

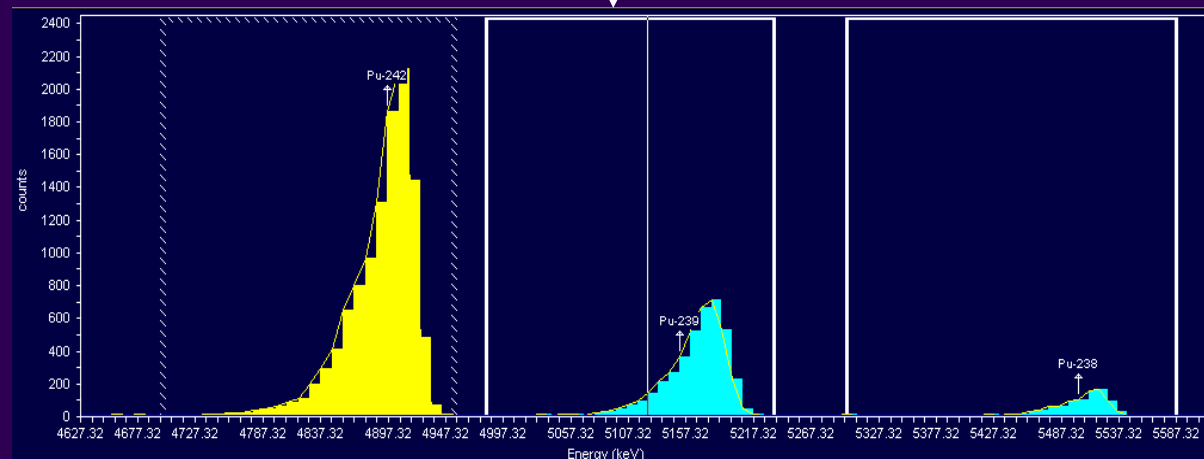
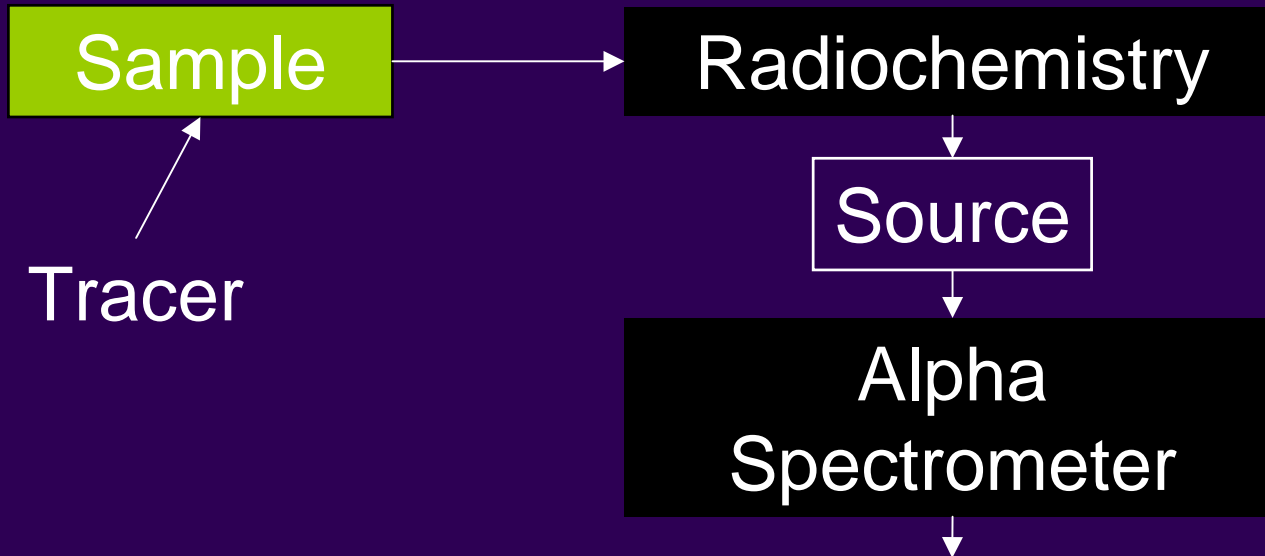
Alpha spectrometry systems



A users perspective

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- We don't need the counter efficiency to calculate the result:-

$$\frac{\text{Sample Counts}}{\text{Tracer Counts}} \times \text{Tracer Activity} = \text{Sample Activity}$$

- Counter efficiency does however give you the chemical recovery.
- This is one useful measure of the quality of the analysis.

- Spectral quality is the other measure of analytical quality.
- With a good analysis giving clean well-separated peaks the spectrometry is easy.
- Unfortunately we are dealing with real samples.
- Spectral quality is not always as good as we would like.
- Discussing how we cope with this and the limitations of current systems is the purpose of this presentation.

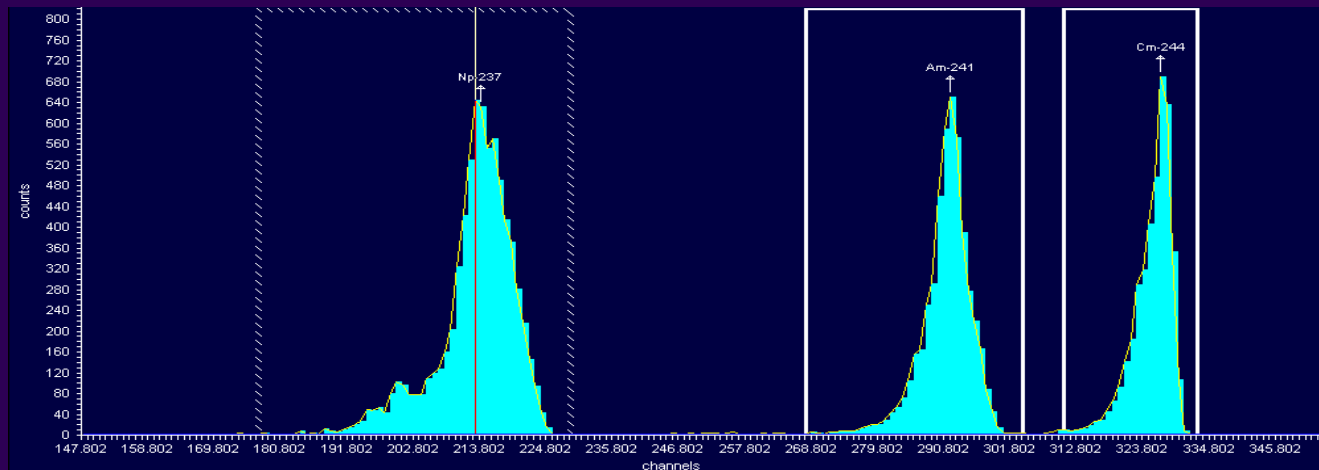
- Stable electronics - 1 week count times.
- Physical size, separate vacuum controls etc can be cumbersome.
- Data storage back up in case of power failure.
- Reasonably robust detectors.
- The hardware from both of the major manufacturers is well tried and tested and performs well.

- Perform both energy and efficiency calibrations.
- Perform and store background counts.
- Keep records of these for each detector.
- Store a master library of nuclide energies etc.
- Save “standard” counting & analysis conditions.
 - count time, isotopes of interest, tracer details, report formats etc.

- Allow samples to be put on in batches.
- Automatically terminate counting at a pre-set time or number of counts.
- Process the spectrum to give results.
- Display spectra graphically.
- Allow manual termination of count and adjustment of regions of interest etc.
- Save all data, preferably on some form of database with housekeeping utilities.

- There is a large amount of data in the system.
- Great care must be taken to ensure all reports display valid data. For example:
 - If input data are changed, the system must ensure that the value shown on the report was the one used to calculate the reported result.
 - Calculations performed while the source is still counting must either not be saved or have their spectra saved with them.

- In my experience nobody actually uses peak recognition.
- The characteristics of alpha peaks seems to make them very resistant to being manipulated by computers.



- My software won't even correctly recognise this triple peak standard correctly.

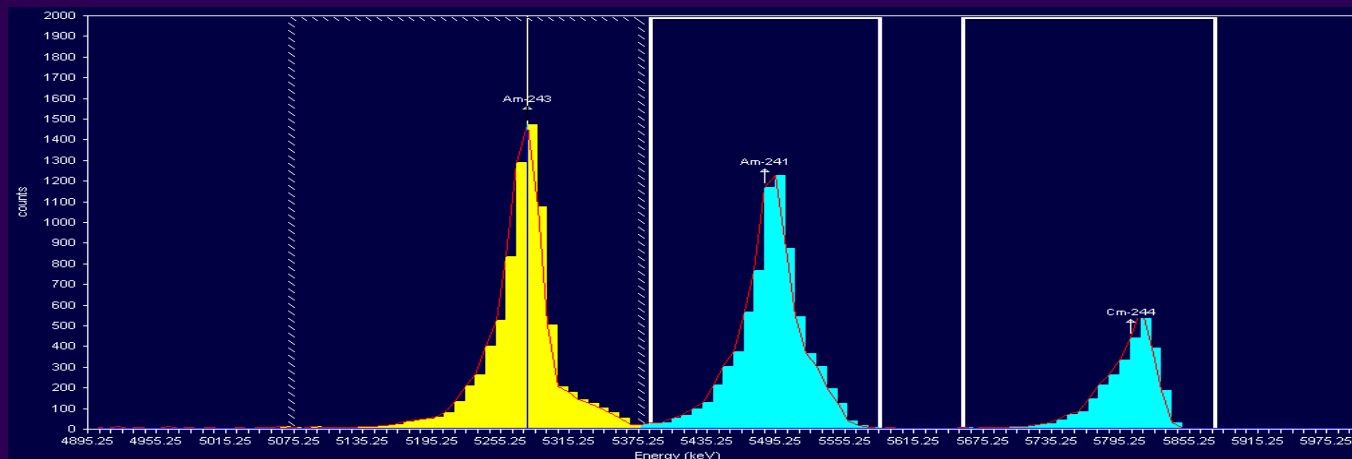
Regions of interest (ROI)



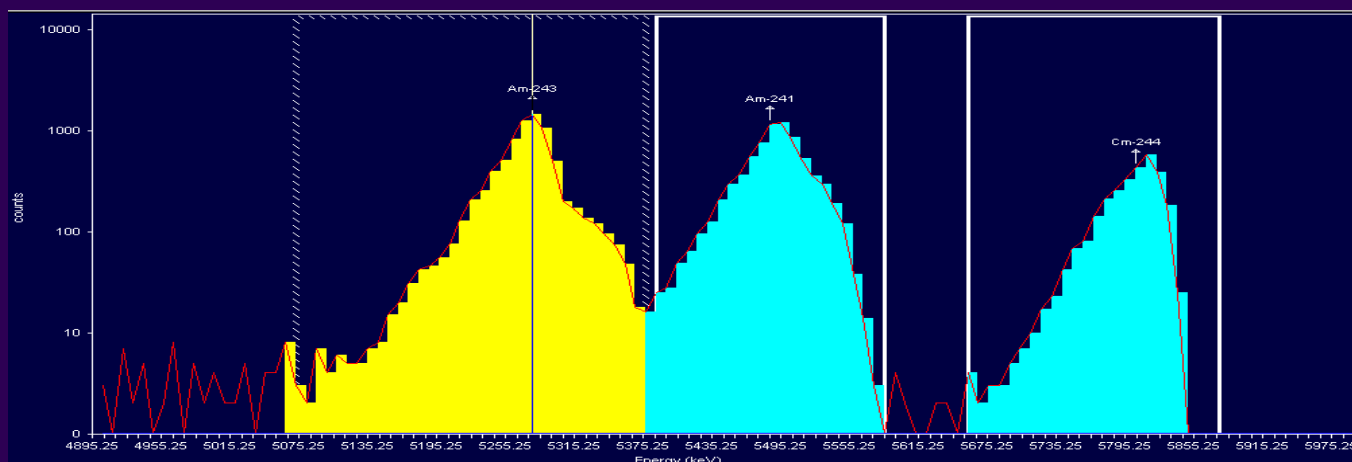
- Because of the problems with peak fitting, nearly everybody uses ROI.
- ROIs defined by channel number can't accommodate different gains in different detectors. This makes set up more difficult because all detectors on the system must have the same gain.
- Often source differences mean ROIs need to be individually adjusted. It's a lot easier if this can be done on the graphics screen rather than by typing in numbers.
- Gain shifts can make an ROI unrecognisable by the software, forcing a re-count.

- Not usually a problem with plutonium but common in the analysis of americium, uranium and thorium.
- Polonium used to be a problem but can be solved by using ^{209}Po instead of ^{208}Po as the tracer.
- Peak fitting and deconvolution would solve the problem if it worked.
- Use of log Y axis can make it easier to see interference.
- But beware it can make the situation look worse than it is.
- Thorium is a particular problem.
 - ^{229}Th has several significant emission energies
 - ^{230}Th energy is close to ^{229}Th

Americium spectra

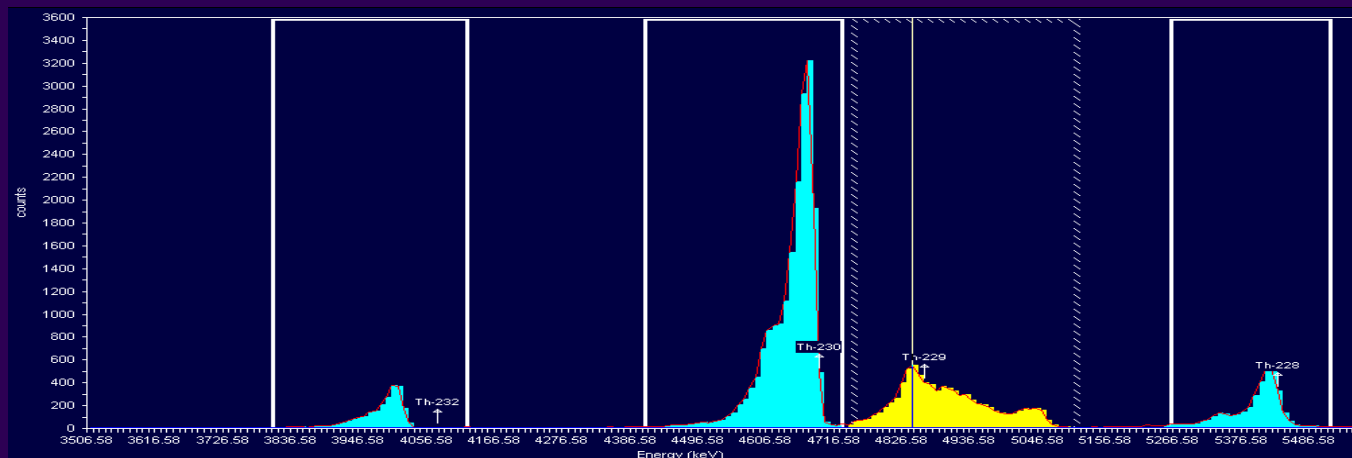


Linear

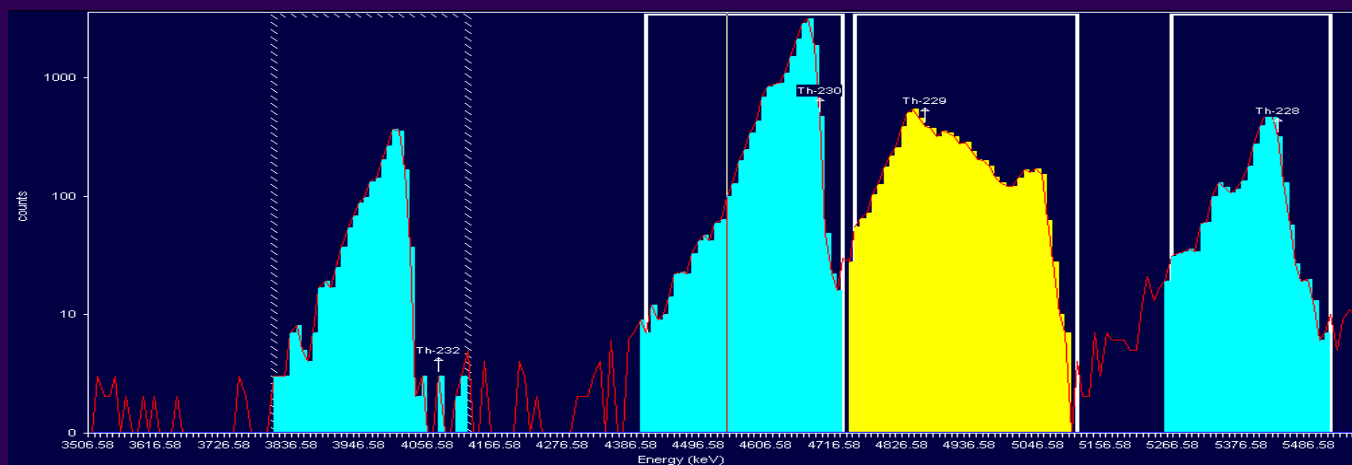


Log

Thorium spectra

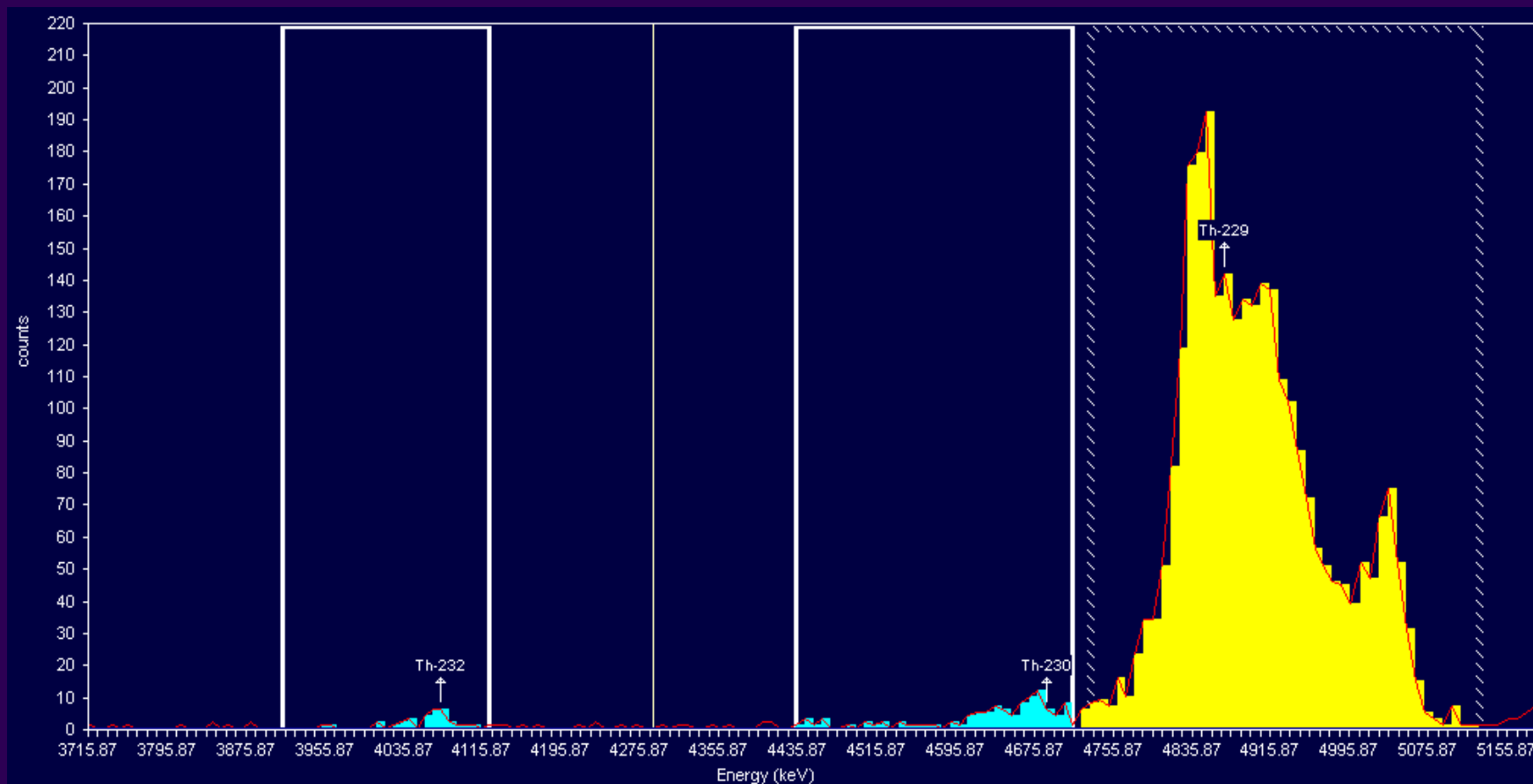


Linear



Log

A “real” Th spectrum

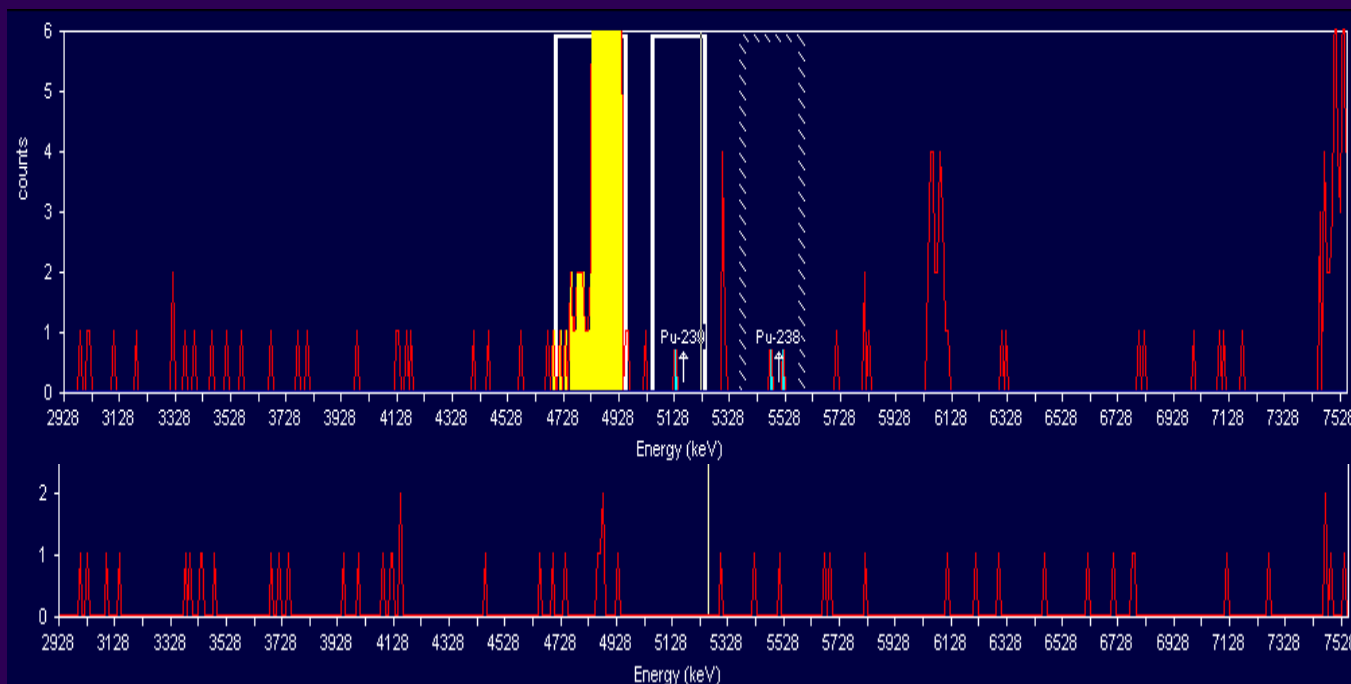


Backgrounds and Limits Of Detection



- Most alpha spectrometry is performed on low activity samples.
- Background is very good on new detectors but U and Th daughters can cause problems, particularly as they decay over a relatively short time.
- What do we do about size of the ROI, particularly if there is an obvious contaminant?
 - Particularly important for limit of detection measurements.
 - The calculated LOD is directly controlled by the background and hence the size of the ROI.

Background and Blanks



Blank
Sample

Detector
Bgd.

- The hardware and software are good but have their limitations.
- How much effort do we need to put in to ensure the quality of purchased software?
- Is there any hope of getting a peak deconvolution routine that actually works?
- LOD: there seems to be a lot of debate about which formulae to use but what about size of the ROI?
- What is a “true” background?

- None of the programs available is good enough to work unsupervised.
- The analyst must inspect all spectra to ensure that the interpretation made by the software is satisfactory.