Analysis of total capture rate in ^{136}Ba using Michel electrons from decay of muon (DoM)

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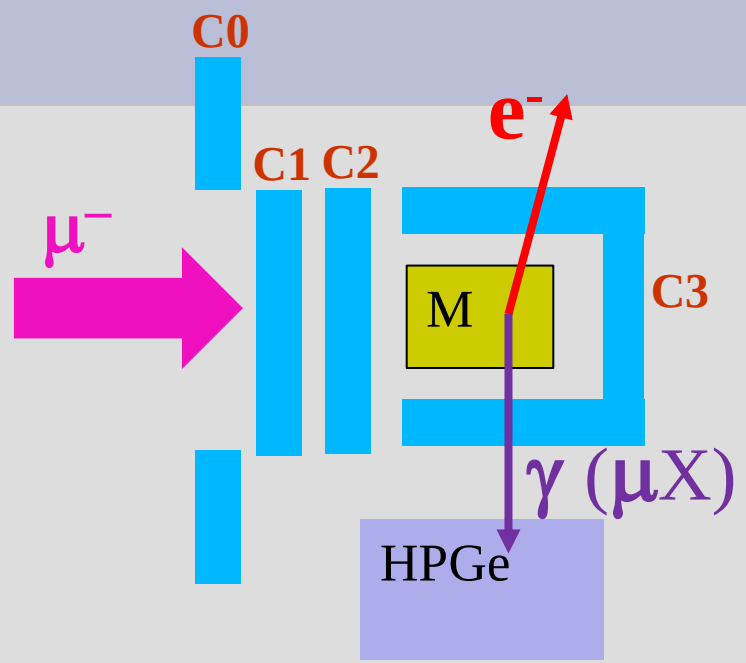
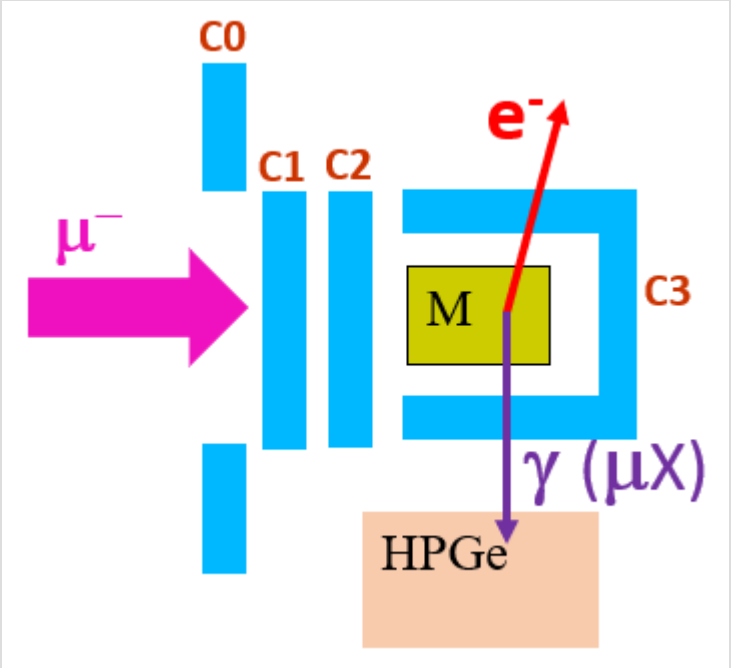
Decay of muon

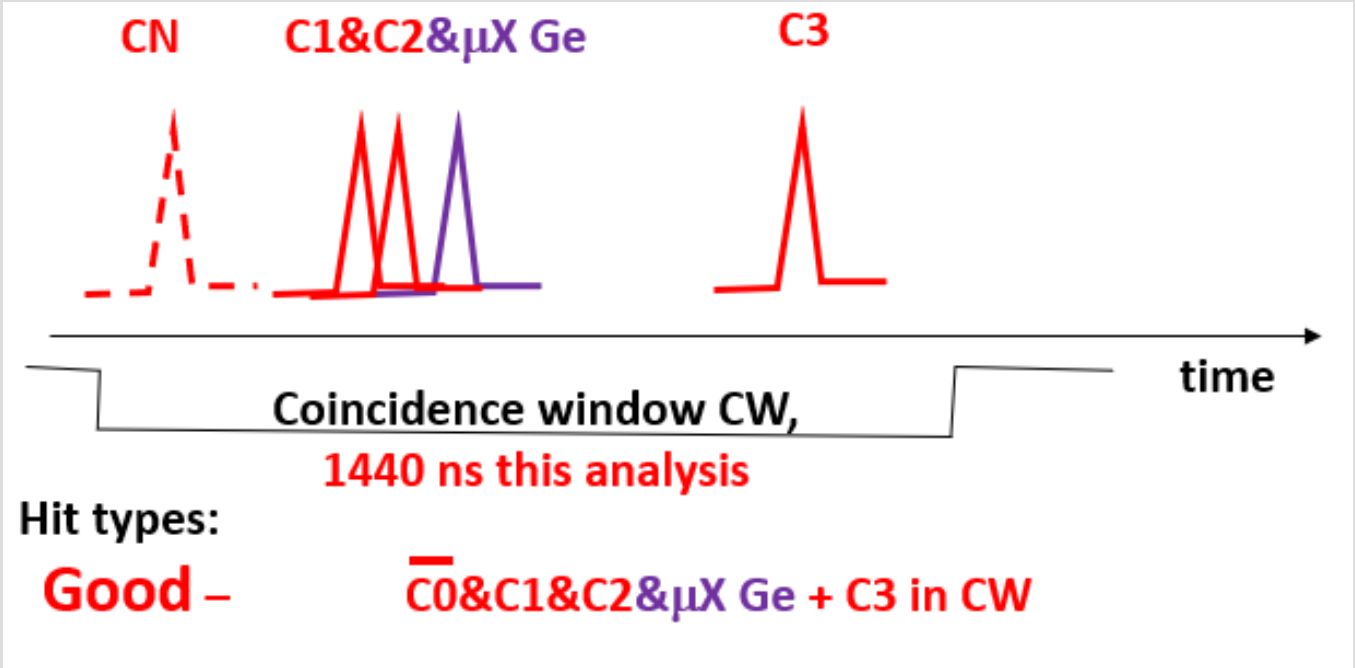


- Muon counter C3 registers Michel electrons followed decay of muon (DoM) - process opposite to OMC.
- The intensity of DoM vs. mu-stop follows lifetime curve of muon in target material M.
- Analysis of time curve of DoM is independent way to measure lifetime of muon (LoM) in target material and alternative 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 $\overline{C0}$&C1&C2 + characteristic μX rays of the element studied.





Type of C3 hits

- **μ-stops are analyzing separately in C0 and C1 counters. Set of C3 types:**

// mu counters are processing separately
// CN&ge-hits & C3 hits coincidences determined with C1 entrance counter
// while C0 (ring) counter is using as veto
// as a result types of hits were extended to following group IDs:
// 1 - **good**: events with single muon in C1 in CW
// 2 - **multiple**: multiple muons in C1 in CW
// 3 - **flagged**: single muon in C1 but non-zero flag(s)
// 4 - **good0**: like 1, but was muon in C0
// 5 – **μXMain**: ge-μX Main line & C3 coincidences
// 6 – **μXOther**: ge-μX Other lines & C3 coincidences
// 7 – **μXGood**: ge-μX Main line & C3 coincidences in **good** event + **C1&C2 in time** + **ge-μX Main line & C1 in time**.
// 8 – **μXNGood** : ge-μX Main line & C3 coincidences in **good** event, but ge-μX, C1, C2 **not** in time.
// plus we have **uncorrelated** & **uncorrelated0** types, but they are not analyzed (can't build time spectra for them), just counted in general statistics (shown in next slide).

General stat of analyzed data

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FINAL STATISTICS: total processed exposure (all runs=26): 5659/1.57 sec/hours
   good processed exposure (runs=26, 100.00 %): 5659/1.57 sec/hours
  Processing speed: inf sec of exposure per CPU sec
  Mu hits:    915234808 events processed ( 19219.9 Mb read)
    C0/C1/C2/C3 counter=185491757/255194643/277555196/196993212 hits
  Ge hits:    127640195 events processed ( 9414.37 Mb read)
    under analysis: all=196993208: good=57406749 (29.14 %), multiple=0 (0.00 %)
                    uncorrelated=98317990 (49.91 %), flagged=22037838 (11.19 %)
                    uncorrelated0=14817034 (7.52 %), good0=4413597 (2.24 %)
                    LX=352305 (0.18 %), KX=178141 (0.09 %)
                    muXGood=180626 (0.09 %), muXNGood=61598 (0.03 %)
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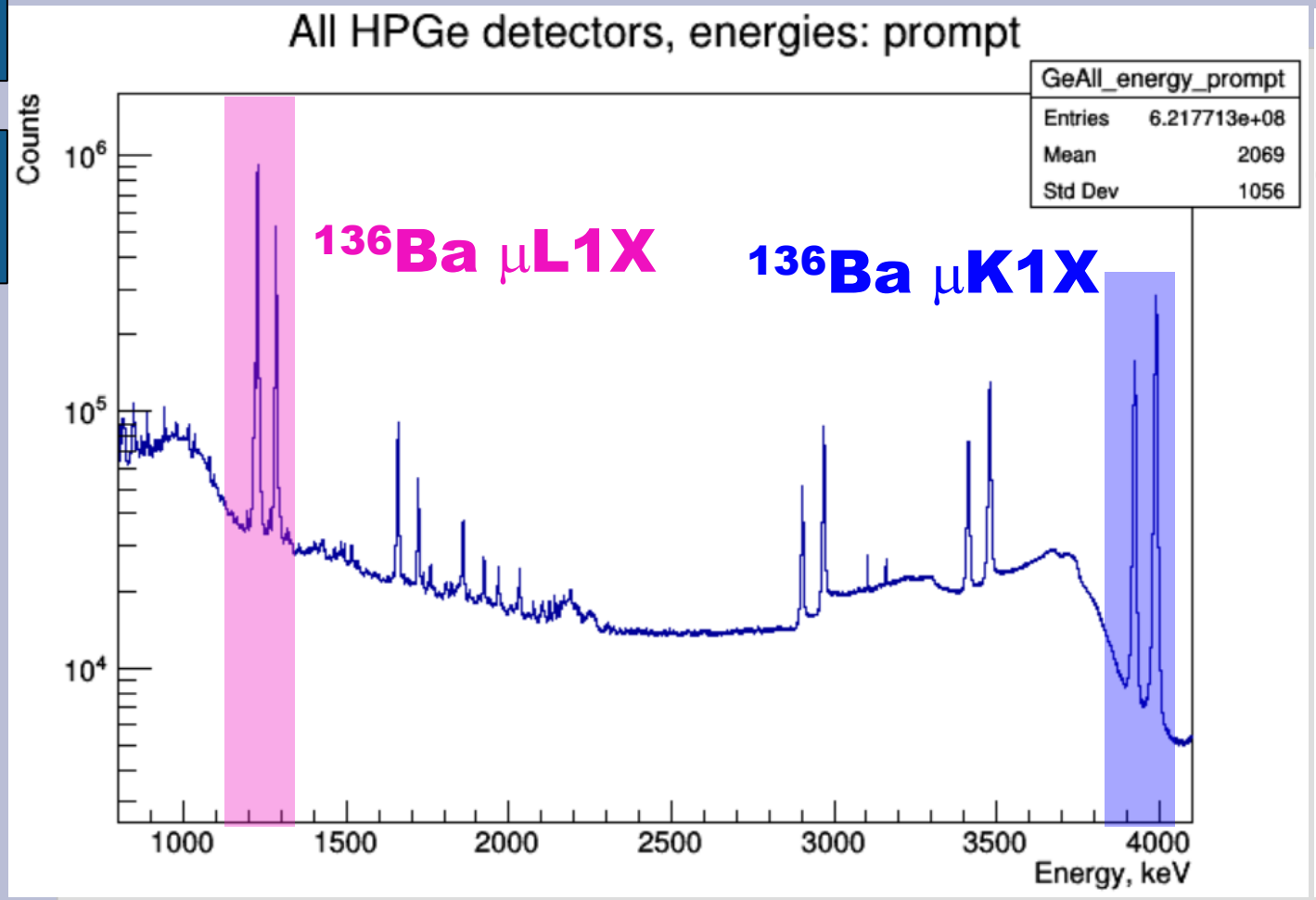
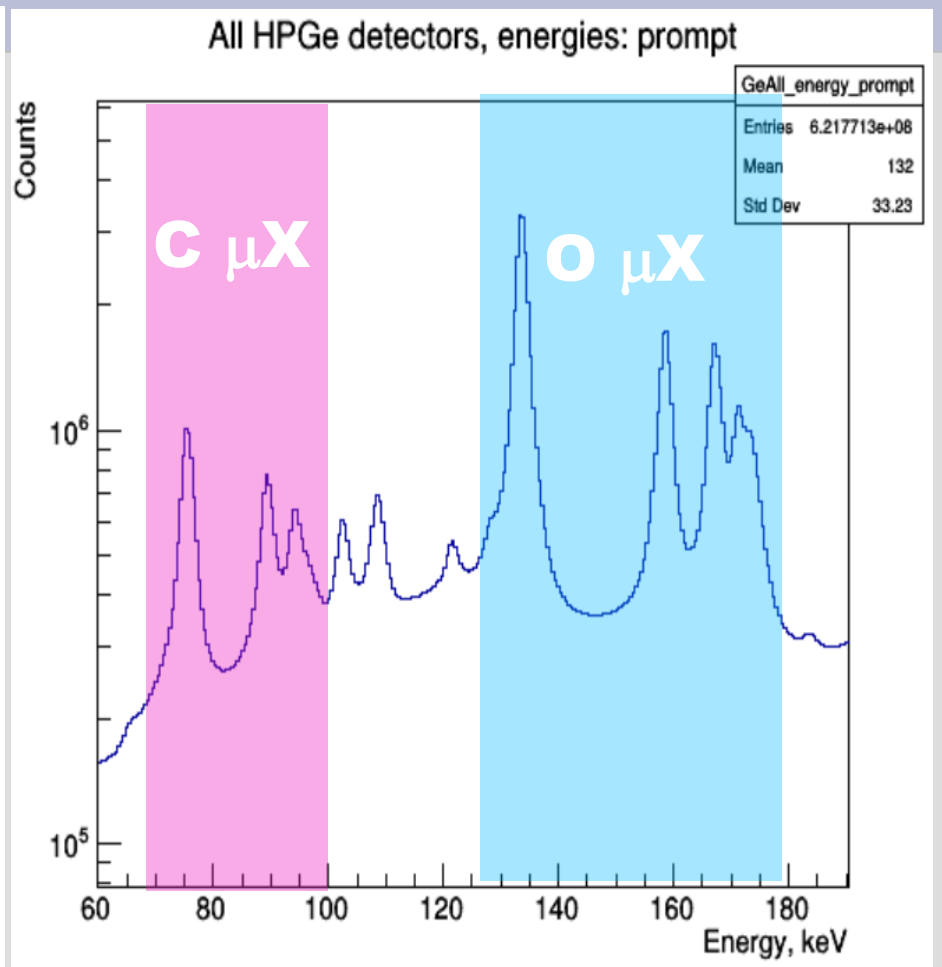
- **Stat on analysis of Ba-136 dataset: analysis of Ba-136 total muon CR.**

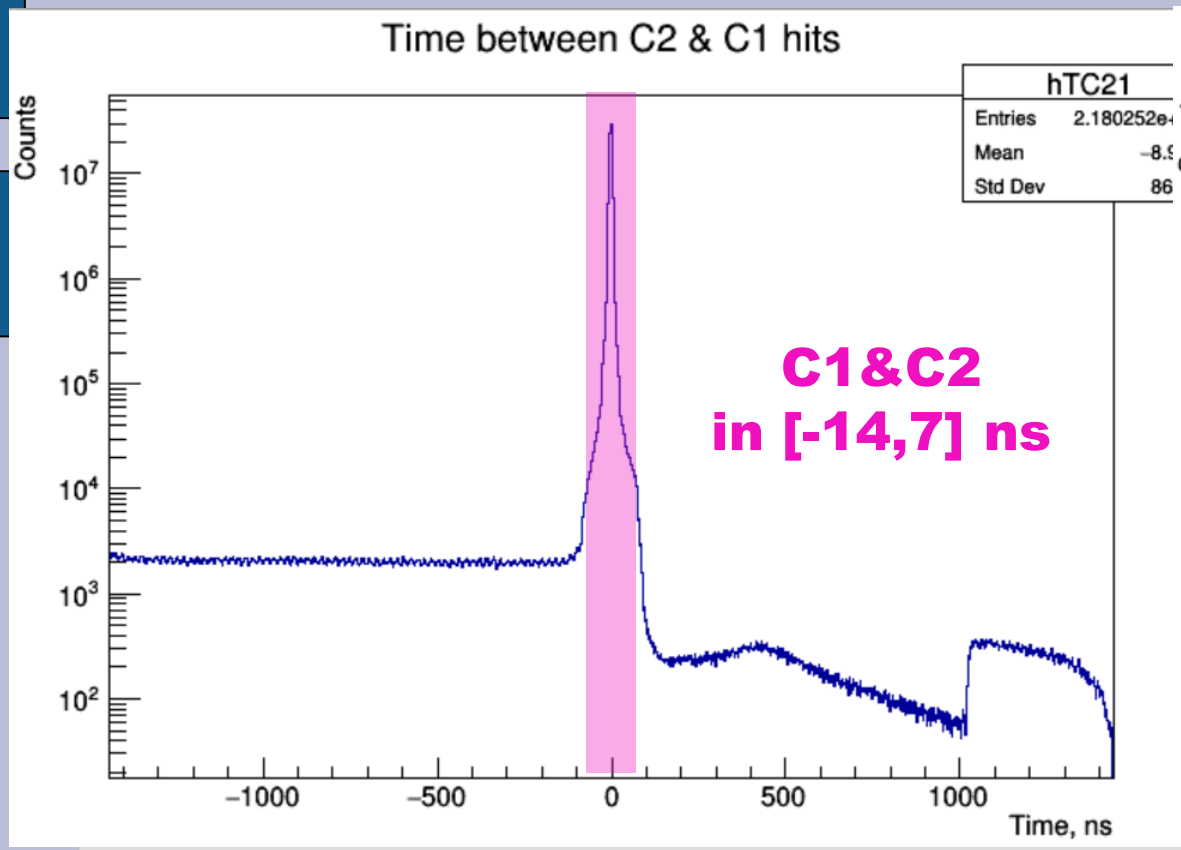
μX lines used in coincidences

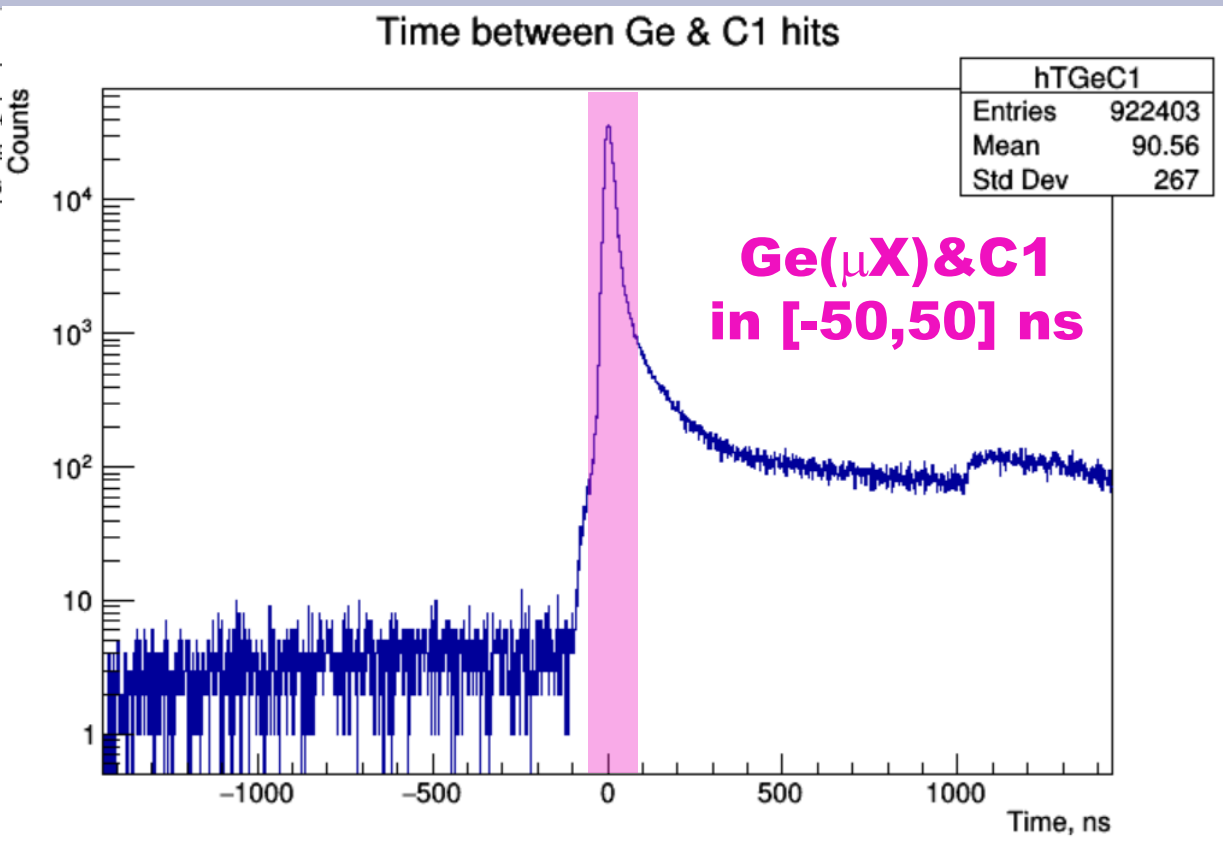




- **Ba-136 lines used for main analysis, while C&O lines – for comparison and method check**

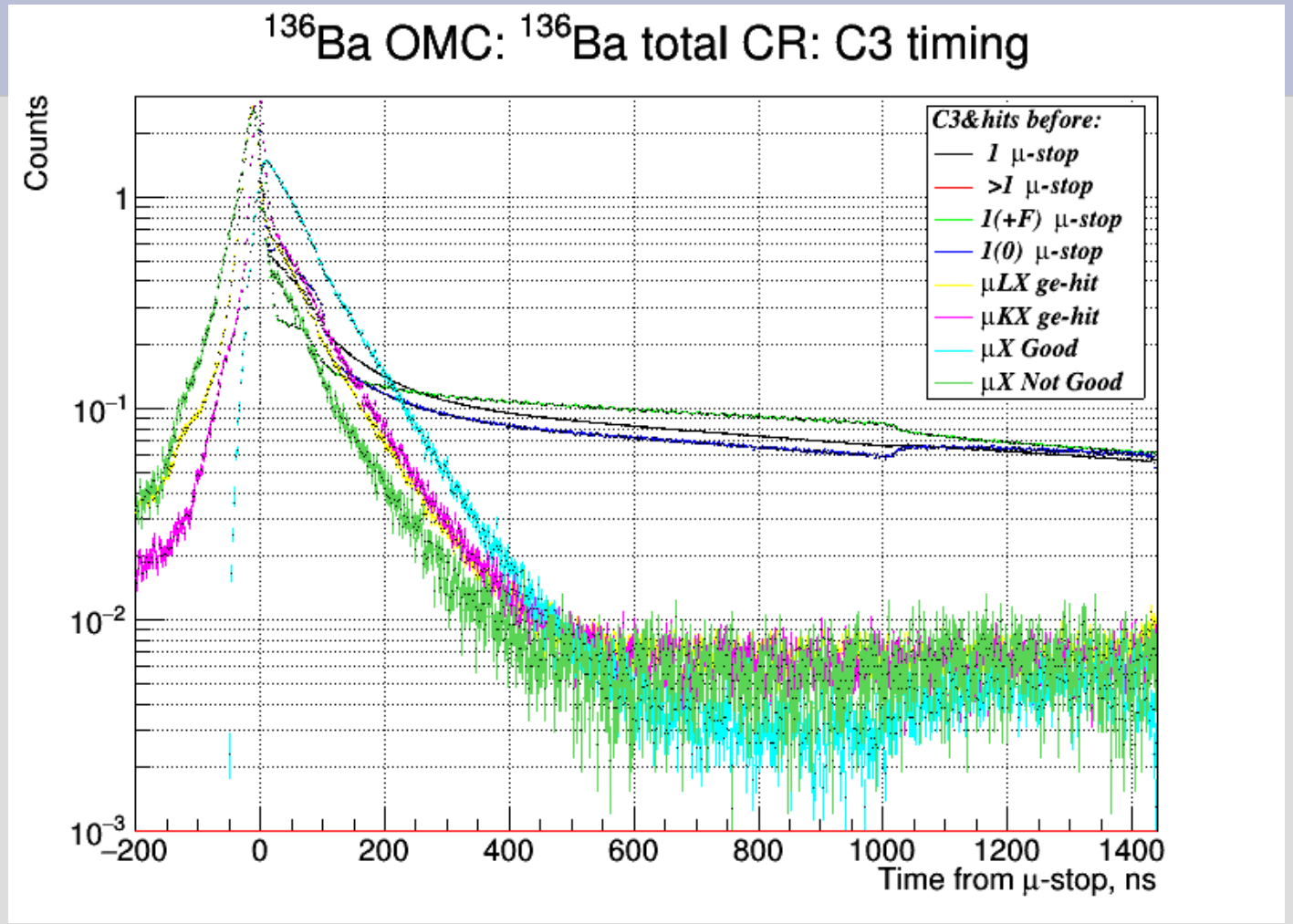
Coincidence spectra & cuts





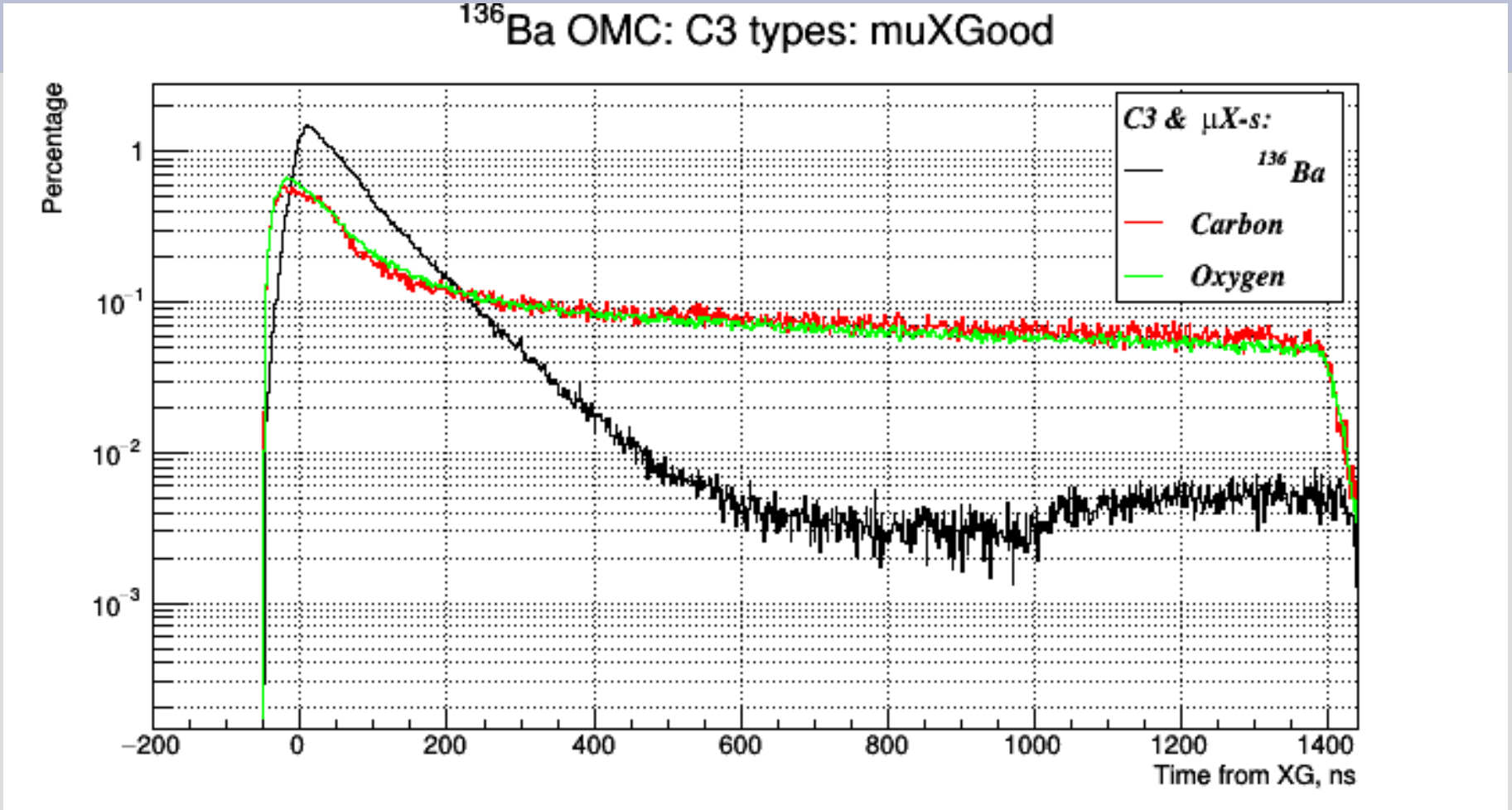
- C1&C2 are taken in [-14,7] ns and Ge(μX)&C1 in [-50,50] ns
- Ge2 and Ge6 data were excluded due to t0 reconstruction problem.

Time curves for different C3 type events



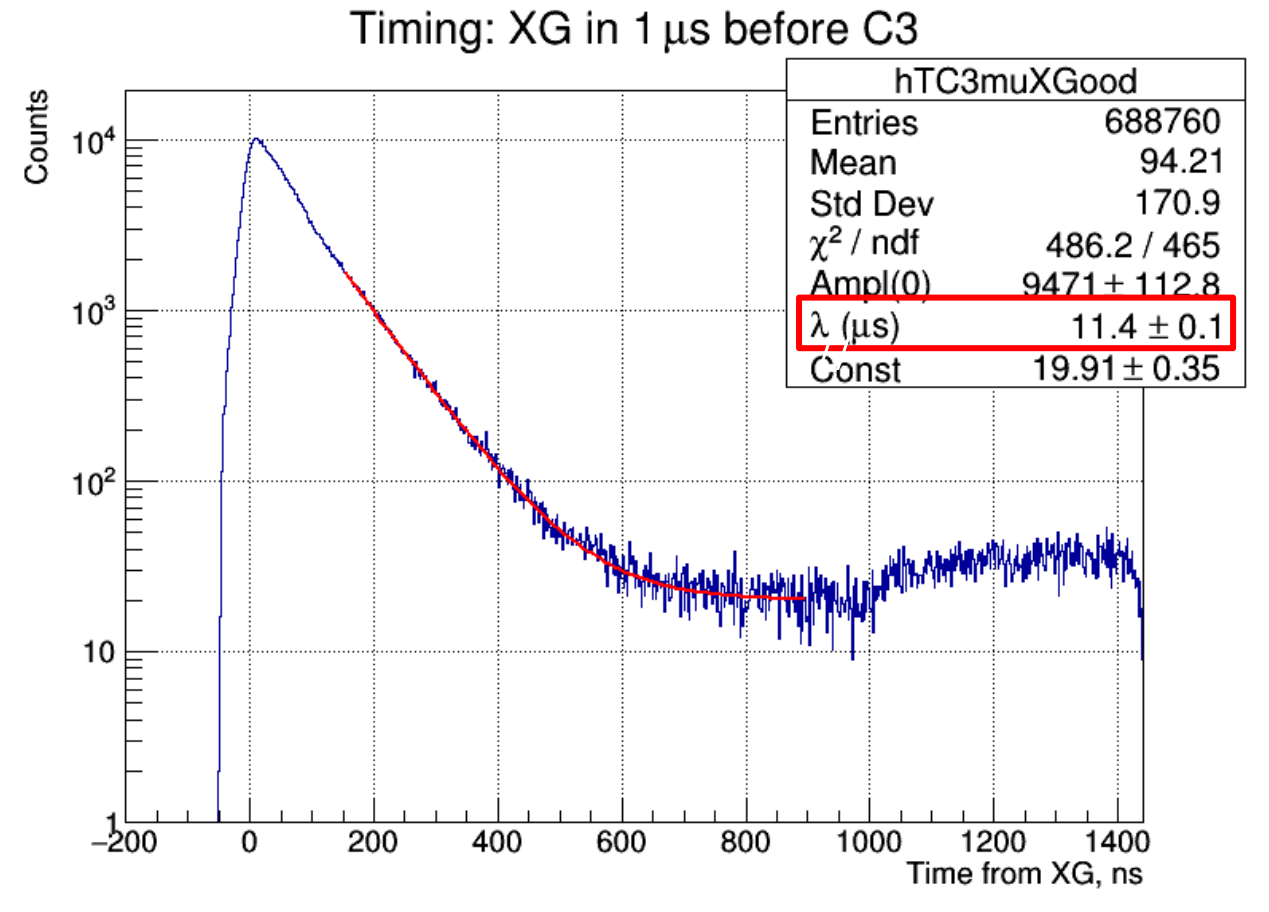
Visible expo tails in coincidences with μX

Time curves for ^{136}Ba, C, and O



Clear difference of muon lifetime in ^{136}Ba vs. C&O.

Defining OMC constant λ



- Fit by function f = exp(-λ*x) + C, where the exponent is contribution from DoM.
- Result λ = 11.4 ± 0.1 μs is in full agreement with result reported in previous analysis from time evolution of γ-lines followed OMC in ^{136}Ba

Conclusion

- Method to define total muon capture rate in ^{136}Ba by Michel electrons (DoM) in C3 in coincidence with μX in HPGe-detectors has been developed and realized.
- Results obtained from this DoM method and the analysis of time evolution of γ-lines followed OMC are in perfect agreement.