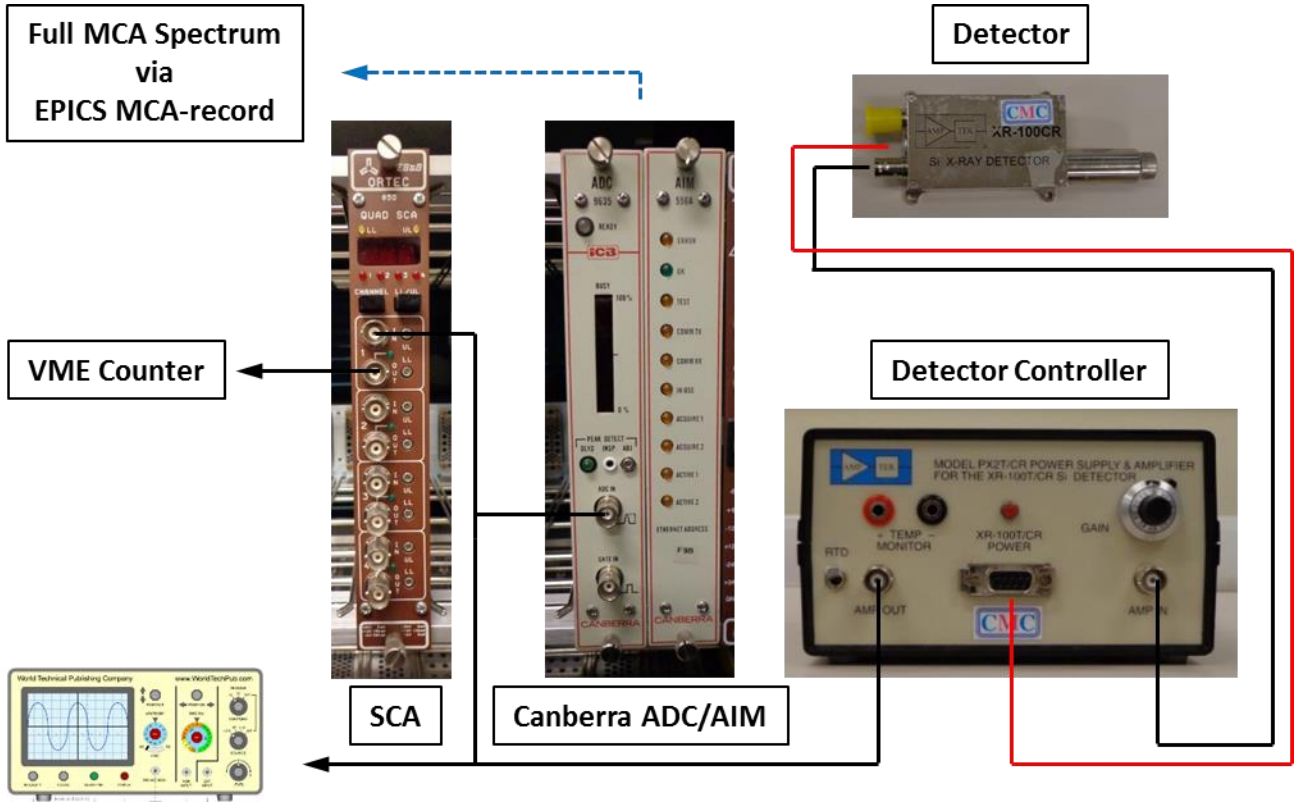
Using an Amptek (Fluorescence-) Detector at Beamline 27-ID

05/17/2016, tg

1. Hardware Setup



Connect

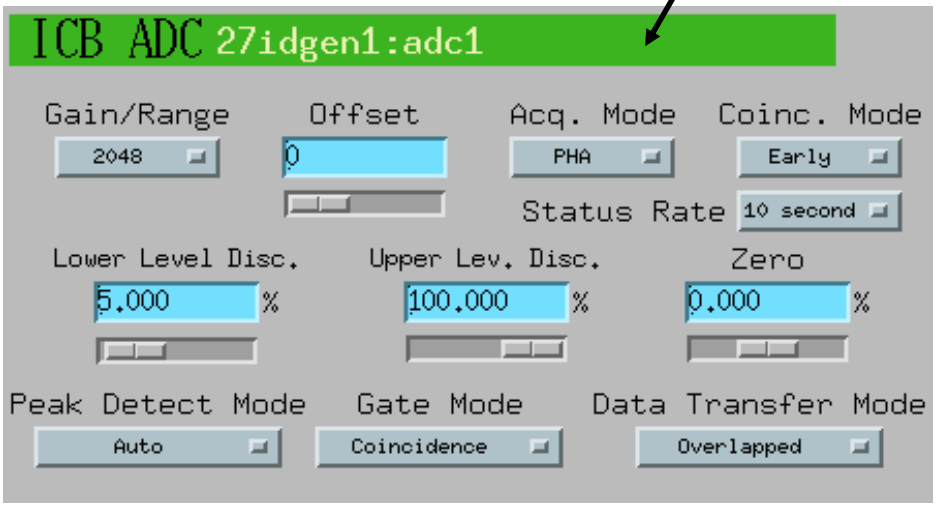
- power cable **Detector** ↔ **Detector Controller** "POWER"
- signal cable **Detector** "OUT" ↔ **Detector Controller** "AMP IN"
- signal cable(s) **Detector Controller** "AMP OUT" ↔
  - **Canberra ADC** "ADC IN" (for full MCA spectrum / "soft" counting within regions of interest)
  - **Ortec SCA "IN"** (for "hard" counting within a region of interest)
  - **Oscilloscope** (for trouble shooting / calibration)

Note: Combination of devices connected to **Detector Controller** "AMP OUT" (ADC, SCA(s), Oscilloscope) can be freely chosen, but will affect calibration of the detector. Therefore, "AMP OUT"-configuration should not be changed after the detector is calibrated.

2. Acquiring Full MCA Spectra

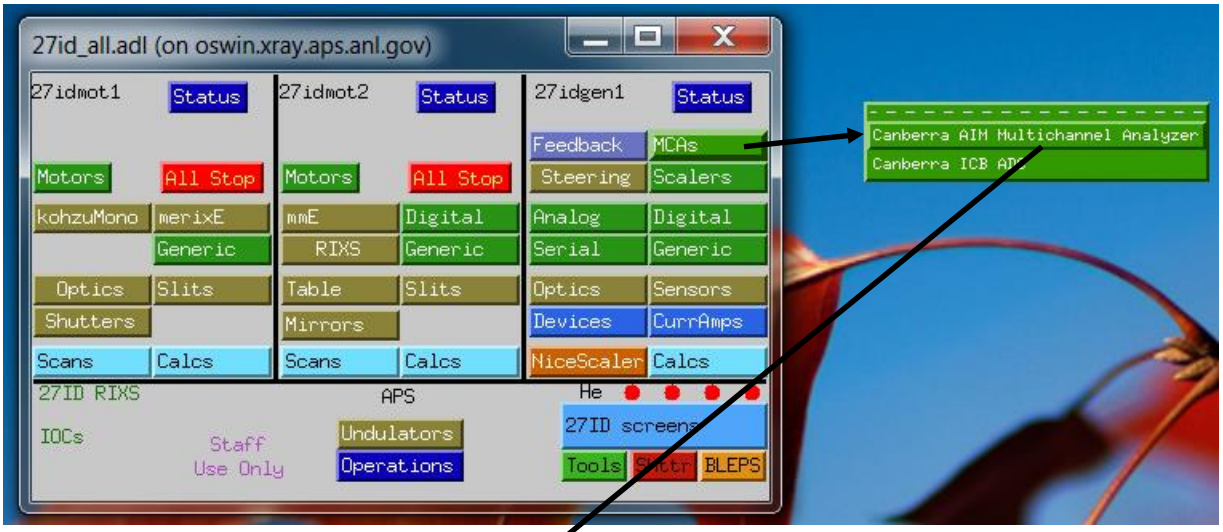
2.1 EPICS Setup

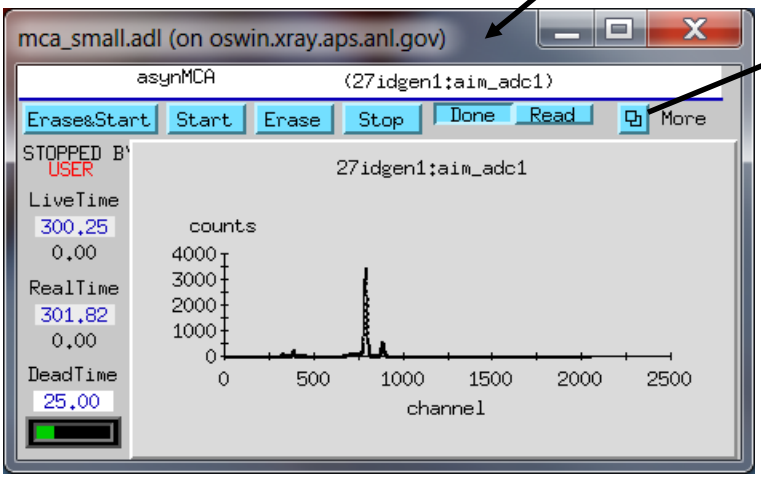
- Canberra ADC setup: Open MEDM window for ADC

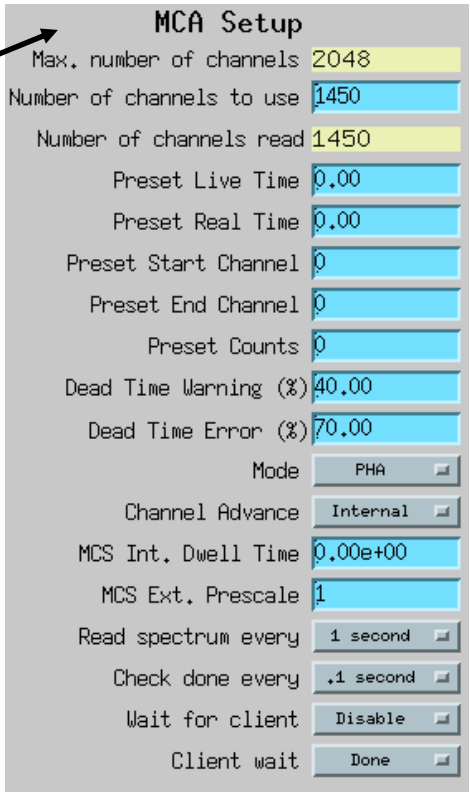


- Configure ADC as shown above
- Use “Gain/Range” setting for total number of channels and resolution (#channels/10 V)
- Use “Lower (Upper) Level Disc.” to suppress noise at lower (upper) end of spectrum

- **MCA setup:** Open MEDM window for MCA and MCA Setup



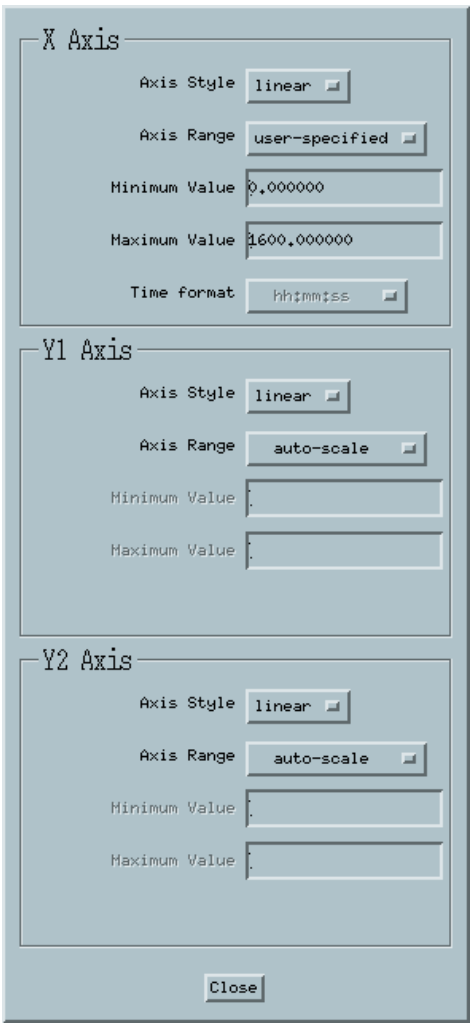


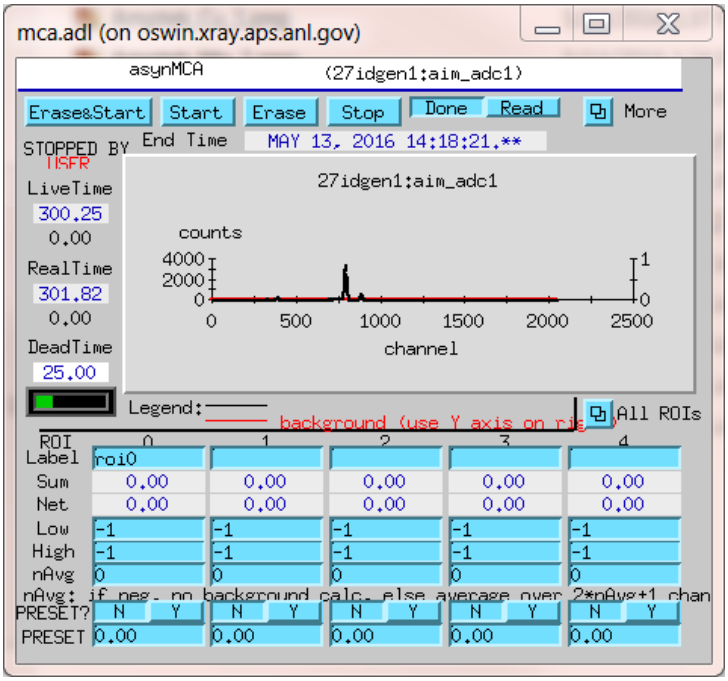


- set number of channels to include
- set “Live” or “Real” acquisition time, 0.00 for continuous acquisition

Plot can be customized through plot setup menu (right-click in plot window)

Regions of interest (ROIs) can be defined in the extended MCA window, accessible through the "More"-menu





Note: For the Canberra ADC/AIM modules to be recognized by EPICS, these modules have to be fully booted-up before the associated IOC "27idgen1" is booted. If Canberra modules are not recognized, then **(STAFF only!)**

- Turn-off IOC "27idgen1" VME crate
- Turn-off NIM-BIN containing Canberra modules
- Turn-on NIM-BIN containing Canberra modules
- Observe boot-up cycle on LEDs on Canberra AIM module and wait for it to complete
- Boot-up cycle is complete when "OK"-LED on Canberra AIM module comes on
- Turn-on VME crate and wait for it to reboot

2.2 MCA Spectrum Acquisition

- Control Acquisition through <Erase&Start>, <Start>, <Erase> and <Stop> Buttons in MCA window
- Spectra can be saved to a file by issuing the following command from a terminal:
Oswin% caget 27idgen1:aim_adc1 >> path/file name

File structure: generating PV• #data points•data separated by •(blanks)
Example:

```
27idgen1:aim_adc1 2048 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 0 0 0 0 0 0 0 1 1 2 0 0 0 1
0 0 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 1 0 0 0 0 0 0 0 0 0 0 1 0 1 1 0 1 0
2 2 1 1 1 1 4 2 1 3 2 4 3 3 2 4 5 1 1 4 6 5 6 2 4 7 1 7 5 4 8 10 4 6 9 6 6
8 8 11 8 12 5 13 8 13 13 22 9 9 17 12 13 12 15 10 11 18 17 15 12 20 ...
```

2.3 Energy Calibration

The assumption is that identifiable fluorescence lines of known energy are present at the detector (Am-241 radioactive source with filters, Metal (EXAFS-) foils in x-ray beam,…).
Let a line of energy E_1 appear in channel c_1 and a line of energy E_2 appear in channel c_2, then the energy E(c) at channel c is given by

$$E(c) = (c - c_1)\frac{(E_2 - E_1)}{(c_2 - c_1)} + E_1 \qquad (1)$$

The Canberra ADC is designed to convert an input pulse of 10V-amplitude to one count in the highest channel, $V(c_{max}) = 10V$. Thus, the voltage V(c) corresponding to a channel c is

$$V(c) = \frac{c}{c_{max}} 10V \qquad (2)$$

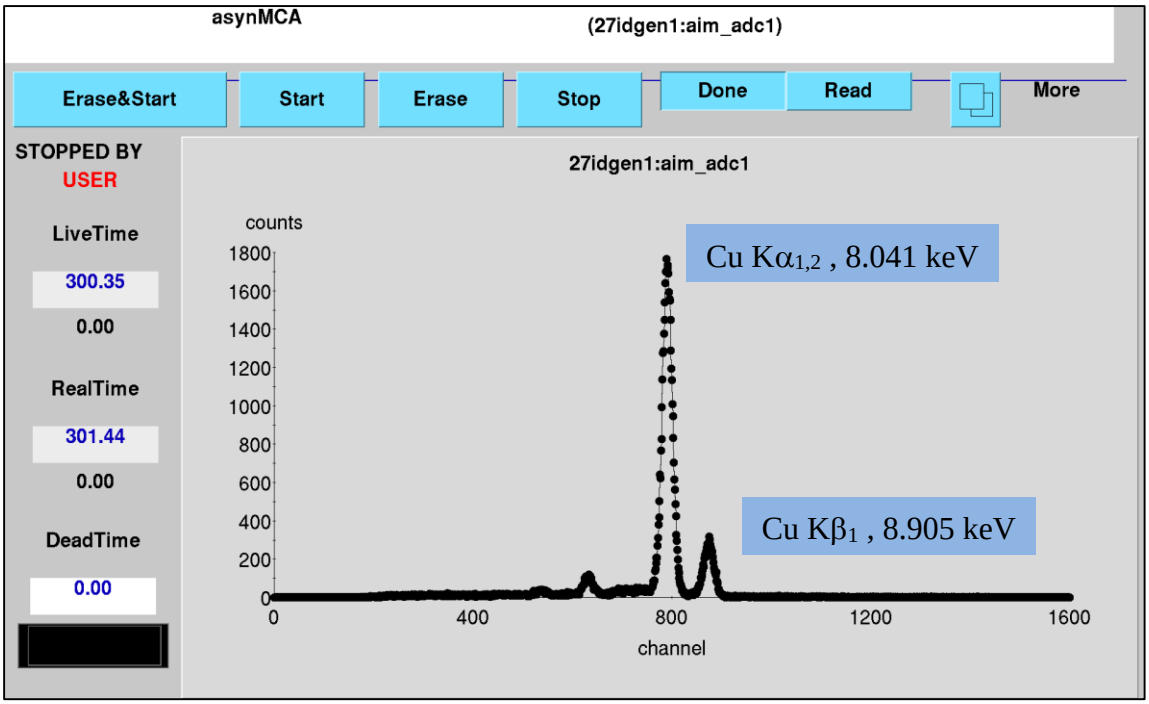
and the voltage V(E) corresponding to an energy E is

$$V(E) = \frac{10V}{c_{max}}\left((E - E_1)\frac{(c_2 - c_1)}{(E_2 - E_1)} + c_1\right) \qquad (3)$$

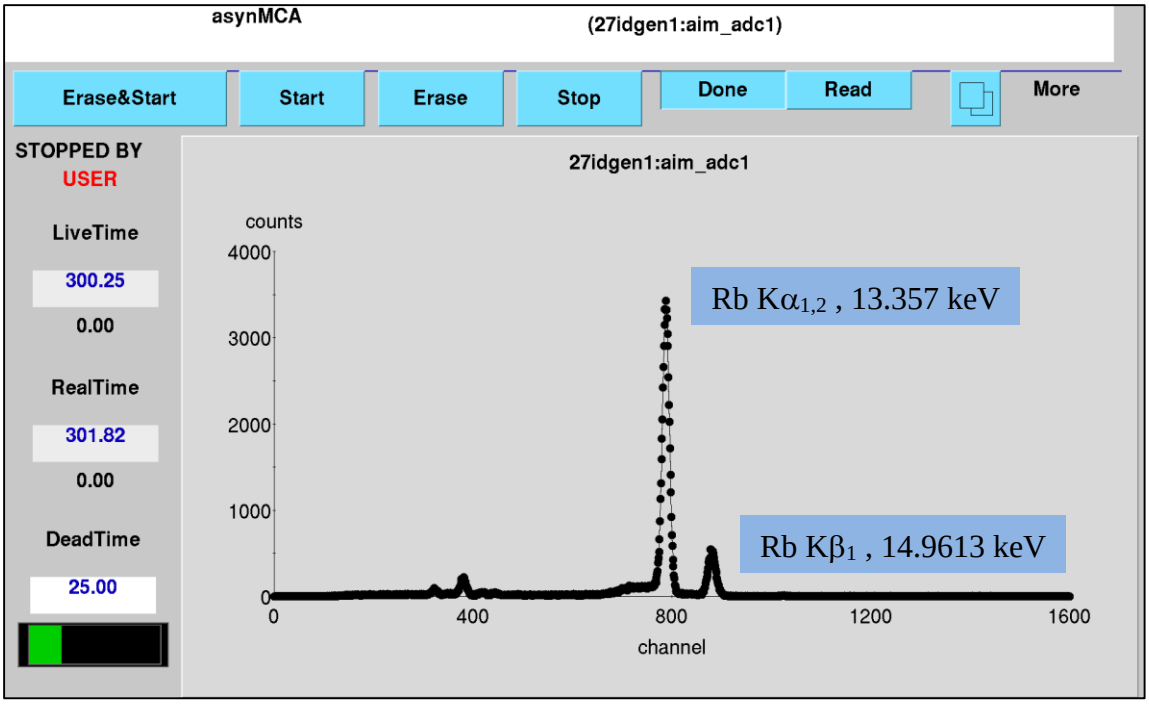
This voltage conversion can be used to set the single-channel analyzer (SCA)

Appendix: Sample Spectra (Am-241 source with filters)

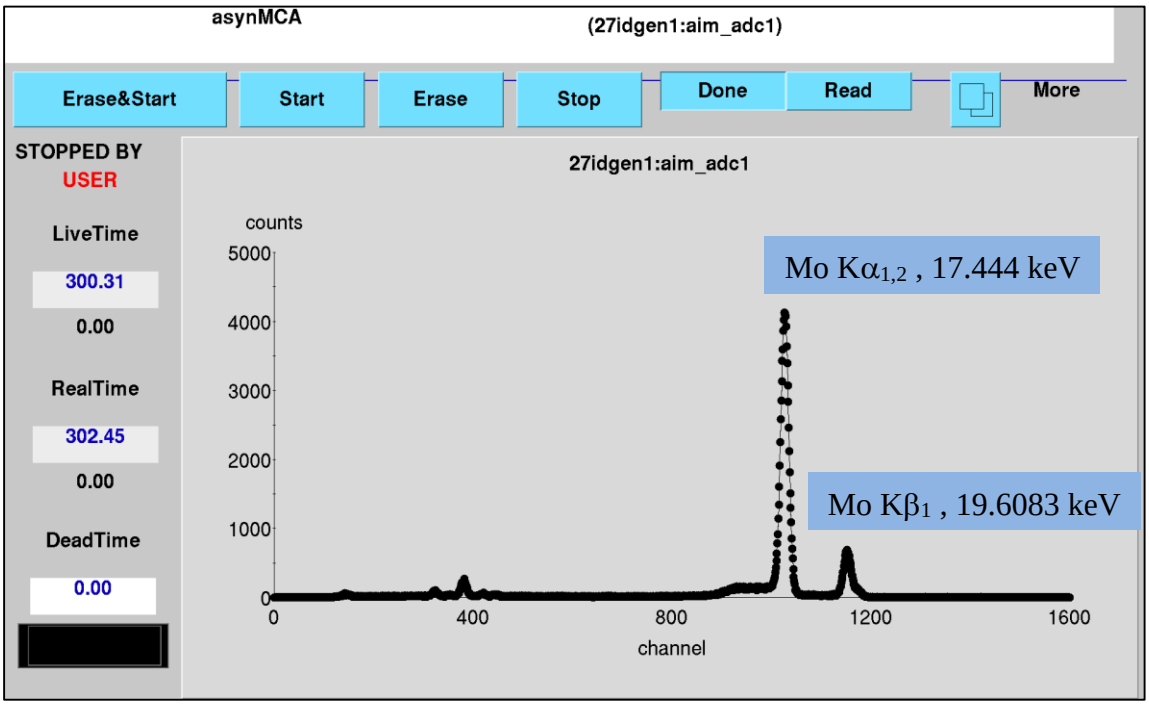
Cu Gain = 6.00



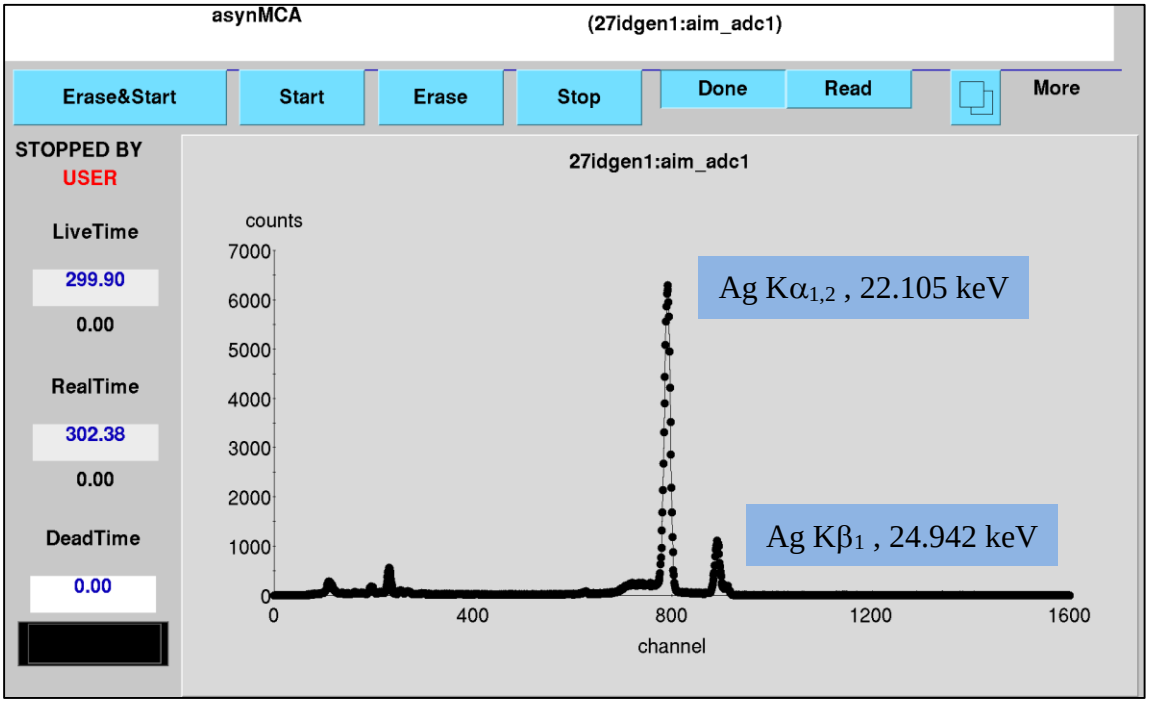
Rb Gain = 3.50



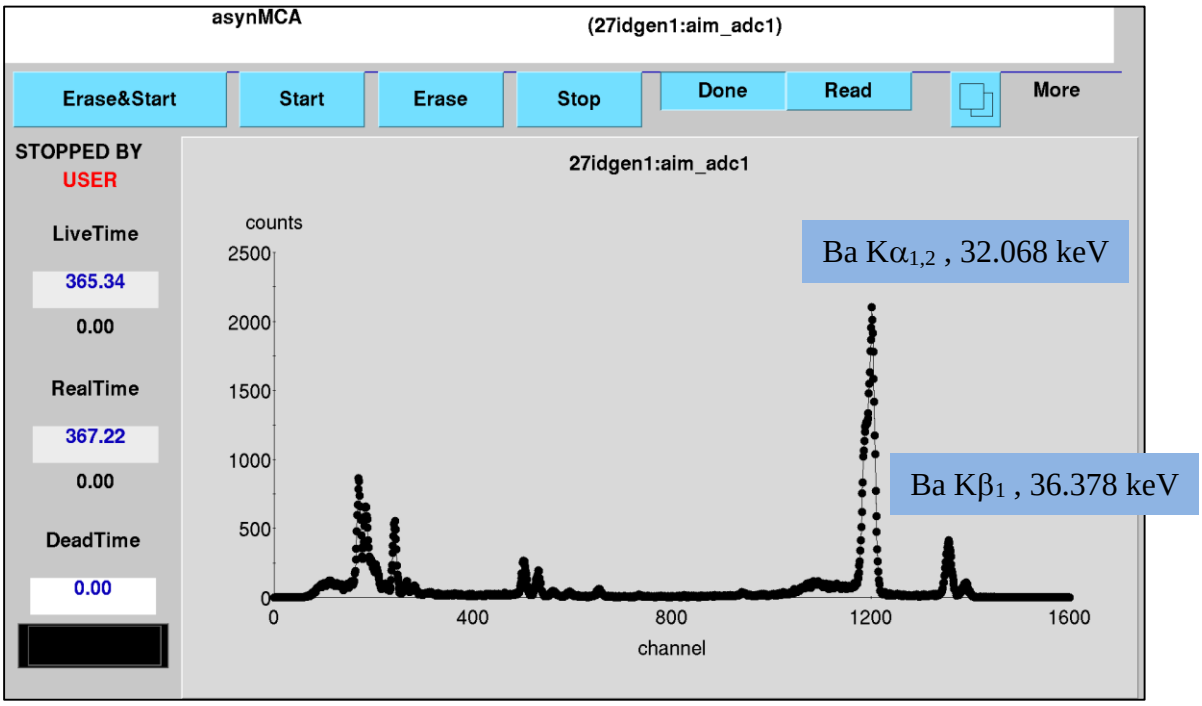
Mo Gain = 3.50



Ag Gain = 2.10



Ba Gain = 2.20



Combined **Cu, Rb, Mo, Ag** Gain = 3.20