit to observe the applied voltage.

On the panel of 575A amplifier, set INPUT to NEG and COARSE GAIN dial to 4 then using FINE GAIN dial, adjust the amplification so that the majority of the output pulses have tops of their positive polarity peaks below +10 Volts. Use the oscilloscope to observe the amplitude and polarity of the output signal, and use the MCA to check the ADC conversion gain

To turn off, using 0-2kV dial on the panel of of 255 2kV HV supply, decrease HV to zero. Turn OFF the 2100 NIMBIN power supply.

ADC card and MAESTRO program

The input to the ADC card should be positive pulses within the range of +1 to +10V. The card transforms the value of the positive maximum of each pulse into channel numbers in the range of 1-4000 (technically 4096 or 2^{12}). After sensing the positive slope of the beginning of the pulse the card waits for it to reach its maximum value and then proceeds with digitizing. During this time the card cannot accept another pulse. The time during which ADC card is busy doing its job is called DEAD TIME.

To start the ADC card and MAESTRO program.

Turn the computer on. MAESTRO program is running under Windows 95. (This means that you can only use filenames that are up to 8 letters long.) In the Program Manager window open the EG&G window. Run the Maestro program (winmca.exe).

When you are done, close the program going to File and Exit. Close Windows and turn off the computer power.

MAESTRO program
It plots a histogram of the number of pulses of given amplitude accepting input from ADC card and puts them to MCB data storage. It also calculates LIVE time = REAL time - DEAD time, REAL time is the time elapsed from the beginning of data collection. It uses two data storage registers MCB and BUFFER. The screen display can be switched to display either MCB or BUFFER.

Data collection.
For the time of data collection always use LIVE TIME. Clear the MCB if needed by choosing Acquire, Stop (if data acquisition is running), and Clear.
To start, switch display to MCB and the data range to full. Choose Acquire and Start.
To stop, Choose Acquire and Stop.
Data are now stored in the MCB.

To save data to the diskette.
Choose Acquire and Copy MCB→Buffer (data can only be saved from the Buffer). Choose File and Save as...Enter A:\filename.ext (use appropriate filename and extension). The program will ask you to enter some file description, which you can ignore and leave it clear since you will not be able to use it later. Click OK. (Be sure you record the file name in your notebook.)

To load previously acquired data to BUFFER.
Go to File and Recall. You will be advised to save buffer, do it if you need as it will be lost after you load your file. Enter a:\filename.ext. Click OK.

To strip background from buffer
Go to Calculate and Strip. In the field “file to strip from memory” enter a:\filename.ext (for the file that you saved doing background measurements). For stripping factor use “Live Time Ratio.” Click OK.

To convert binary data to text (ASCII)
The Maestro program saves data files in its internal binary format. To be able to use them in a spreadsheet or editor you will have to convert the data files to an acceptable format. To do that you will need the conversion program called **trnmca.exe**.

If you want to be able to do the conversion on a different computer, find and copy it to your disk: In the Windows 95 Program Manager go to Windows and Main. Navigate to find file **trnmca.exe** in folder **c:\mca.** Copy it to your disk.

To convert data files copy them together with **trnmca.exe** in a separate folder. Run **trnmca.exe**. The program will ask you to enter names of input and output files together with extensions. The output of the program is the number of counts for each channel starting from channel one. The data should now be in a format that can be read into a spreadsheet program and plotted.