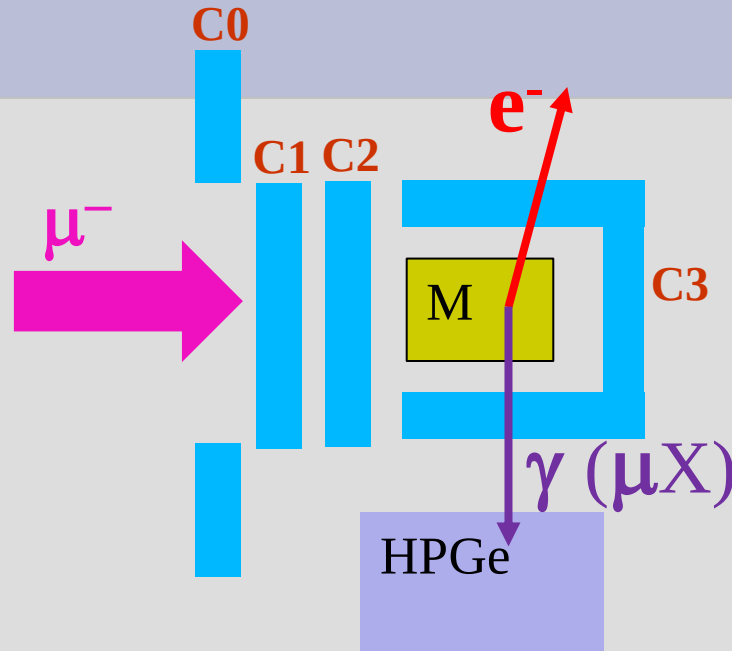


# **Analysis of total capture rate in $^{76}\text{Se}$ using Michel electrons from decay of muon (DoM)**

**Yu.Shitov**

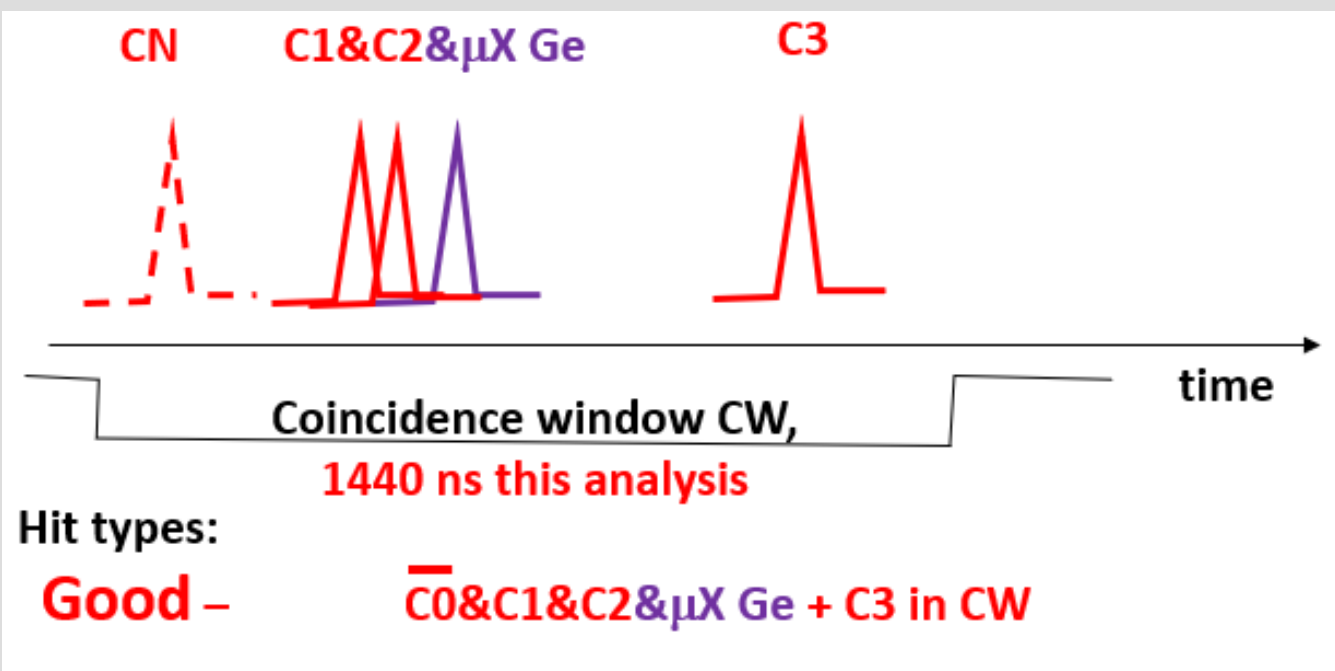
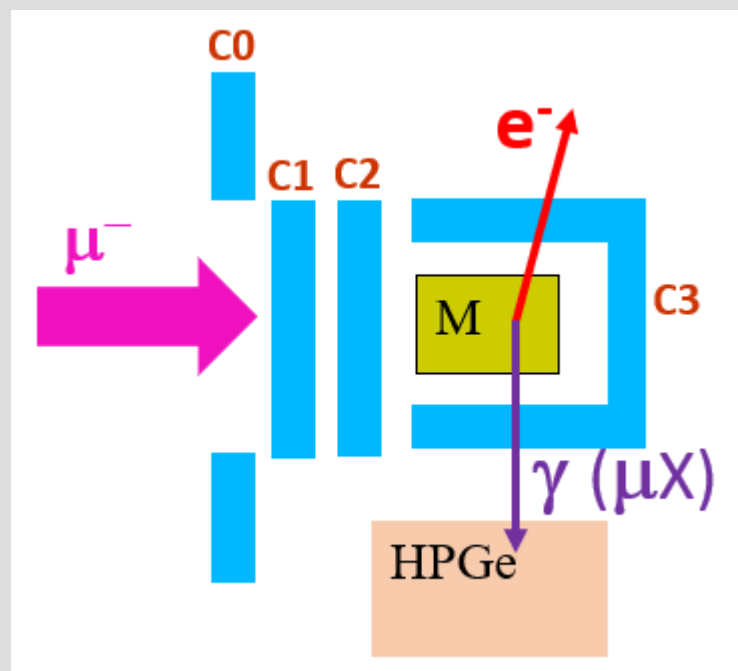
# Decay of muon



- Muon counter C3 registers Michel electrons followed decay of muon (DoM) - process opposite to OMC.
- The intensity of DoM vs. mu-stop follows lifetime curve of muon in target material M.
- Analysis of time curve of DoM is independent way to measure lifetime of muon (LoM) in target material and alternative to determination of LoM in OMC.
- Determination of LoM in target in both, DoM and OMC is a good way to obtain more robust result

# Data processing

- We are using DUBNA trees (code e\_time.C & etime\_fit.C adapted from g\_time.C & gtime\_fit.C)
- Looking into single muon stop in target  $\bar{C0\&C1\&C2}$  + characteristic  $\mu X$  rays of the element studied.



# Analyzed types of events

- 1 - **Good**: event with 1 C1 hit (single muon stop) in CW before C3 hit (Michel e).
  - 2 - **Multiple**: > 1 C1 hits in CW before C3 hit. **Absent as deadtime of counter = CW!**
  - 3 - **Flagged**: like good, but WAS non-zero flag(s) in C1 and/or C3. **Multiple are here!**
  - 4 - **Good0**: like good, but was C0 hit (possible muon) in CW before C3 hit (Mitchel e).
  - 5 -  **$\mu$ XGood**: **Good + Se76  $\mu$ X + C1&C2 + C1&Ge  $\mu$ X – main clean spectrum**
  - 6 -  **$\mu$ XOther**: Multiple/Flagged/Good0 + Se76  $\mu$ X + C1&C2 + C1&Ge  $\mu$ X
  - 7 -  **$\mu$ XNGood**: Good + Se76  $\mu$ X, but no C1&C2 and/or C1&Ge  $\mu$ X
  - 8 -  **$\mu$ XBOther**: Multiple/Flagged/Good0 + Se76  $\mu$ X, but no C1&C2 and/or C1&Ge  $\mu$ X.
  - 9 -  **$\mu$ XAny**: XGood + XOther.
- w/o  $\mu$ X control
- with  $\mu$ X control

plus we have **Uncor** & **Uncor0** types, but they are not analyzed (can't build time spectra for them), just counted in general statistics (shown in next slide).

# Stat by event types

Processsing data file='/monument/data-1/OMC4DBD/tree/tree44480.root' (351/354, 99.

Run time: 181 sec

Mu hits: 28116441 events processed ( 590.445/206269 Mb read in data file/all)

Ge hits: 5253277 events processed ( 322.671/112854 Mb read in data file/all)

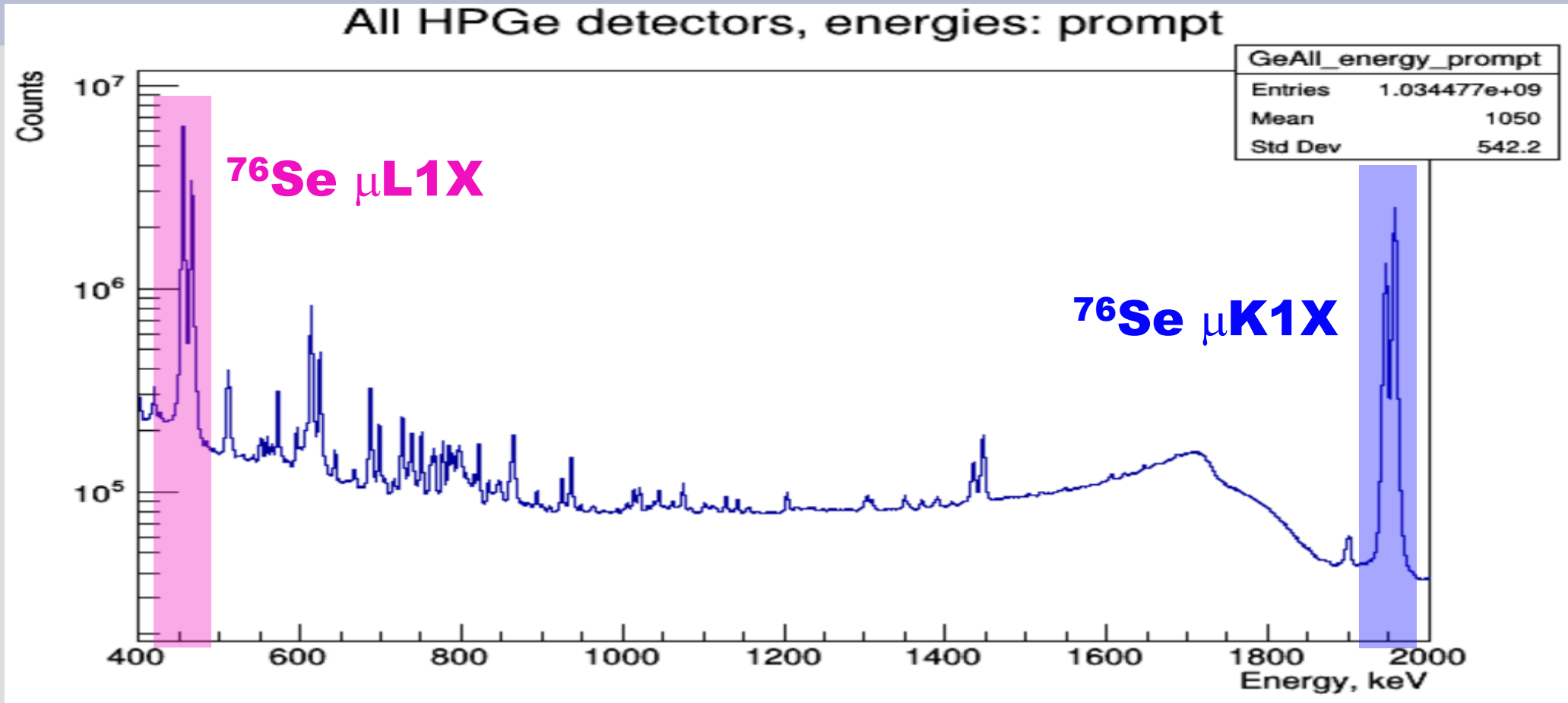
under analysis: all=2049973389: good=676360970 (32.99 %), multiple=0 (0.00 %)  
uncorrelated=932255781 (45.48 %), flagged=262218304 (12.79 %)

uncorrelated0=131670894 (6.42 %), good0=47467440 (2.32 %)

muXGood=8550177 (0.42 %), muXOther=2211265 (0.11 %)

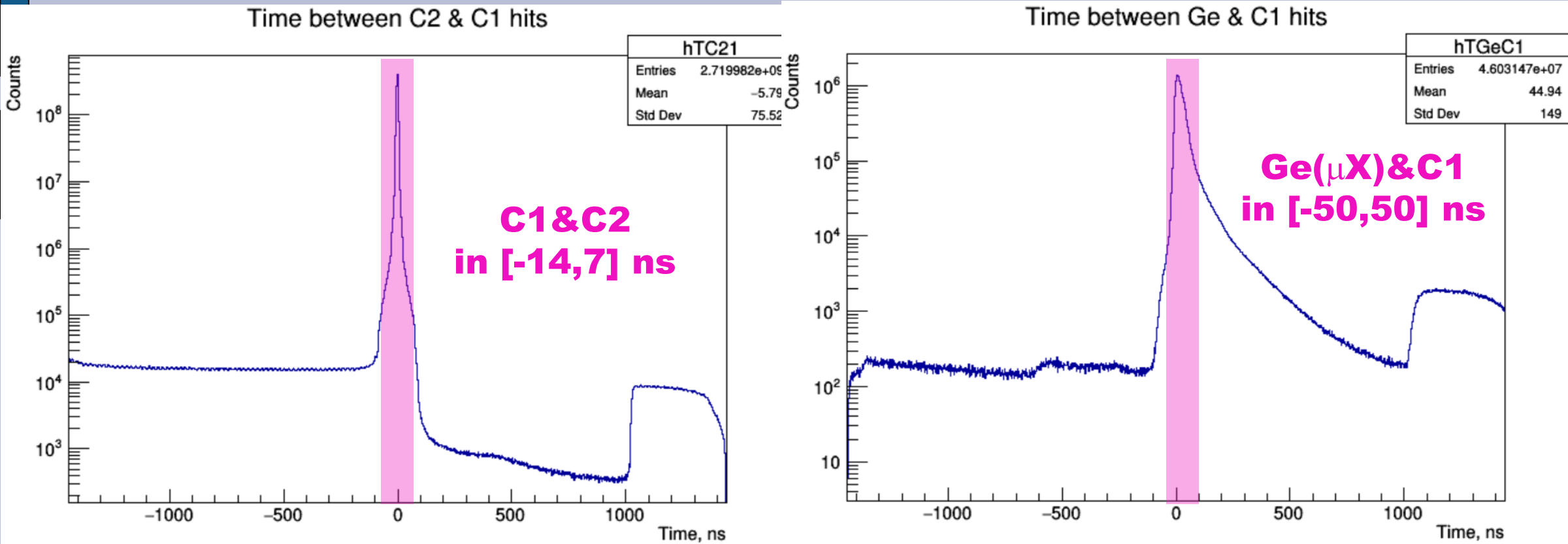
muXNotGood=2888180 (0.14 %), muXBadOther=1457069 (0.07 %)

# $\mu$ X lines used in coincidences

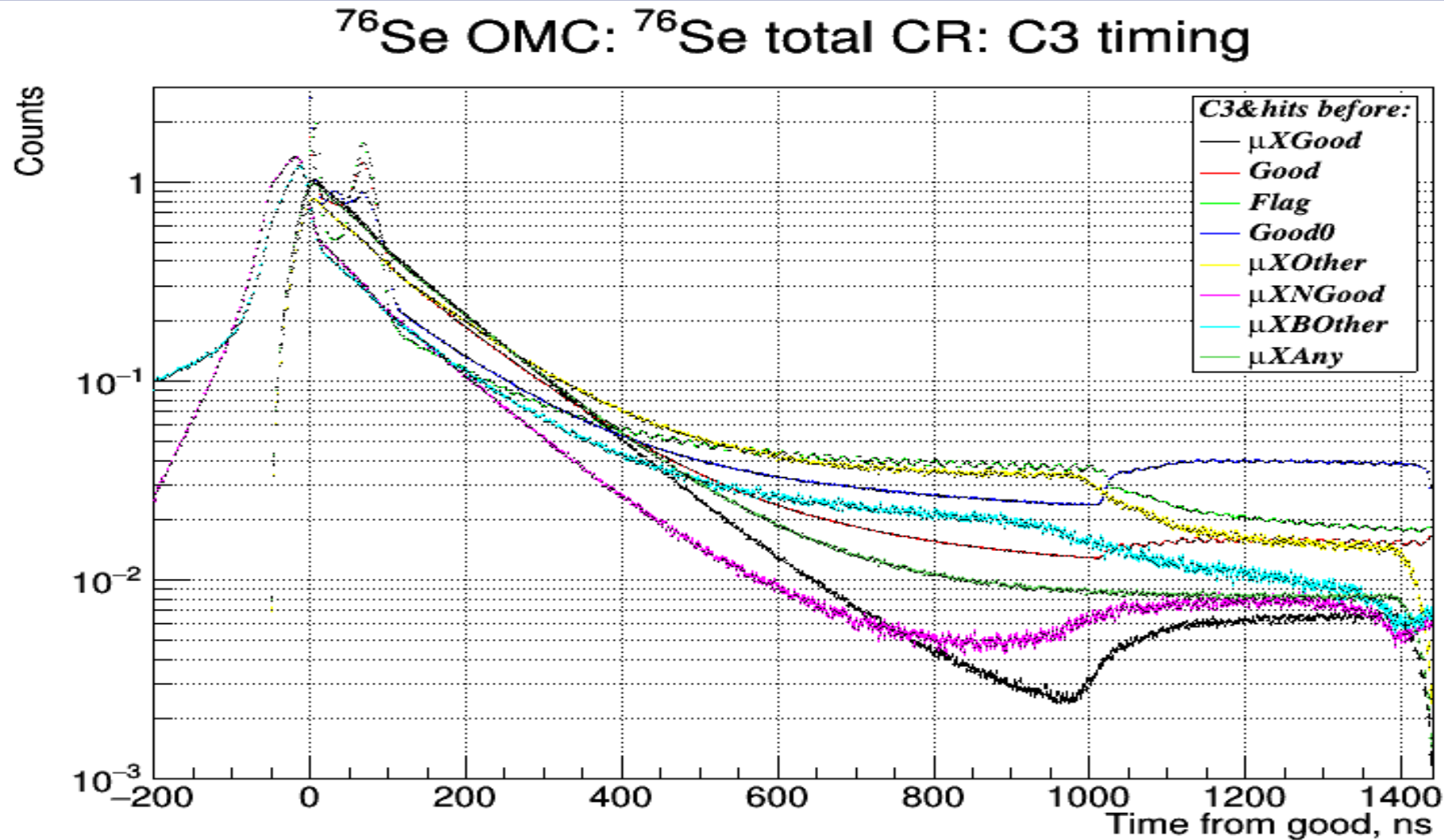


- Se-76  $\mu$ X lines after OMC used for main analysis

# Coincidence cuts controlled for clean events



- C1&C2 are taken in [-14,7] ns and Ge( $\mu$ X)&C1 in [-50,50] ns
- Ge2 and Ge6 data **were excluded** due to **t0 reconstruction problem**.

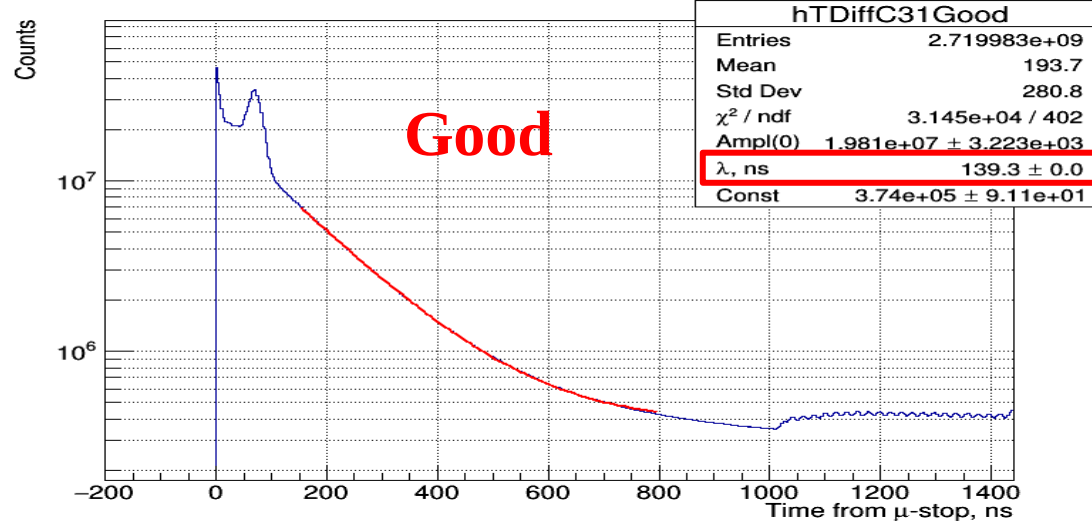


# Defining $\lambda_{TOT}$ : method

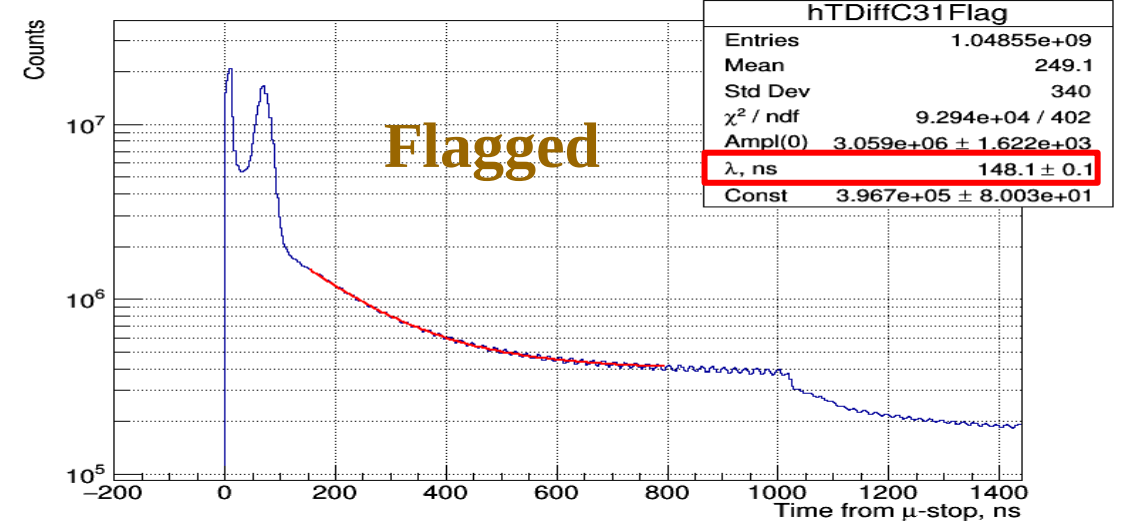
- Fit of time distributions of different event types by function  $f = A \cdot \exp(-x/\lambda) + C$ , where the exponent is contribution from DoM.

# Defining $\lambda_{TOT}$ 4 different event types

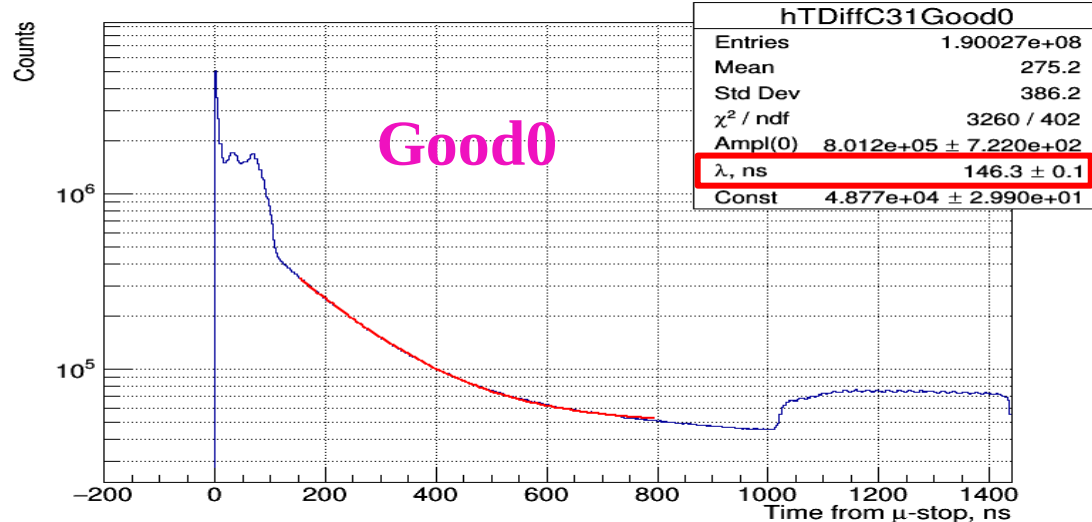
Timing: 1  $\mu$ -stop (C1) in 1  $\mu$ s before C3



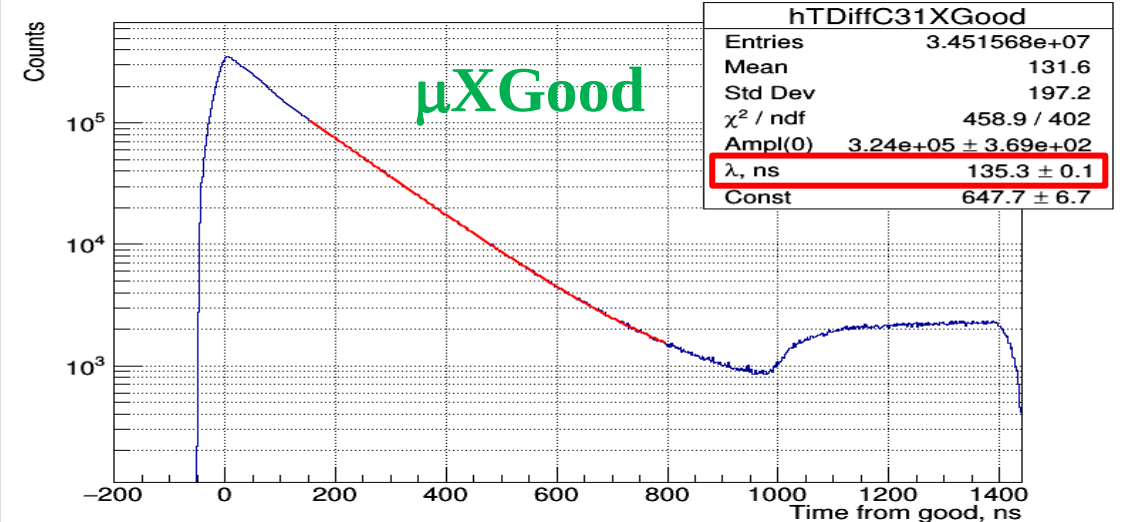
Timing: 1(+Flag)  $\mu$ -stop (C1) in 1  $\mu$ s before C3



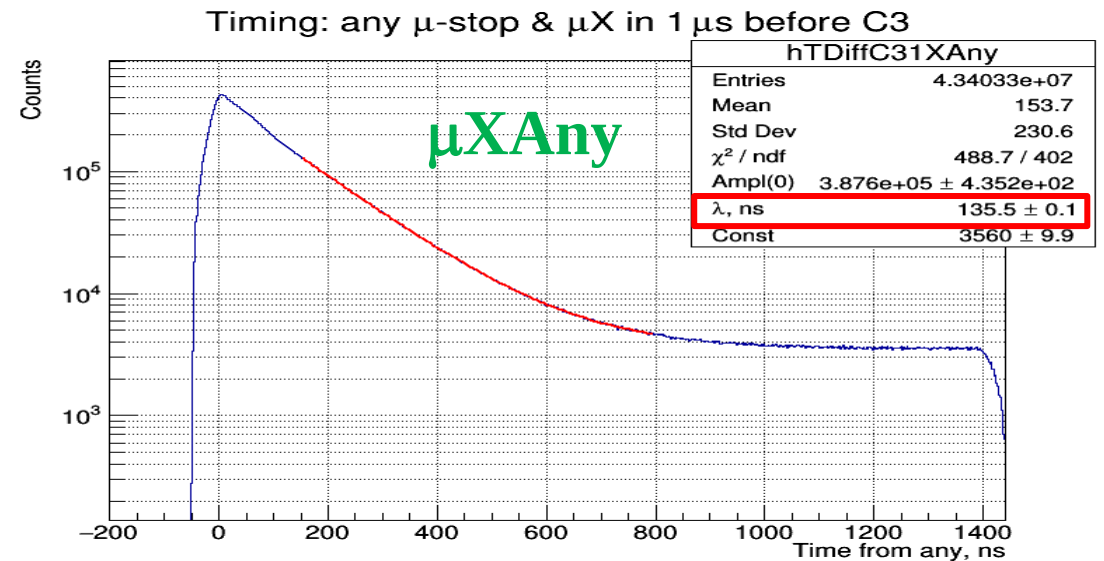
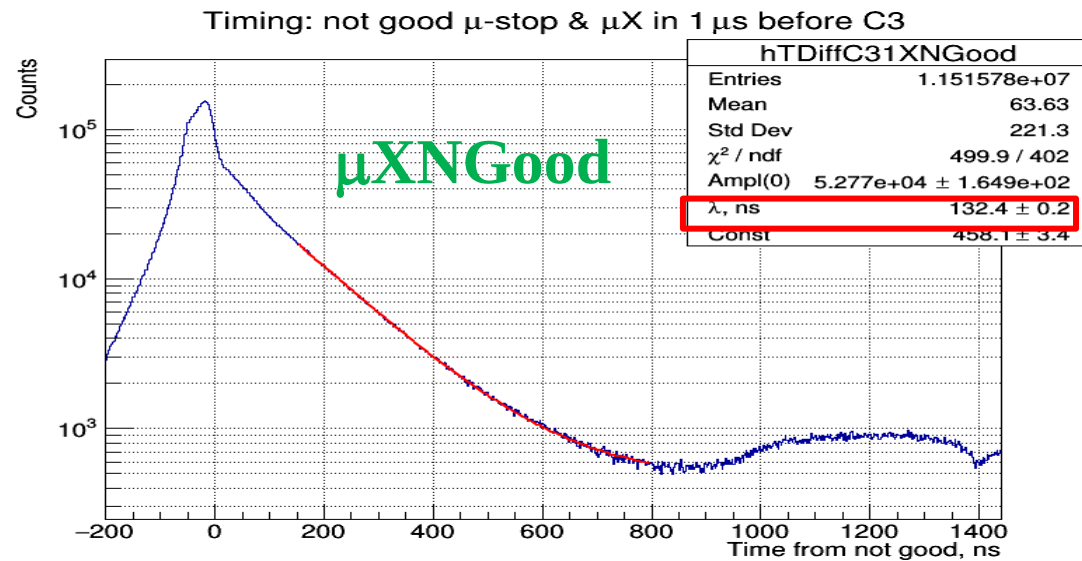
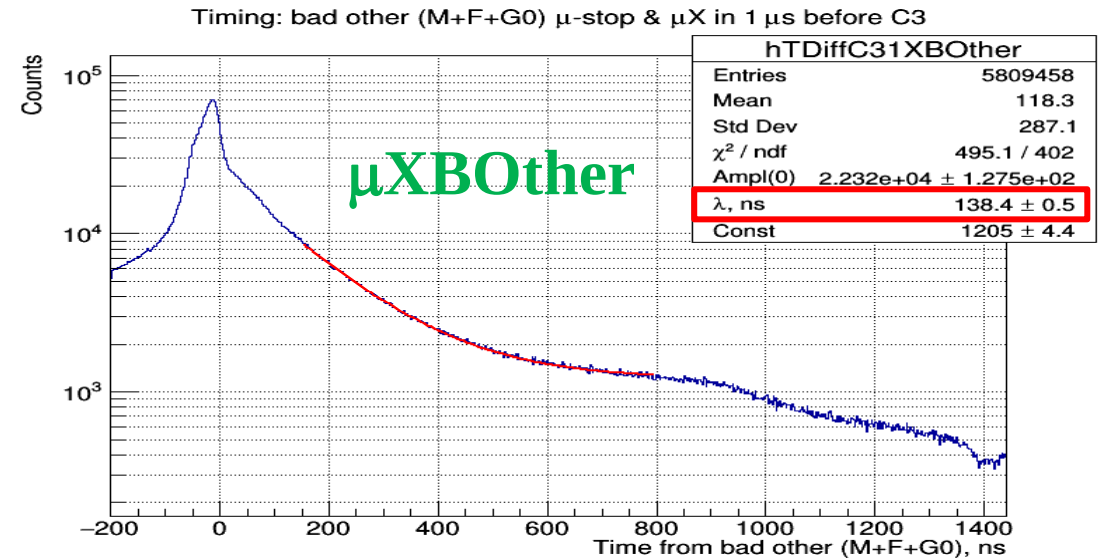
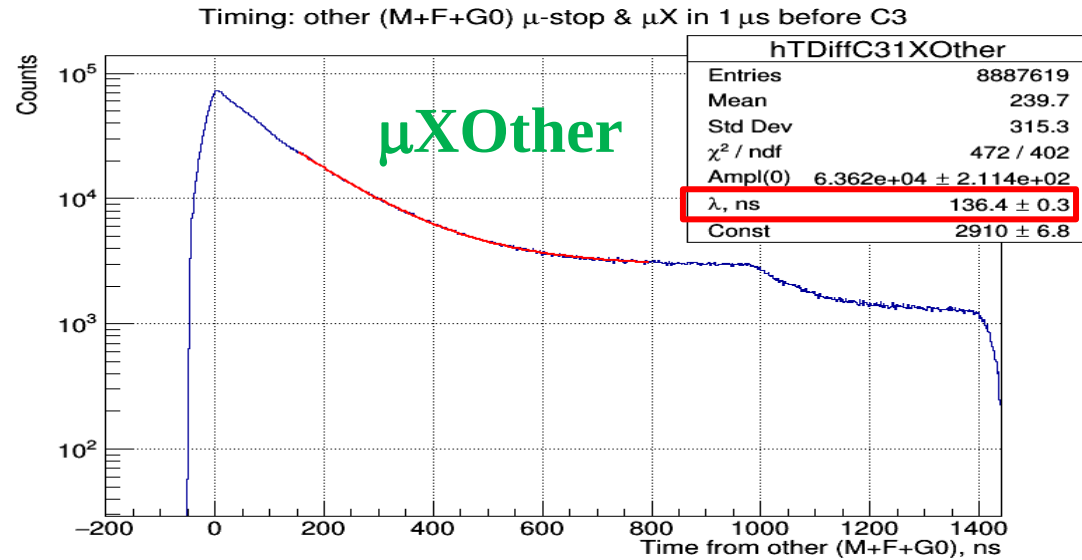
Timing: 1(+C0 hit)  $\mu$ -stop (C1) in 1  $\mu$ s before C3



Timing: good  $\mu$ -stop &  $\mu$ X in 1  $\mu$ s before C3



# Defining $\lambda_{TOT}$ 4 different event types



# Results

| Event type   | Lambda        |             |
|--------------|---------------|-------------|
|              | Value         | Error       |
| Good         | 139,28        | 0,01        |
| <b>Flag</b>  | <b>148,06</b> | <b>0,06</b> |
| <b>Good0</b> | <b>146,25</b> | <b>0,09</b> |
| <b>XGood</b> | <b>135,33</b> | <b>0,09</b> |
| XOther       | 136,37        | 0,29        |
| XNGood       | 132,40        | 0,23        |
| XBOther      | 138,43        | 0,51        |
| XAny         | 135,49        | 0,09        |

Results from  $\gamma$ -line analysis:  
 **$\lambda = 137.2(3)$  ns** (w/o 2,6 detectors), and **136.0 ns** (w/o 2,6,8 detectors).

# Conclusion

- Method to define total muon capture rate in  $^{76}\text{Se}$  by Michel electrons (DoM) in C3 in coincidence with  $\mu\text{X}$  in HPGe-detectors has been realized.
- Results obtained from this DoM method and the analysis of time evolution of  $\gamma$ -lines followed OMC are in perfect agreement  $\lambda = 135\text{-}136\text{ ns}$ .
- Characteristic behavior with  $\lambda = 146\text{-}148\text{ ns}$  (close to previous result) was observed for events with multiple mu-stops in the targets (Flagged & Good0).
- From the performed analyses, it can be assumed that the reason for the discrepancy between the current and previous published results is **the uncontrolled contribution from events with multiple muon stops in the target in the previous experiment.**