Total Capture Rate of ^{76}Se with ALPACA Data

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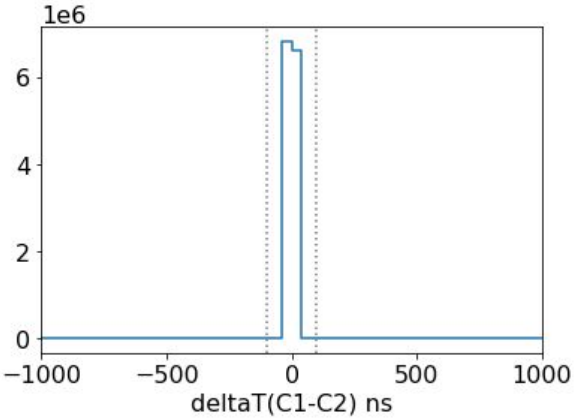
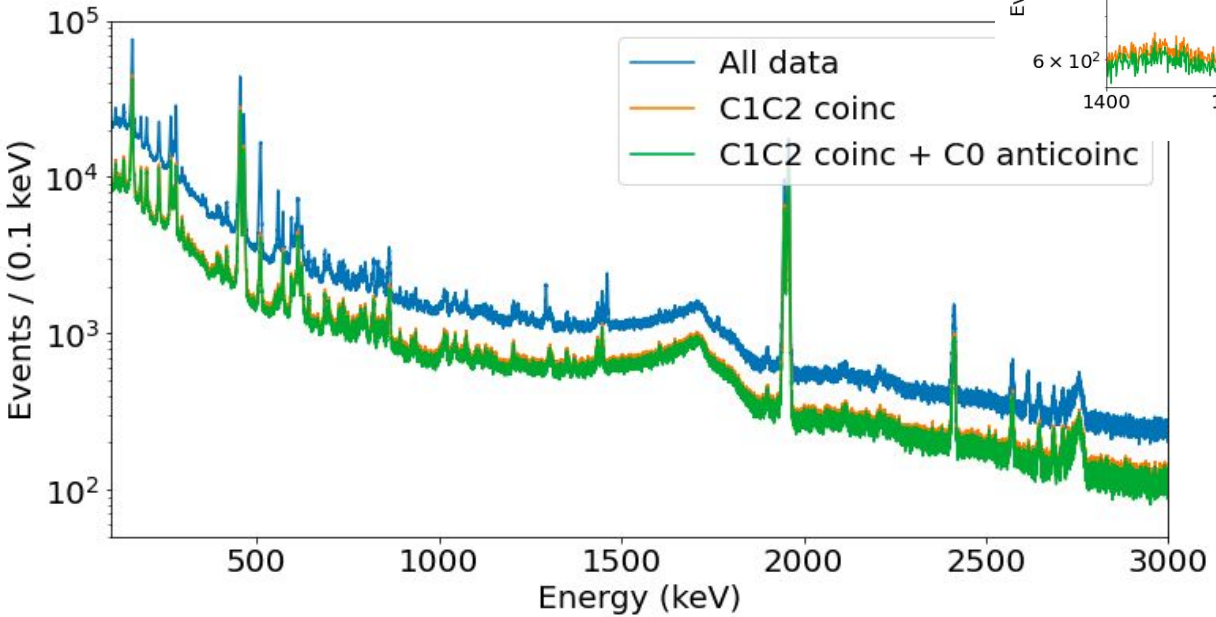
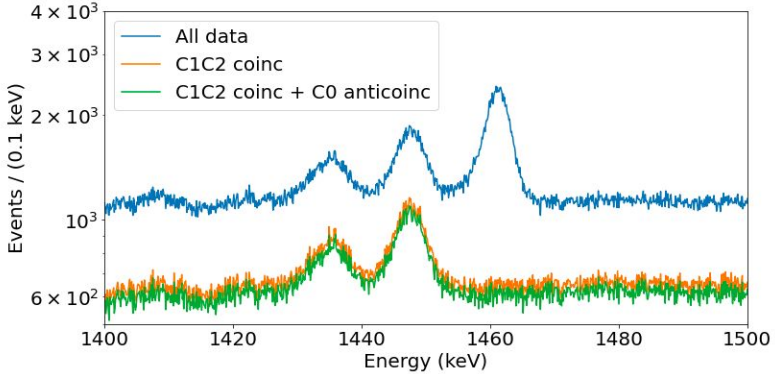
Definition of Correlated events SlidesTrigger

- Select events with only one trigger in C1 and C2
- Use C1C2 coincidence trigger: |deltaT(C1-C2)|<100ns
- Define the muon-stop trigger time as $t_{\mu stop}=(t_{C1}+t_{C2})/2$
- Use anticoincidence trigger with C0: $|deltaT(\mu_{stop}-C0)|<100$ ns
- Not use the anticoincidence trigger with C3: |deltaT(μ-stop-C3)|<100 ns cuts too much data



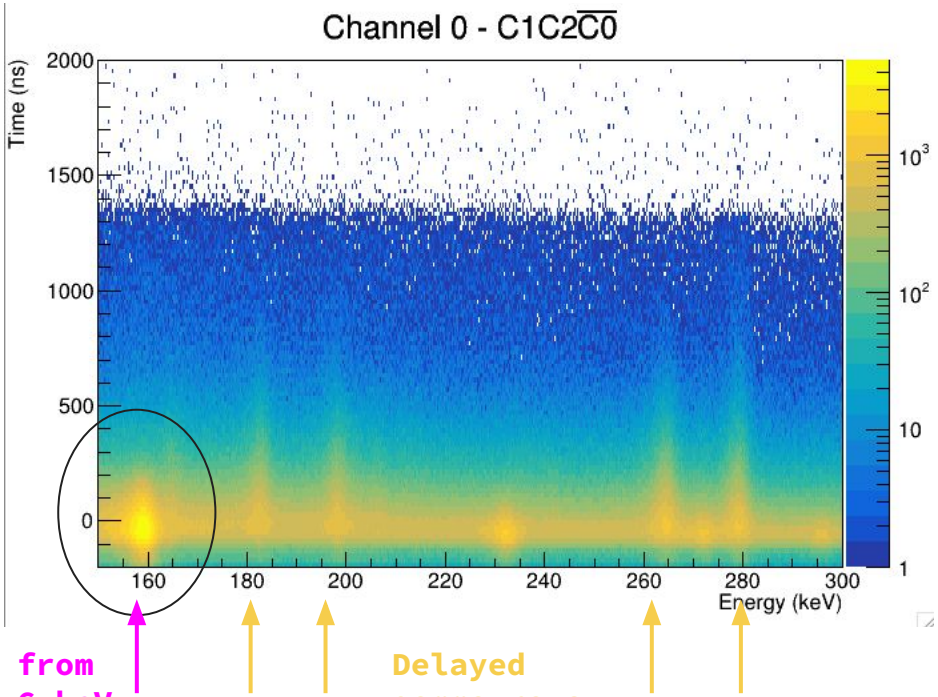
Spectra of correlated events





Se76 data set used for analysis

- All **ALPACA Se76 runs** merged together (from 29 Oct to 4 Nov)
- Use correlated events (see previous slide)



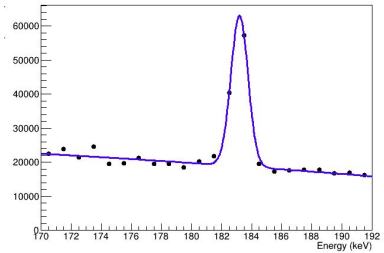
Muonic X-ray expected “prompt”, but “bad” time resolution

Muonic X-ray from M-series 158.6 keV

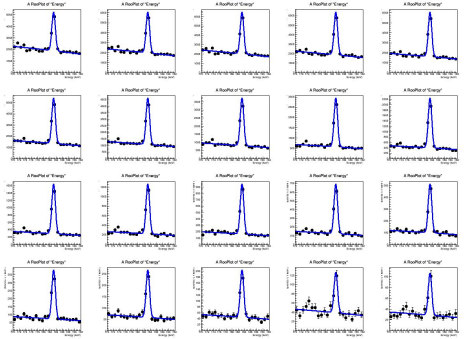
Delayed gamma-rays

Total Capture rate (τ) determination

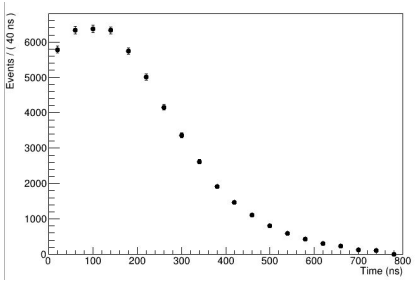
1. Fit total energy spectrum for each detector



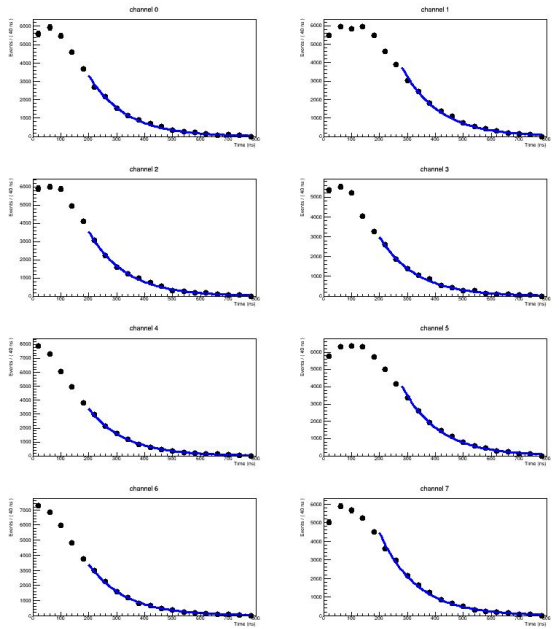
2. Bin data in time and fit each slice for each detector



3. Get intensity vs time for each detector



4. Fit simultaneously intensity vs time of all detectors to extract τ

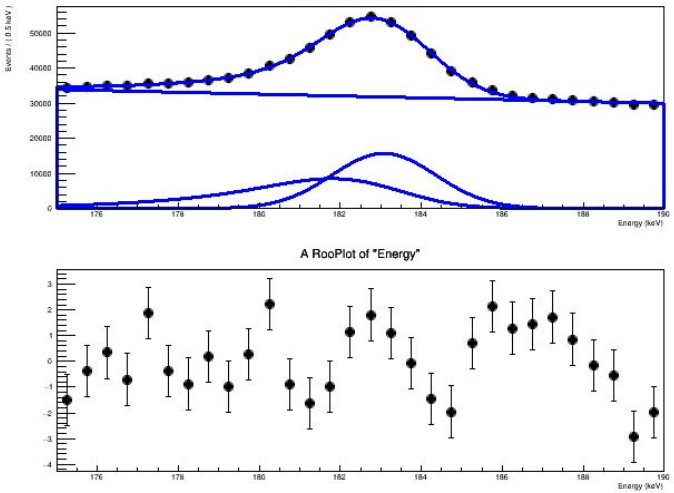


Fit model for gamma-peaks: total energy spectrum

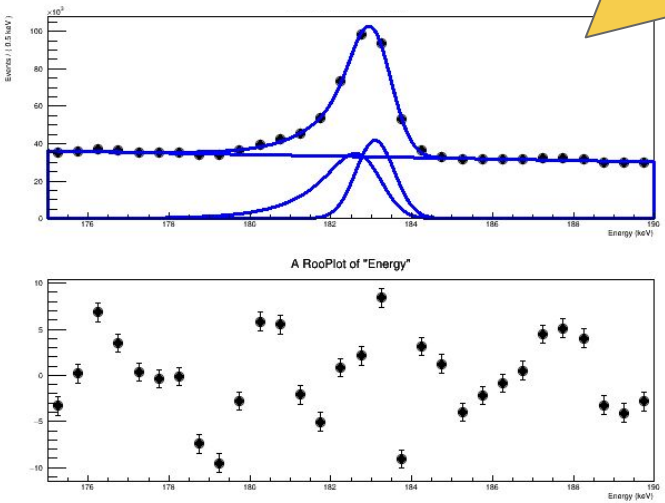
- Signal: gaussian peak + left tail
- Linear background (+ more gaussian peaks)

All parameters free!

Channel 0 - REGe

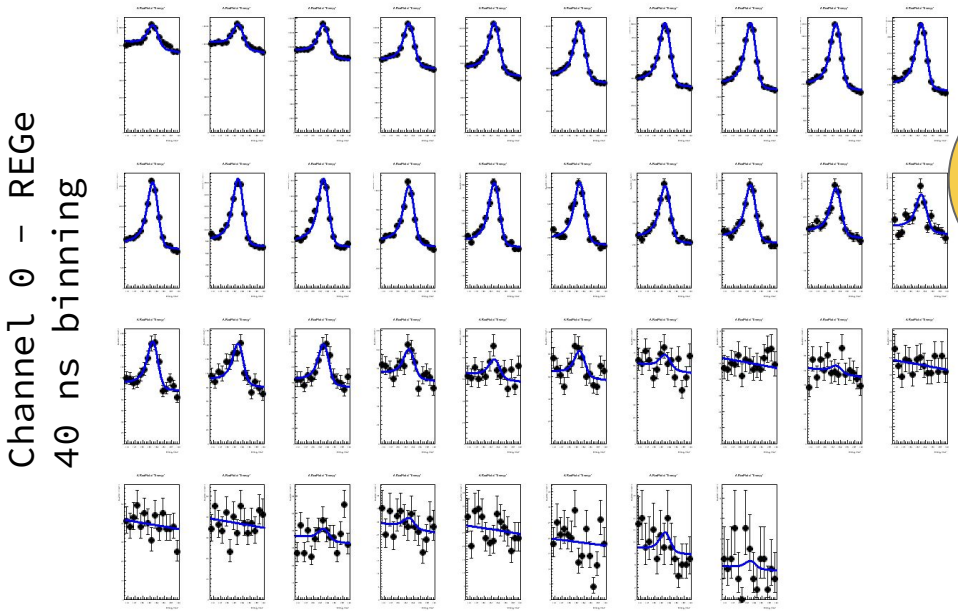


Channel 1 - BEGe



Fit of time-binned data

- Energy spectrum binned in time: fit each bin with previously determined model

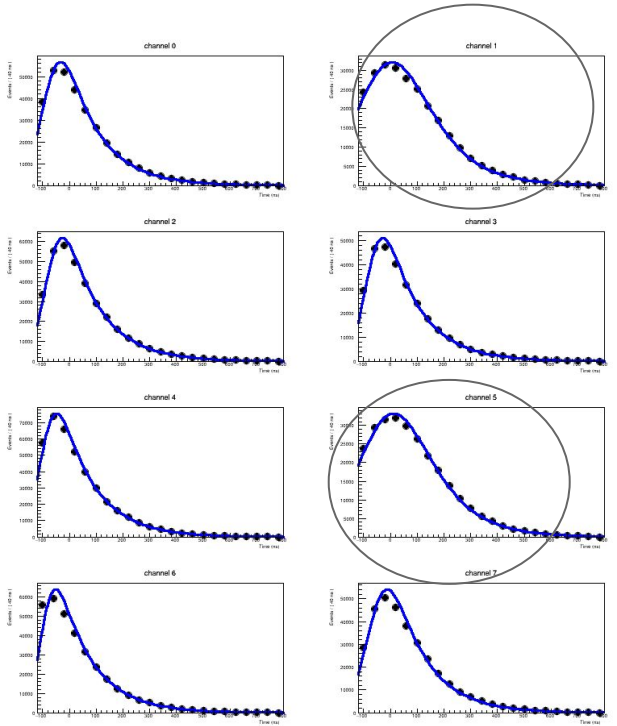


Only two free parameters: intensity of the peak and background normalization

Fit model for intensity vs time

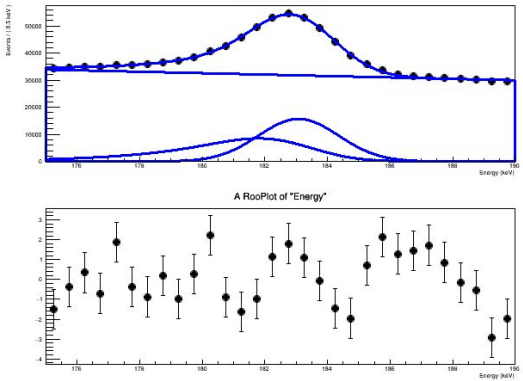
BEGe detectors: worse time resolution ~ 120 ns

- Exponential decay convoluted with a gaussian term for time resolution [Roofit class: RooDecay]
- Fit simultaneously all detectors: total decay rate as common parameter
- Fit range (-100,1300) ns
- Binning 40 ns

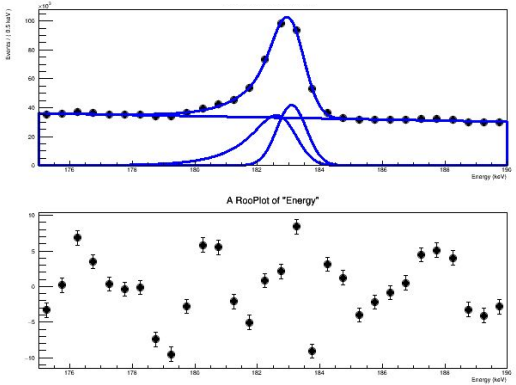


Results: 182.9 keV line

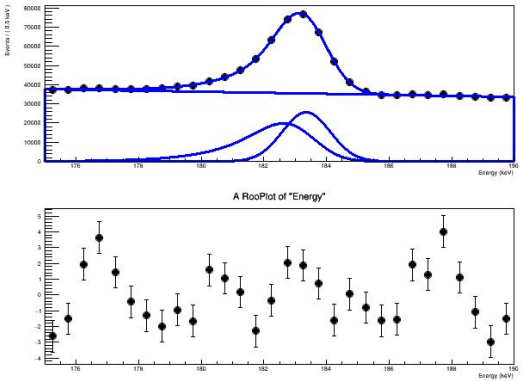
Channel 0 – REGe



Channel 1 – BEGe



Channel 6 – Coax

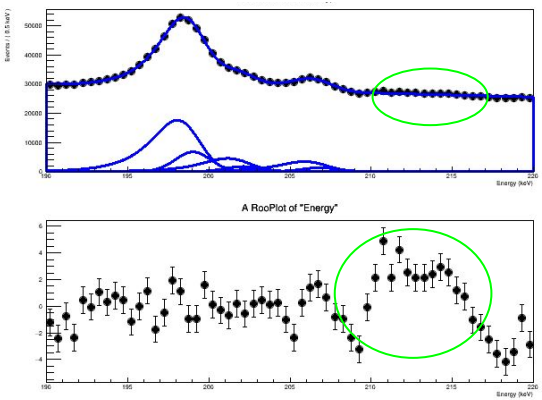


Combined total capture rate: 138.0 +/- 2.3 ns

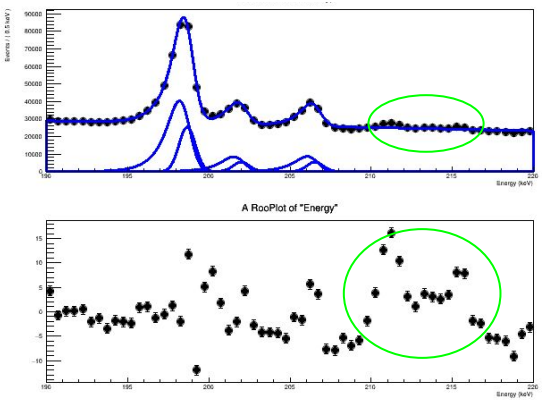
Results: 198.6 keV line

*Maybe one or two more background peaks, but should not affect too much the result

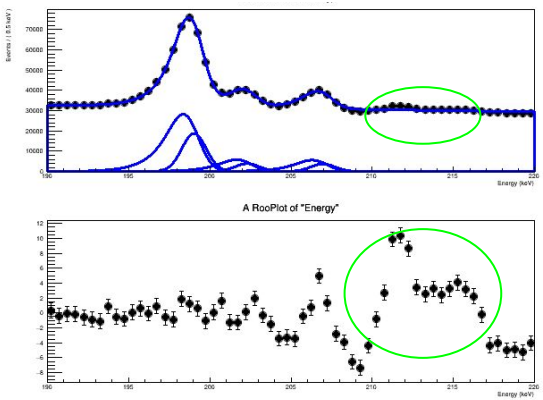
Channel 0 - REGe



Channel 1 - BEGe



Channel 6 - Coax

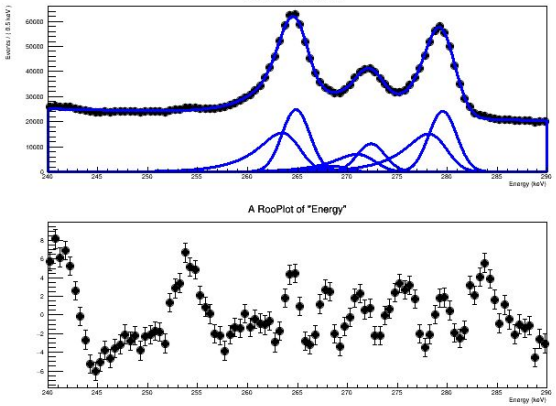


Combined total capture rate: 138.4 +/- 1.8 ns

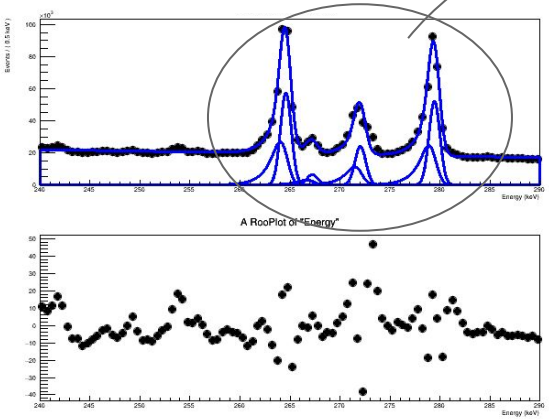
Results: 264.7 keV & 279.5 keV lines

Several peaks visible in BEGe detectors, also used in the fit model for the other detectors

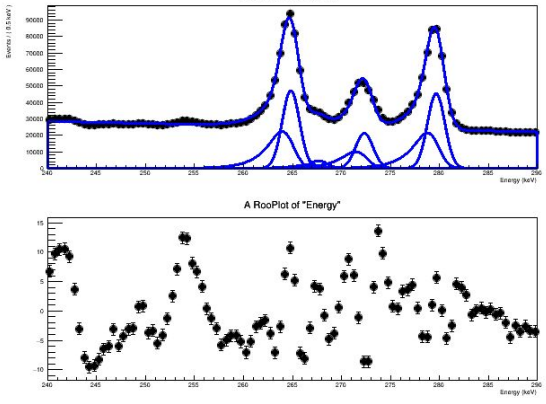
Channel 0 - REGe



Channel 1 - BEGe



Channel 6 - Coax



Combined total capture rate (264.7 keV): 130.7 +/- 3.8 ns
Combined total capture rate (279.5 keV): 143.4 +/- 2.8 ns

Summary of preliminary results

- Only statistical uncertainty
- Weighted average: 138.4 +/- 1.2 ns

Line Energy (keV)	τ (ns)
182.9	138.0 +/- 2.3
198.6	138.4 +/- 1.8
264.7	130.7 +/- 3.8
279.5	143.4 +/- 2.8

Systematic uncertainties

Need to study systematic uncertainties

- Binning
- Fit model (both in energy and in time)
- Fit range (time)
- Trigger (C1C2, C1C2notC0notC3)

Conclusions & outlook

- First preliminary results of the total capture rate in Se76 with ALPACA data:

  138.4 +/- 1.2 ns

  (weighted average of 4 lines, only statistical uncertainty)

- Need to study systematic uncertainties (binning, fit model, range, trigger)
- Technical report in progress

BACKUP

Muonic X-rays M-series