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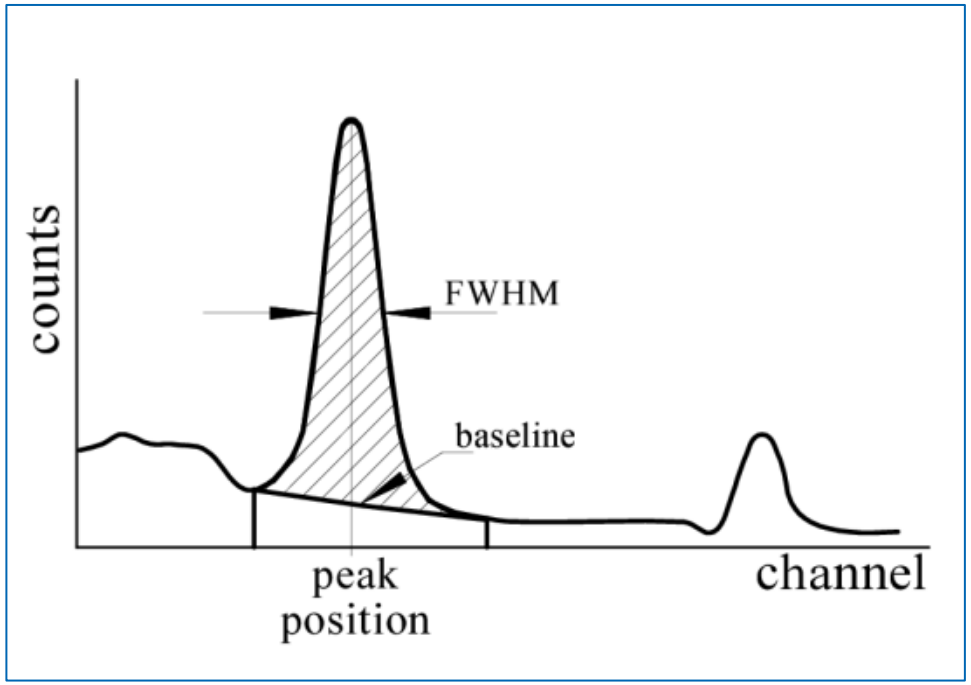
# Peak area determination in γ-ray spectrometry

## Influence caused by subjective elements

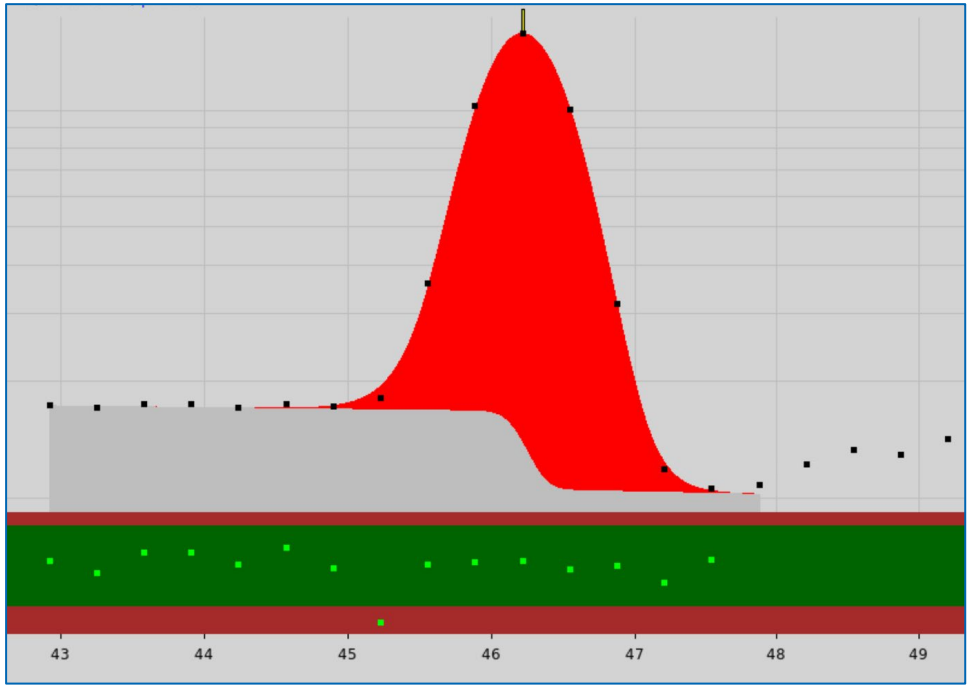
Roy Pöllänen

# 1. Two main approaches in the peak area determination

## ROI-method:

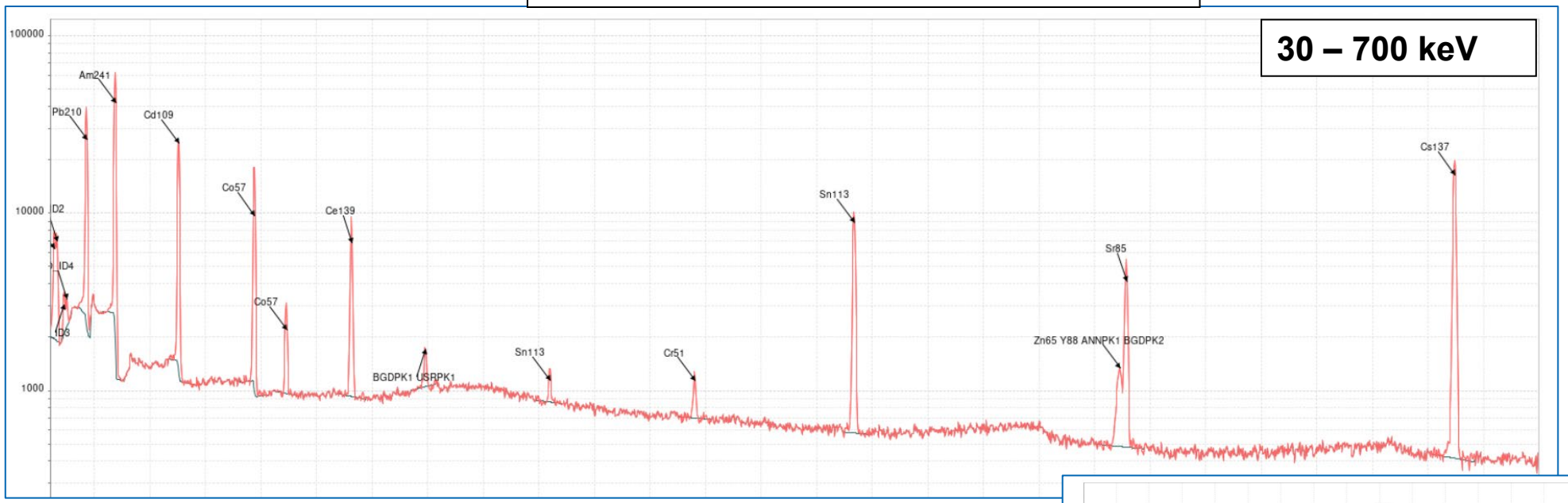


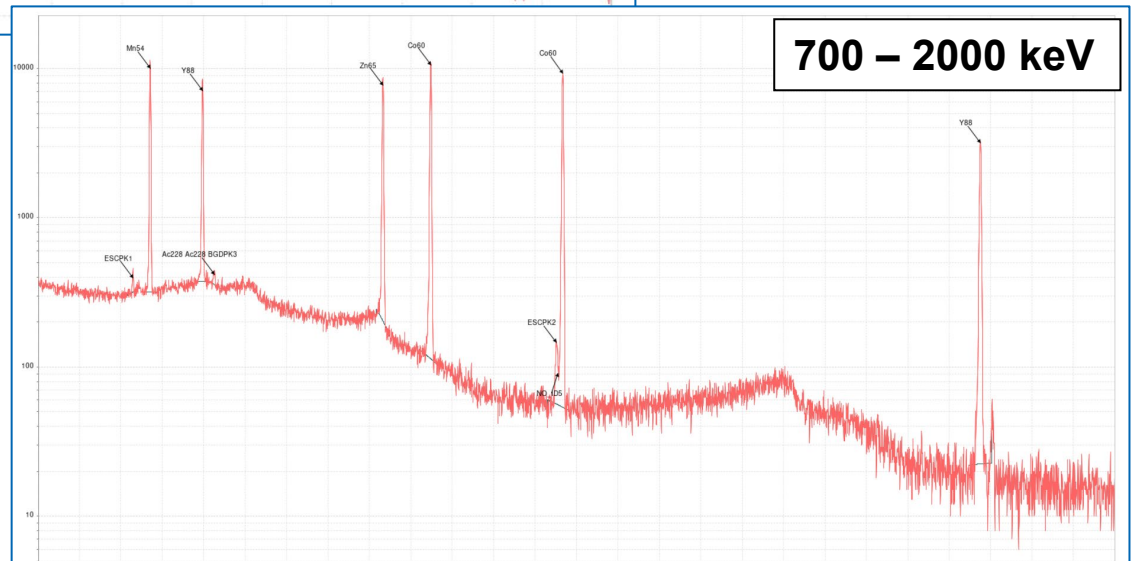

## Peak fitting:



# 2. Mixed nuclide energy spectrum (for the efficiency calibration)

Several nuclides present: Pb-210 … Y-88




- **Simple case from the point of view of peak area determination.**
- **But does the person analyzing the spectrum have an effect on the determined peak areas?**

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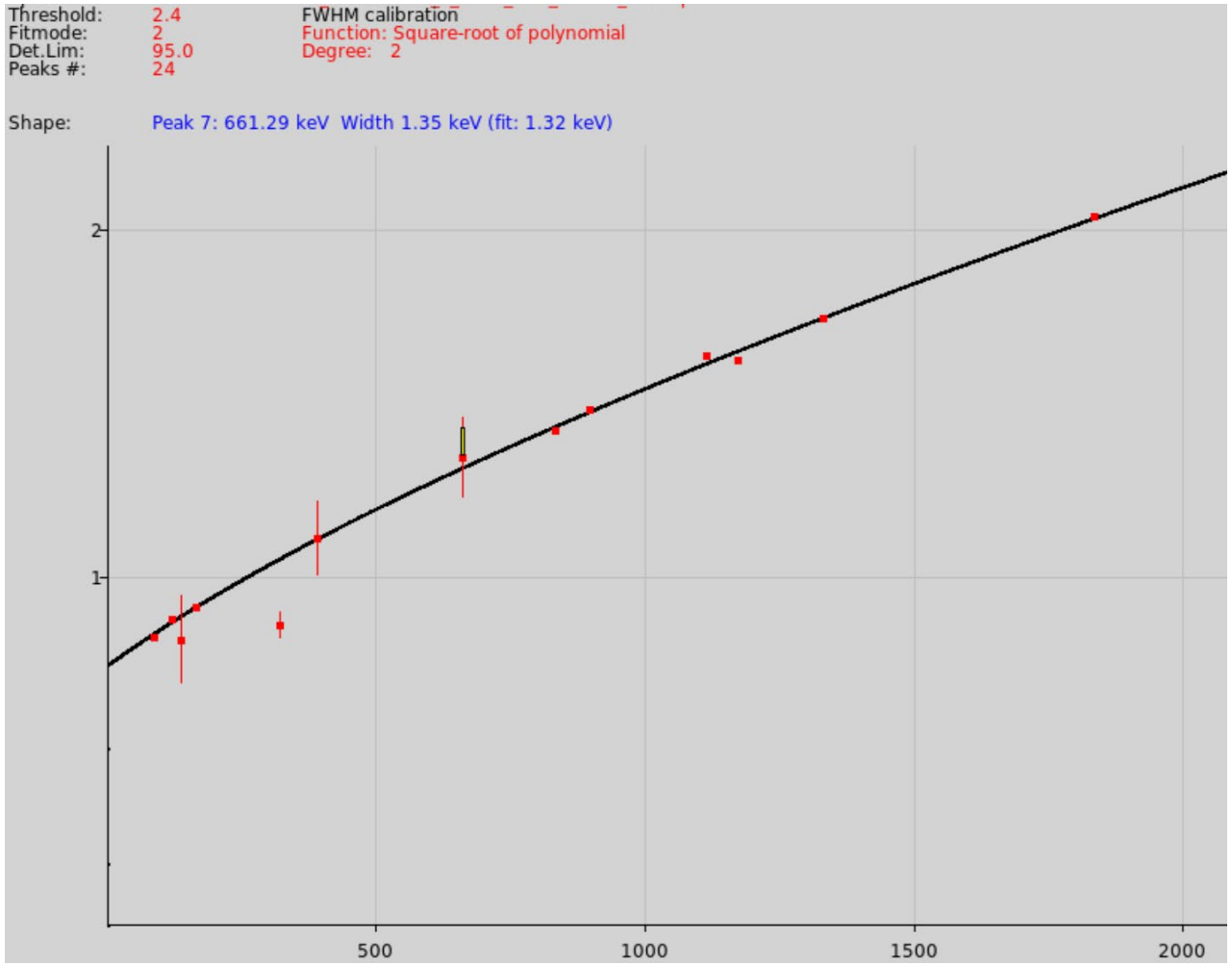
# 3. Example case: peak fitting by using Unisampo program



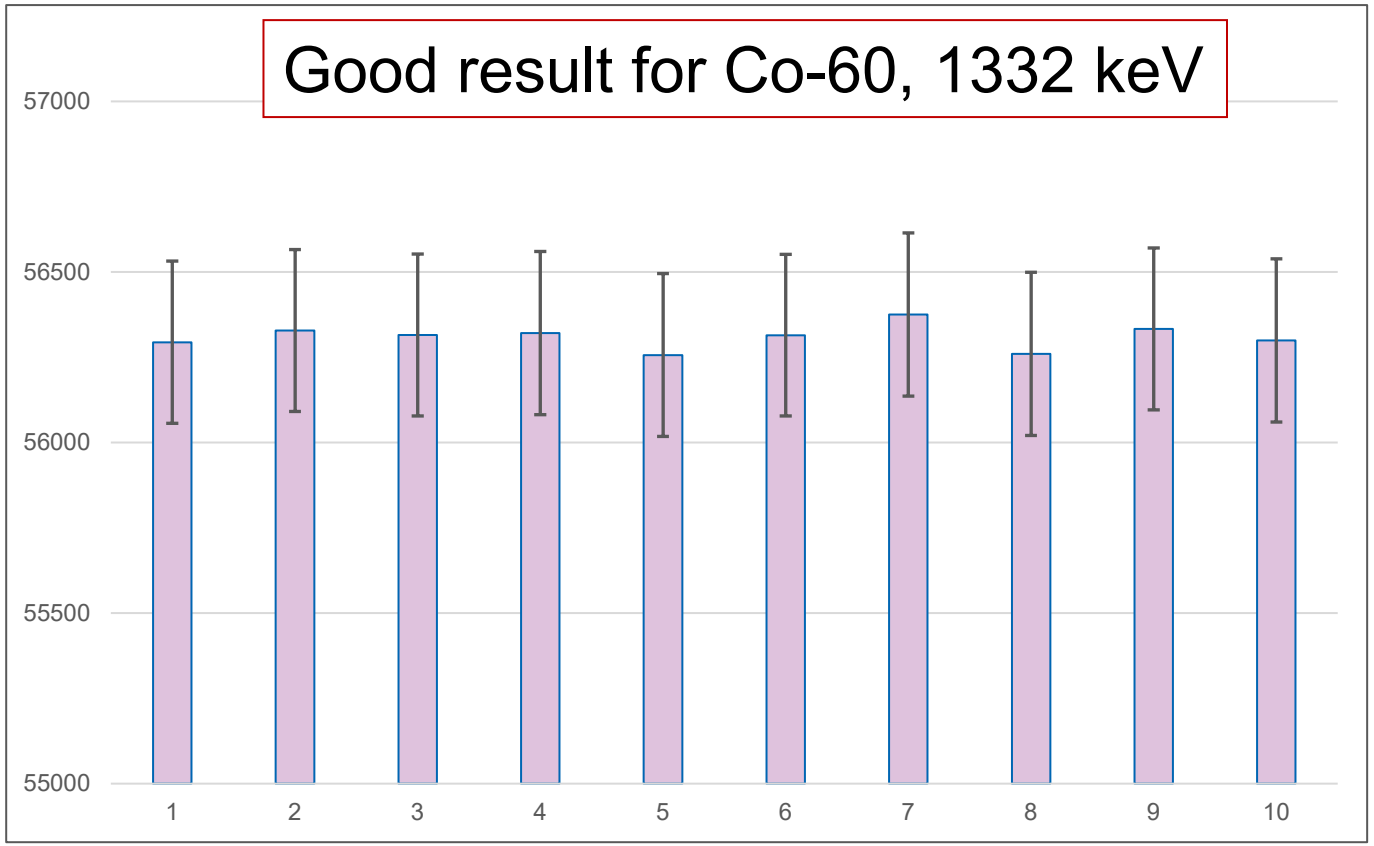

Automated peak shape calibration → the analyst can tailor it ! (as well as other parameters affecting the peak area)

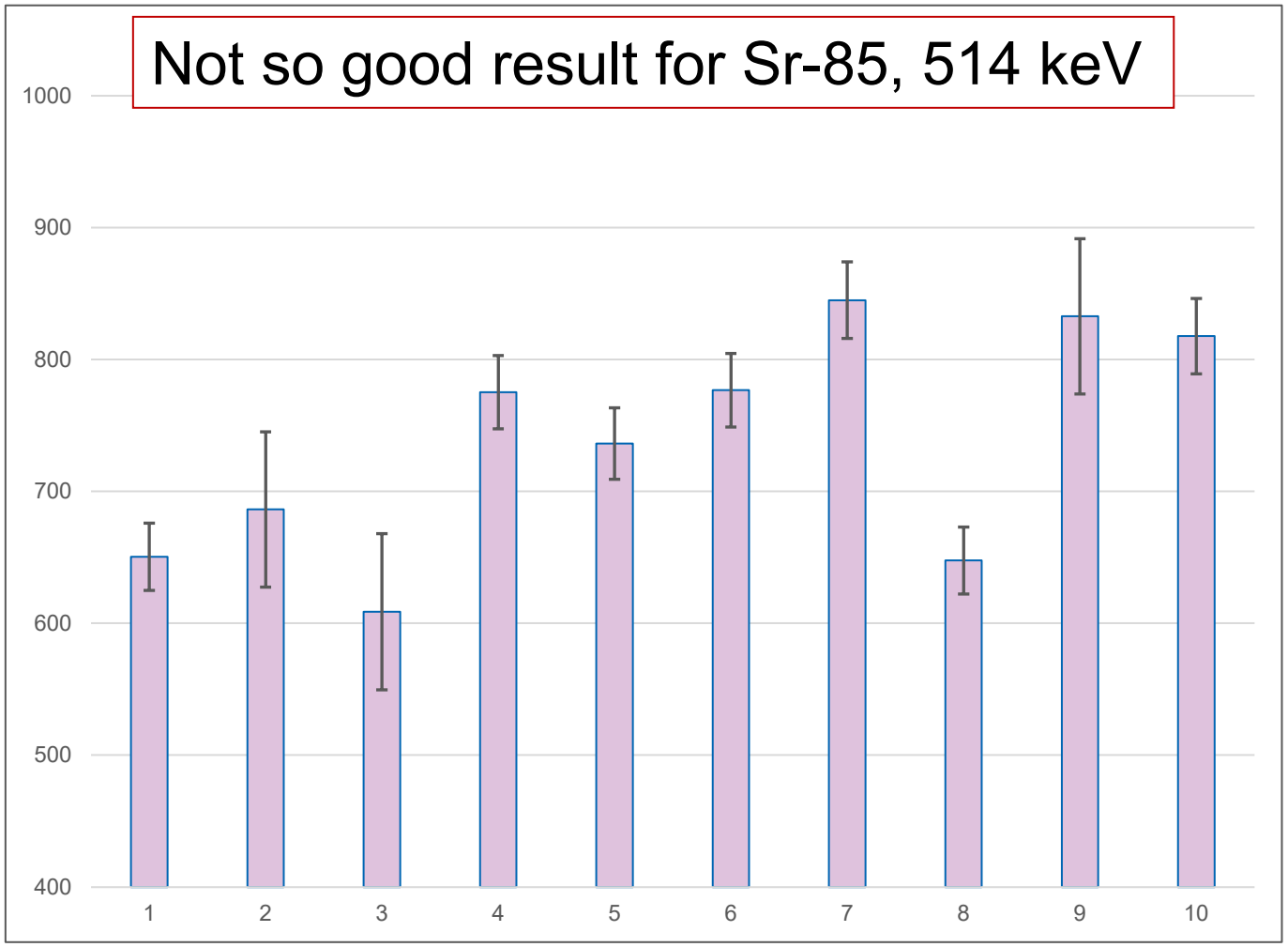
Peak area

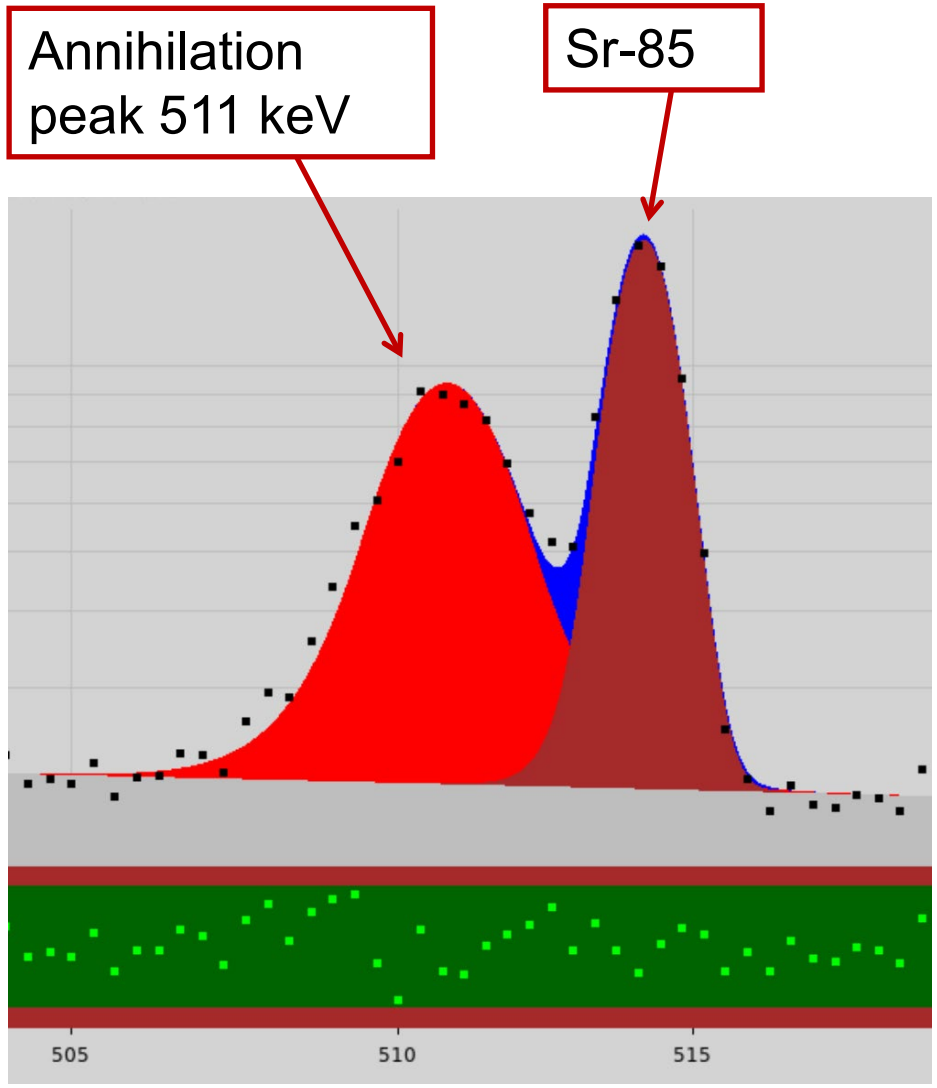
$$A_i = \frac{N_i}{\varepsilon_i \cdot I_\gamma \cdot t} \cdot c_i$$

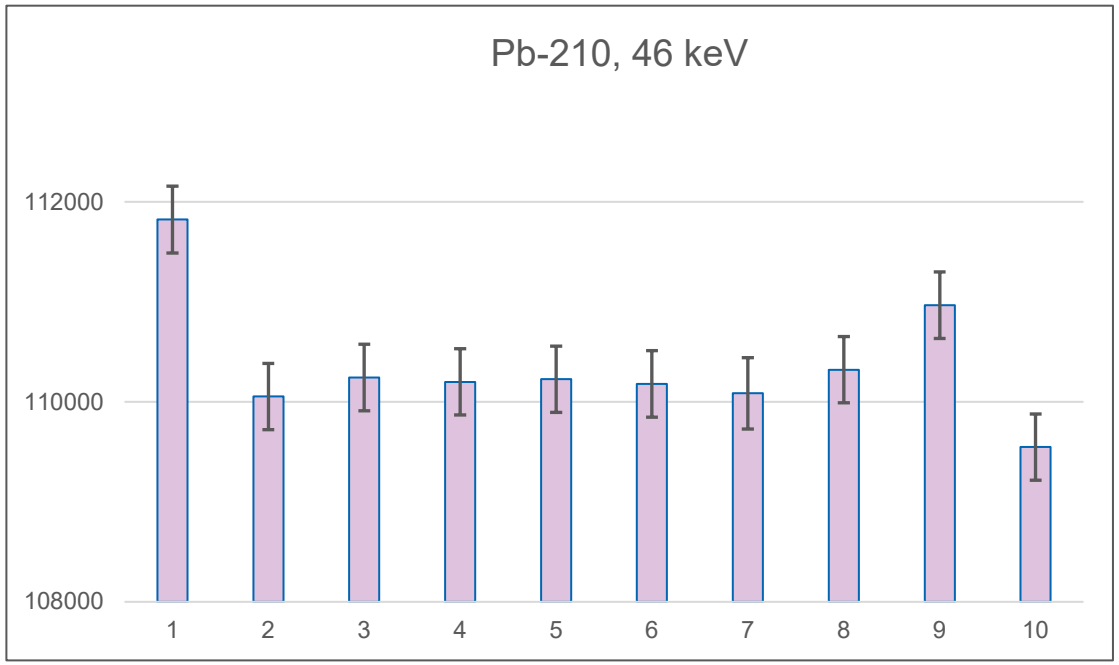
# 10 experienced gamma spectrum analyzers independently calculated peak areas from the same spectrum

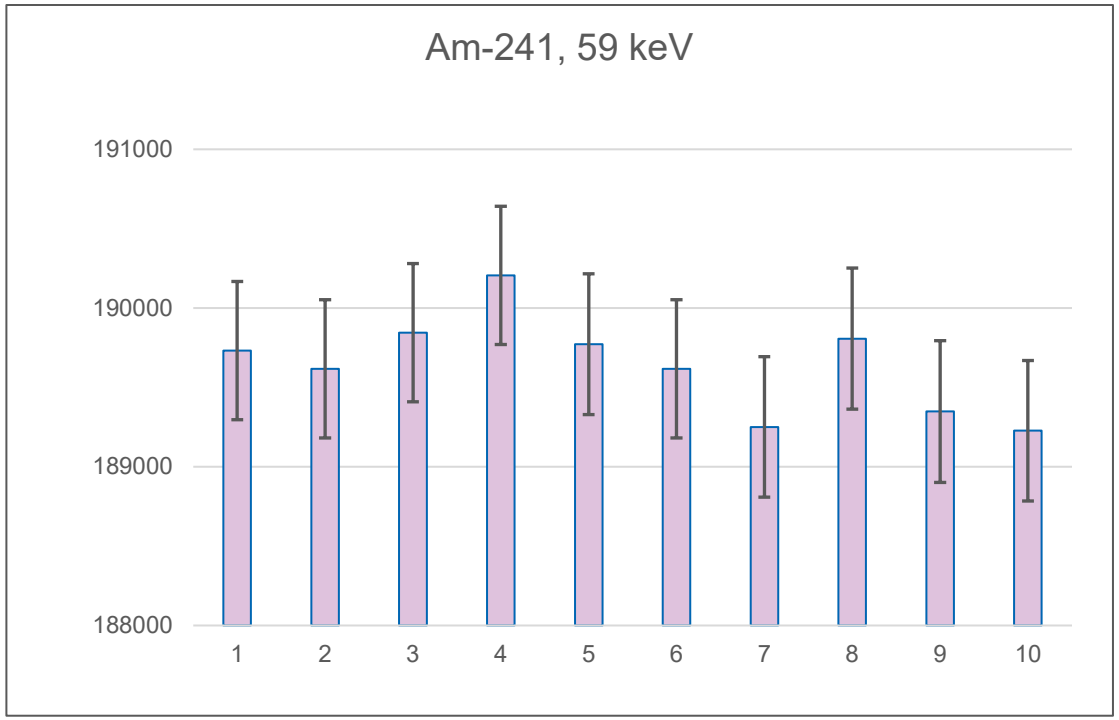
Note the scale!



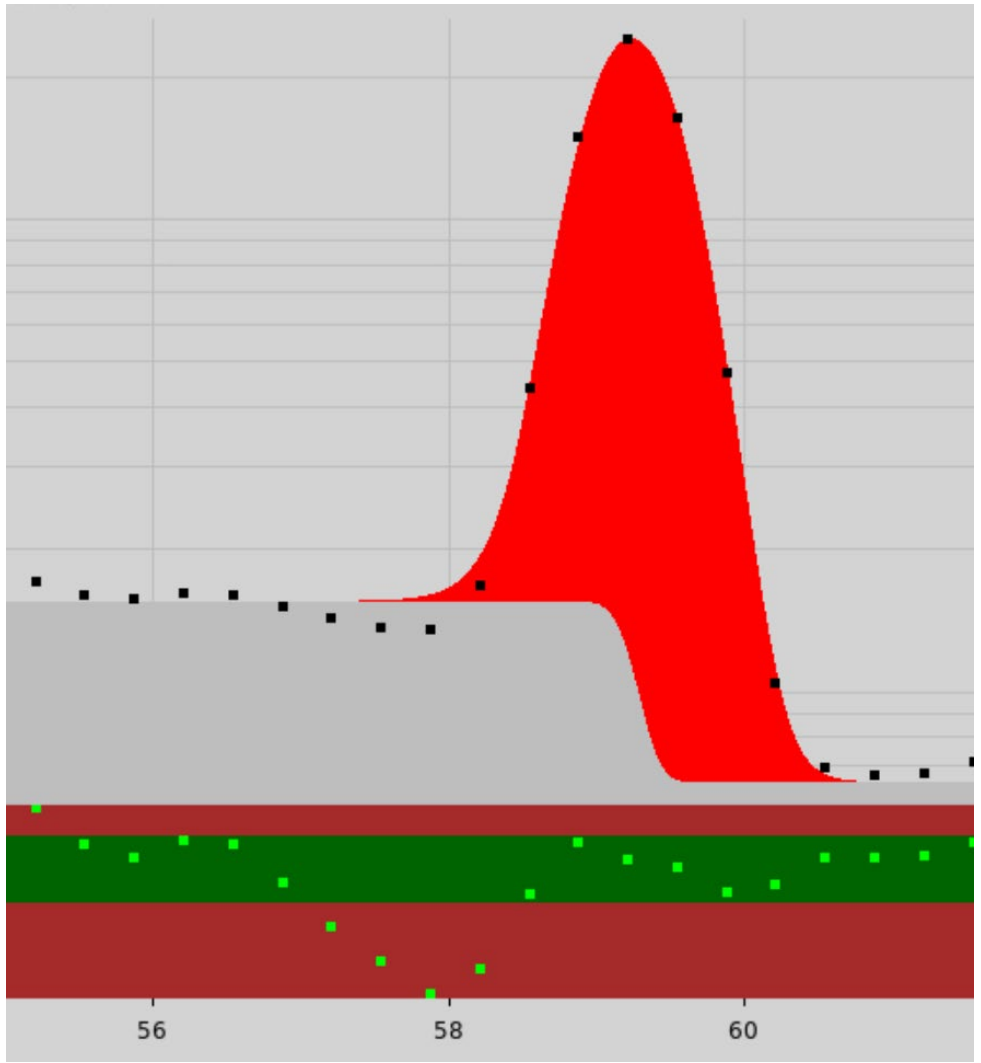

Not so good result for Sr-85, 514 keV
1000
900
800
700
600
500
400
1
2
3
4
5
6
7
8
9
10


Annihilation peak 511 keV
Sr-85
505
510
515

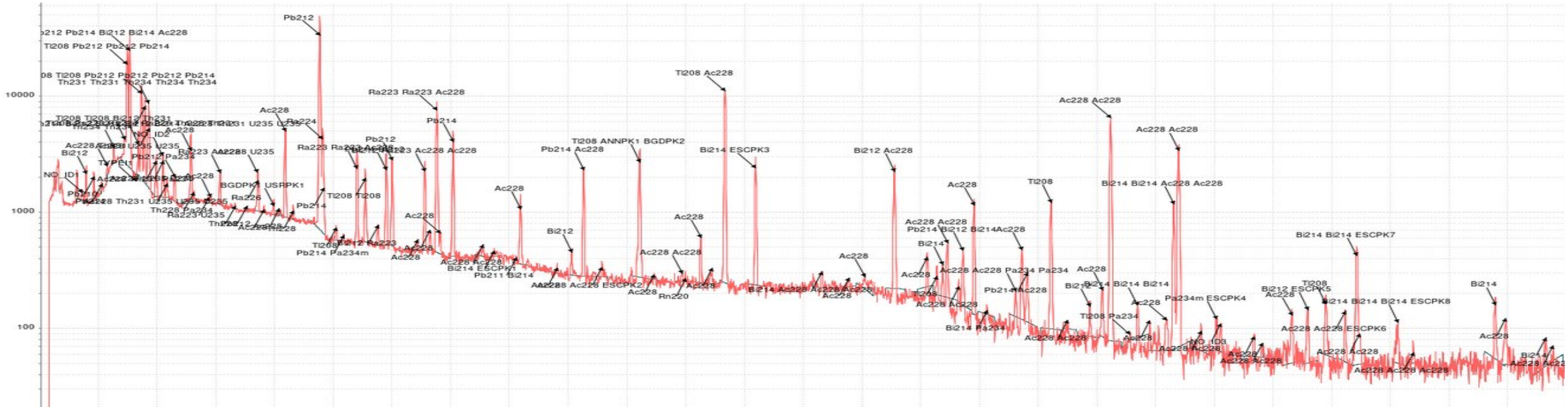

Pb-210, 46 keV
112000
110000
108000
1
2
3
4
5
6
7
8
9
10


Am-241, 59 keV
191000
190000
189000
188000
1
2
3
4
5
6
7
8
9
10

Am-241


56
58
60

- Although the example spectrum was easy to analyze there were several points that had to be taken into account:
  - Using step function (or not)
  - Neighbouring peaks (such as Sr-85 and 511 keV annihilation peak)
  - Escape peaks (e.g. Co-60: 1173 keV – 511 keV = 662 keV → Cs-137: 661 keV)
  - Compton edges (e.g. Co-60 edge at the energy of around 1115 keV → Zn-65: 1116 keV)
  - Lots of other things/effects …
- What about then when a more complex spectrum must be analyzed?



# 4. Conclusion

Quality & metrological perspective:

**How to take human-related factors into account especially in the uncertainty estimation?**

# Comments, please!