Analysis of Se-76: total OMC rates from time evolution of g-lines followed the OMC

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Se-76 data: processing statistics

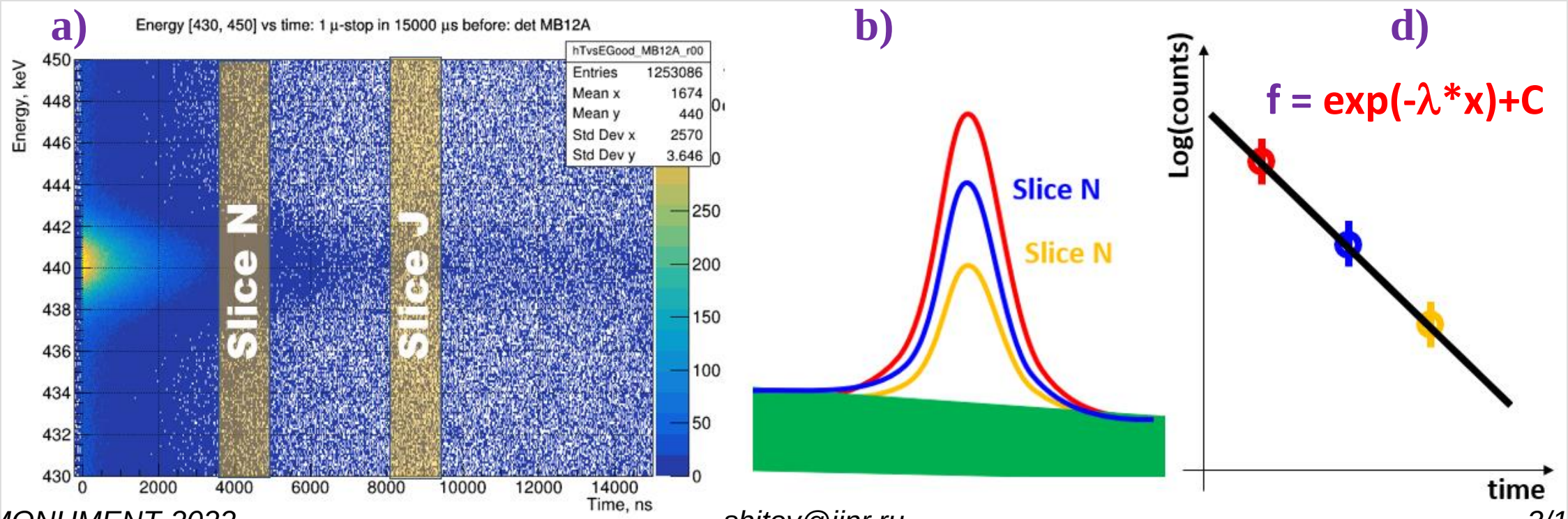
- **1411 runs (~ 86 h) in the data list:**
- **We analyzed spectra of individual detectors, with the exception of Ge2 and Ge6, which have problems with determining the t0 signal.**

Muon logic:

“Incoming muon” – C_1 & not(C_0) hit

Defining OMC time constant λ

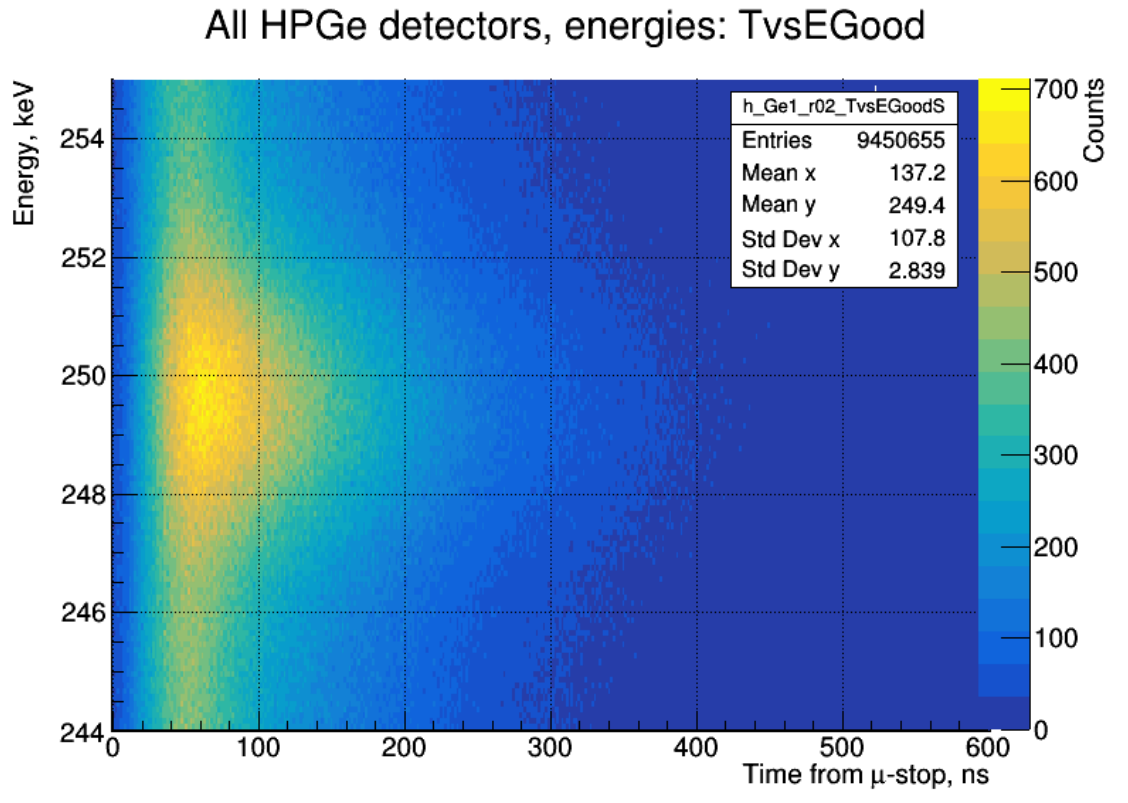
- Here we are a) slicing 2D histo along energy range, b) fit each slice by gaus + lin model with fixed gaus peak position and sigma c) subtract constant contribution from long-lived isotopes evaluated in [9-14] μs range, d) fit obtained peak intensities vs time with f = exp(-λ*x), where the exponent is from OMC. The c-d) steps are same like in new method 1)

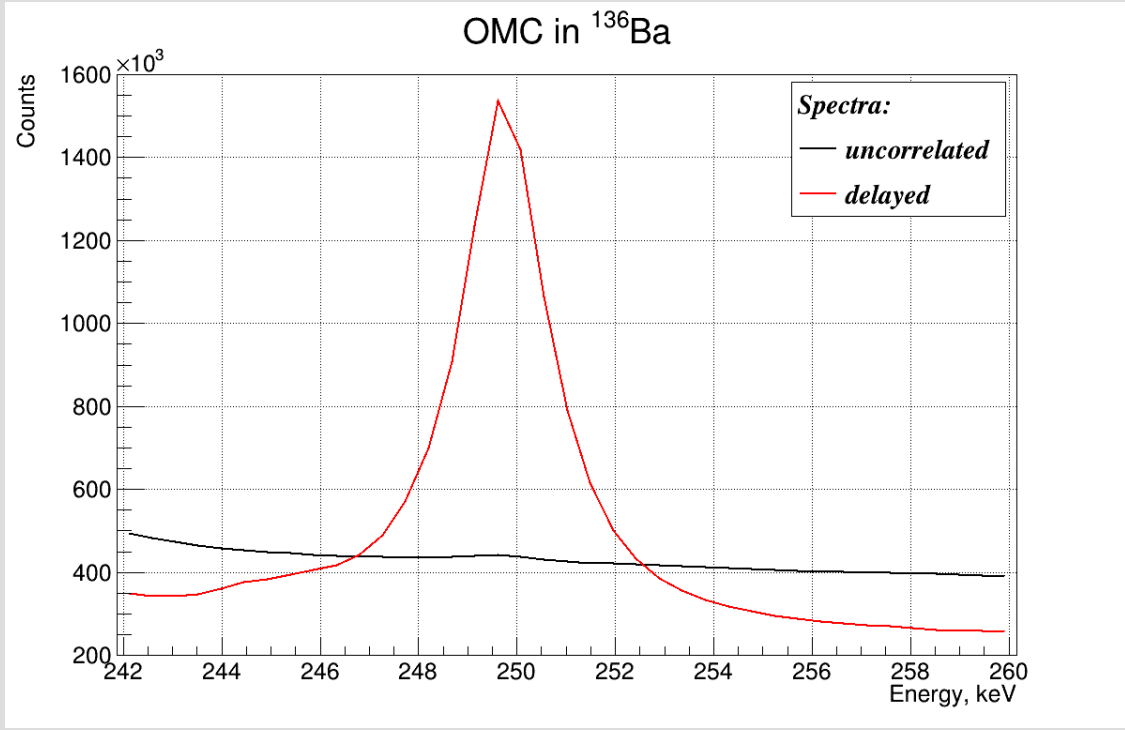


Example of spectra (Cs-135: line 250 keV)

- **This is one of the strongest lines, emitted only from OMS, so its time evolution should correspond to the life curve of a muon in barium**

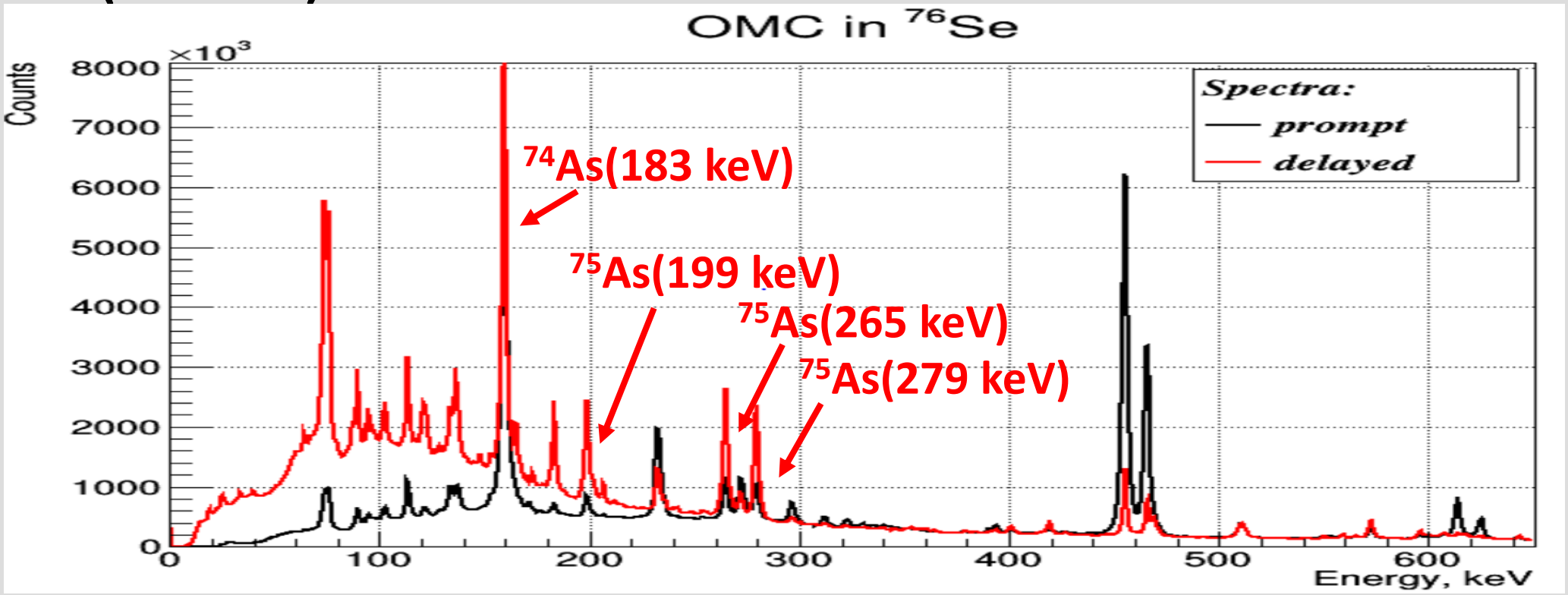
2D Time vs. energy



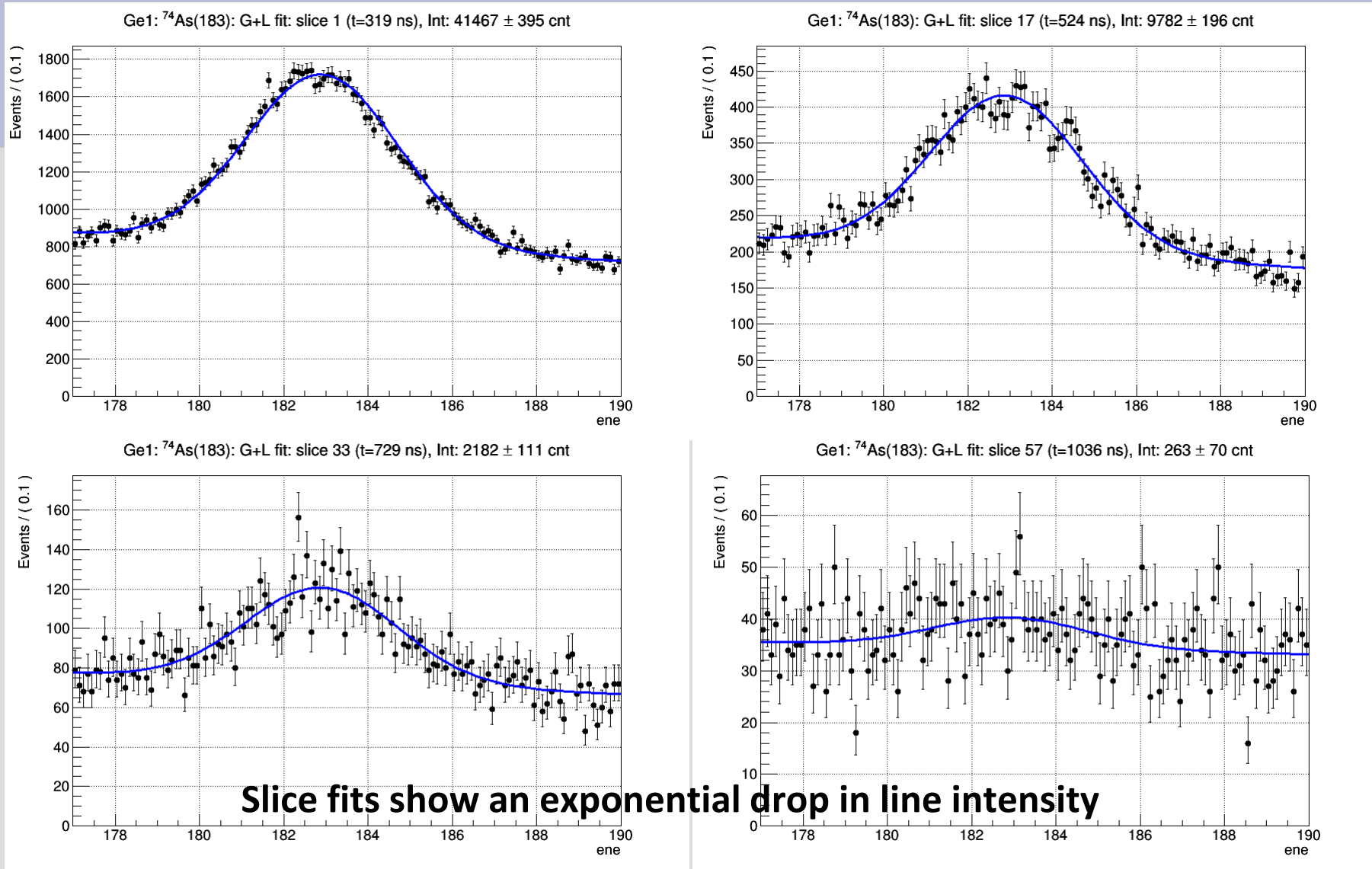


Analyzed γ-lines in ^{76}Se

- Most strongest γ-lines: ^{74}As(183 keV), ^{75}As(199 keV), ^{75}As(265 keV), ^{75}As(279 keV)

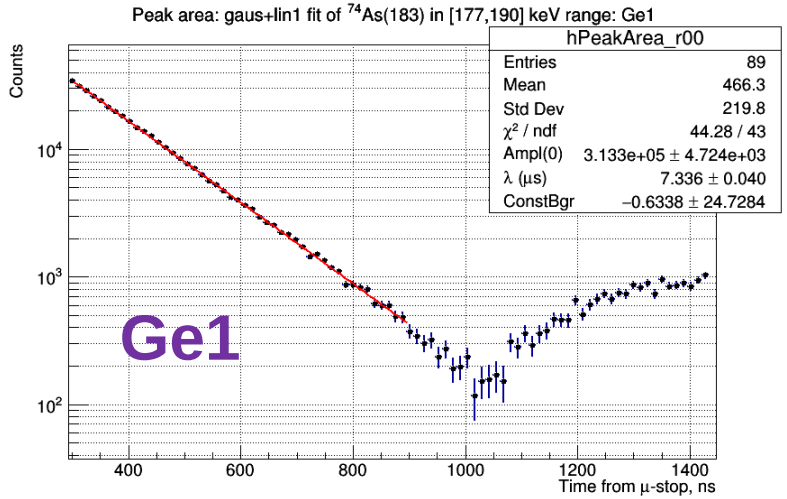


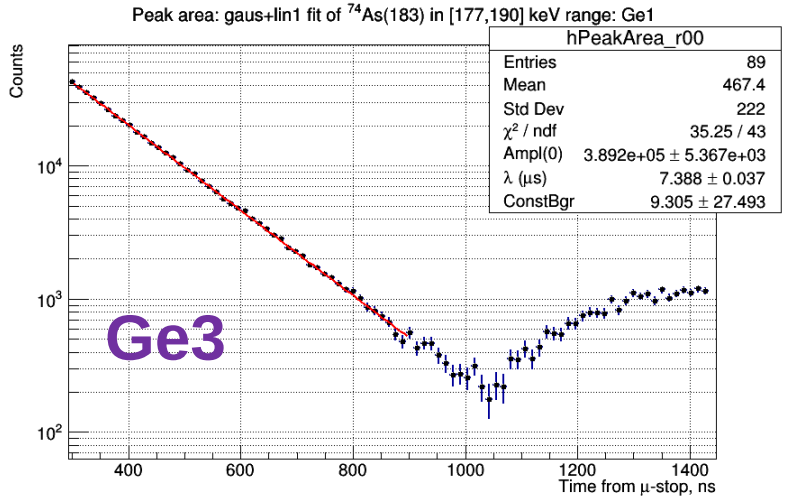
^{74}As(183 keV): Ge1: G+L fitted slices

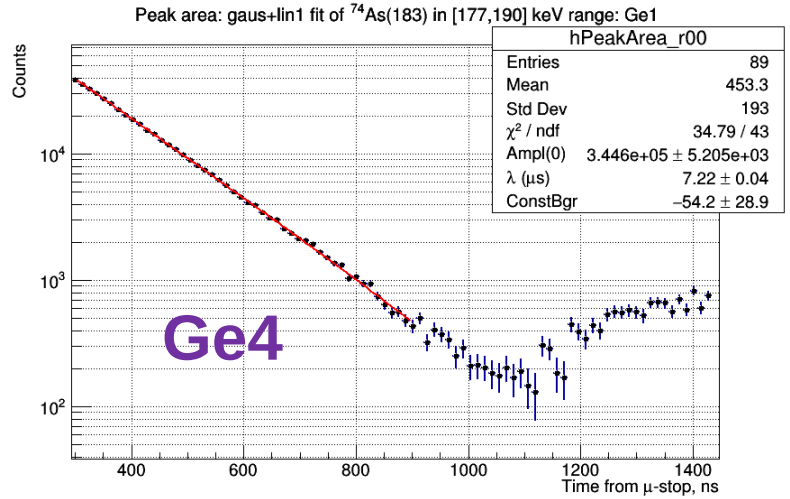


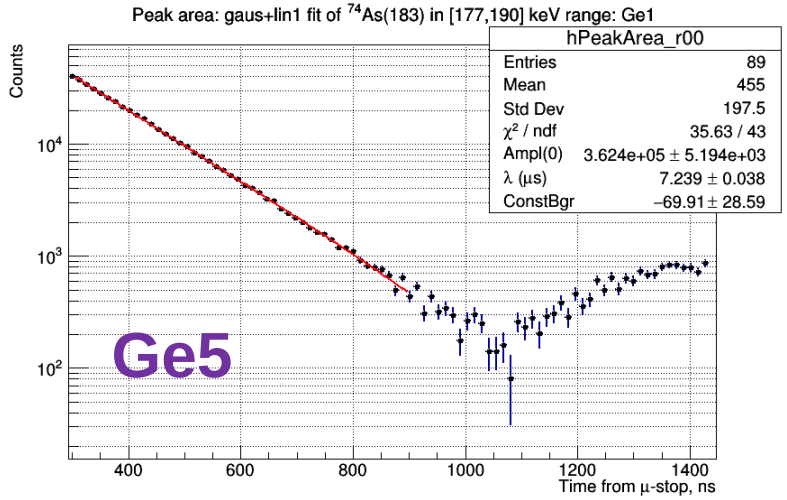
Slice fits show an exponential drop in line intensity

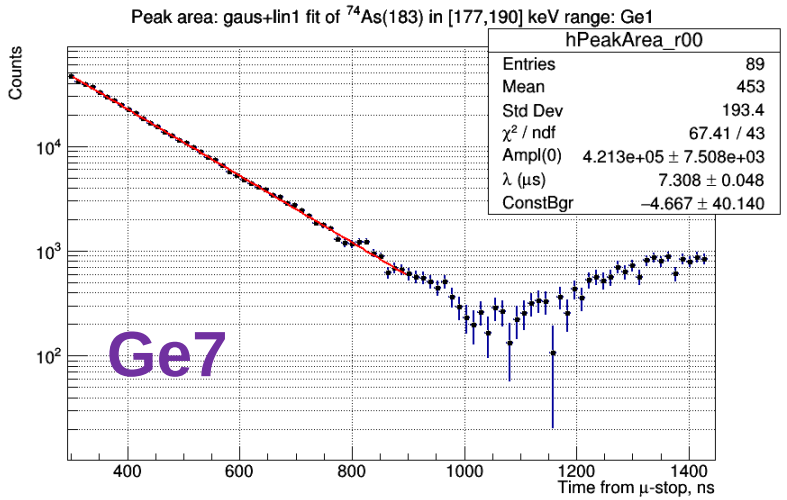
^{74}As(183 keV): expo fit of time evolution

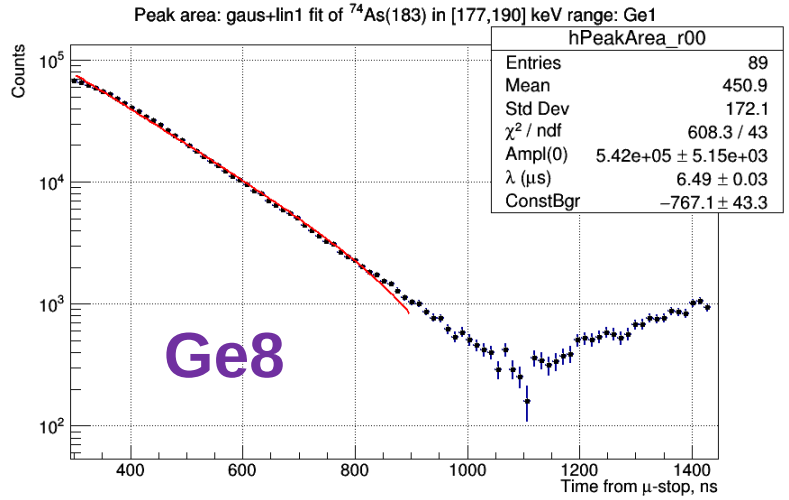




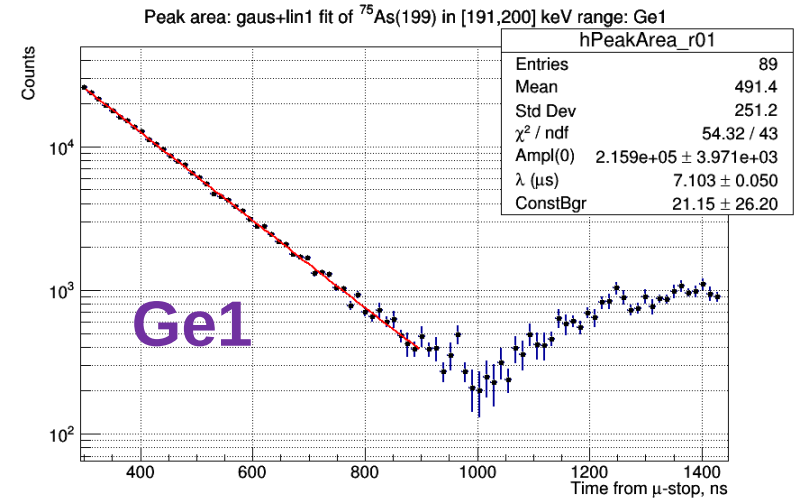


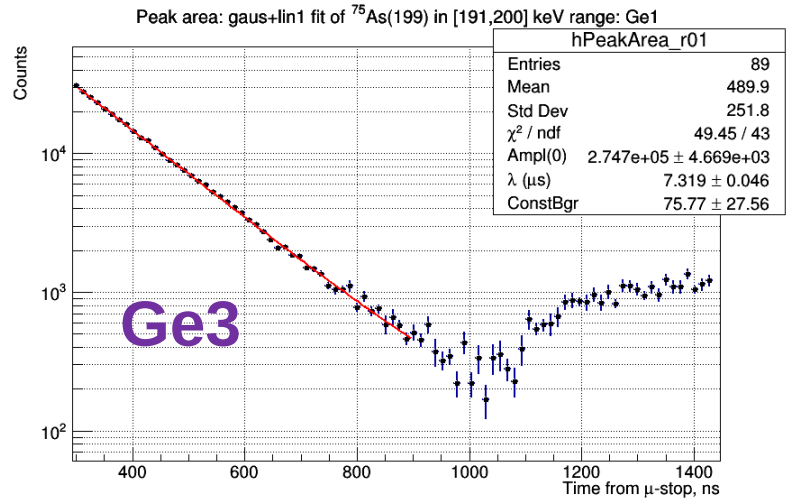


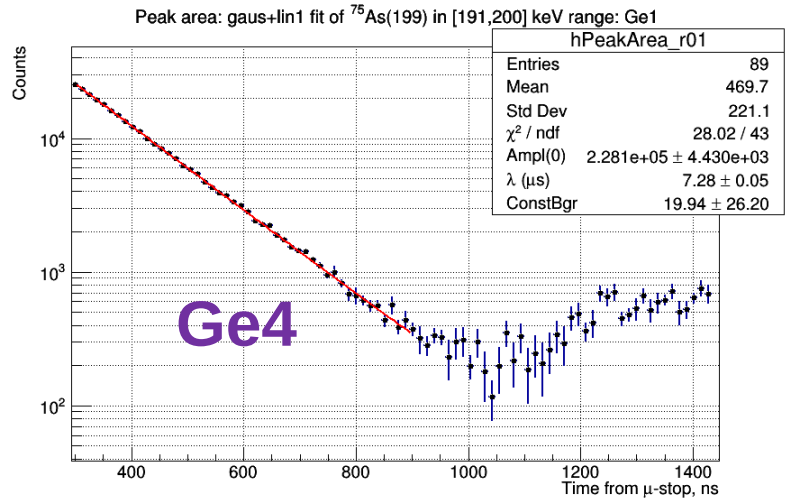


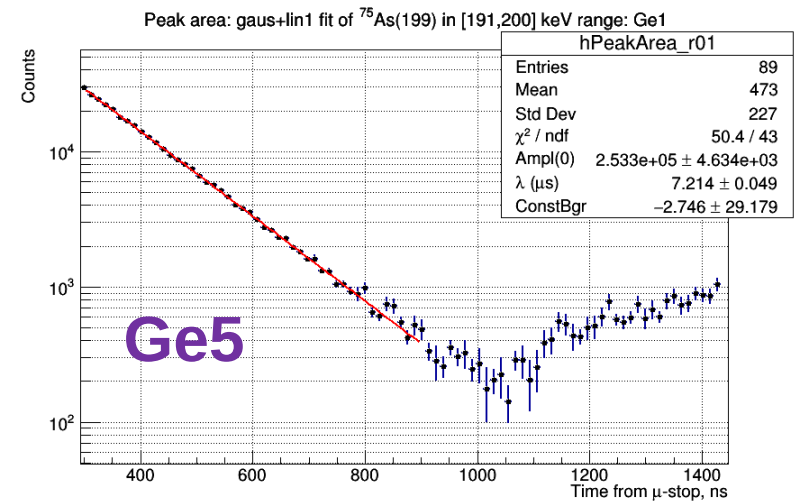


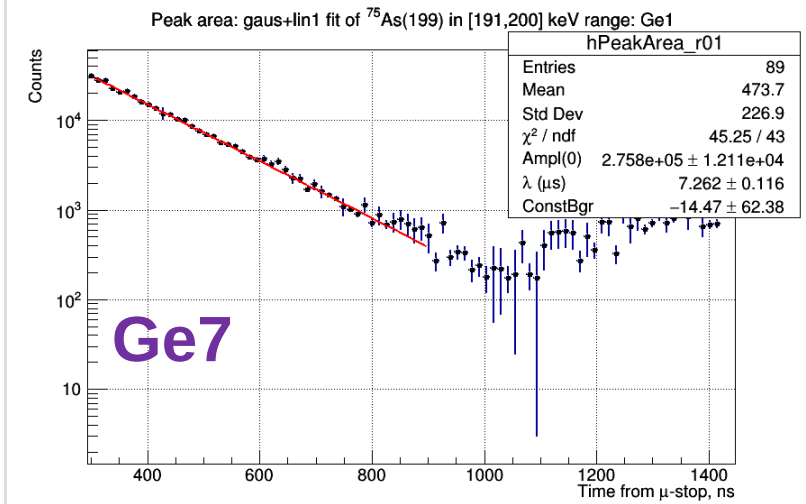
^{75}As(199 keV): expo fit of time evolution

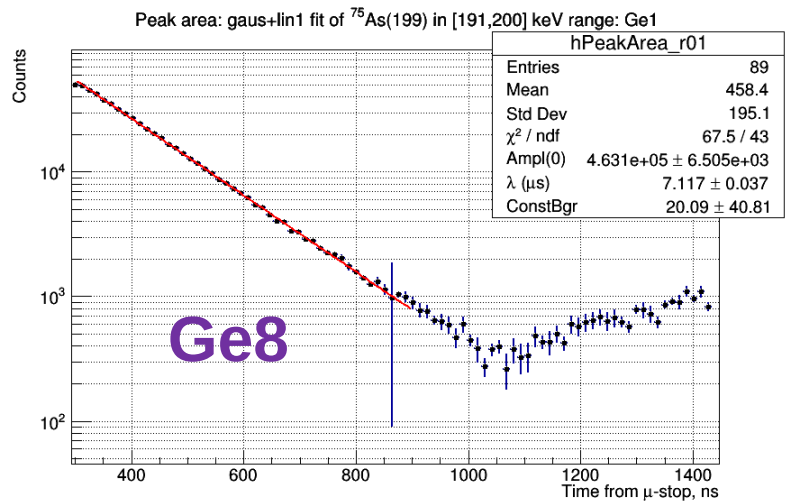




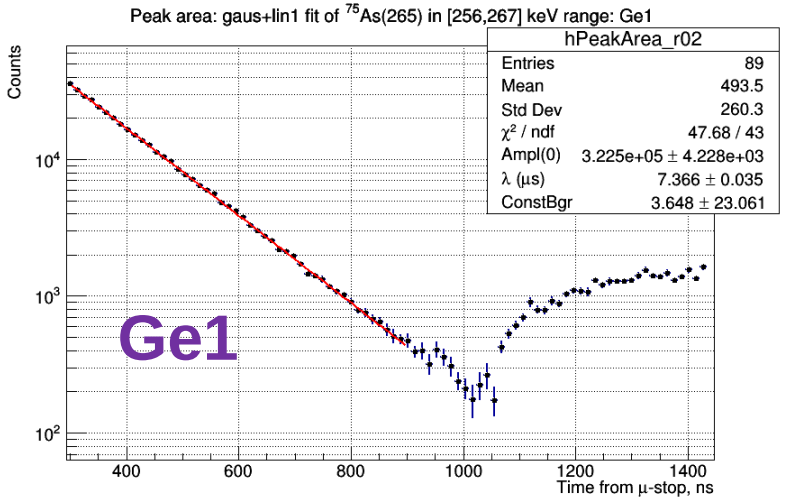


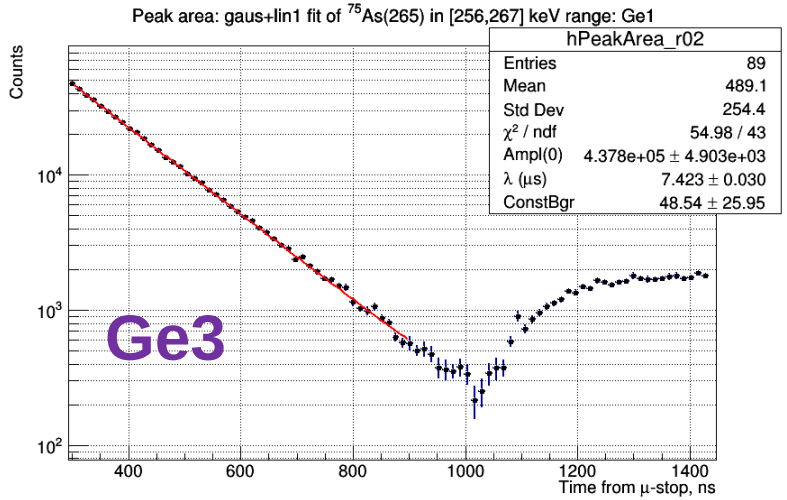


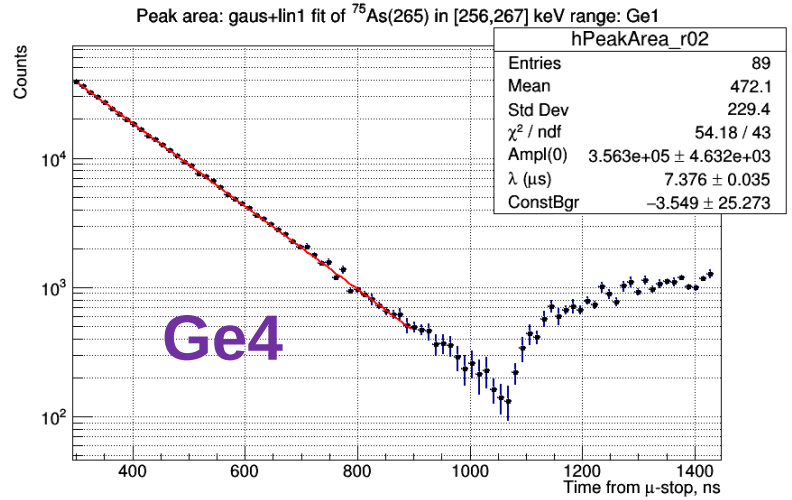


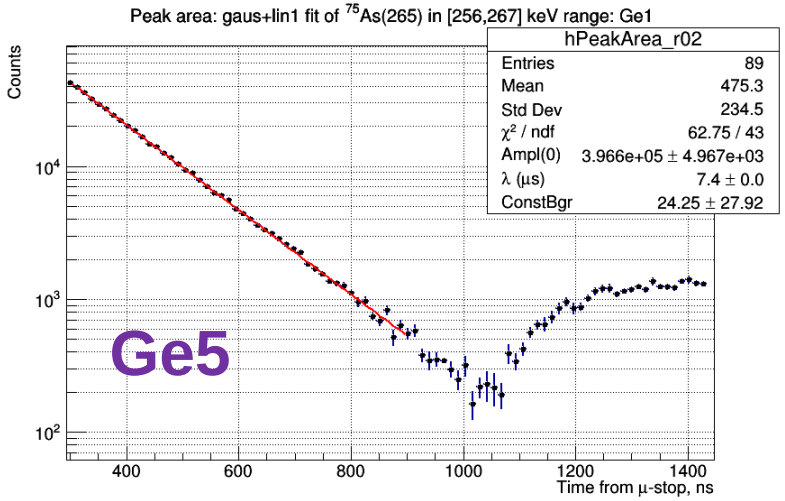


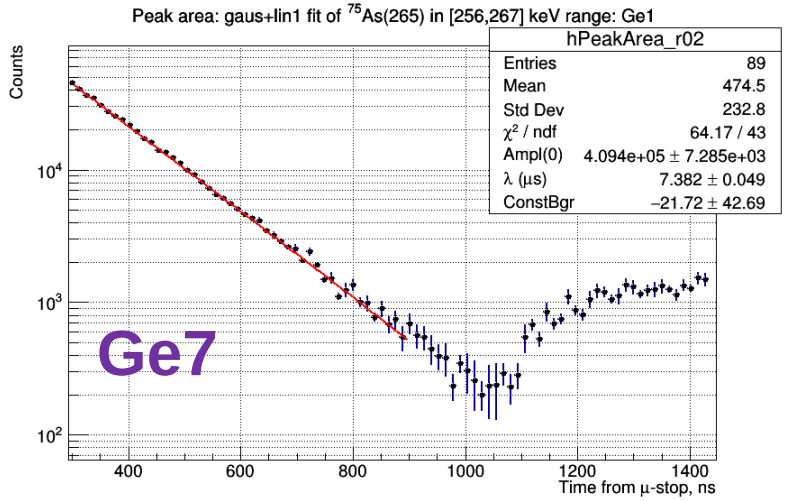
^{75}As(265 keV): expo fit of time evolution

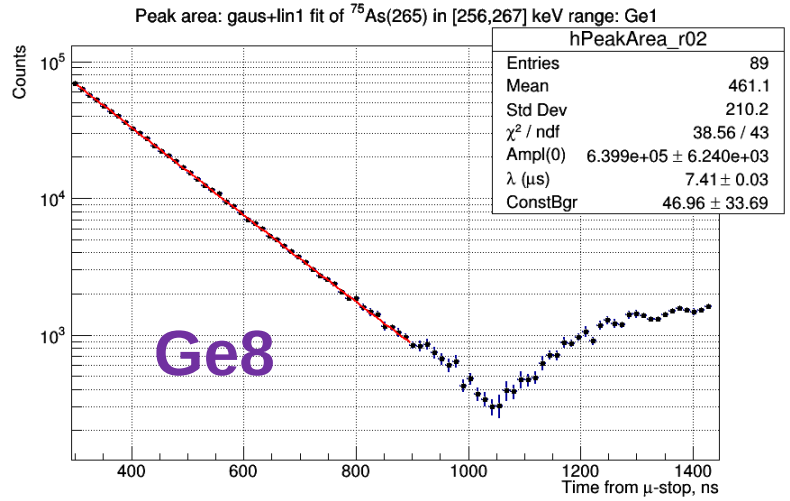




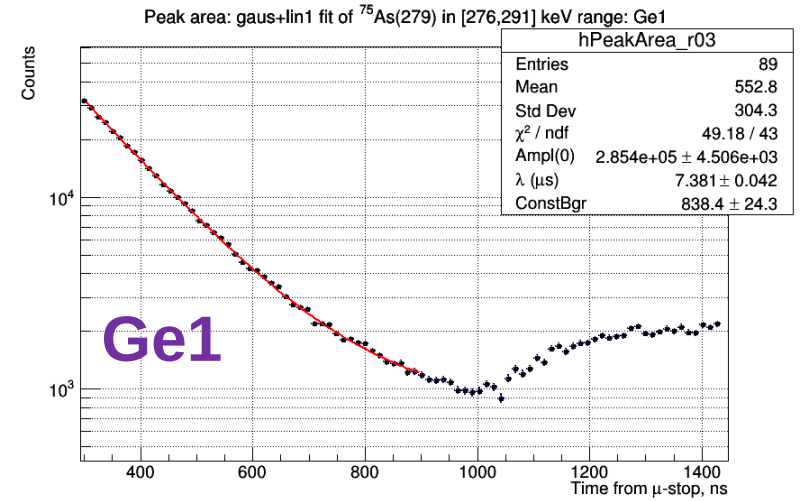


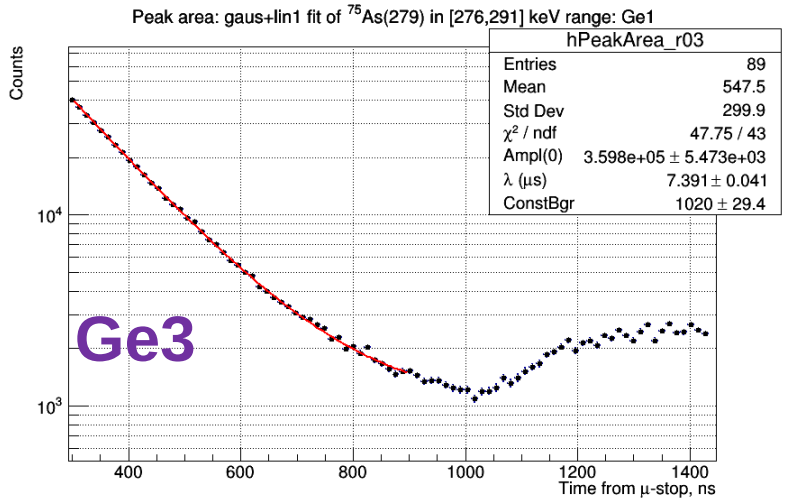


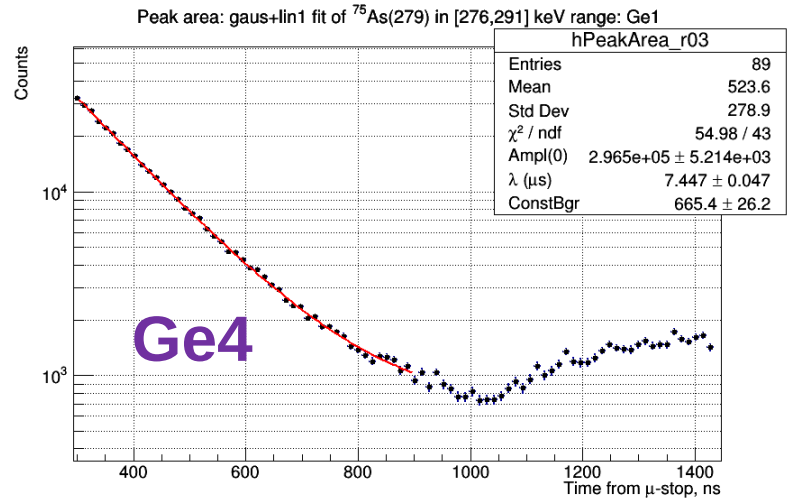


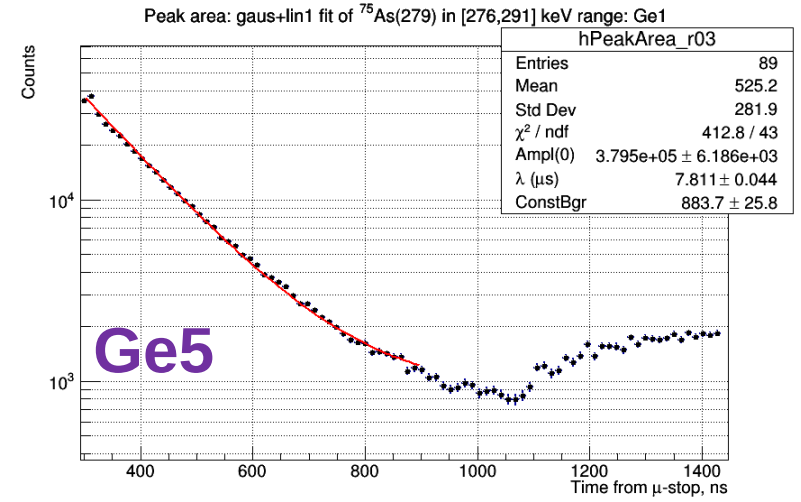


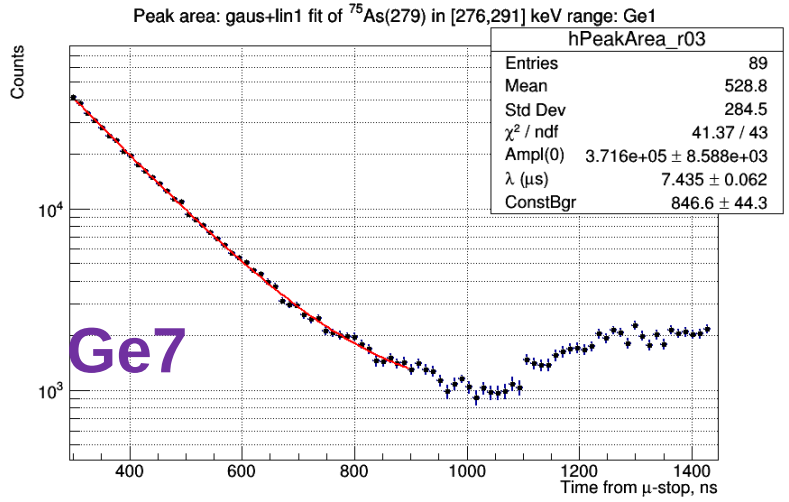
^{75}As(279 keV): expo fit of time evolution

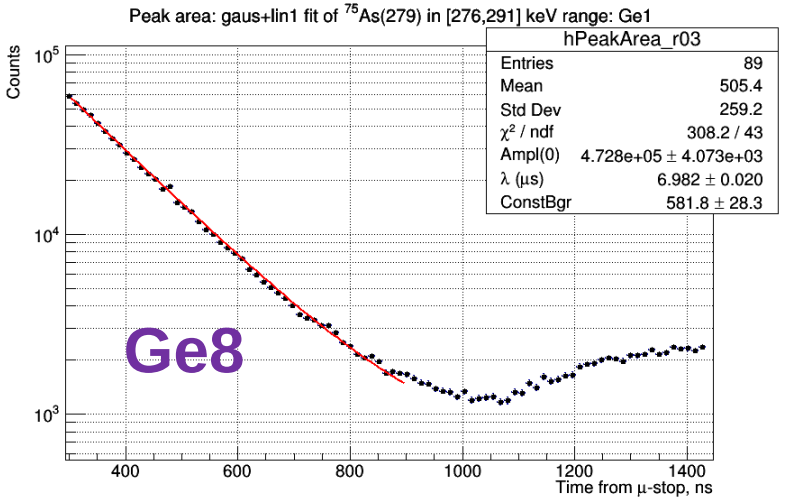




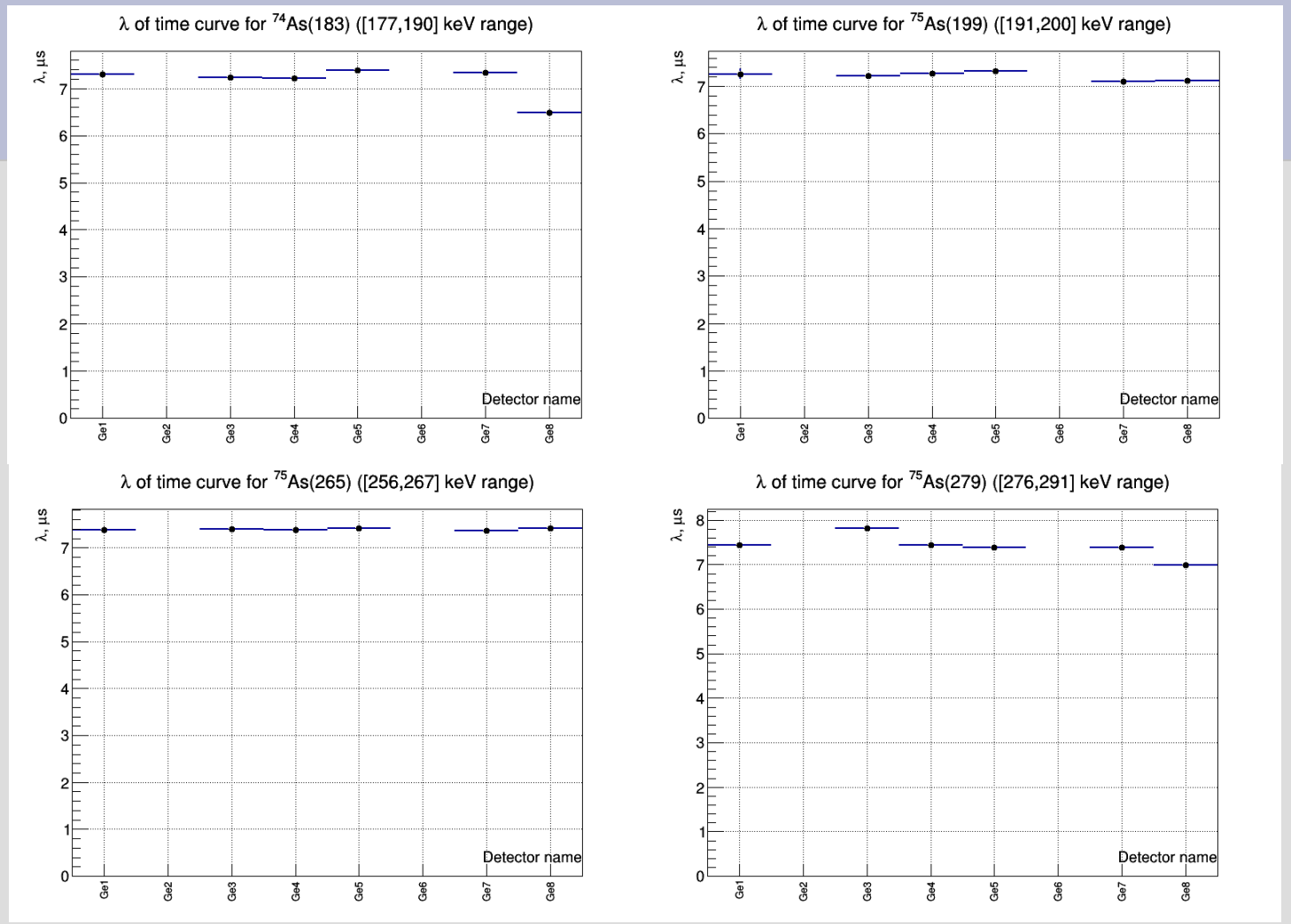








^{76}Se: results of exp(-λt) fits for all lines&det



Results are consistent with each other

^{76}Se: results of exp(-λt) fits for all lines&det

Gamma lines	Detector	Aver. muon lifetime	
		Value	Error
74As (183 keV)	Ge1	136,84	0,89
	Ge3	138,14	0,73
	Ge4	138,5	0,77
	Ge5	135,36	0,68
	Ge7	136,31	0,75
	Ge8	154,08	0,59
75As (199 keV)	Ge1	137,7	2,19
	Ge3	138,62	0,95
	Ge4	137,36	0,99
	Ge5	136,63	0,86
	Ge7	140,78	0,99
	Ge8	140,51	0,74

Gamma lines	Detector	Aver. muon lifetime	
		Value	Error
75As (265 keV)	Ge1	135,46	0,9
	Ge3	135,13	0,62
	Ge4	135,57	0,64
	Ge5	134,72	0,55
	Ge7	135,76	0,65
	Ge8	134,95	0,48
75As (279 keV)	Ge1	134,49	1,12
	Ge3	128,02	0,73
	Ge4	134,29	0,85
	Ge5	135,29	0,75
	Ge7	135,48	0,78
	Ge8	143,24	0,4

Average muon lifetime in ^{76}Se: λ = 137.2(3) ns

Previous results

- **Tension with $\lambda = 137.22(3)\ \mu s^{-1}$ (this work) vs. published value $\lambda = 148.5(1)\ \mu s^{-1}$: difference is much bigger than the standard errors, so some systematics is here…**

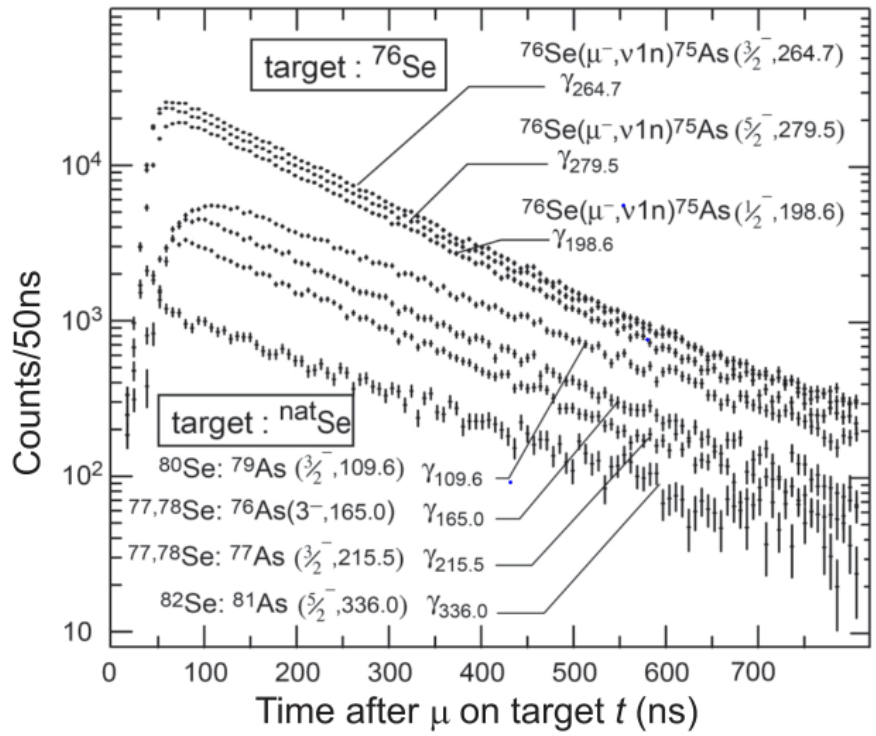


FIG. 11. Evolution of γ lines intensity with time after μ stop in Se targets. The figure shows two separate measurements, one with an enriched ^{76}Se target (top graphs) and one with a natural Se target. In the latter the main components of the initial Se isotopes are indicated. The identification is based on the different lifetimes and the isotopic abundances. The deterioration of the time resolution below ≈200 keV γ-ray energy is clearly observed.

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Ordinary muon capture studies for the matrix elements in $\beta\beta$ decay

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^{76}Se	^{75}As	198.6	148.4(7)	
		264.7	148.4(5)	
		279.5	148.6(5)	
	^{74}As	183.0	148.5(13)	
*			⟨⟩ = 148.48(10)	6.300(4)

Conclusion

- **The muon life time in 76-Se has been estimated for 4 g-lines followed the OMC. Results are consistent between the lines & detectors.**
- **Result obtained with $\lambda = 137.22(3)\ \mu s^{-1}$ (this work) vs. published value $\lambda = 148.5(1)\ \mu s^{-1}$: difference is much bigger than the standard errors, so some systematics is here… .**
- **Analysis with C-counters (Michel electrons) is on the way.**