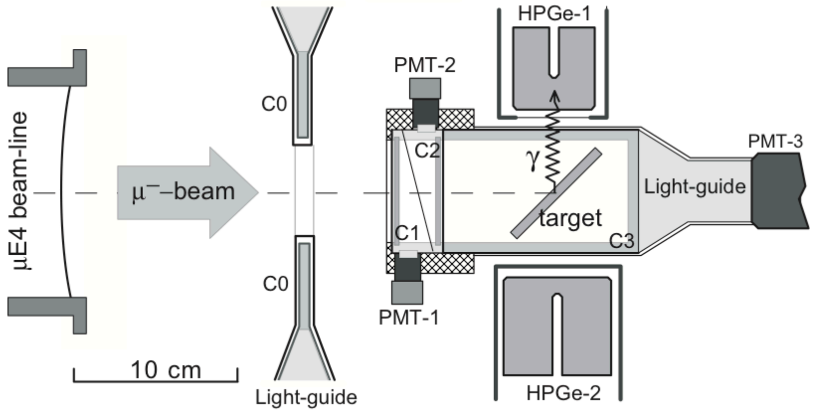
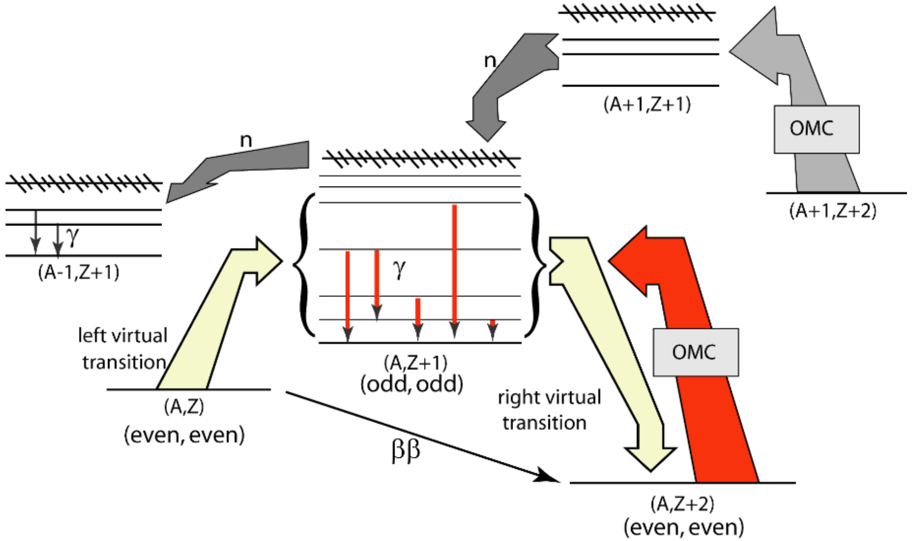
# Raw data analysis of the 2019'PSI campaign with OMC in 24Mg

Igor Zhitnikov

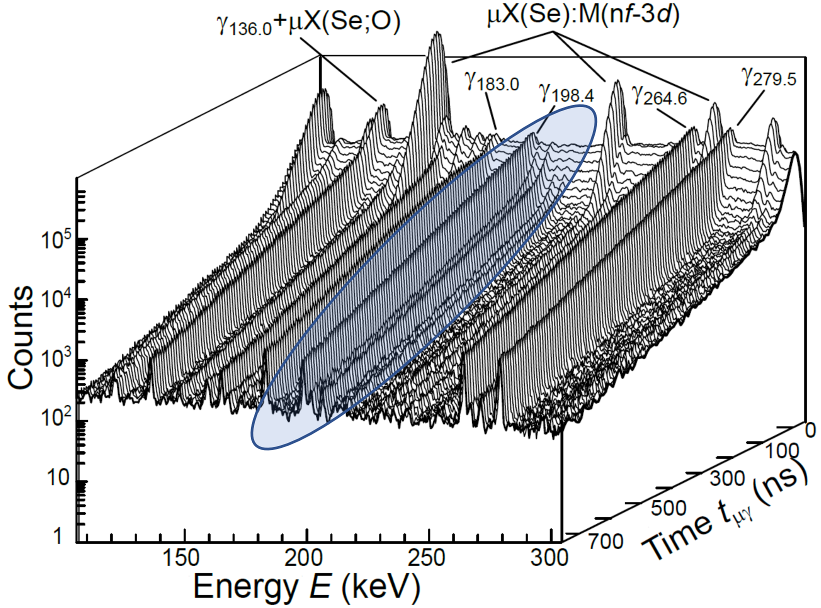
OMC4DBD@20.04.2021

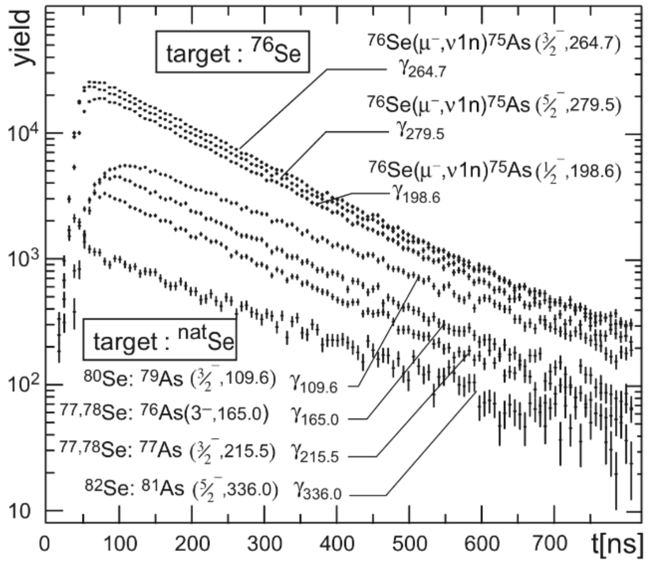
# Experimental method of OMC




**PSI: μE4 beam-line**
**Number of μ-stop = (8 – 25) x 10³ with 20 – 30 MeV/c**

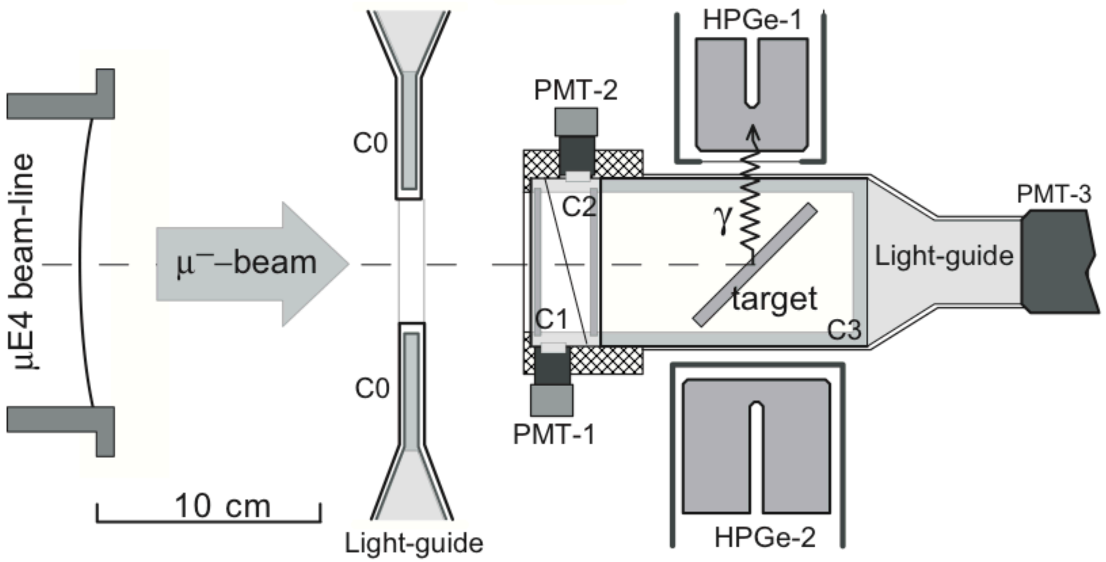



**D. Zinatulina, V. Egorov et al. // Phys. Rev. C 99(2019)024327**

# What do we want to measure ?

- Time and energy from C0, C1, C2 etc (very high rates, short pulses)
- Time and energy (with good resolution) from Ge detectors (high rates, long pulses)



# MIDAS + analyzer

## Pros

- Already exist
- Works
- Already tuned (energy calibration of Ge detectors, time offsets, special algorithm for calculating Ge-event timestamp)

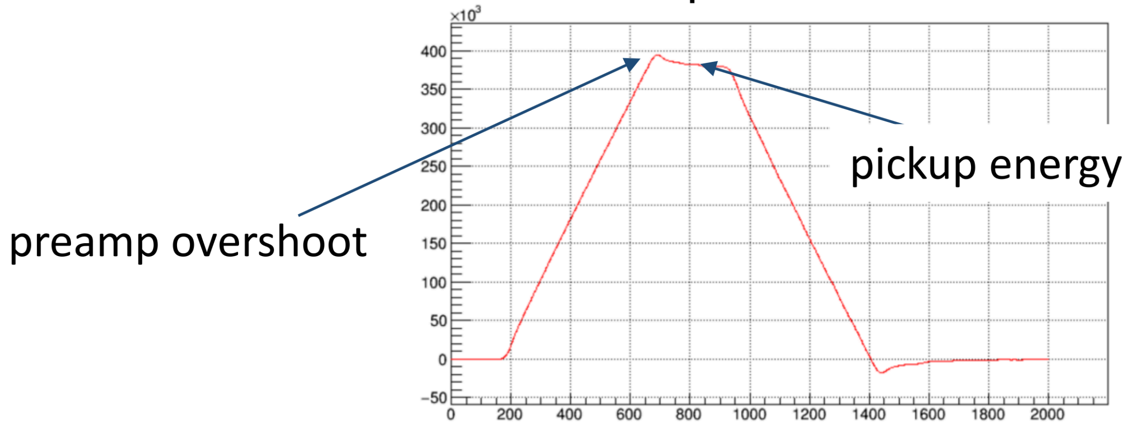
## Cons

- Tuned not for our experiment needs
- Hard to tune from scratch

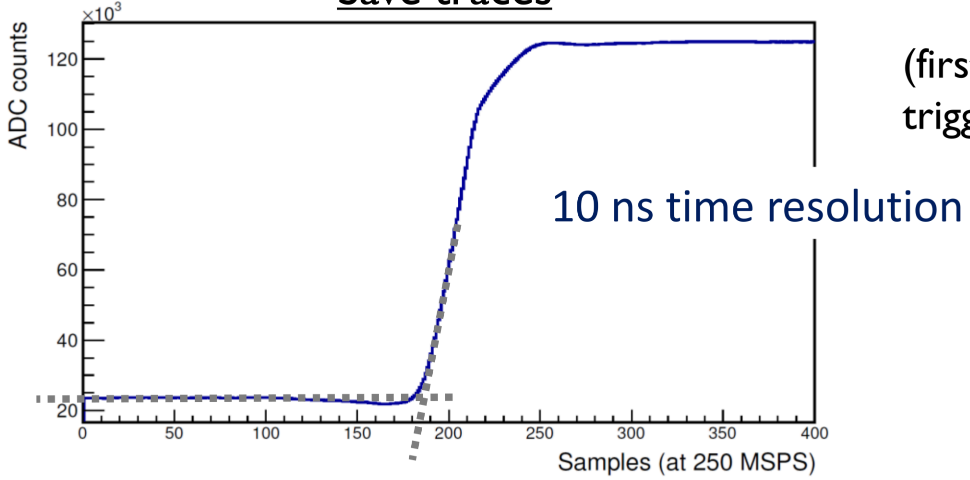
# readout

3 x 250 MHz digitizers (Struck SIS3316)

Trapezoid filter



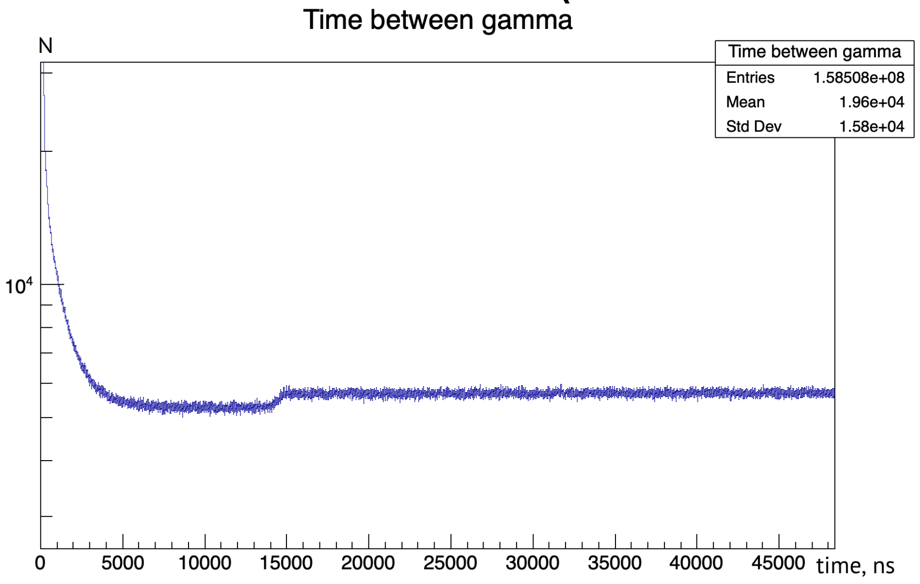

Save traces

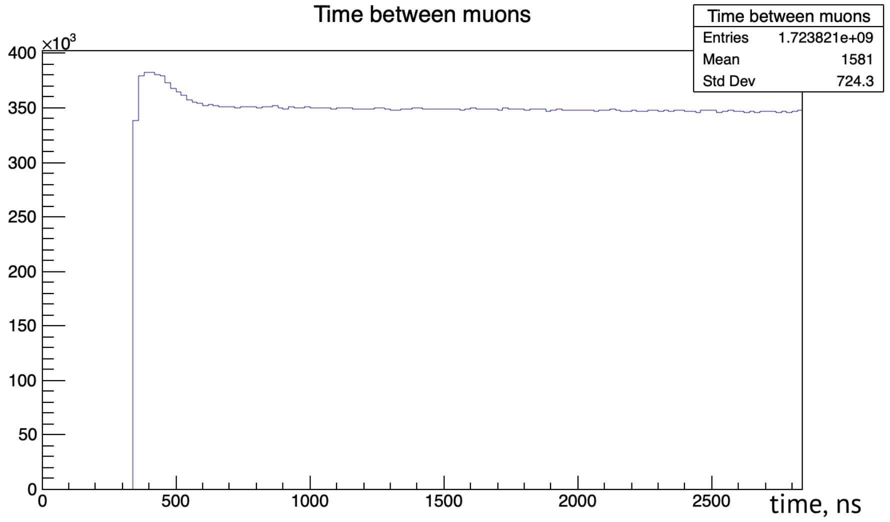


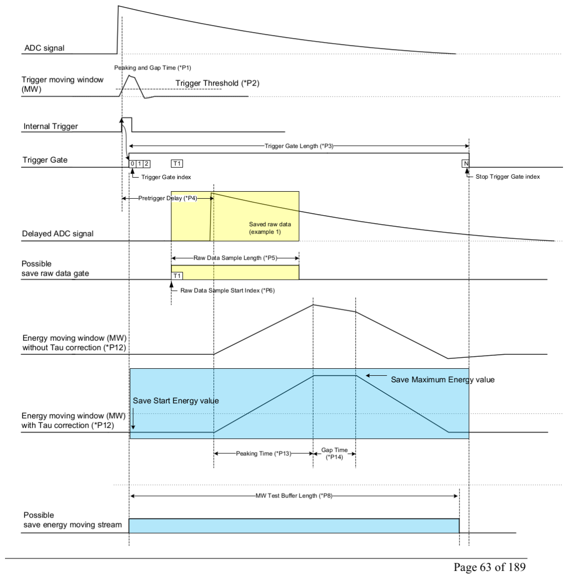

(first order time from trigger filter)

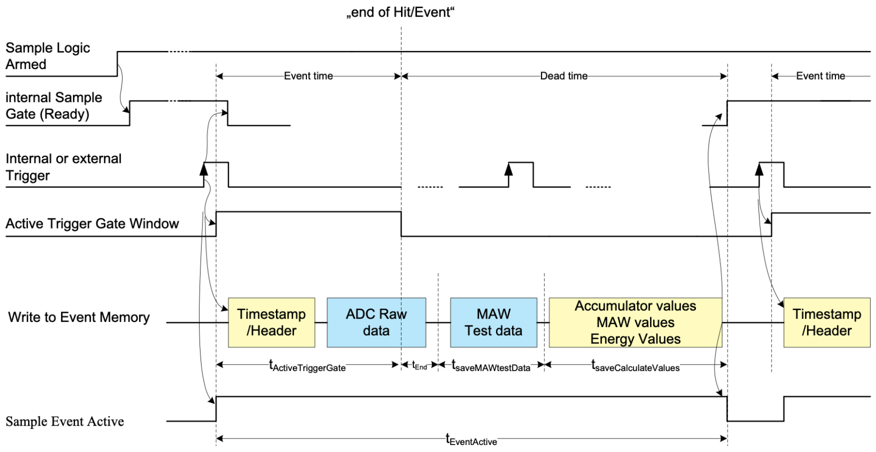
# SIS3316 “effective dead” time

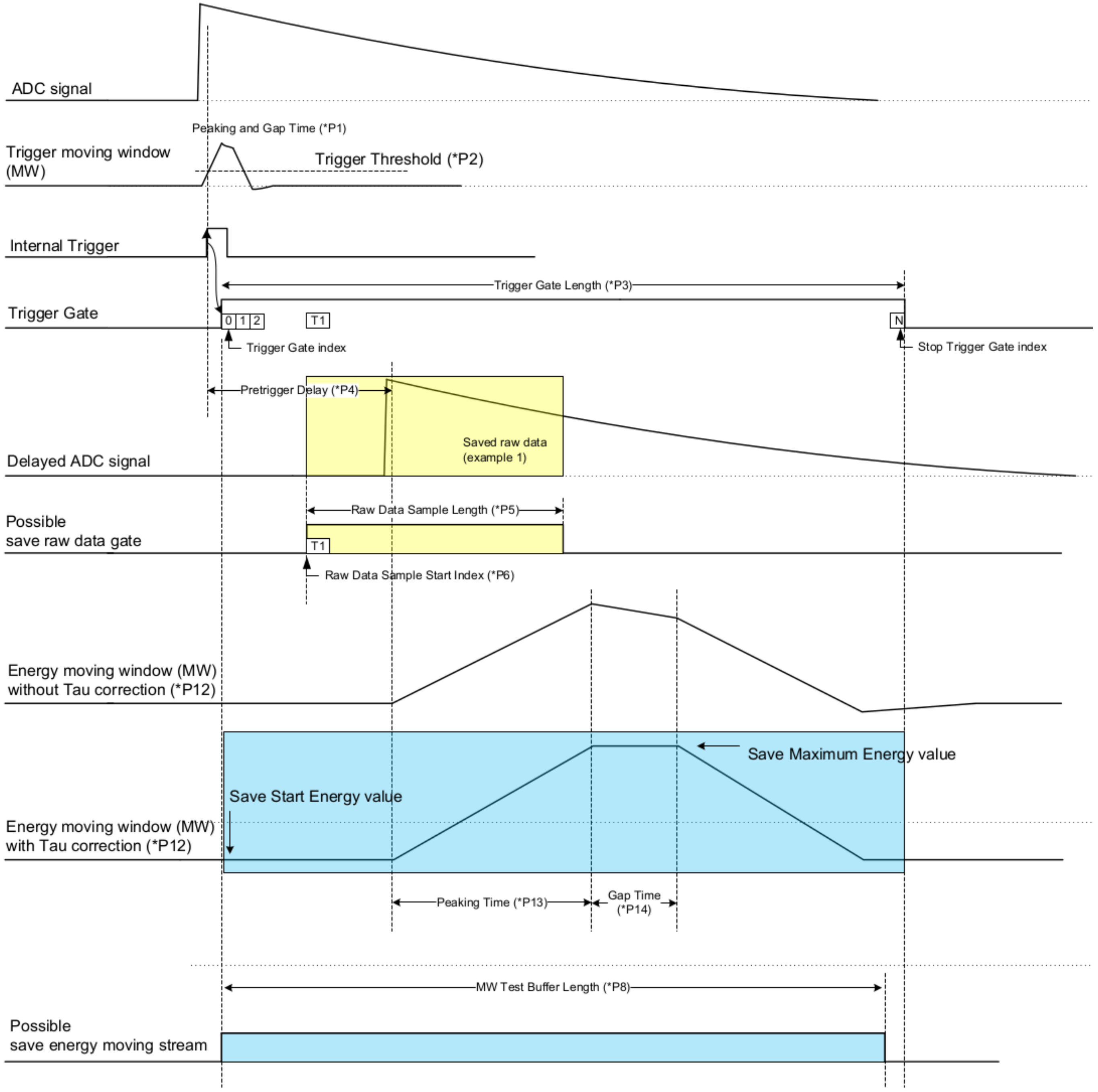
(event active time from SIS3316 manual)

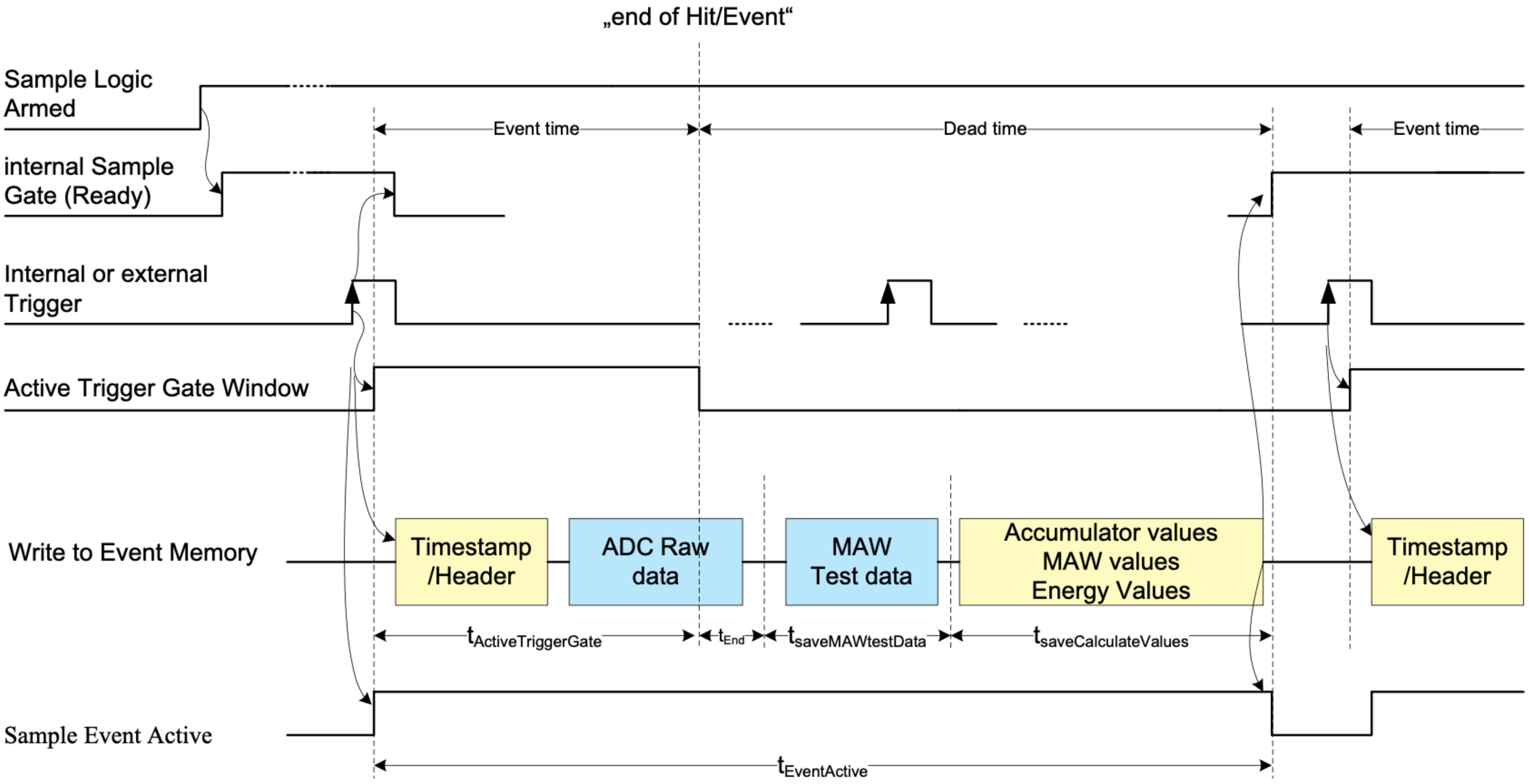



ADC signal
Peaking and Gap Time (*P1)
Trigger moving window (MW)
Trigger Threshold (*P2)
Internal Trigger
Trigger Gate Length (*P3)
Trigger Gate
0 1 2
T1
N
Trigger Gate index
Stop Trigger Gate index
Pretrigger Delay (*P4)
Saved raw data (example 1)
Delayed ADC signal
Raw Data Sample Length (*P5)
Possible save raw data gate
T1
Raw Data Sample Start Index (*P6)
Energy moving window (MW) without Tau correction (*P12)
Save Maximum Energy value
Save Start Energy value
Energy moving window (MW) with Tau correction (*P12)
Peaking Time (*P13)
Gap Time (*P14)
MW Test Buffer Length (*P8)
Possible save energy moving stream


„end of Hit/Event"
Sample Logic Armed
internal Sample Gate (Ready)
Internal or external Trigger
Active Trigger Gate Window
Write to Event Memory
Sample Event Active
Event time
Dead time
Event time
Timestamp /Header
ADC Raw data
MAW Test data
Accumulator values MAW values Energy Values
Timestamp /Header
tActiveTriggerGate
tEnd
tsaveMAWtestData
tsaveCalculateValues
tEventActive

# Hardware settings for the Dubna run

[/Equipment/Trigger/Settings/sis3316/00]
Names = STRING[16] :
[32] MB12A
[32] MB12B
[32] MB12C
[32] MB13A
[32] MB13B
[32] MB13C
[32] MB14A
[32] MB14B
[32] MB14C
[32] MB18A2
[32] Ge10
[32] Ge11
[32] ch13
[32] ch14
[32] ch15
[32] Clock

[/Equipment/Trigger/Settings/sis3316/01]
Names = STRING[16] :
[32] MB16A
[32] MB16B
[32] MB16C
[32] MB17A
[32] MB17B
[32] MB17C
[32] MB18A
[32] MB18B
[32] MB18C
[32] MB22A
[32] MB22B
[32] MB22C
[32] MB23A
[32] MB23B
[32] MB23C
[32] Clock

[/Equipment/Trigger/Settings/sis3316/02]
Names = STRING[16] :
[32] MuonEntrance ← Your C1
[32] MuonVeto ← inactive ?
[32] MuonC2
[32] VetoC3
[32] VetoTop
[32] VetoBack
[32] VetoRight
[32] VetoLeft
[32] ND03
[32] NU03
[32] ch11
[32] ch12
[32] ch13
[32] ch14
[32] proton
[32] Clock

C2 as muon Det, C3 as Veto detector

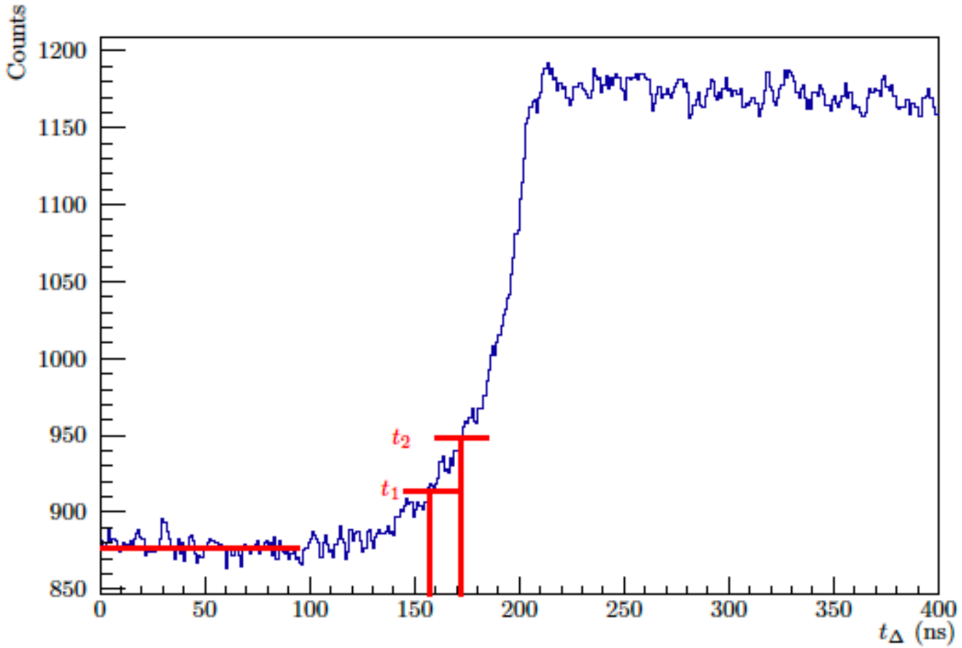
! Hardware channels start from “Channel 1”, Midas is C and is zero counted

# Rates (recorded data)

| DETECTOR | EVENTS PER SEC | PILEUPS PER SEC | %, PILEUPS/EVENTS |
|---|---|---|---|
| **MB12A** | **1244.82** | **36.6074** | **2.94077** |
| **MB12B** | **1240.1** | **23.0053** | **1.85512** |
| **MB12C** | **1143.8** | **19.5727** | **1.71119** |
| **MB13A** | **1201.9** | **18.9993** | **1.58077** |
| **MB13B** | **1011.31** | **14.4127** | **1.42515** |
| **MB13C** | **1000.89** | **14.2211** | **1.42084** |
| **MB14A** | **1238.97** | **25.4194** | **2.05166** |
| **MB14B** | **1118.86** | **18.4393** | **1.64804** |
| **MB14C** | **1092.5** | **22.5395** | **2.06311** |
| **MB18A2** | **539.335** | **9.8615** | **1.82846** |
| **Ge10** | **1800.07** | **69.6289** | **3.86811** |
| **Ge11** | **647.704** | **6.70895** | **1.0358** |
| **MUON WINDOW** | **27586.7** | **113.969** | **0.00413132** |

DETECTOR EVENTS PER SEC PILEUPS PER SEC %, PILEUPS/EVENTS

# EXTRAPOLATED LEADING EDGE THRESHOLD (ELET) TIME CORRECTION



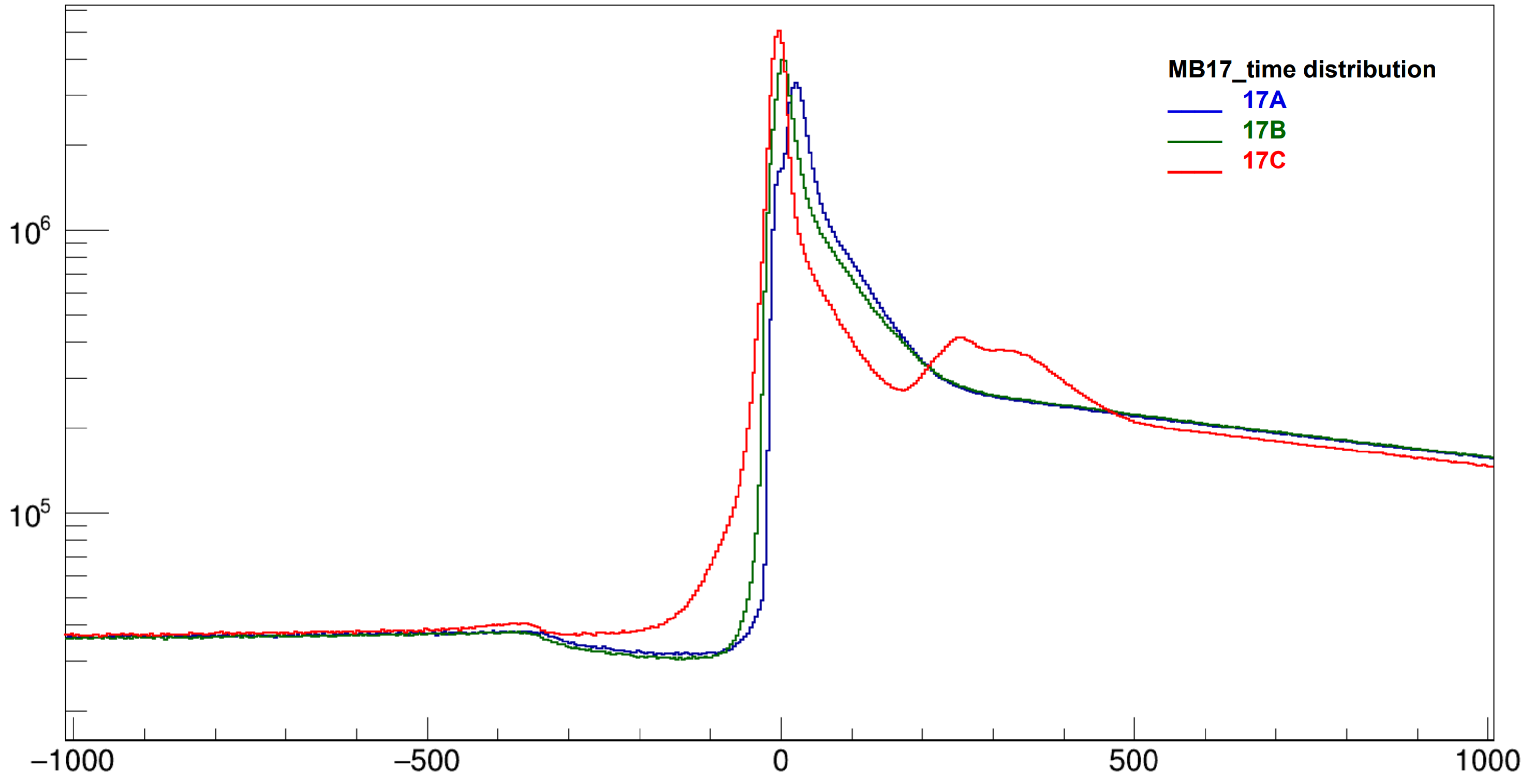

- Avoid threshold activation due to noise (jitter effect)
- Avoid walk effect due to varying time signal shape
- Assume that rising slope is almost linear at the beginning

$$\Delta t = t_1 - t_0$$

$$\Delta t = t_2 - t_1$$

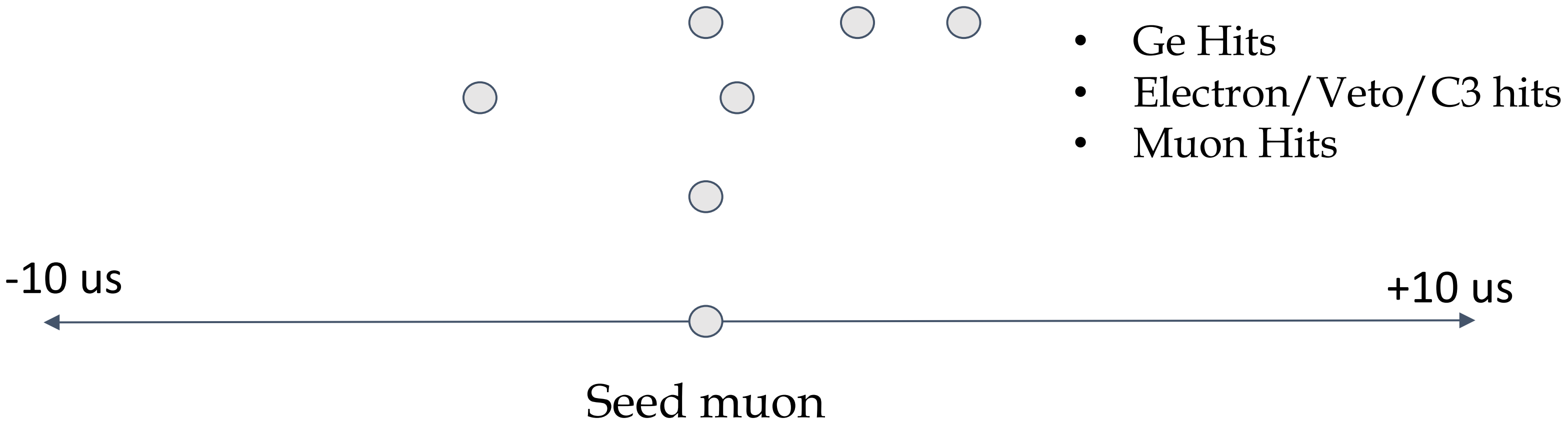
$$t_0 = 2t_1 - t_2$$

# Time alignment




| Detectors | | | | |
|---|---|---|---|---|
| MB12A + | MB12B + | MB12C + | MB13A + | MB13B + |
| MB13C +- | MB14A + | MB14B + | MB14C - | Ge10 + |
| Ge11 + | MB16A + | MB16B + | MB16C x | MB17A + |
| MB17B + | MB17C - | MB18A + | MB18B + | MB18C + |
| MB22A + | MB22B x | MB22C + | MB23A + | MB23B + |
| MB23C + | MB18A2 - | | | |

# Analyzing the Tree's




**Overlap is possible**

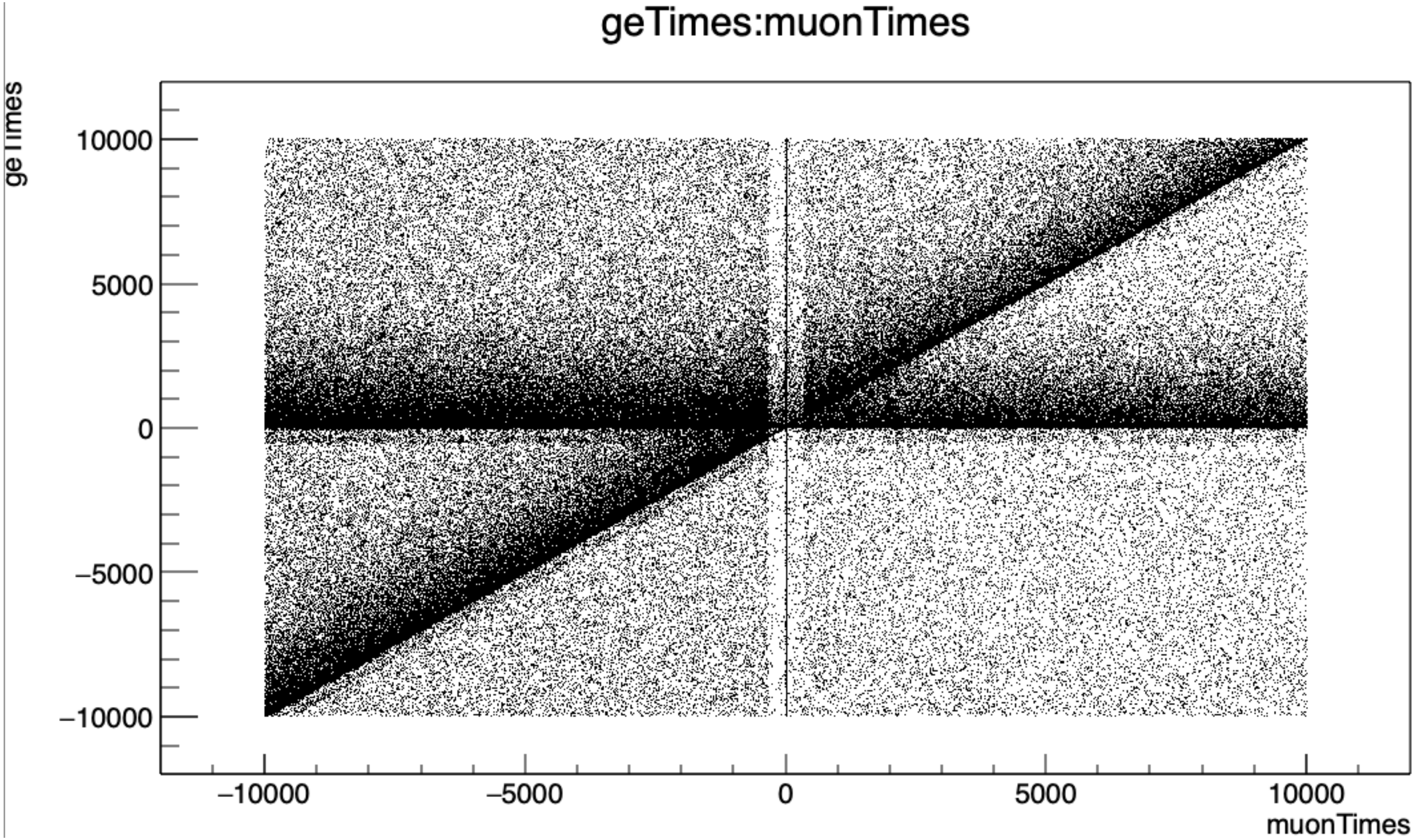
## MuonEvent
## (default TTrees from mux-analyzer)

```
struct Hit_t {
  float energy
  float energyADC;
  float time; // time relative to the muon
  bool pile_up; // Pile up flag from sis module
  unsigned short int channel; // channel of struct module
  unsigned short int module;
  //trace
  std::vector<unsigned int> raw_samples;
  float trigger_time;
};


struct MuonEvent_t {
  ULong64_t muonTime;   // muon time in clock ticks
  bool pp;  // Pile-Up Protected muon event
  bool goodEvent;  // flexible good event flag
  std::vector<Hit_t> geHits; // at [-10,10] us time window
  std::vector<Hit_t> muonHits;
  std::vector<Hit_t> electronHits;
  std::vector<Hit_t> neutronHits;

  std::vector<ClusterHit_t> geClusters;
};
```

# Overlaps for predefined Muon events



# Dubna version of TTree (simplified)

- Original internal structure of event

```
struct Hit_t {
  float energy
  float energyADC;
  float time; // time relative to the muon
  bool pile_up; // Pile up flag from sis module
  unsigned short int channel; // channel of
                              // struct module
  unsigned short int module;
  //trace
  std::vector<unsigned int> raw_samples;
  float trigger_time;
};
```

- Dubna structs for TTree's

```
struct base_event
{
    Double_t energy;    // for Ge events only
    Double_t energyADC;
    Double_t time;
    uint16_t module;
    uint16_t channel;
    uint8_t status_flag;
};

TTree * mu_tree = (TTree*)f->Get("MuonTree");
TTree * ge_tree = (TTree*)f->Get("GeTree");
```

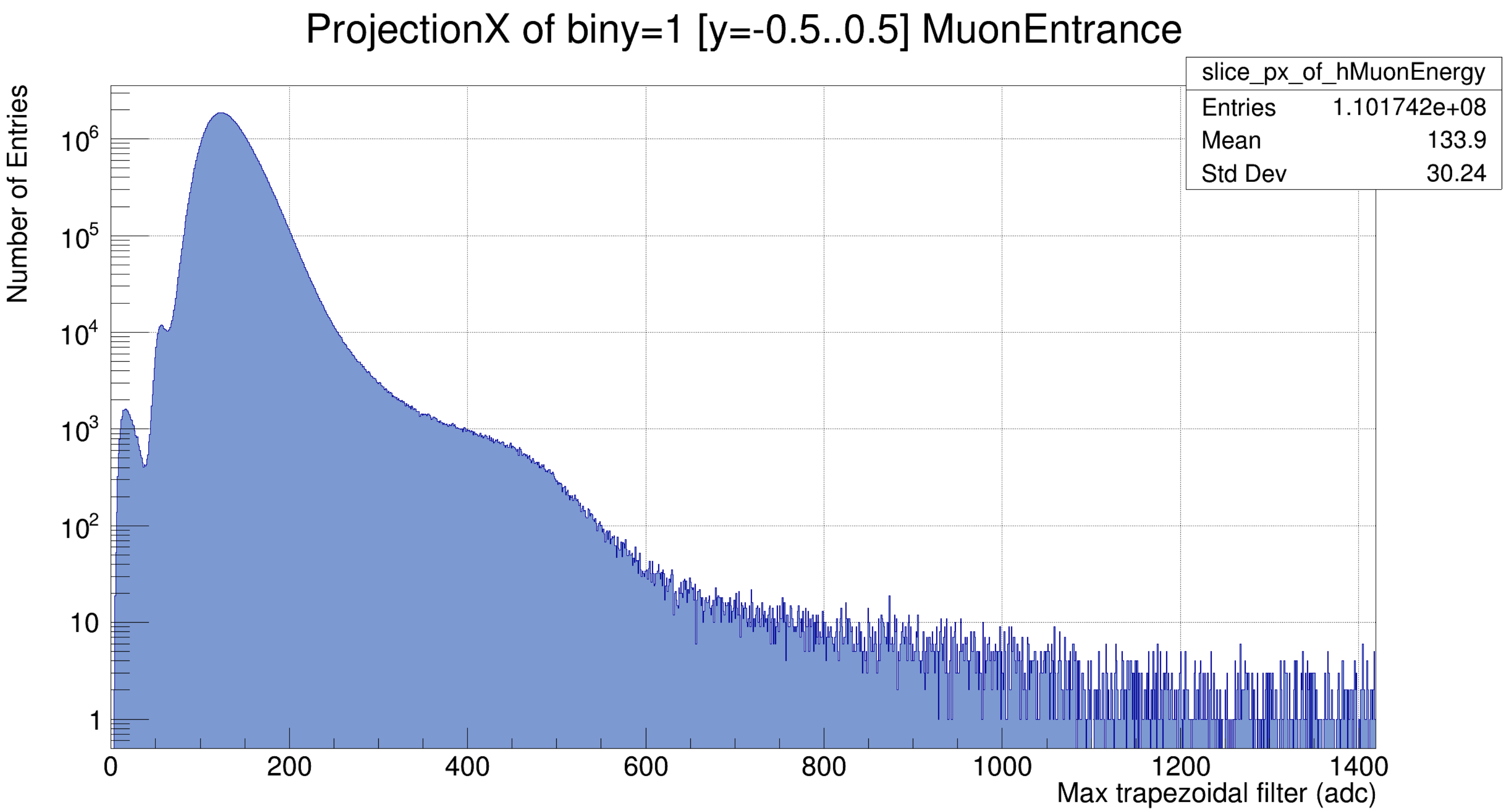
# Configuration

- We have midas data files: run"%05d".mid.gz
- *mid.gz -> analyzer (+ *.odb midas configuration) -> *.root
- *.root:

```
struct base_event
{
    Double_t energy;
    Double_t energyADC; // for Ge events only
    Double_t time;
    uint16_t module;
    uint16_t channel;
    uint8_t status_flag;
};

TTree * mu_tree = (TTree*)f->Get("MuonTree");
TTree * ge_tree = (TTree*)f->Get("GeTree");
TTree * n_tree =  (TTree*)f->Get("NeutronTree");
TTree * el_tree = (TTree*)f->Get("ElTree");  // Electron Veto Events
```

# Muon entrance



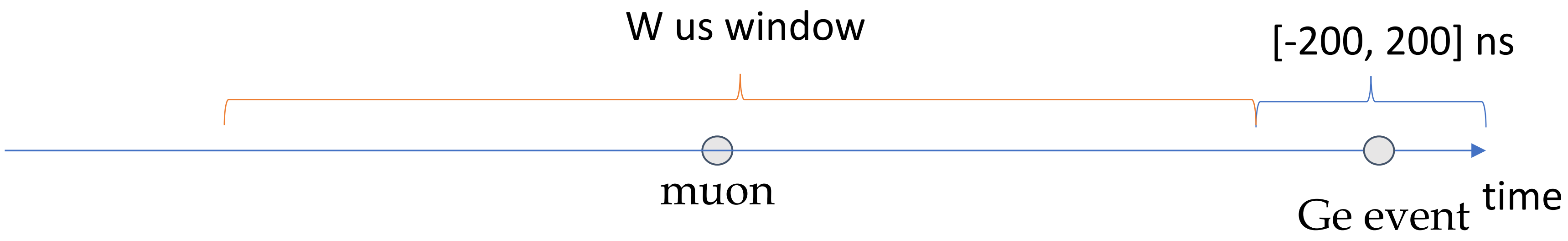
# Constructing spectra for further analysis

- **all** – all event from Ge detector
- **correlated** - event from Ge detector, if we detected 1 muon event during W us before
- **uncorrelated** - event from Ge detector, if we detected 0 muon events during W us before
- **rejected** - event from Ge detector, if we detected >1 muon events during W us before
- **prompt** - event from Ge detector, if we detected 1 muon event during 200 ns before and after (because time fixation distribution)
- **delayed** - event from Ge detector, if we detected 1 muon event from 200 ns to W us before

**prompt + delayed = correlated**

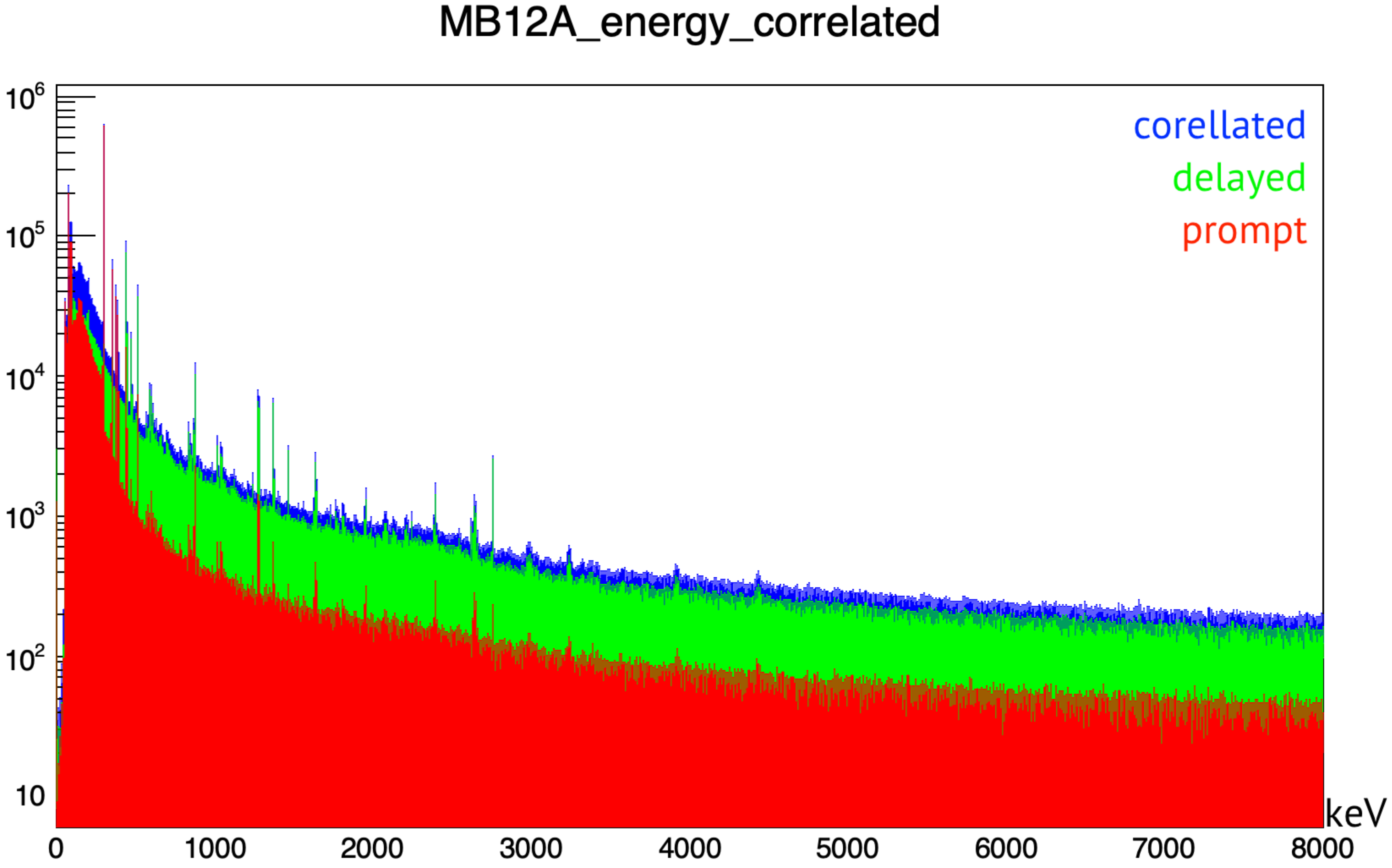
**correlated + uncorrelated + rejected = all**

W = { 3.5, 6, 8, 10, 12, 14 } us



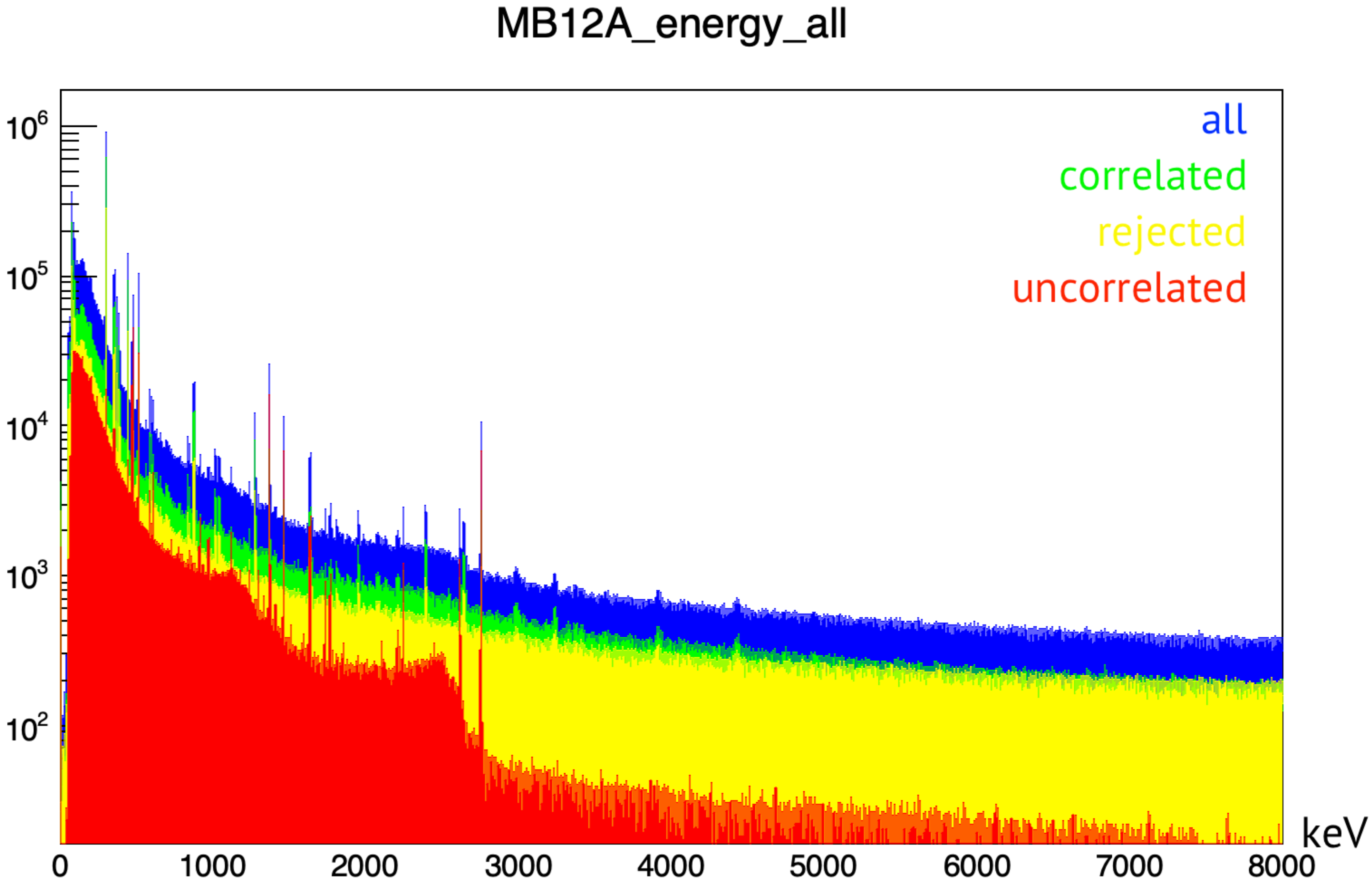
# MB12A spectra

## (prompt + delayed = correlated)

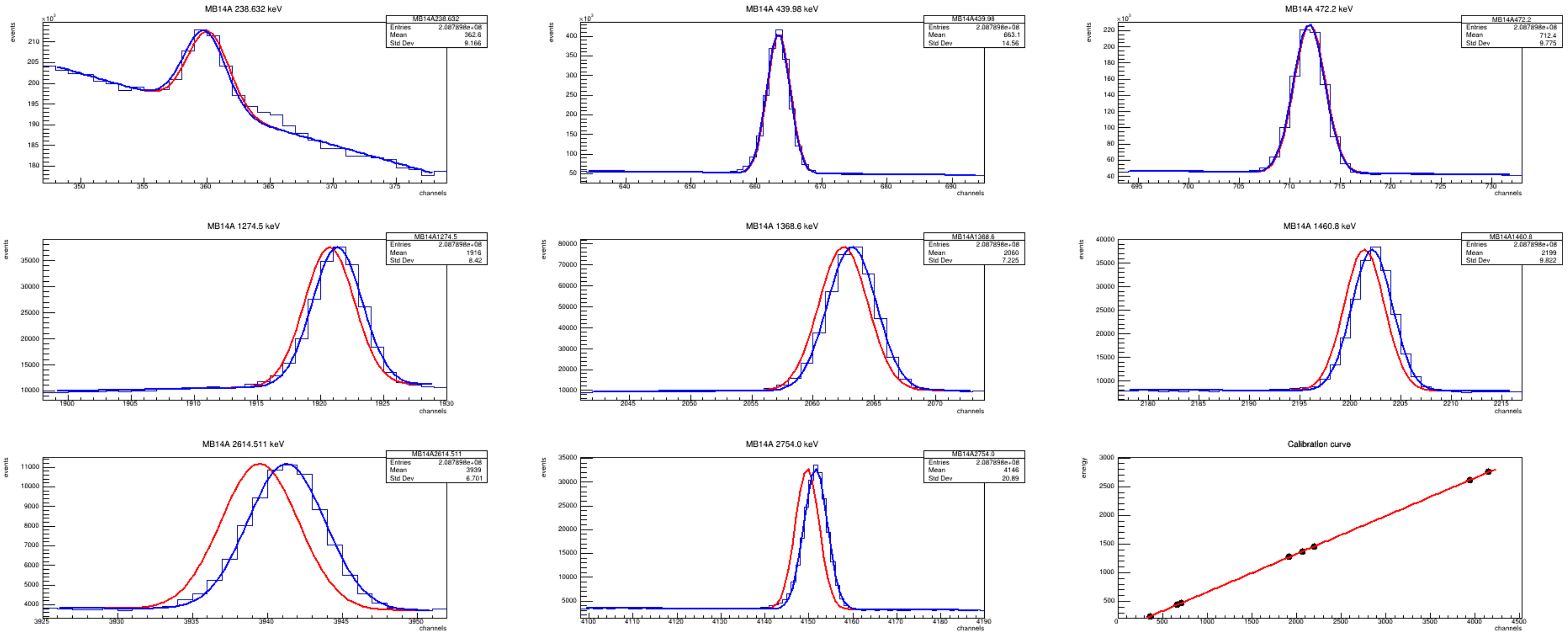


# MB12A spectra

## (correlated + uncorrelated + rejected = all)



# MB14A energy calibration the worst case (red old, blue – new)



# Calibration sources

Mg-24 run

| energy,keV | source |
|---|---|
| 238.632 | Pb-212 |
| 439.98 | Ne-23 |
| 472.2 | Na24m |
| 1274.5 | Na-22 |
| 1368.6 | Na-24 |
| 1460.8 | K-40 |
| 2614.511 | Tl-208 |
| 2754.0 | Na-24 |

Am-241, Co-60, Y-88 run

| energy,keV | source |
|---|---|
| 898.042 | Y-88 |
| 1836.063 | Y-88 |
| 1173.228 | Co-60 |
| 1332.492 | Co-60 |

Au run

| energy,keV | source |
|---|---|
| 869.98 | Au-197 |
| 899.14 | Au-197 |
| 2474.22 | Au-197 |
| 5590.7 | Au-197 |

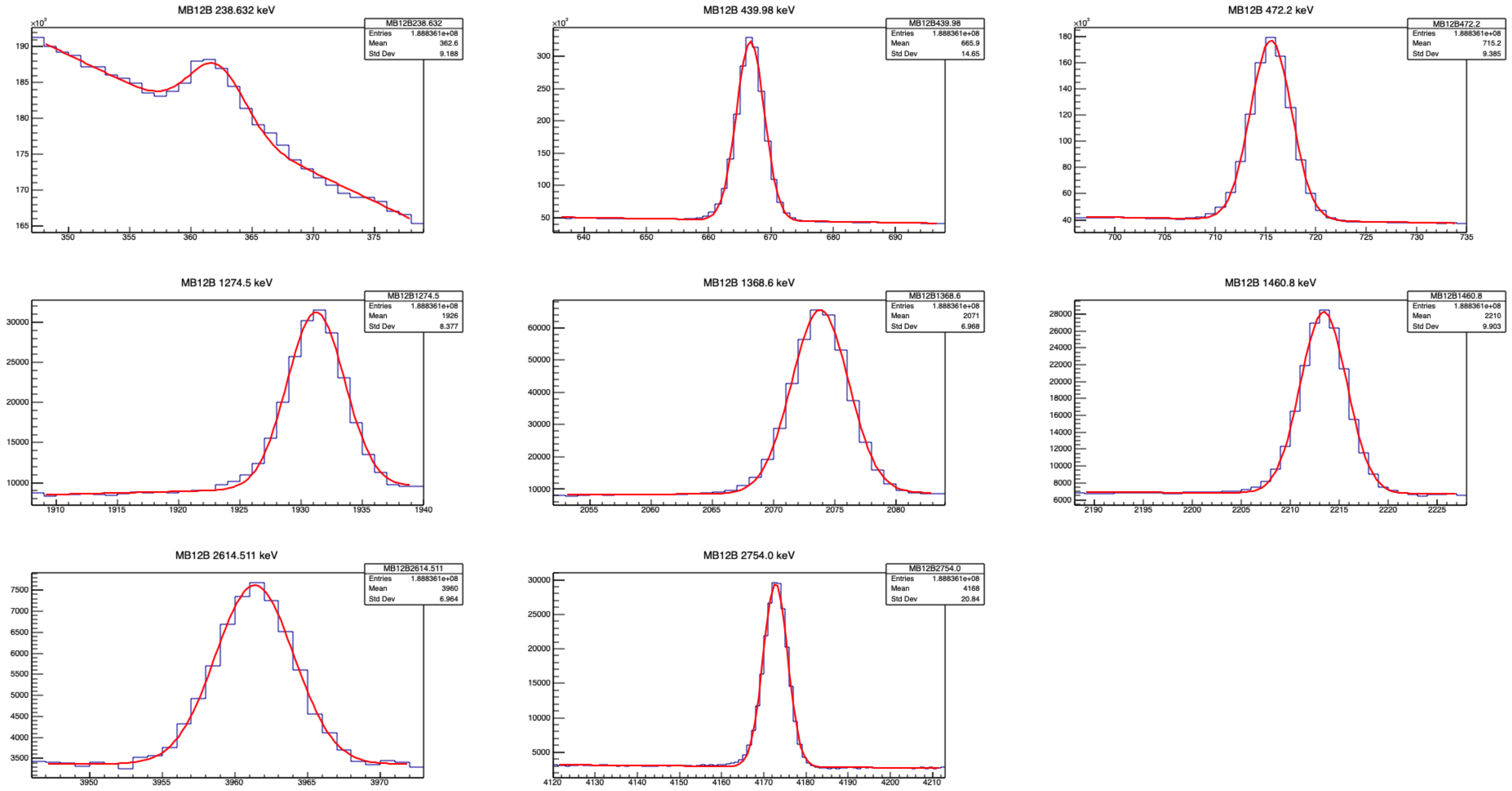
Eu-152 run

| energy,keV | source |
|---|---|
| 121.7817 | Eu-152 |
| 244.6974 | Eu-152 |
| 344.2785 | Eu-152 |
| 411.1165 | Eu-152 |
| 443.9606 | Eu-152 |
| 778.9045 | Eu-152 |
| 867.38 | Eu-152 |
| 964.057 | Eu-152 |
| 1085.837 | Eu-152 |
| 1112.076 | Eu-152 |
| 1408.013 | Eu-152 |

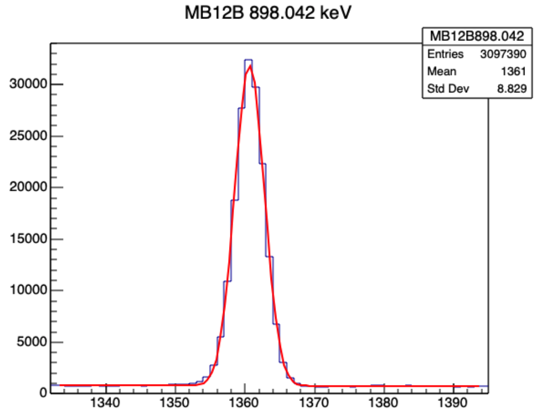
Th-232 run

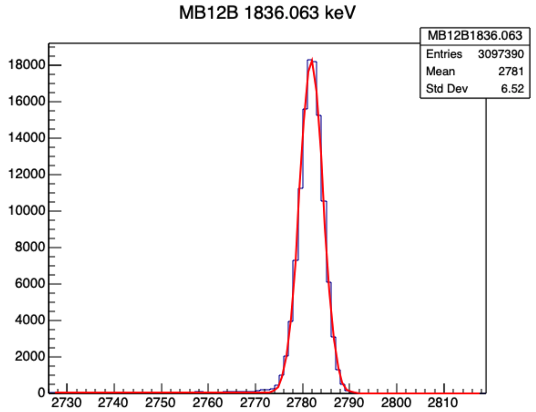
| energy,keV | source |
|---|---|
| 1143.85 | Th-232 |
| 1185.74 | Th-232 |
| 3125.07 | Th-232 |
| 6053.3 | Th-232 |

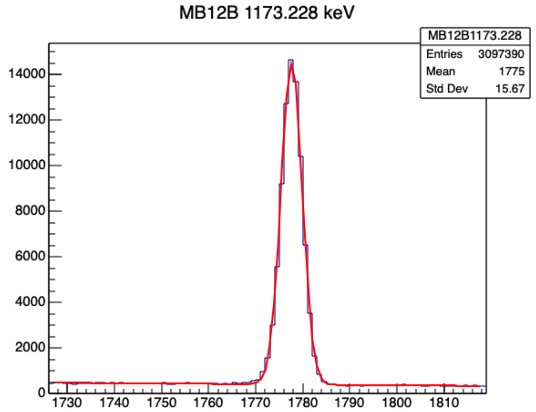
# Mg-24 run (MB12B)

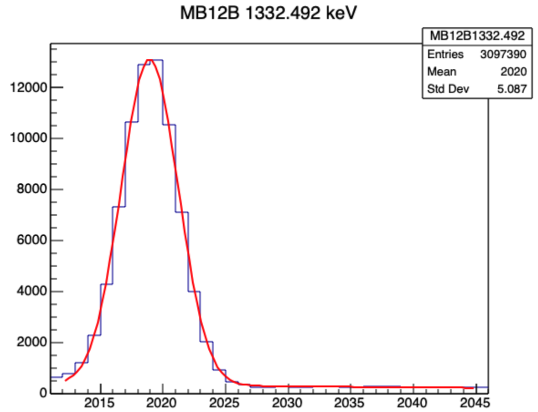


# Am-241,Co-60,Y-88 run (MB12B)

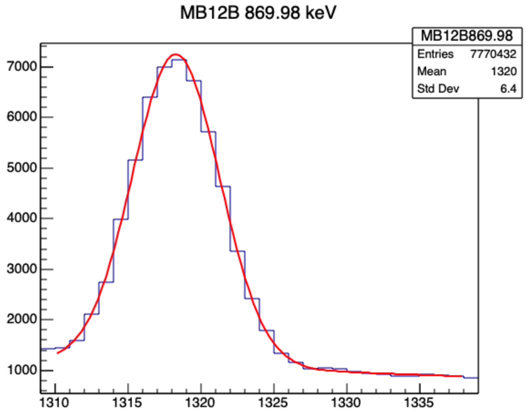


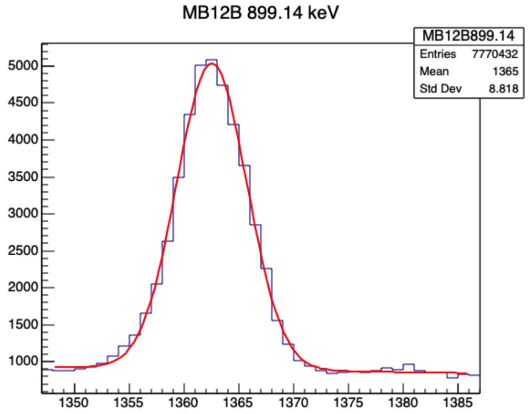



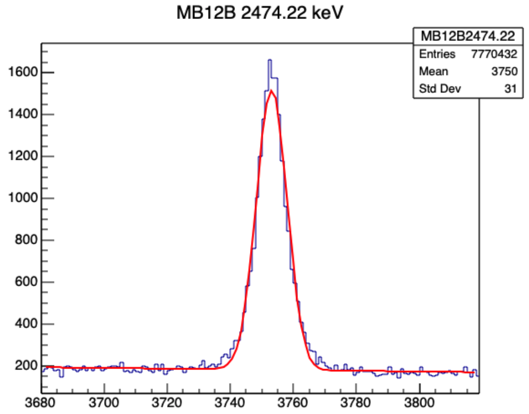
# Au run (MB12B)



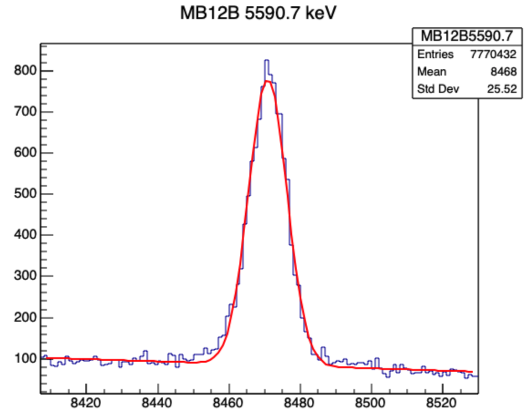
MB12B 869.98 keV
MB12B869.98
Entries 7770432
Mean 1320
Std Dev 6.4

MB12B 899.14 keV
MB12B899.14
Entries 7770432
Mean 1365
Std Dev 8.818

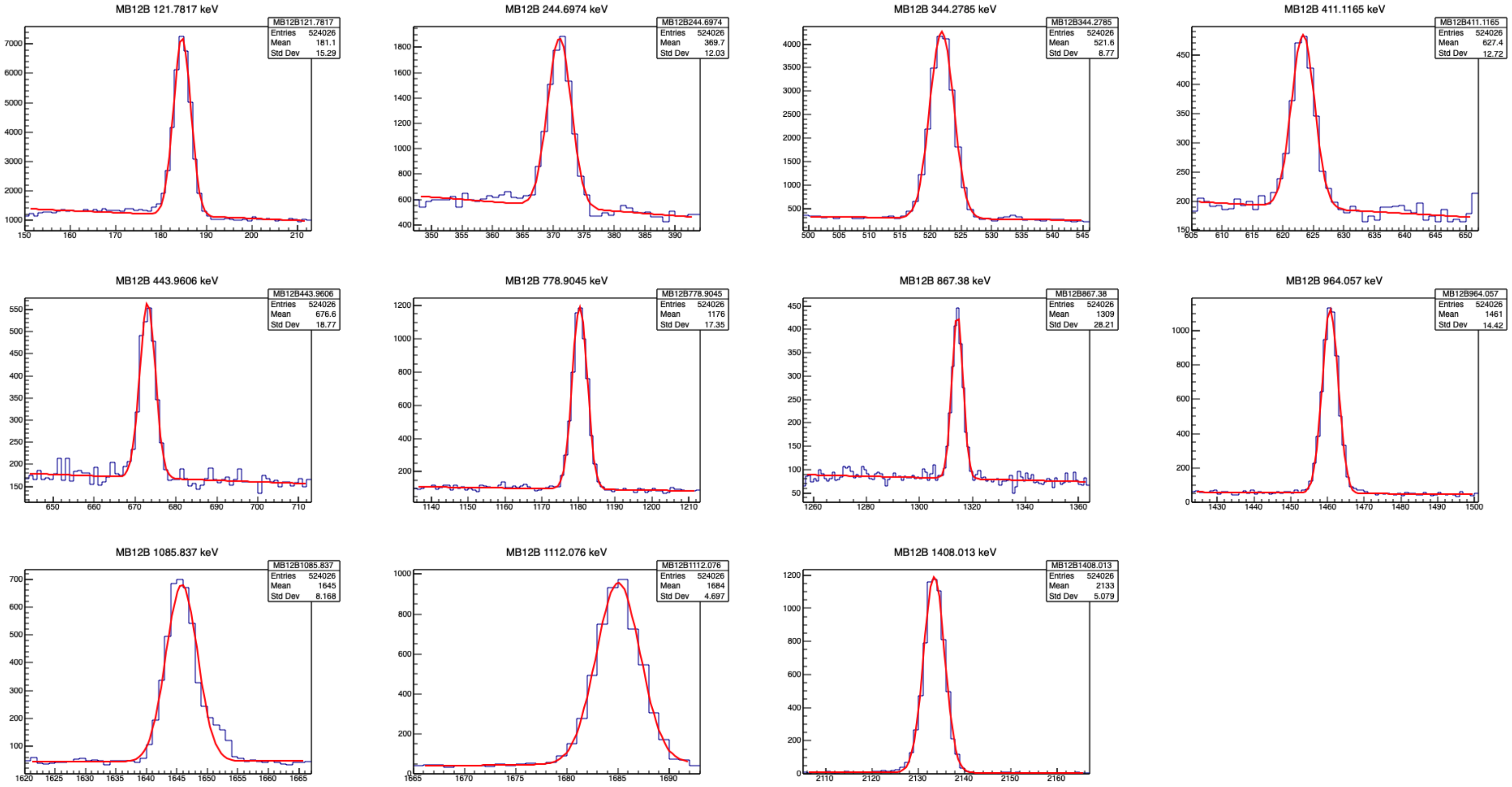



MB12B 2474.22 keV
MB12B2474.22
Entries 7770432
Mean 3750
Std Dev 31

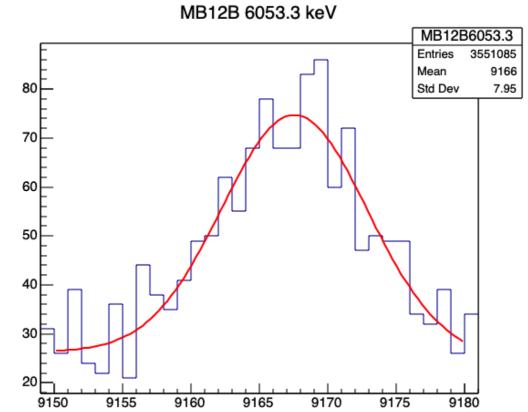



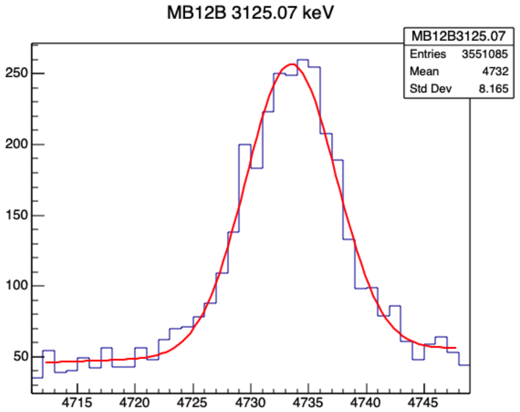
MB12B 5590.7 keV
MB12B5590.7
Entries 7770432
Mean 8468
Std Dev 25.52

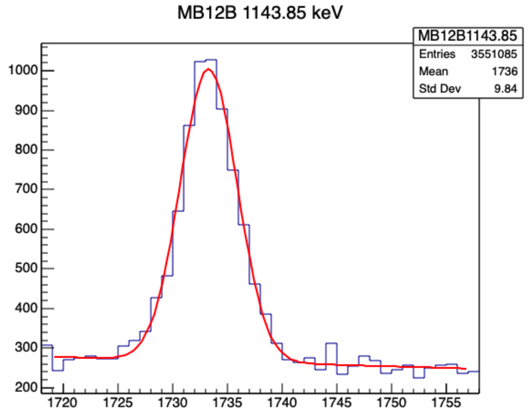
# Eu-152 run (MB12B)

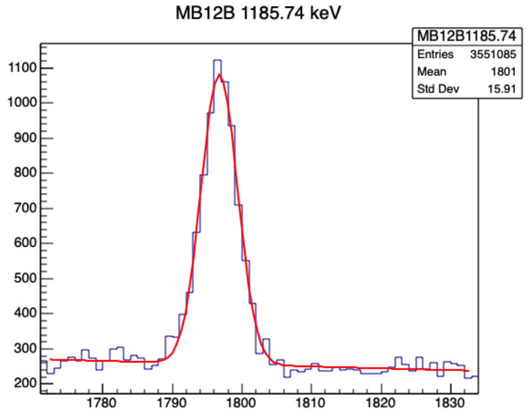


# Th-232 run (MB12B)

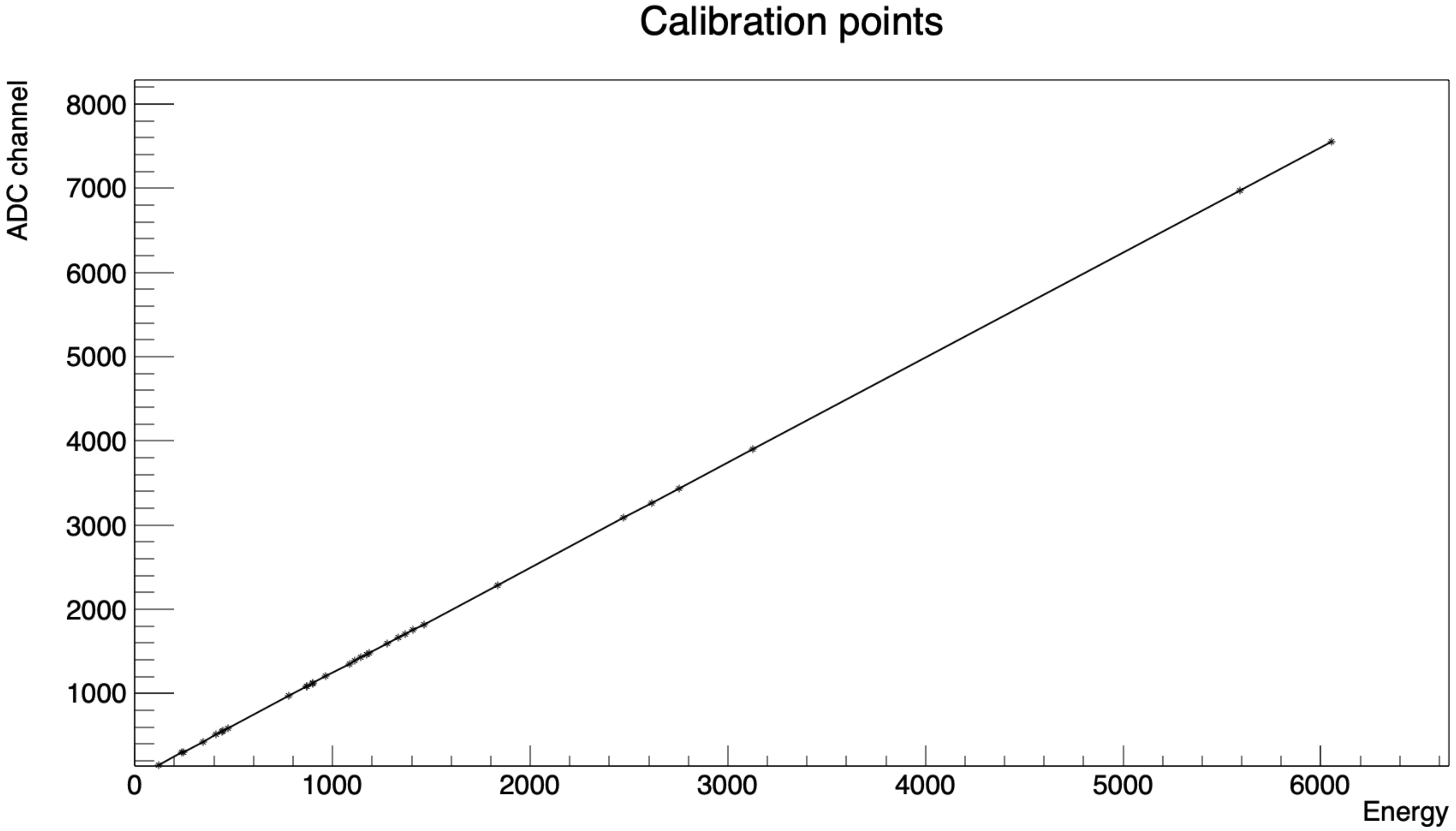


# Calibration curve (MB12B)



# Calibration points residuals, keV

| energy_keV | 121.7817 | 238.632 | 244.6974 | 344.2785 | 411.1165 | 439.98 | 443.9606 | 472.2 | 778.9045 | 867.38 | 869.98 | 898.042 | 899.14 | 964.057 | 1085.837 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| source | Eu-152 | Pb-212 | Eu-152 | Eu-152 | Eu-152 | Ne23 | Eu-152 | Na24m | Eu-152 | Eu-152 | Au-197 | Y-88 | Au-197 | Eu-152 | Eu-152 |
| Ge10 | -0.147 | -0.364 | -0.067 | -0.005 | -0.009 | -0.080 | 0.063 | -0.095 | 0.155 | 0.194 | -0.089 | 0.154 | -0.065 | 0.189 | -0.188 |
| Ge11 | -0.030 | 0.006 | -0.005 | -0.008 | 0.021 | 0.051 | -0.016 | 0.051 | -0.075 | 0.124 | -0.055 | -0.007 | -0.011 | -0.010 | 0.028 |
| MB12A | -0.331 | -0.409 | -0.193 | -0.136 | -0.046 | -0.140 | -0.047 | -0.126 | 0.077 | 0.094 | 0.033 | 0.224 | 0.005 | 0.206 | 0.145 |
| MB12B | -0.134 | -0.376 | -0.154 | -0.079 | -0.205 | 0.023 | -0.184 | 0.022 | 0.041 | 0.125 | 0.084 | 0.201 | 0.054 | 0.141 | -0.172 |
| MB12C | -0.098 | -0.301 | -0.002 | 0.029 | -0.072 | 0.269 | -0.168 | 0.272 | 0.046 | -0.028 | 0.119 | 0.053 | 0.161 | 0.111 | -0.222 |
| MB13A | 0.020 | -0.414 | -0.024 | -0.082 | -0.078 | 0.057 | 0.043 | 0.046 | 0.015 | 0.033 | -0.001 | 0.191 | 0.041 | 0.072 | -0.180 |
| MB13B | -0.192 | -0.332 | -0.144 | -0.172 | -0.043 | 0.060 | 0.084 | 0.075 | 0.013 | 0.052 | 0.064 | 0.088 | 0.131 | 0.011 | -0.308 |
| MB13C | -0.219 | -0.274 | -0.175 | -0.140 | -0.217 | -0.061 | -0.172 | -0.058 | 0.124 | 0.143 | 0.072 | 0.188 | 0.079 | 0.171 | 0.041 |
| MB14A | -0.378 | -0.600 | -0.116 | -0.045 | 0.101 | -0.378 | 0.191 | -0.368 | 0.098 | 0.220 | -0.179 | 0.302 | -0.185 | 0.301 | 0.351 |
| MB14B | -0.183 | -0.518 | -0.187 | -0.135 | -0.118 | -0.235 | 0.038 | -0.250 | 0.172 | 0.233 | 0.171 | 0.298 | 0.146 | 0.246 | 0.018 |
| MB14C | -0.248 | -0.309 | -0.231 | -0.172 | -0.097 | -0.171 | -0.053 | -0.159 | 0.172 | 0.251 | 0.077 | 0.218 | 0.054 | 0.202 | 0.098 |
| MB16A | -0.093 | -0.511 | -0.021 | -0.005 | 0.034 | -0.094 | 0.030 | -0.051 | 0.109 | 0.148 | -0.124 | 0.185 | -0.128 | 0.216 | -0.029 |
| MB16B | -0.250 | -0.286 | -0.231 | -0.112 | -0.111 | 0.112 | -0.139 | 0.111 | -0.019 | -0.007 | 0.087 | 0.189 | 0.073 | -0.011 | -0.216 |
| MB17A | -0.095 | -0.586 | -0.018 | 0.074 | 0.206 | 0.028 | 0.037 | 0.046 | -0.040 | 0.088 | -0.173 | -0.022 | -0.174 | 0.168 | 0.035 |
| MB17B | -0.090 | -0.681 | 0.007 | 0.100 | 0.187 | -0.151 | 0.177 | -0.106 | 0.075 | 0.242 | -0.182 | 0.135 | -0.156 | 0.262 | -0.018 |
| MB17C | -0.117 | -0.653 | 0.019 | 0.090 | 0.023 | -0.160 | -0.014 | -0.120 | 0.179 | 0.298 | -0.093 | 0.203 | -0.064 | 0.250 | -0.125 |
| MB18A | 0.042 | -0.488 | 0.068 | 0.213 | -0.145 | -0.135 | 0.142 | -0.077 | 0.113 | -0.890 | 0.093 | -0.013 | 0.056 | 0.168 | 0.034 |
| MB18B | -0.106 | -0.629 | -0.016 | 0.034 | 0.119 | -0.159 | 0.149 | -0.140 | 0.167 | 0.150 | -0.215 | 0.115 | -0.221 | 0.208 | 0.101 |
| MB18C | -0.086 | -0.648 | -0.027 | 0.145 | 0.199 | -0.141 | 0.046 | -0.115 | 0.131 | 0.269 | -0.413 | 0.126 | -0.383 | 0.327 | 0.215 |
| MB22A | -0.189 | -0.568 | -0.178 | -0.034 | -0.012 | -0.023 | -0.042 | 0.005 | 0.050 | 0.068 | 0.097 | 0.253 | 0.116 | 0.125 | -0.207 |
| MB22C | -0.176 | -0.302 | -0.121 | -0.103 | -0.106 | 0.051 | -0.144 | 0.033 | 0.062 | 0.143 | 0.039 | 0.262 | 0.049 | 0.036 | -0.295 |
| MB23A | -0.206 | -0.388 | -0.148 | -0.088 | -0.043 | -0.042 | -0.043 | -0.016 | 0.021 | 0.026 | 0.117 | 0.184 | 0.048 | 0.114 | -0.029 |
| MB23B | -0.090 | -0.309 | -0.055 | -0.181 | -0.304 | 0.188 | -0.135 | 0.159 | 0.036 | 0.184 | 0.205 | 0.189 | 0.195 | 0.030 | -0.394 |

# Calibration points residuals, keV

| energy_keV | 1112.076 | 1143.85 | 1173.228 | 1185.74 | 1274.5 | 1332.492 | 1368.6 | 1408.013 | 1460.8 | 1836.063 | 2474.22 | 2614.511 | 2754.0 | 3125.07 | 5590.7 | 6053.3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| source | Eu-152 | Th-232 | Co-60 | Th-232 | Na-22 | Co-60 | Na-24 | Eu-152 | K-40 | Y-88 | Au-197 | Tl-208 | Na-24 | Th-232 | Au-197 | Th-232 |
| Ge10 | 0.110 | -0.137 | 0.112 | -0.137 | 0.140 | 0.245 | 0.220 | 0.297 | 0.284 | 0.349 | -2.767 | 0.420 | 0.379 | 1.123 | -1.332 | 1.049 |
| Ge11 | 0.076 | -0.124 | -0.052 | -0.140 | 0.046 | -0.027 | 0.026 | 0.015 | 0.105 | 0.029 | -0.021 | | | | | |
| MB12A | 0.326 | 0.099 | 0.432 | 0.063 | -0.009 | 0.475 | 0.016 | 0.338 | 0.096 | 0.624 | -2.523 | -0.070 | -0.182 | 1.062 | -0.965 | 0.861 |
| MB12B | 0.178 | 0.102 | 0.235 | 0.118 | 0.152 | 0.248 | 0.152 | 0.209 | 0.218 | 0.338 | -2.589 | 0.232 | 0.178 | 1.077 | -1.301 | 1.067 |
| MB12C | 0.092 | 0.037 | -0.036 | 0.110 | 0.271 | -0.144 | 0.073 | 0.022 | -0.016 | 0.065 | -2.530 | 0.235 | 0.330 | 1.366 | 0.235 | -0.279 |
| MB13A | 0.199 | -0.034 | 0.220 | 0.063 | 0.079 | 0.165 | 0.085 | 0.153 | 0.097 | 0.306 | -2.594 | 0.164 | 0.227 | 1.120 | 0.190 | -0.179 |
| MB13B | 0.191 | 0.145 | 0.086 | 0.131 | 0.265 | 0.028 | 0.254 | 0.148 | 0.263 | 0.181 | -2.658 | 0.314 | 0.336 | 1.205 | -1.289 | 1.013 |
| MB13C | 0.262 | 0.128 | 0.187 | 0.145 | 0.121 | 0.212 | 0.082 | 0.322 | 0.120 | 0.332 | -2.525 | 0.206 | 0.144 | 0.955 | -1.225 | 1.031 |
| MB14A | 0.565 | -0.058 | 0.650 | -0.036 | -0.149 | 0.691 | -0.092 | 0.488 | -0.203 | 0.932 | -2.507 | -0.364 | -0.195 | 0.993 | -0.759 | 0.729 |
| MB14B | 0.291 | 0.030 | 0.358 | -0.016 | -0.093 | 0.490 | -0.011 | 0.446 | -0.062 | 0.563 | -2.368 | -0.291 | -0.108 | 1.218 | -1.042 | 0.901 |
| MB14C | 0.256 | 0.047 | 0.259 | 0.075 | 0.005 | 0.352 | 0.050 | 0.369 | 0.067 | 0.474 | -2.569 | 0.007 | 0.039 | 1.126 | -1.212 | 1.026 |
| MB16A | 0.271 | -0.189 | 0.229 | -0.211 | 0.222 | 0.185 | 0.171 | 0.274 | 0.133 | 0.375 | -2.750 | 0.463 | 0.513 | 0.863 | -1.073 | 0.860 |
| MB16B | 0.082 | 0.031 | 0.261 | 0.102 | 0.293 | 0.284 | 0.332 | 0.115 | 0.314 | 0.345 | -2.701 | 0.308 | 0.408 | 0.902 | -1.497 | 1.232 |
| MB17A | 0.371 | -0.068 | 0.193 | 0.003 | 0.274 | -0.043 | 0.198 | 0.126 | 0.042 | 0.343 | -2.694 | 0.354 | 0.497 | 0.950 | -0.503 | 0.380 |
| MB17B | 0.357 | -0.233 | 0.259 | -0.243 | 0.198 | 0.120 | 0.171 | 0.173 | 0.070 | 0.385 | -2.735 | 0.474 | 0.481 | 0.868 | -0.702 | 0.554 |
| MB17C | 0.220 | -0.065 | 0.167 | -0.123 | 0.004 | 0.285 | 0.062 | 0.399 | 0.148 | 0.376 | -2.645 | 0.390 | 0.388 | 0.893 | -1.150 | 0.935 |
| MB18A | 0.604 | -0.274 | 0.220 | -0.105 | 0.020 | 0.390 | 0.126 | 0.586 | 0.132 | 0.417 | -2.688 | 0.196 | 0.042 | 1.230 | -0.300 | 0.224 |
| MB18B | 0.437 | -0.335 | 0.339 | -0.323 | 0.176 | 0.273 | 0.231 | 0.310 | 0.186 | 0.492 | -2.736 | 0.267 | 0.461 | 0.786 | -0.753 | 0.631 |
| MB18C | 0.487 | -0.406 | 0.301 | -0.291 | 0.206 | 0.091 | 0.272 | 0.269 | 0.215 | 0.413 | -2.859 | 0.441 | 0.541 | 0.878 | -1.029 | 0.827 |
| MB22A | 0.114 | 0.127 | 0.280 | 0.122 | 0.216 | 0.293 | 0.145 | 0.145 | 0.088 | 0.346 | -2.675 | 0.125 | 0.216 | 1.286 | -1.492 | 1.205 |
| MB22C | 0.135 | -0.028 | 0.207 | -0.020 | 0.247 | 0.278 | 0.271 | 0.141 | 0.263 | 0.169 | -2.904 | 0.584 | 0.415 | 1.181 | -1.771 | 1.400 |
| MB23A | 0.155 | 0.047 | 0.238 | 0.109 | 0.215 | 0.157 | 0.197 | 0.164 | 0.131 | 0.310 | -2.606 | 0.296 | 0.290 | 1.076 | -1.500 | 1.215 |
| MB23B | -0.073 | 0.188 | 0.042 | 0.088 | 0.190 | 0.136 | 0.231 | 0.157 | 0.172 | 0.075 | -2.480 | 0.127 | 0.346 | 1.371 | -1.218 | 0.929 |
| MB23C | 0.296 | -0.030 | 0.374 | -0.006 | 0.152 | 0.291 | 0.175 | 0.204 | 0.138 | 0.459 | -2.653 | 0.208 | 0.270 | 0.985 | -1.449 | 1.202 |

# Questions

- What do we want to see online during measurements ?
- Who will tune MIDAS+**analyzer** (with our suggestions) for 2021 run ?
- What version of analyzer will we use ?
- Can we record all events from C0,C2,C3… ? (LLAMA)
- Can we record shapes of all Ge detector pulses for good energy resolution and reducing dead time of DAQ? (MIDAS and LLAMA)