PAUL SCHERRER INSTITUT

PSI

DFG Deutsche Forschungsgemeinschaft

muX analysis meeting 2.12.2020

Software & DAQ developments

Frederik Wauters
Johannes Gutenberg University Mainz

JOHANNES GUTENBERG UNIVERSITÄT MAINZ

JG|U

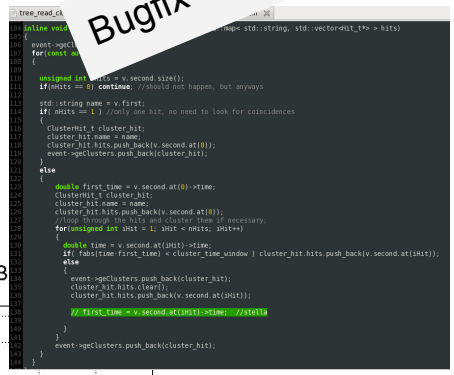
Cluster of Excellence PRISMA+ Precision Physics, Fundamental Interactions and Structure of Matter

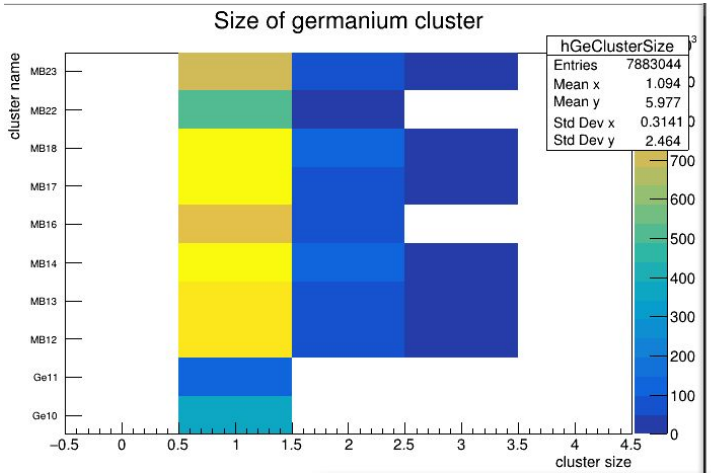
Data analysis progress

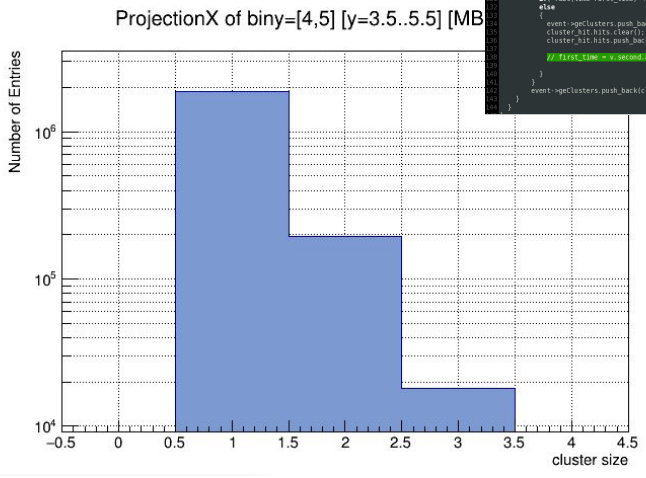
Clustering

- See https://muon.npl.washington.edu/elog/neutralcurrents/Analysis2019/2
- On the ROOT *tree* level
- Code:
  - Add *ClusterHit_t's* to *MuonEvent_t* (*MuonEventStruct.h*)
  - Utility functions in *Cluster.h*
  - Example ROOT macro: *tree_read_clustering.C*
- Cuts listed in *Cluster.h*, based on data (change for your needs)

Bugfix Stella 9117d2e



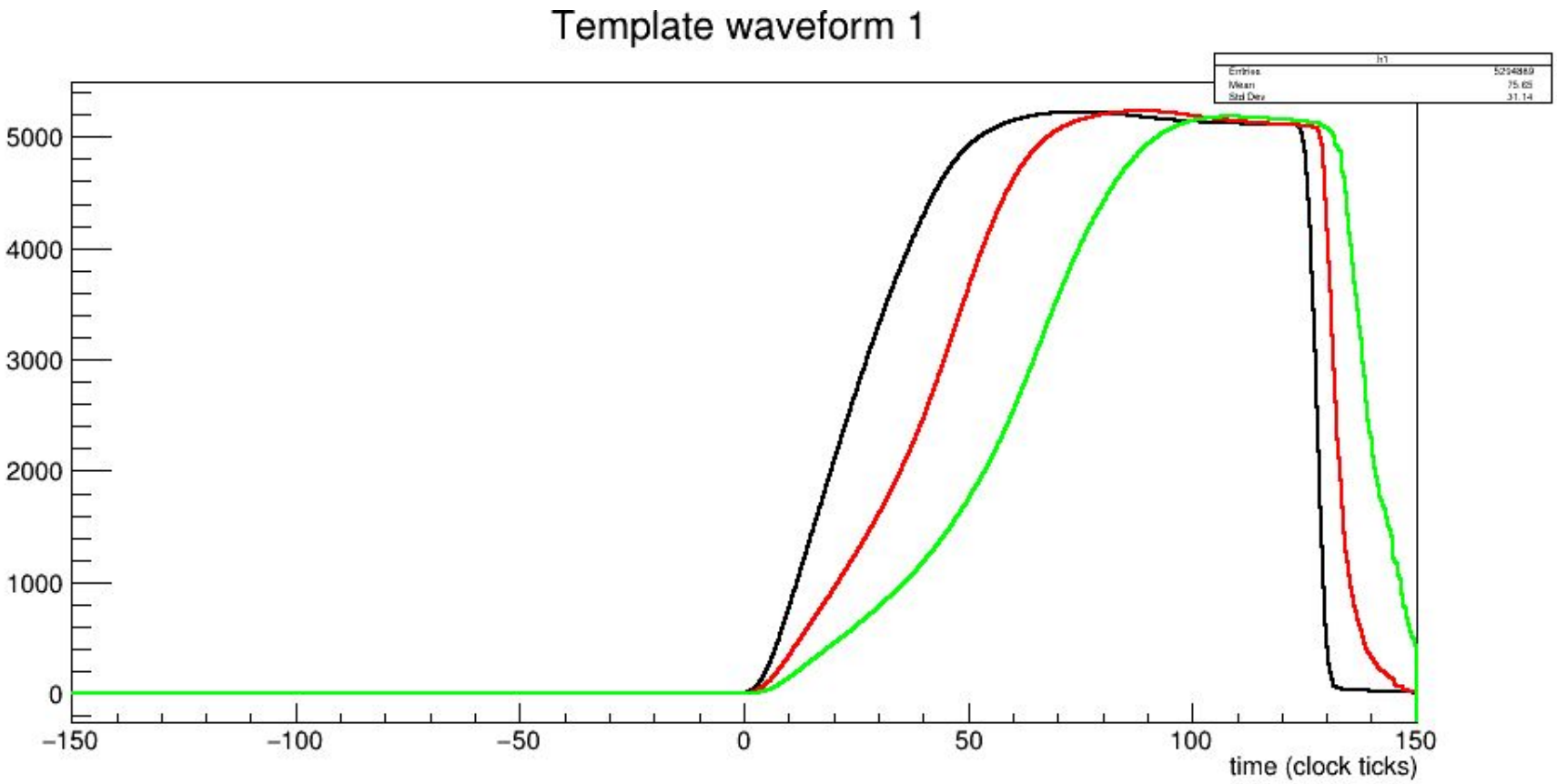




Data analysis progress

Template fitting

- Wide variety of waveforms, classifying tricky
- Works for a *nice* subset
- Not mature



Data analysis progress

Machine learning

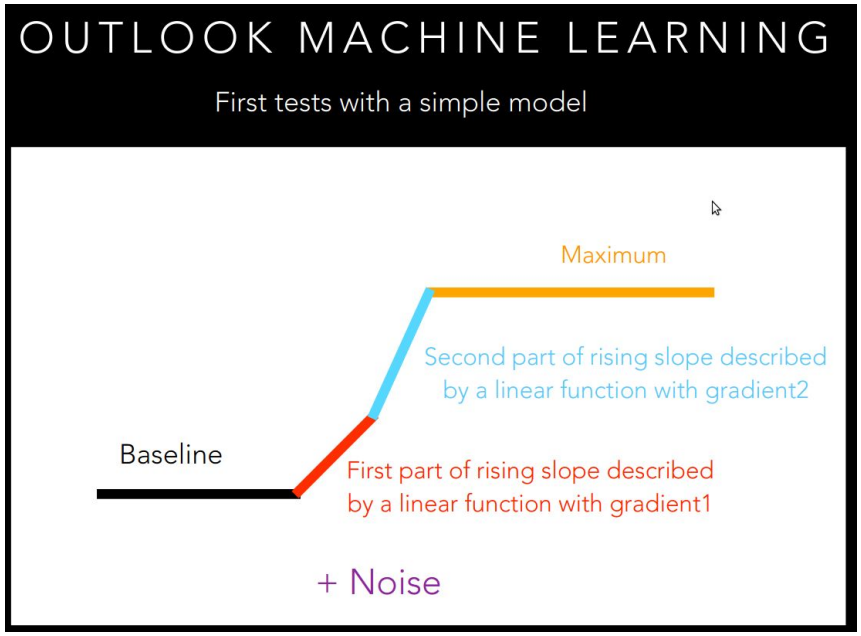
- Proof of principle my Alex
- *Invented waveform models* as input

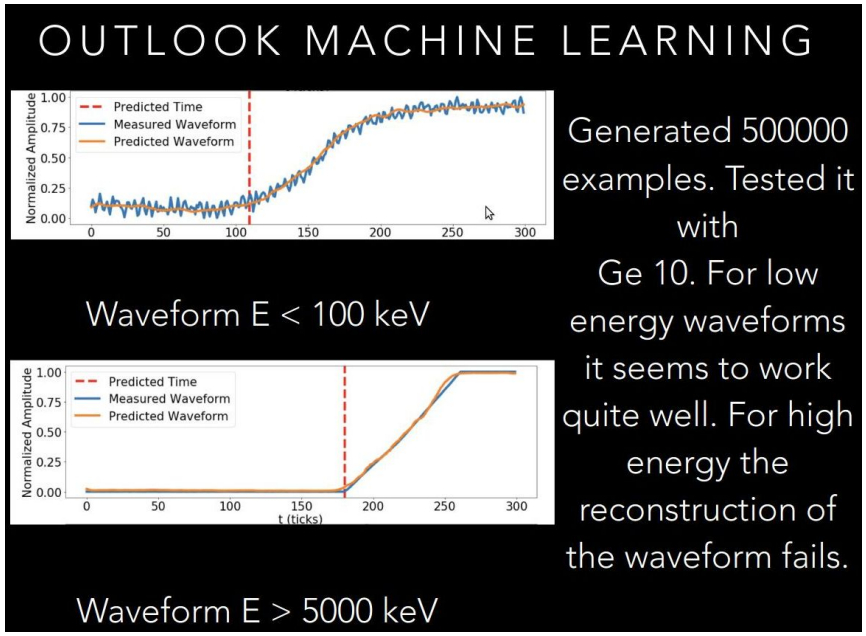
What is the user need?

- Reliable timing in a specific range

Proposal: why not train on data?

- With clever analysis cuts, you can generate t=0 *truth*





Data analysis progress

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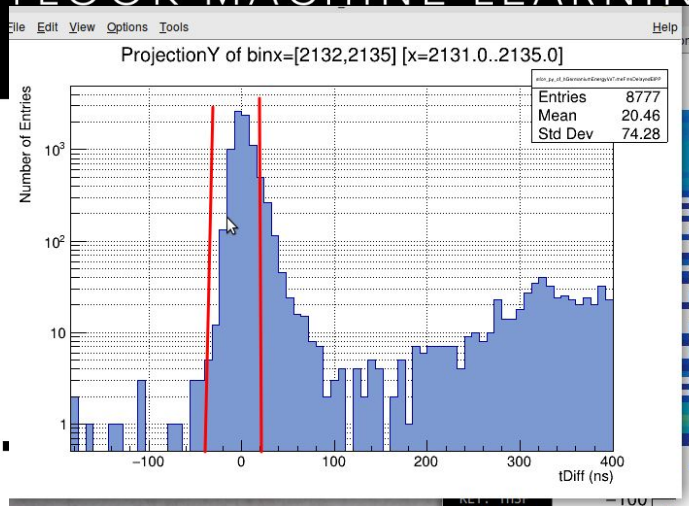
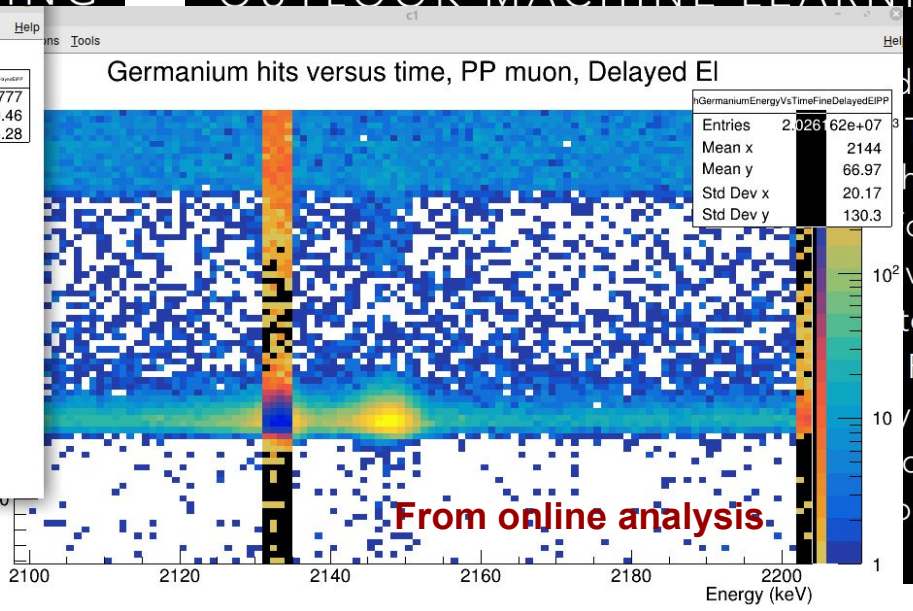
OUTLOOK MACHINE LEARNING





OUTLOOK MACHINE LEARNING

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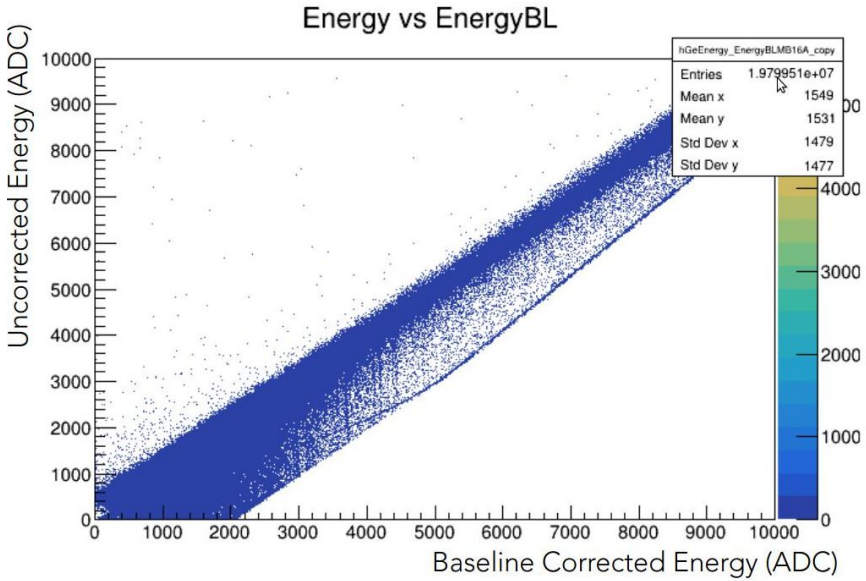
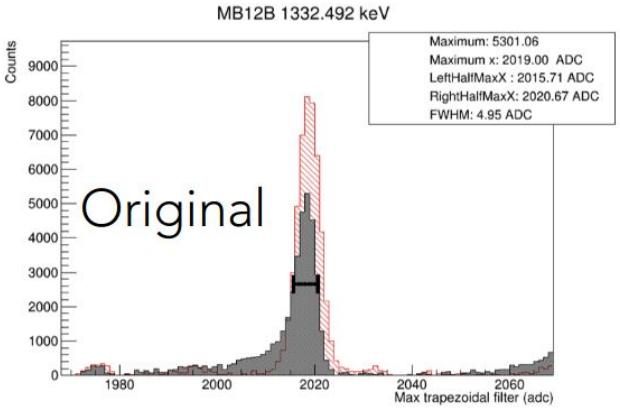
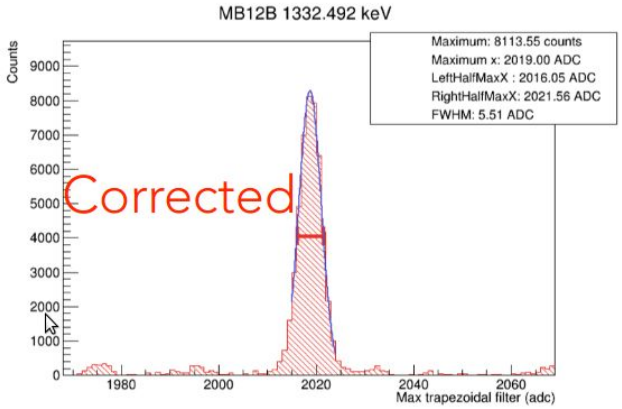
Data analysis progress

Baseline restoration

- Alex showed that you **need** to do this if you have medium-high rates https://indico.psi.ch/event/8881/







Data analysis progress

Baseline restoration

- Alex showed that you **need** to do this if you have medium-high rates https://indico.psi.ch/event/8881/
- That being said, there are 3 things you can do:
  - Nothing
  - Event by event (we have the MAW baseline in `SIS3316Trigger struct.`)
  - RAW-MAW extrapolation
- Switch in ge_analysis.cpp

Motivation: at the moment, the *master* branch is cluttered with 50 source code file parametrizing 2018/Alex specific analysis

```
if(ge_analysis_param.blrmethod==1) {
    hit.SetBaselineCorrection(baseline_filter);
}
else if(ge_analysis_param.blrmethod==2) {
    float baseline_filter_inter = hit. GetMAWBaselineFromRAW(&blr_data[ge_det_names[nDet]]);
    hit.SetBaselineCorrection(baseline_filter_inter);
}
else if(ge_analysis_param.blrmethod!=0)  std::cout << "Warning, BLR method not defined" << std::endl;
```

- csv-file reader utility

```
if(ge_analysis_param.blrmethod==2)  {
     //Get BLR files
     std::string path = ge_analysis_param.blrpath;
     for(const auto &name: detector_names)        {
     blr_data[name] =  ReadCSV(path+"/"+name+".csv");
     }
}
```

In odb:

```
[local:muX:S]Ge Analysis>ls
BLRpath                         /home/frederik/Analysis/NC/BLR
BLRmethod                       0
```

Data analysis progress

Baseline restoration

- Alex showed that you **need** to do this if you have medium-high rates https://indico.psi.ch/event/8881/
- That being said, there are 3 things you can do:
  - Nothing
  - Event by event (we have the MAW baseline in `SIS3316Trigger struct.`)
  - RAW-MAW extrapolation
- Switch in ge_analysis.cpp

```
frederik@frederik-ThinkPad-T550:~/Analysis/NC/BLR$
cat MB12A.csv
raw,maw,err,mode
2.5,0.0,0.16666666666666666,0.0
7.5,0.0,0.16666666666666666,0.0
12.5,0.0,0.16666666666666666,0.0
17.5,0.0,0.16666666666666666,0.0
22.5,0.0,0.16666666666666666,0.0
27.5,0.0,0.16666666666666666,0.0
32.5,0.0,0.16666666666666666,0.0
37.5,0.0,0.16666666666666666,0.0
42.5,0.0,0.16666666666666666,0.0
...
1667.5,-0.6840117230020623,0.015565401534759066,2.0
1672.5,-0.6831230880533199,0.015310175155323806,2.0
1677.5,-0.6822409222135187,0.015089130796495974,2.0
1682.5,-0.6815115203954806,0.014922493468643258,2.0
1687.5,-0.6813403002707945,0.014885029921032729,2.0
1692.5,-0.6817956489321264,0.014985971407605637,2.0
1697.5,-0.682430899355531,0.015134688703748258,2.0
...
```

```
if(ge_analysis_param.blrmethod==1) {
                                    tion(baseline_filter);

                                .blrmethod==2) {
                                _inter = hit. GetMAWBaselineFromRAW(&blr_data[ge_det_names[nDet]]);
                                tion(baseline_filter_inter);

                                .blrmethod!=0)  std::cout << "Warning, BLR method not defined" << std::endl;




                                thod==2)  {

                                _analysis_param.blrpath;
                                 detector_names)        {
                                dCSV(path+"/"+name+".csv");
```

n odb:

```
/home/frederik/Analysis/NC/BLR
0
```

Data analysis progress

Baseline restoration

- Generate input: User responsibility
- Demo in `~/mux-daq/scripts/BLR_oct.ipynb`

```
frederik@frederik-ThinkPad-T550:~/Analysis/NC/BLR$
cat MB12A.csv
raw,maw,err,mode
2.5,0.0,0.16666666666666666,0.0
7.5,0.0,0.16666666666666666,0.0
12.5,0.0,0.16666666666666666,0.0
17.5,0.0,0.16666666666666666,0.0
22.5,0.0,0.16666666666666666,0.0
27.5,0.0,0.16666666666666666,0.0
32.5,0.0,0.16666666666666666,0.0
37.5,0.0,0.16666666666666666,0.0
42.5,0.0,0.16666666666666666,0.0
...
1667.5,-0.6840117230020623,0.015565401534759066,2.0
1672.5,-0.6831230880533199,0.015310175155323806,2.0
1677.5,-0.6822409222135187,0.015089130796495974,2.0
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1697.5,-0.682430899355531,0.015134688703748258,2.0
...
```
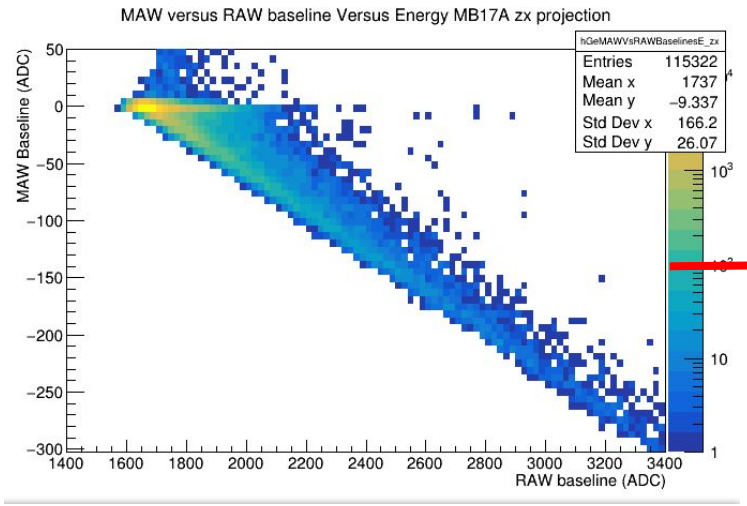
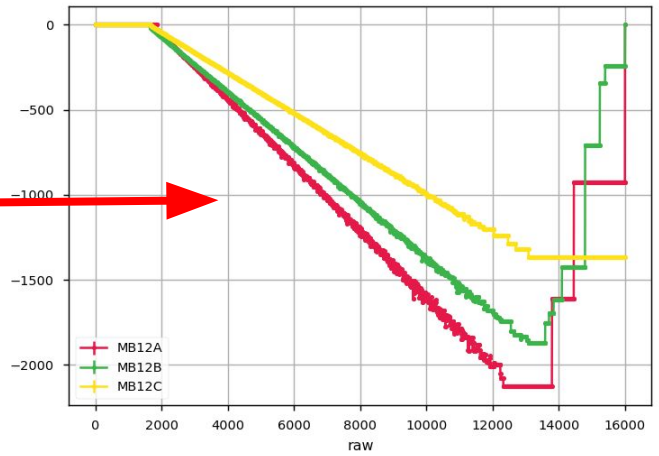



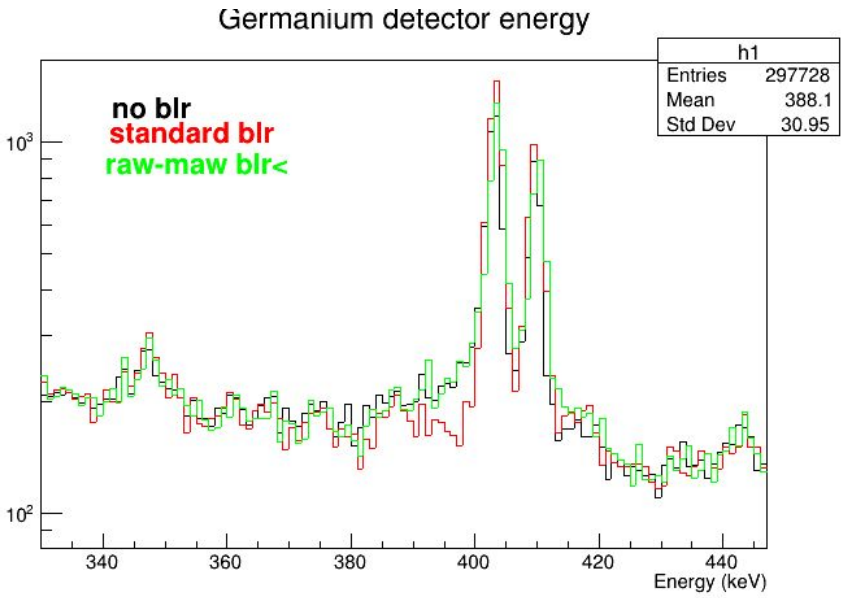


Data analysis progress

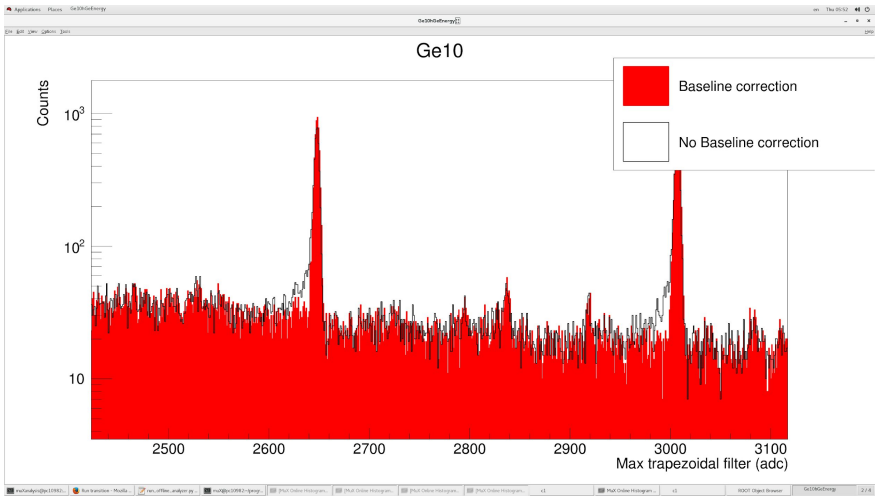
Baseline restoration

- What approach is the best: it depends.

2019 data



2018 data



https://muon.npl.washington.edu/elog/neutralcurrents/Run2018/187
https://muon.npl.washington.edu/elog/neutralcurrents/Analysis2019/26

DAQ software upgrades

MIDAS

Written in C, full C++ compatible now

Lots of new development, also driver by Mu3e (includes SRitt)

- ODBxx https://midas.triumf.ca/MidasWiki/index.php/Odbxx

  C++ / dictionary style ODB interface

```
variables["Current"]=current;
variables["Current Limit"]=currentlimit;

//watch functions
variables["Current Limit"].watch( [&](midas::odb &arg) { this->CurrentLimitChanged(); } );
variables["Demand Voltage"].watch( [&](midas::odb &arg) { this->DemandVoltageChanged(); } );

Void DemandVoltageChanged(){
 …
}
```

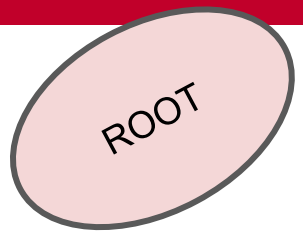
- Python MIDAS interface (easy mini-frontends)

  https://midas.triumf.ca/MidasWiki/index.php/Python

- New Interactive *History* system

- https://midas.triumf.ca/elog/Midas/
- https://midas.triumf.ca/MidasWiki/index.php/Main_Page

DAQ software upgrades



- ROOT5:
  - Release 5.34/38 - 12 Mar 2018
  - Release 5.34/36 - 05 Apr 2016
  - Release 5.34/34 - 02 Oct 2015
  - Release 5.34/32 - 23 Jun 2015
- ROOT6:
  - Release 6.22/02 - 17 Aug 2020
  - Release 6.22/00 - 02 Jul 2020
  - Release 6.20/08 - 20 Aug 2020
  - Release 6.20/06 - 10 Jun 2020

- JSROOT to have a histogram viewer in the Browser

  https://root.cern.ch/js/

DAQ software upgrades

See https://indico.psi.ch/event/7702/contributions/18069/attachments/14487/19539/DAQandSoftware.pdf and https://muon.npl.washington.edu/elog/neutralcurrents/Run2019/555

- Based on **old** MIDAS analyzer mana.c. Works well for us but
  - TFolder (which we hacked away)
  - Crashes with ROOT6 when closing?
  - experim.h not compatible with new MIDAS data formats
    https://muon.npl.washington.edu/elog/neutralcurrents/Analysis2019/23

- ROOTANA is supported
  https://midas.triumf.ca/MidasWiki/index.php/Rootana_Analyzer_Framework
  - Midas and ODB support
  - Can run online
  - JSROOT support
    ↔ Online Display

Mucap (2003-2007) inheritance

- So what would a changeover entail:
  - Rewrite the backbone and analysis modules
  - Keep Detector/Physics objects and utilities

DAQ software upgrades

Online

- SIS1100 driver (PC-VME crate connection)

4.3 LINUX Driver installation (below 2.0x)

The LINUX operating system is subject to continuous evolution. Part of the changes between different Kernel revisions are incompatible unfortunately. In the transition between 2.4 and 2.6 kernels and the use of 2.6 features in later 2.4 kernels even the number of parameters in the call to subroutines is changed in some cases. The current SIS1100/3100 driver distribution consists of the V1.0 and the V1.3 driver to take this into account (you may want to erase the directory which is not used on your machine after installation).

Kernel	Driver
2.4.4 – 2.4.18 (and slightly beyond?)	1.0
about 2.4.21 onwards	1.3
2.4.? and 2.6.? with SIS5100CAMAC support	2.0x

Kernel revisions below 2.4.4 are not supported

4.6 2.13-6 driver, SIS1100-eCMC support (kernel 2.6.18 and higher)

Driver versions from 2.12 on support the SIS1100-eCMC PCI Express card in addition to the different SIS1100 PCI flavours. Unpack and compile the driver as shown below.

```
tar -xf sis1100-2.13-6.tar.gz
cd sis1100-2.13-6/dev/pci
make
sudo make install
```

This will compile the driver sources and result in the loadable module sis1100.ko.
'make install' will take care of copying the module to the current kernel module directory, 'modprobe'-ing of the module and copying of the udev rules to the appropiate directoty.

- SIS1100/310x Linux driver V2.13-9
- SIS1100/310x Linux driver V2.13-12 (tested up to kernel 4.13.0 under Debian 9)
- SIS1100/310x Linux driver V2.13-13 (tested up to kernel 4.16.3-041603-generic Ubuntu 16.04 LTS)
- SIS1100/310x Linux driver V2.14-2 (current, tested up to kernel 5.3.0 under Ubuntu 19.10)

/lib/modules/$(KERNVER)/build
Not available on latest Kernels

***Struck ROOT*GUI for SIS3316 only compiles with ROOT5(?)**

DAQ software upgrades

Online

But beware

- SIS1100 driver (PC-VME crate connection)

lab:
g++/gcc/c++ compiler version: 9.2.1
kernel version: 5.3.0-64-generic
root version: 5.34/39
OS version: Ubuntu 19.10

piE1:
ROOT 5.34
g++ (GCC) 4.7.2
Scientific Linux release 6.9
Kernel 2.6

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2.4.? and 2.6.? with SIS5100CAMAC support	2.0x

Kernel revisions below 2.4.4 are not supported

4.6 2.13-6 (

Driver version
different SIS1

```
tar -xf si
cd sis110(
make
sudo make
```

This will compi
'make install' will
'modprobe'-ing of the module and copying of the udev rules to the appropiate directory.

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DAQ software upgrades

THUS

TODO's

- Clean up master branch

Motivating upgrades:

- Core muX late in experimental cycle
- Working software package

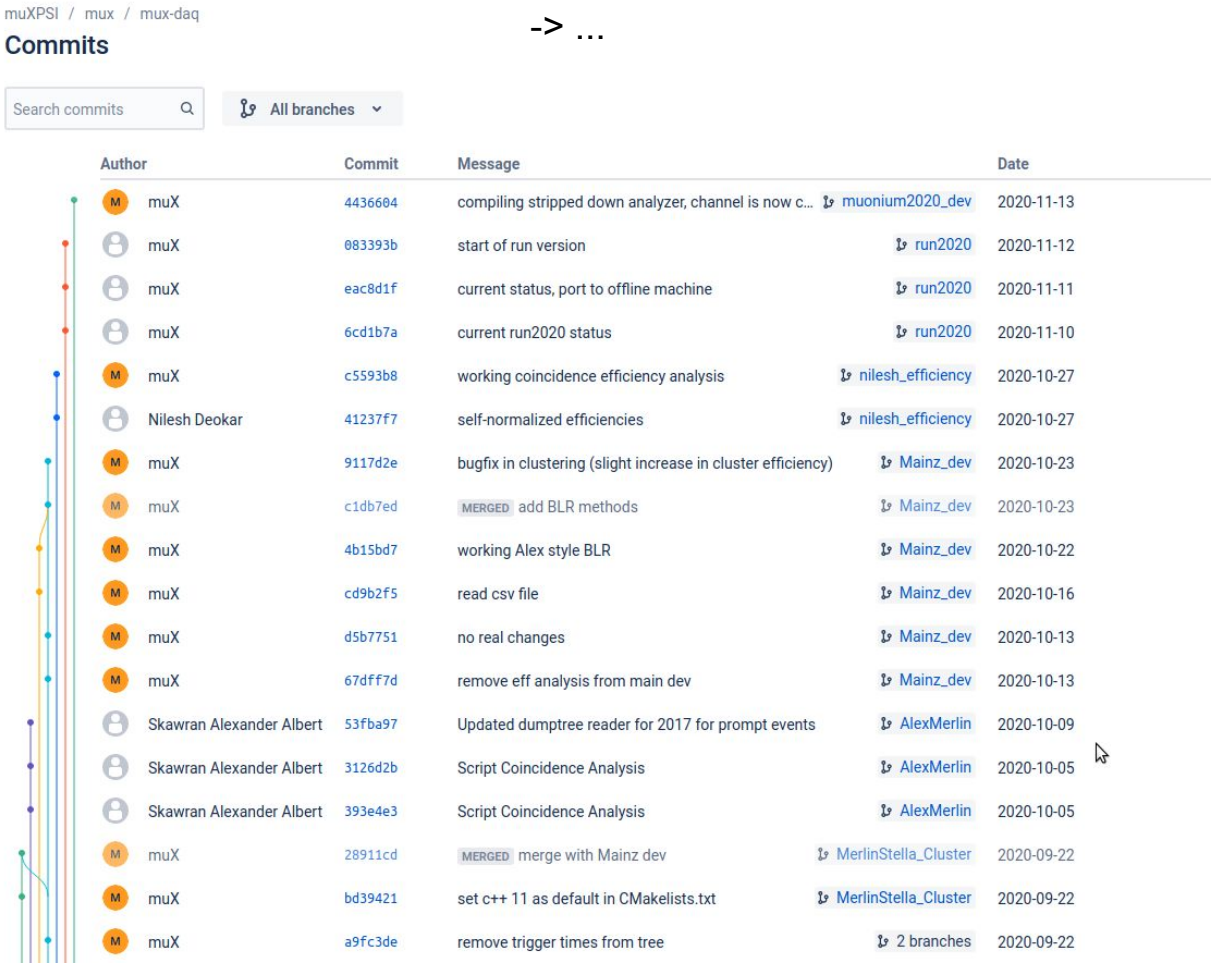
+ slowly more and more outdated
+ FE & analyzer used by
    - muX
    - Dubna
    - Muonium (2020)
    - Hypermu (2019)
    - MIXE (2019/2020)

Have little time in Q1/2 2021, happy to help students with development

DAQ software upgrades

Everyone is free to do private development, but …

+ User level code (tree, histograms cuts, ...)
- Low level stuff
  -> Mac - Linux (- Merlin) switch
  -> BLR
  -> ...



muXPSI / mux / mux-daq

Commits

Search commits | All branches

Author	Commit	Message	Date
muX	4436604	compiling stripped down analyzer, channel is now c... muonium2020_dev	2020-11-13
muX	083393b	start of run version run2020	2020-11-12
muX	eac8d1f	current status, port to offline machine run2020	2020-11-11
muX	6cd1b7a	current run2020 status run2020	2020-11-10
muX	c5593b8	working coincidence efficiency analysis nilesh_efficiency	2020-10-27
Nilesh Deokar	41237f7	self-normalized efficiencies nilesh_efficiency	2020-10-27
muX	9117d2e	bugfix in clustering (slight increase in cluster efficiency) Mainz_dev	2020-10-23
muX	c1db7ed	MERGED add BLR methods Mainz_dev	2020-10-23
muX	4b15bd7	working Alex style BLR Mainz_dev	2020-10-22
muX	cd9b2f5	read csv file Mainz_dev	2020-10-16
muX	d5b7751	no real changes Mainz_dev	2020-10-13
muX	67dff7d	remove eff analysis from main dev Mainz_dev	2020-10-13
Skawran Alexander Albert	53fba97	Updated dumptree reader for 2017 for prompt events AlexMerlin	2020-10-09
Skawran Alexander Albert	3126d2b	Script Coincidence Analysis AlexMerlin	2020-10-05
Skawran Alexander Albert	393e4e3	Script Coincidence Analysis AlexMerlin	2020-10-05
muX	28911cd	MERGED merge with Mainz dev MerlinStella_Cluster	2020-09-22
muX	bd39421	set c++ 11 as default in CMakelists.txt MerlinStella_Cluster	2020-09-22
muX	a9fc3de	remove trigger times from tree 2 branches	2020-09-22