

Status of curium and radium analysis

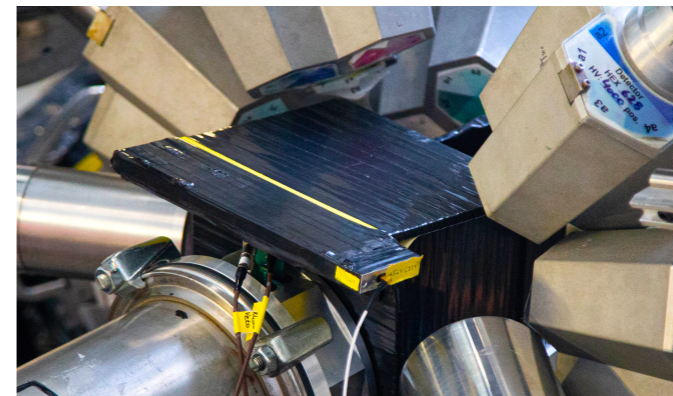
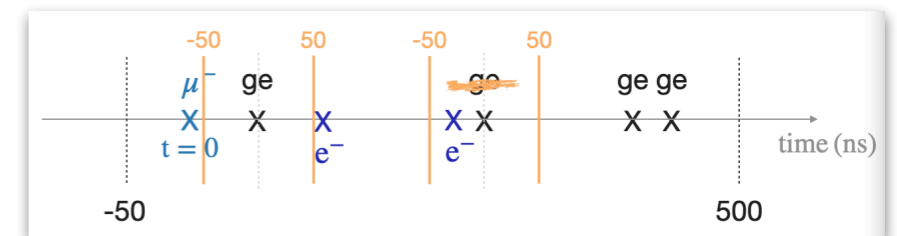
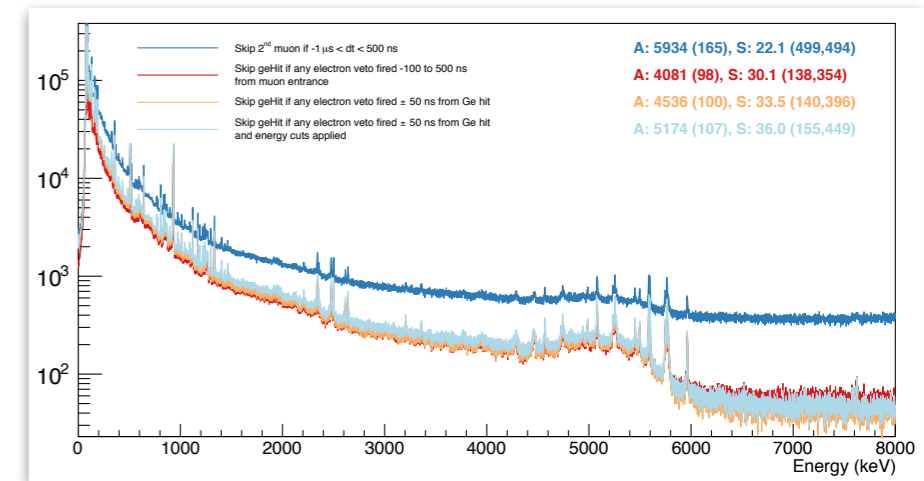
Stella Vogiatzi
muX collaboration meeting
09.12.2021



Signal to Background optimisation - reminder

Previous talks: tested optimisation methods of the signal to background ratio using the peak significance of the 2p-1s muonic X-ray in gold as a measure

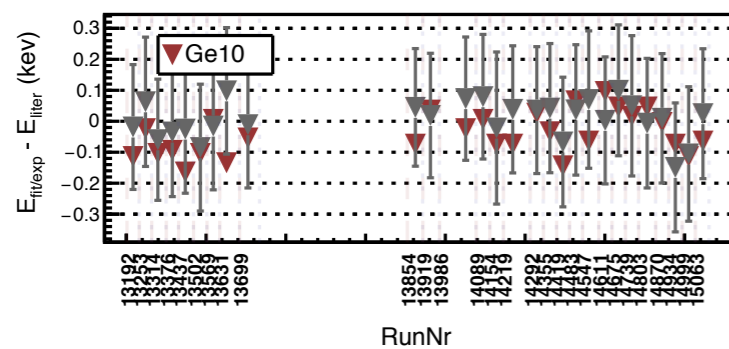
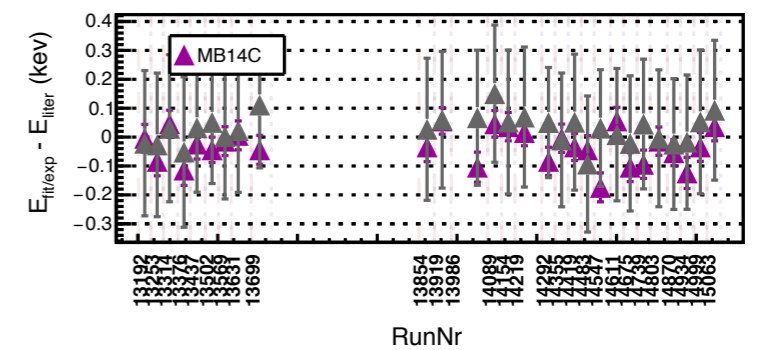
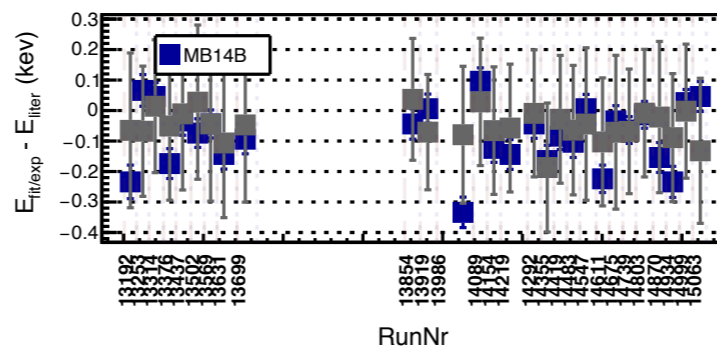
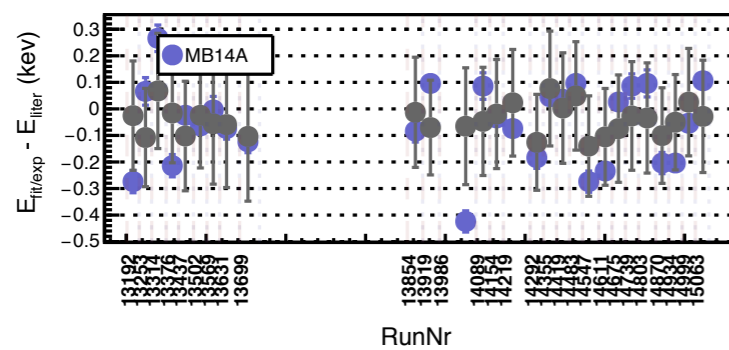
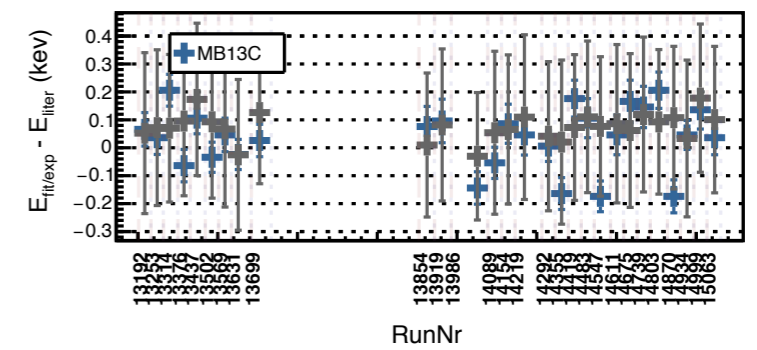
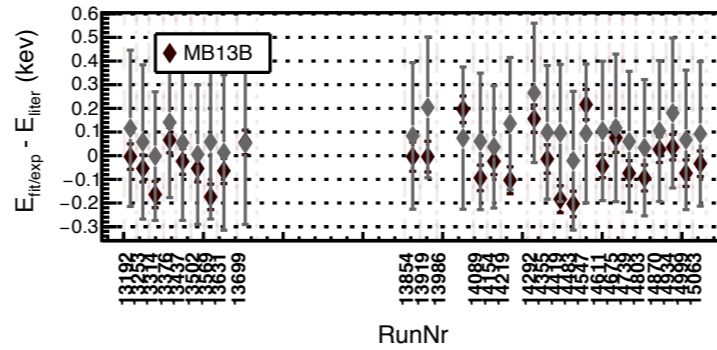
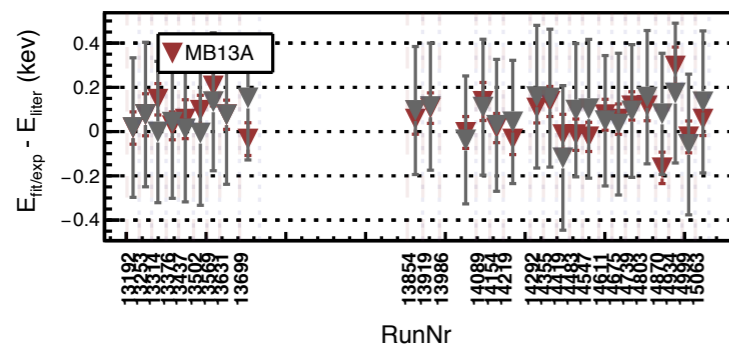
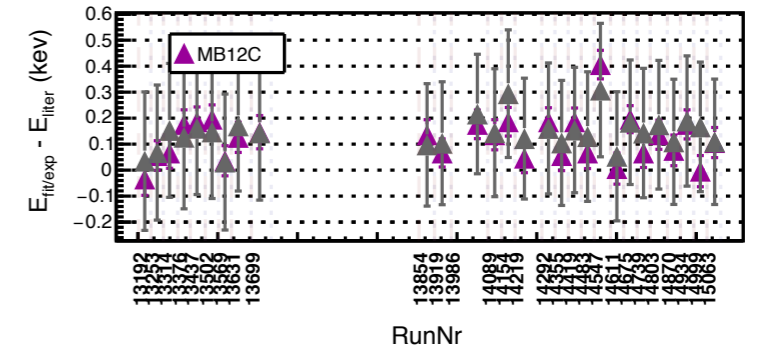
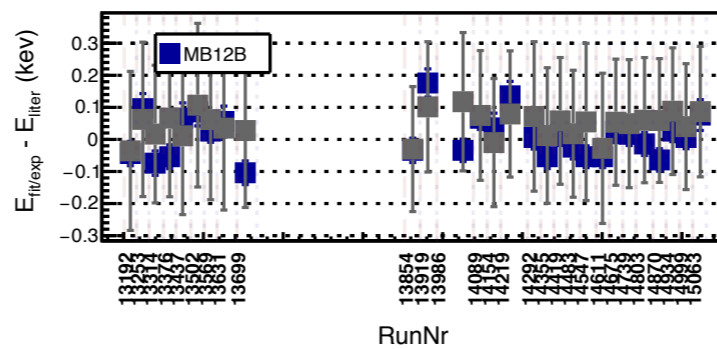
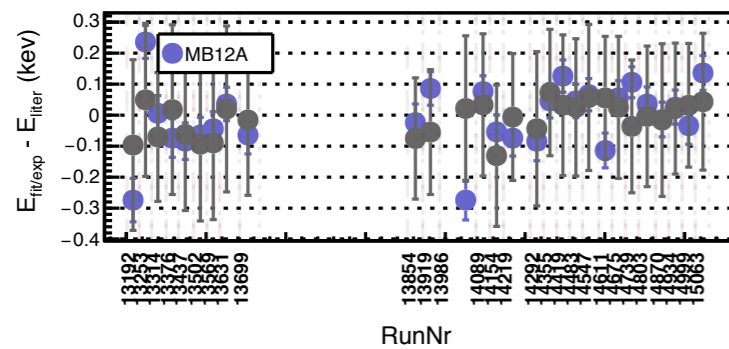
- ▶ Baseline correction (implemented by Alex Skawran)
- ▶ Optimal electron veto cuts
 - Remove the background produced by the muon decay by implementing the anti-coincidence with the electron veto detectors
- ▶ Coincidence analysis (e.g. trigger 3d-2p and look at the 2p-1s)
 - Reduces the significance of the muonic X-ray peaks
- ▶ Clustering (implemented by Frederik Wauters)
- ▶ Gain stabilisation/energy calibration



Finalised energy calibration

Gain stabilisation and energy calibration every couple hours of measurement

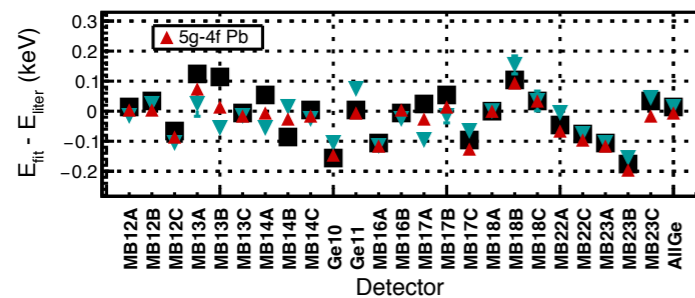
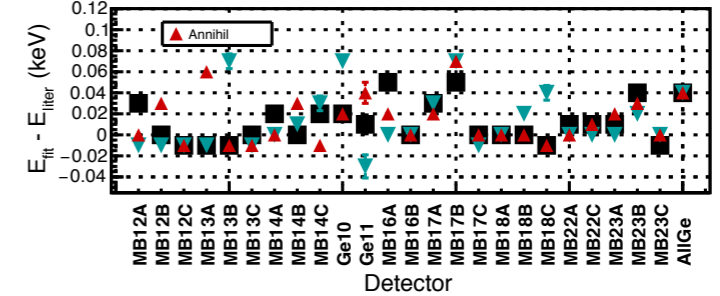
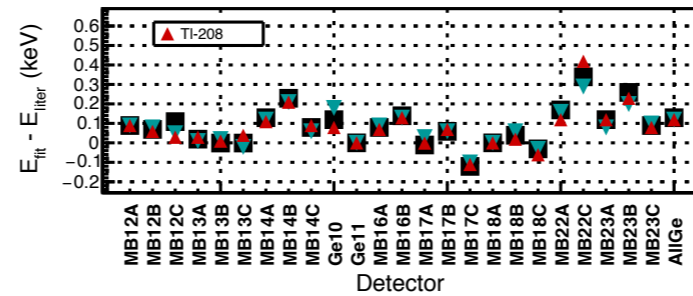
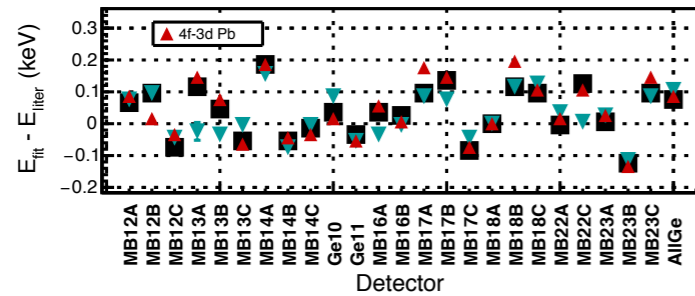
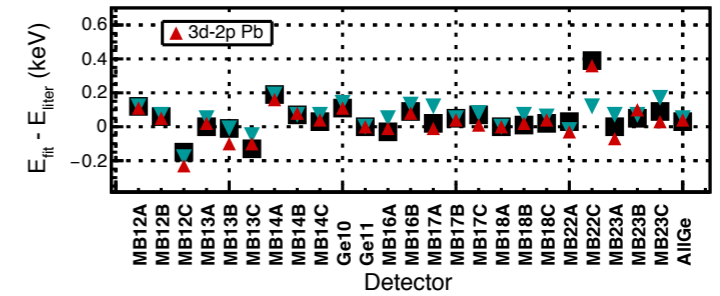
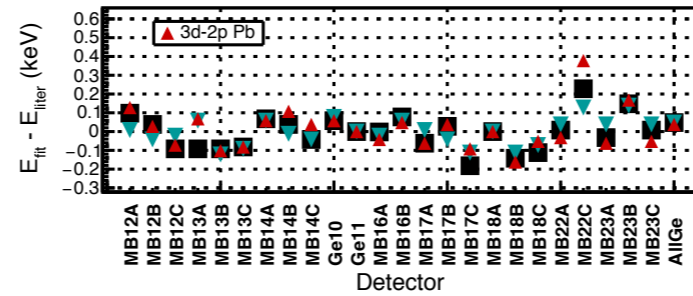
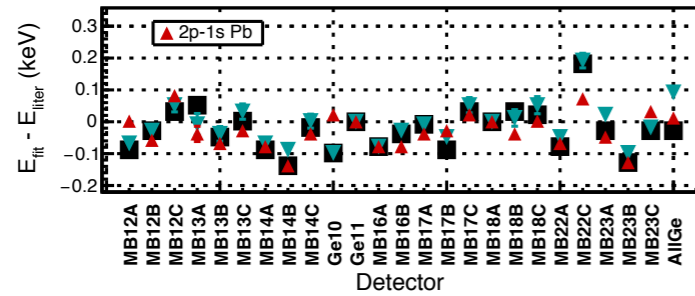
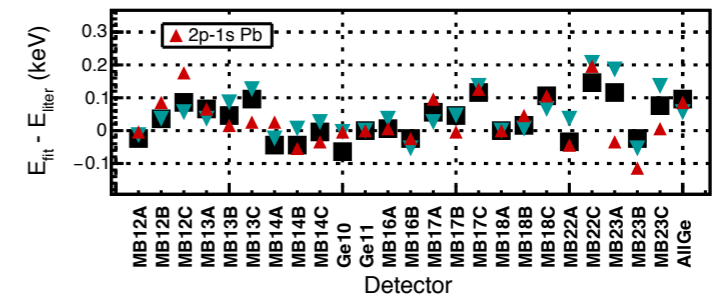
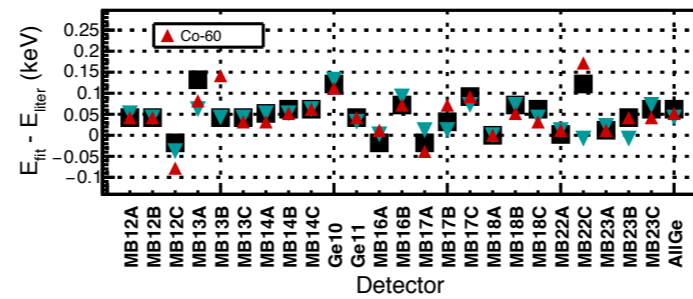
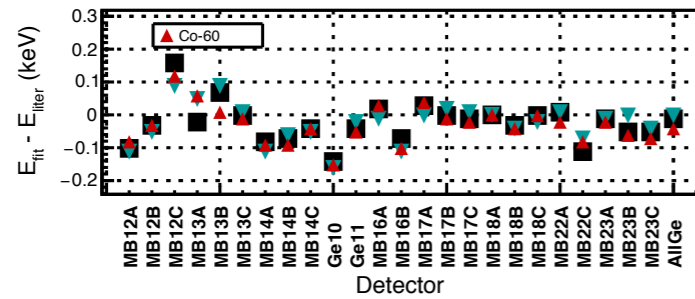
2p-1s Pb @ 5963 keV
Cm-248 target



Finalised energy calibration

Gain stabilisation and energy calibration every couple hours of measurement

Cm-248: 13192-15122 (red)
 Ra-226 (weak): 16816-18752 (black)
 Ra-226 (strong): 15159-16784 (cyan)



^{248}Cm spectrum

Energy calibrated and baseline corrected

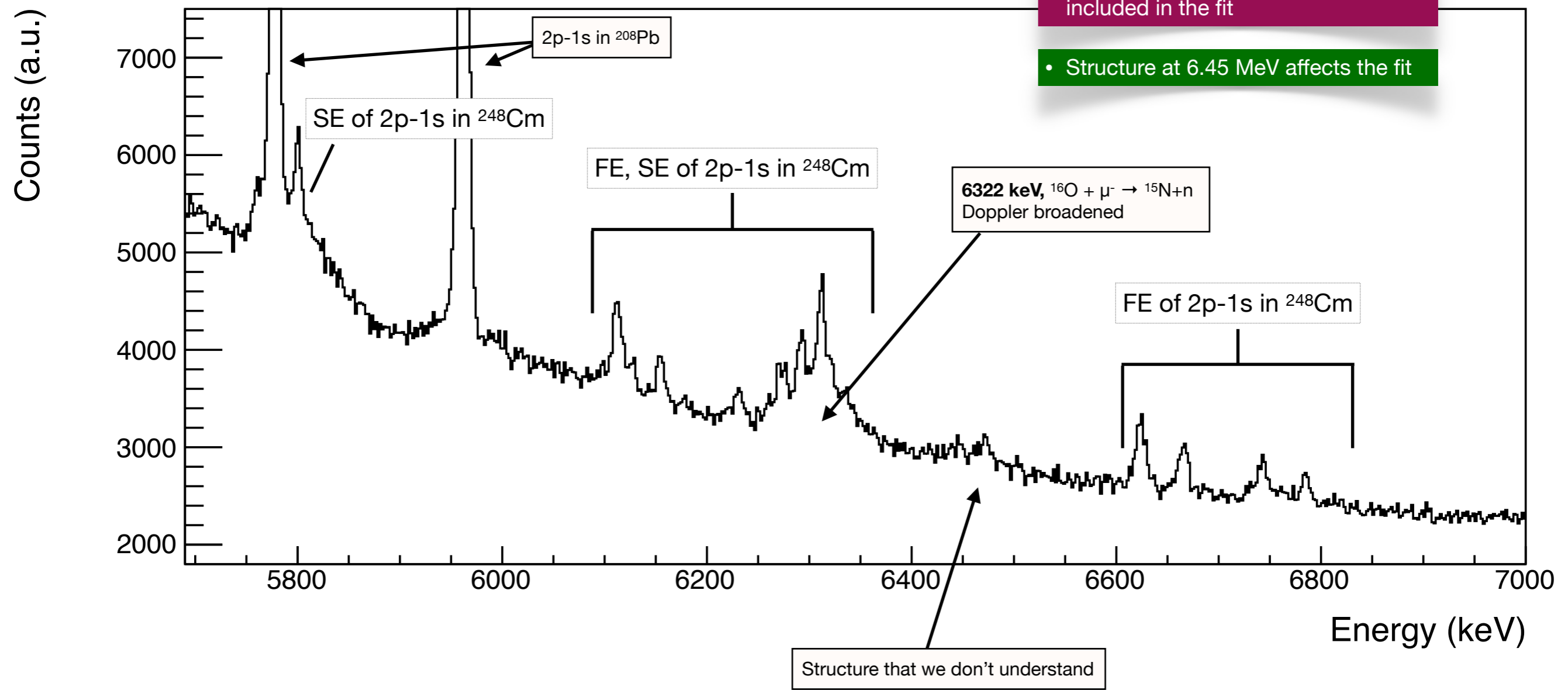
- Theoretical predictions of the 2p-1s hyperfine transitions in ^{248}Cm

- Lead subtraction to include the SE peaks of ^{248}Cm in the fit

- Extraction of detector's line shape using the muonic X-rays in ^{208}Pb

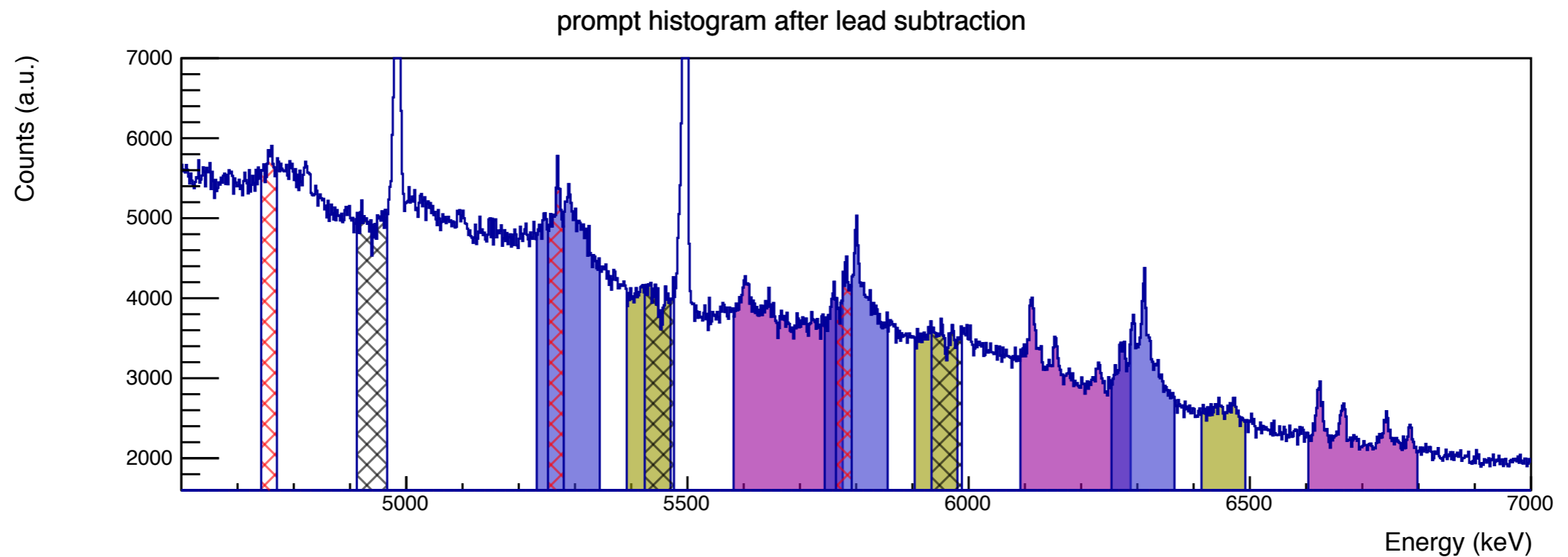
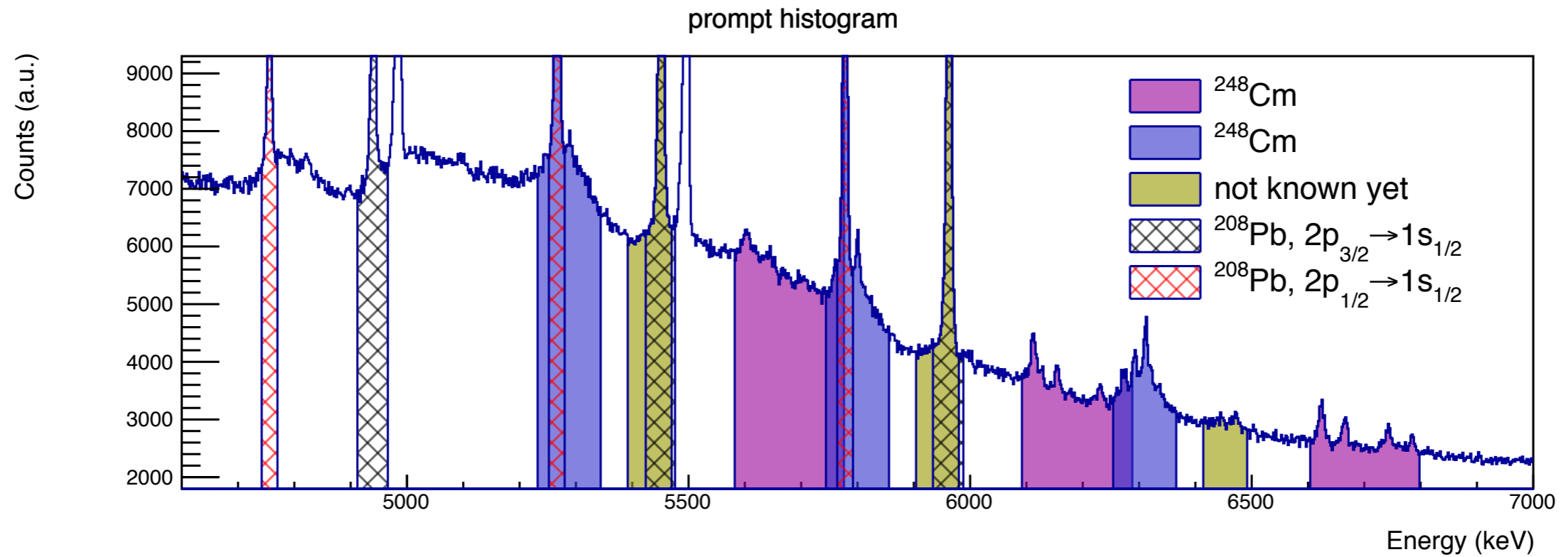
- 6.3 MeV line in the spectrum included in the fit

- Structure at 6.45 MeV affects the fit



^{248}Cm spectrum

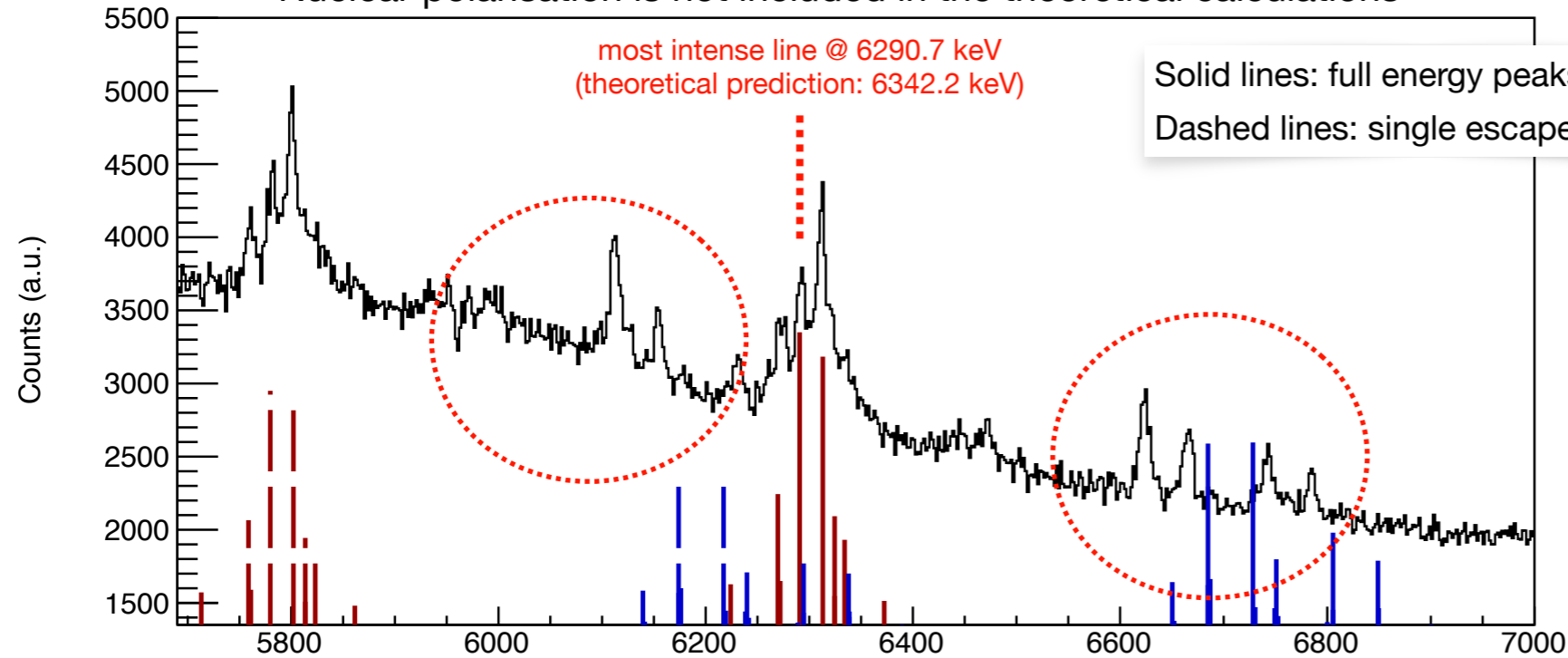
Before and after lead subtraction



^{248}Cm spectrum

Compare with preliminary theoretical predictions

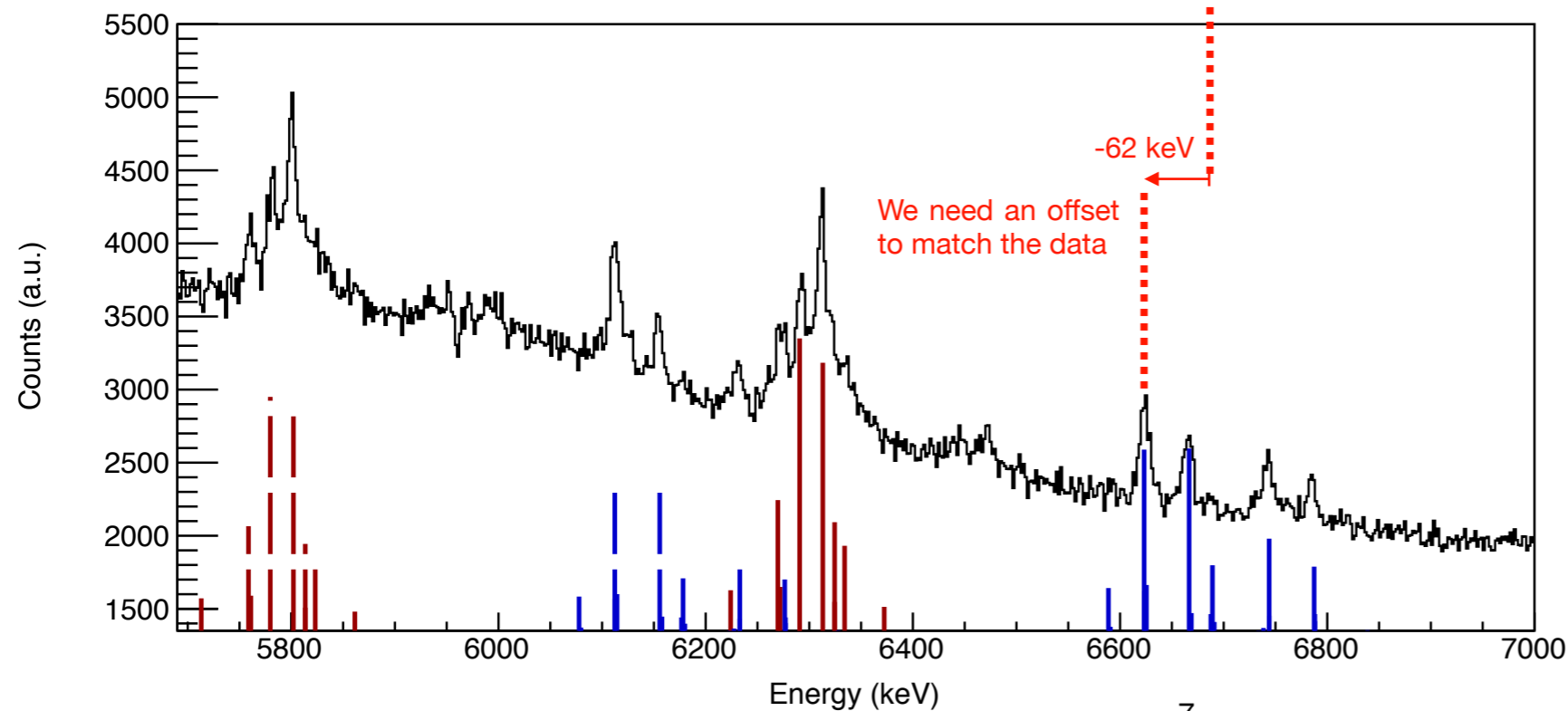
Nuclear polarisation is not included in the theoretical calculations



- Preliminary energies' and intensities' calculations by Natalia Oreshkina.
- Relative intensities and energy differences between each transition with the most intense transition.

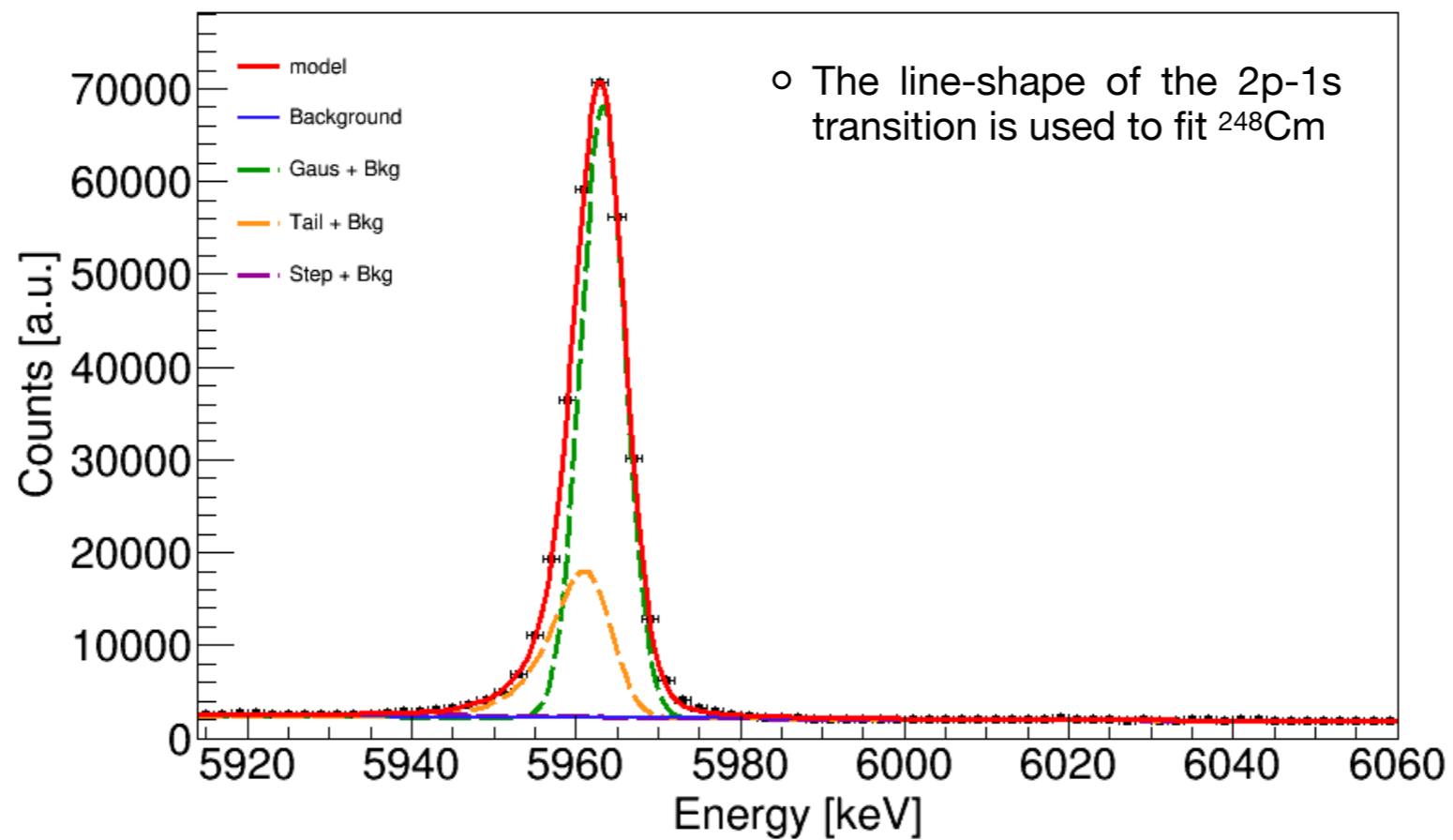
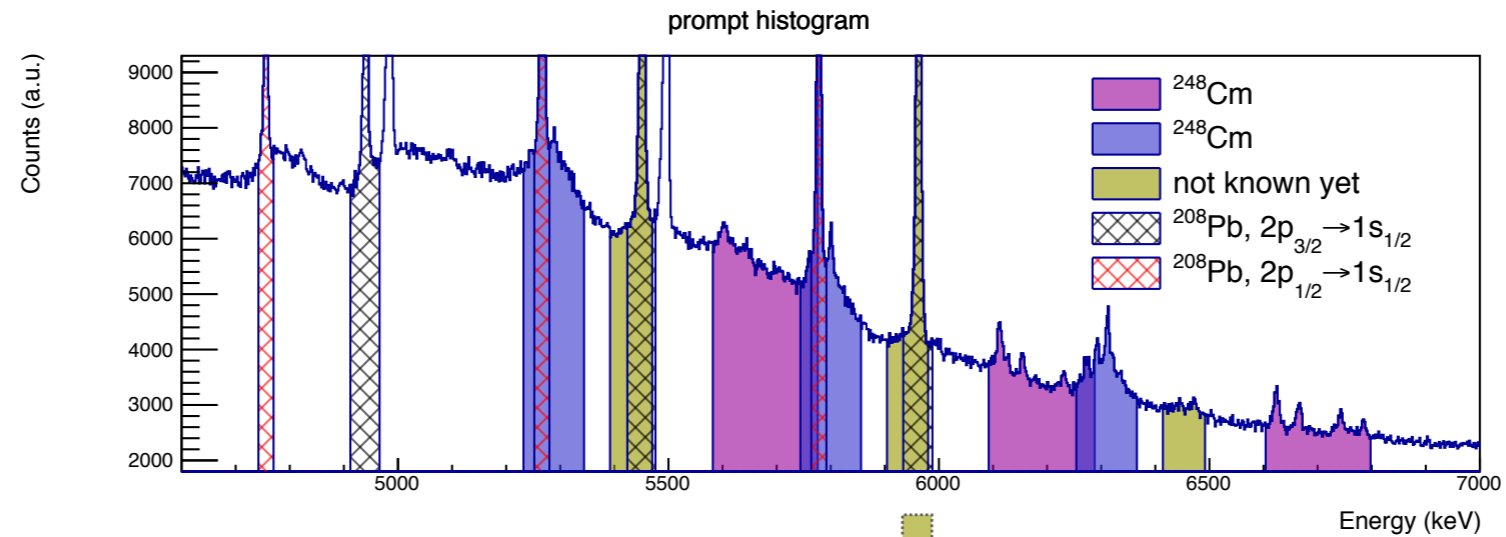
$$RI_i, \Delta E_i$$

- Currently, no function of the charge radius in these preliminary calculations.



^{248}Cm spectrum

Preliminary line-shape estimation

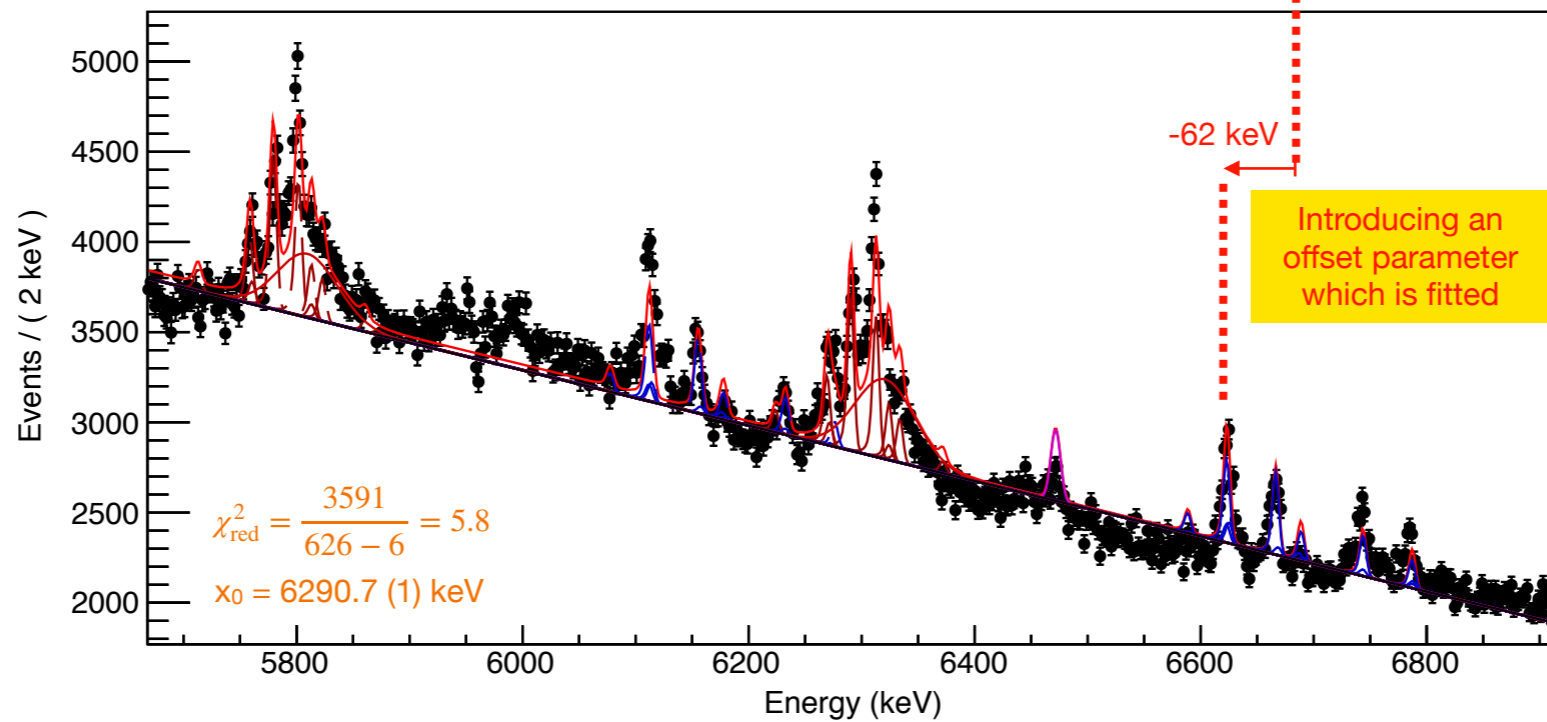
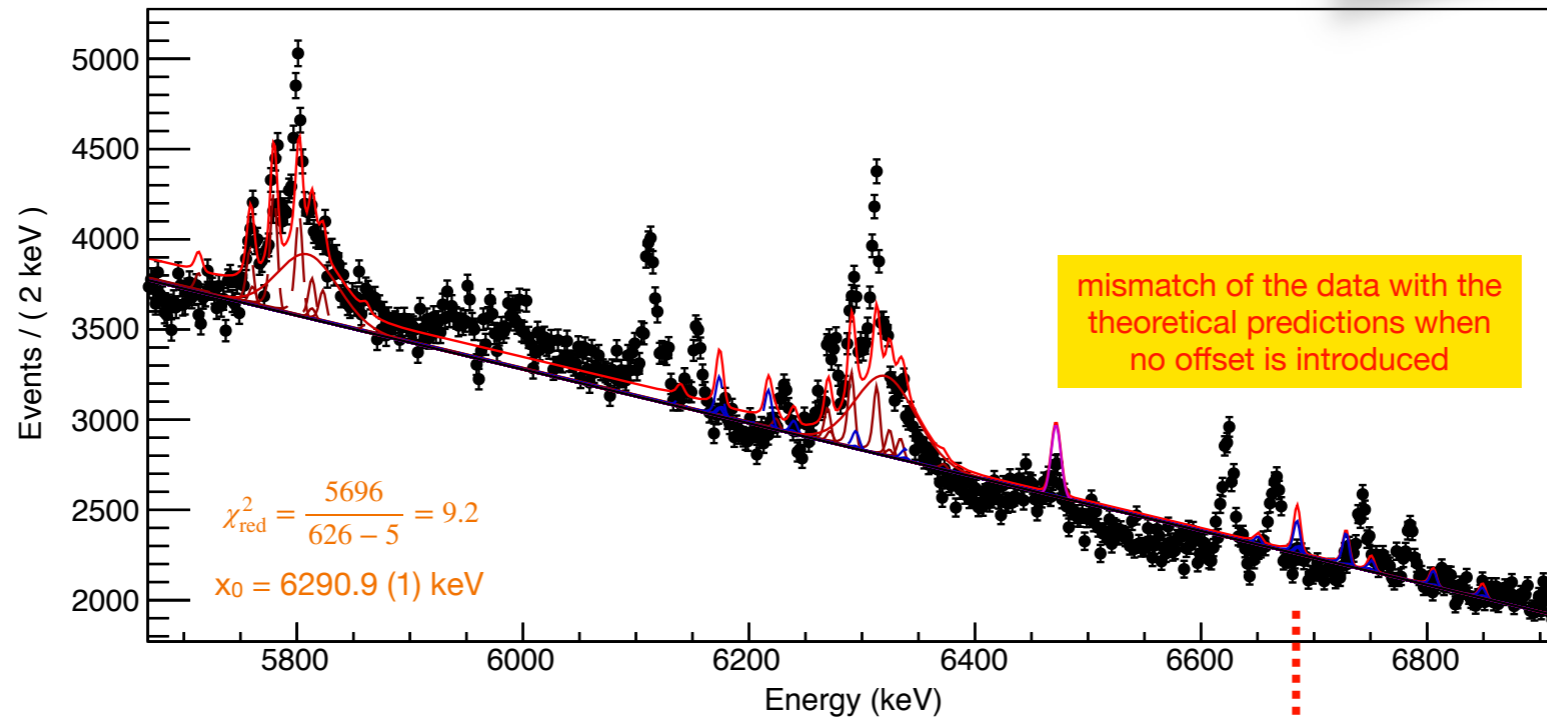


^{248}Cm spectrum

Preliminary fit of the spectrum

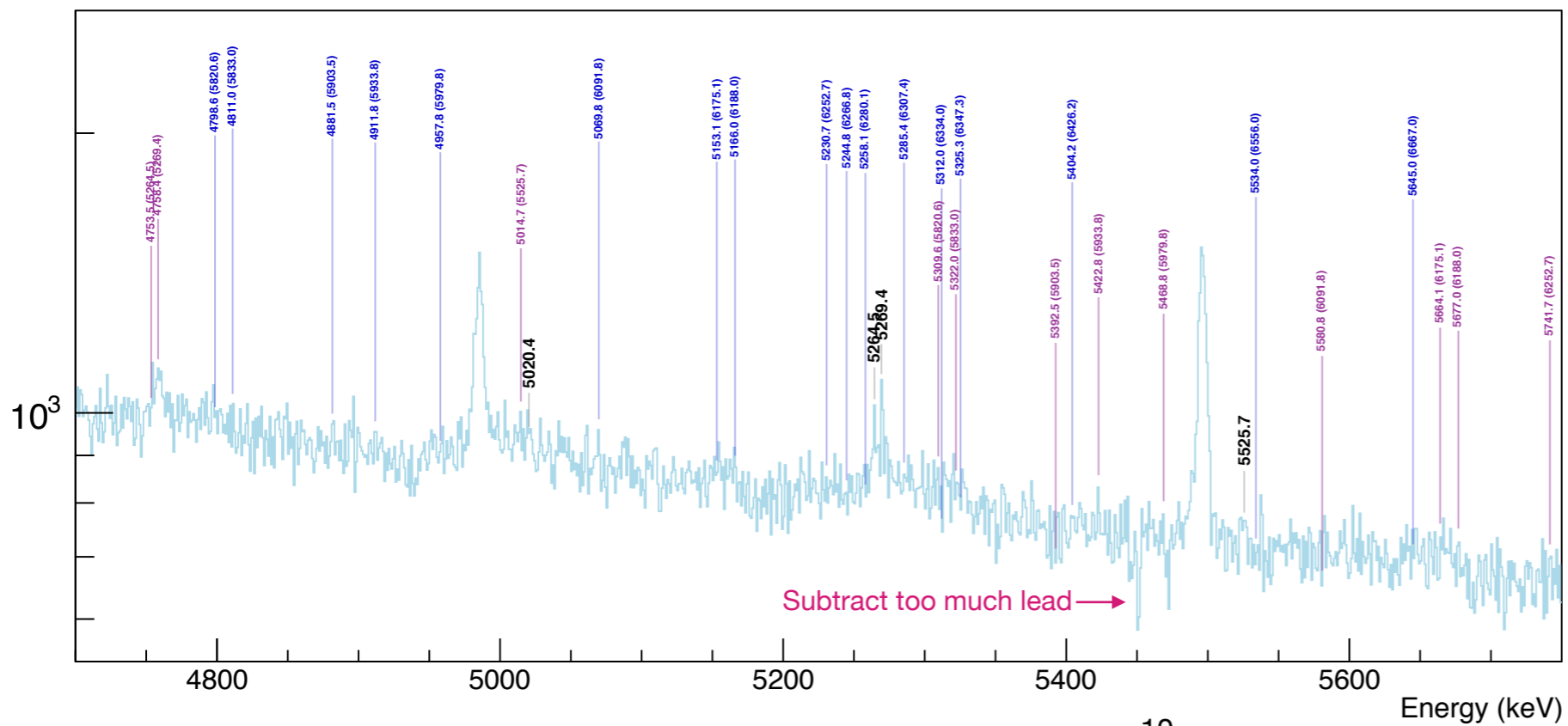
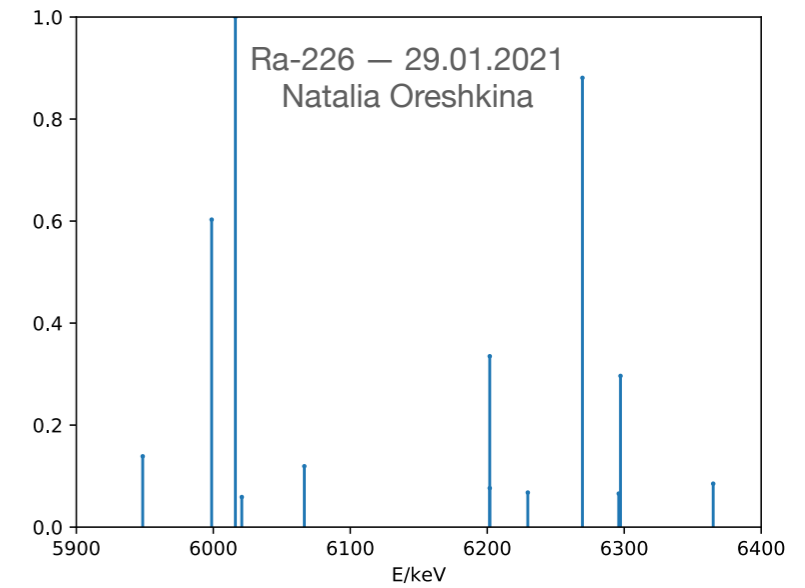
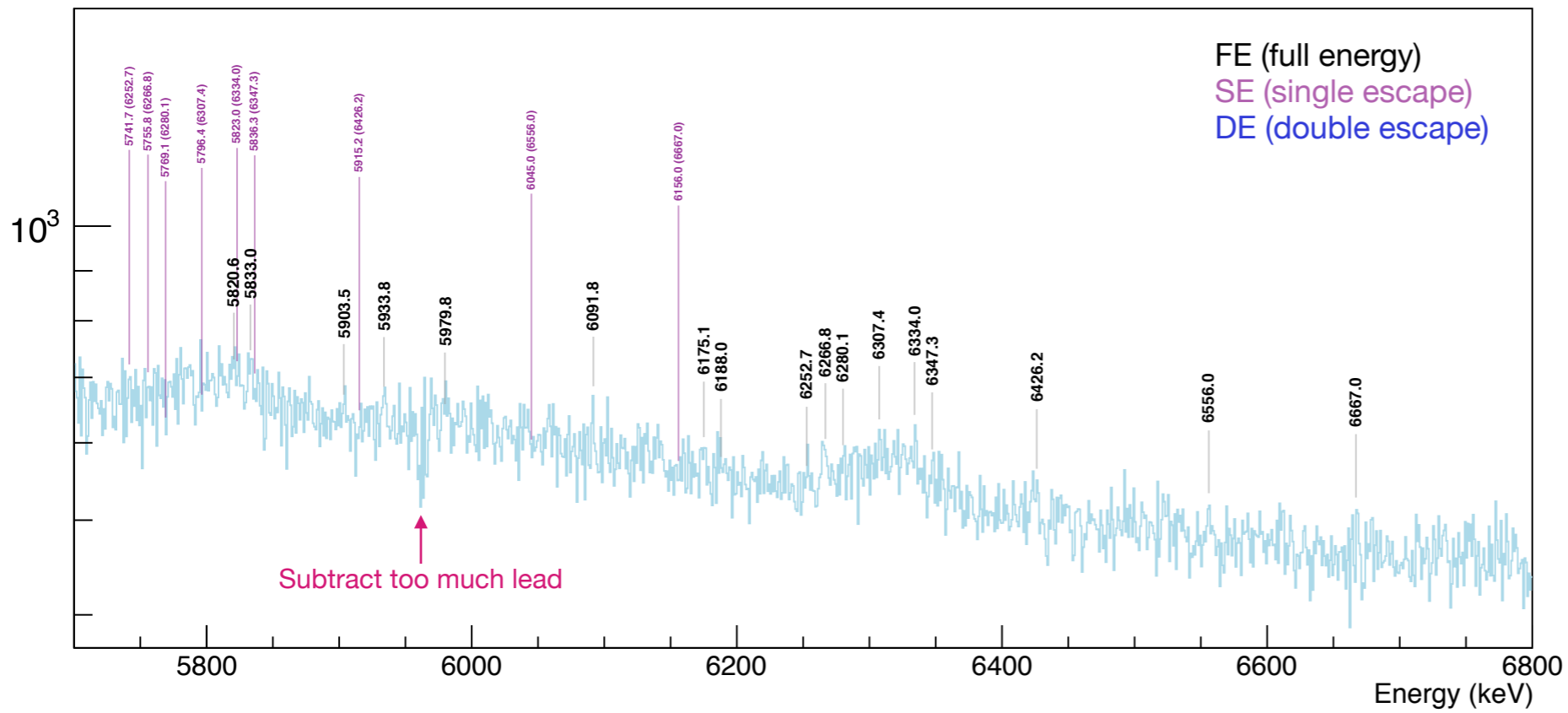
The 6.3 MeV line and the 6.45 MeV structure are fixed in the spectrum

2p-1s in ^{248}Cm



^{226}Ra spectrum

After energy calibration, baseline correction, electron veto cuts and lead subtraction



Outlook

- Analysis of ^{248}Cm for the extraction of its charge radius: determination of the detectors' response, fitting of the HFS transitions and estimate systematic uncertainty on the charge radius result

Backup slides

