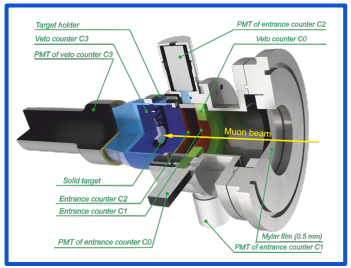
ALPACA-DAQ

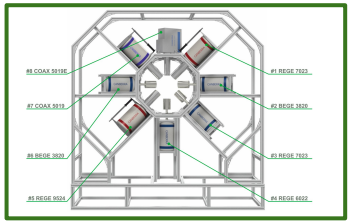
Report on dead-time

Mario Schwarz, Elizabeth Mondragón, Elisabetta Bossio

DAQ: overview



PMT (4x)



Ge (8x)

Linear Fan-In Fan-Out

Linear Fan-In Fan-Out

ALPACA

SIS3316 FADC 125 MHz

DAQ server

Ethernet

VME / optical

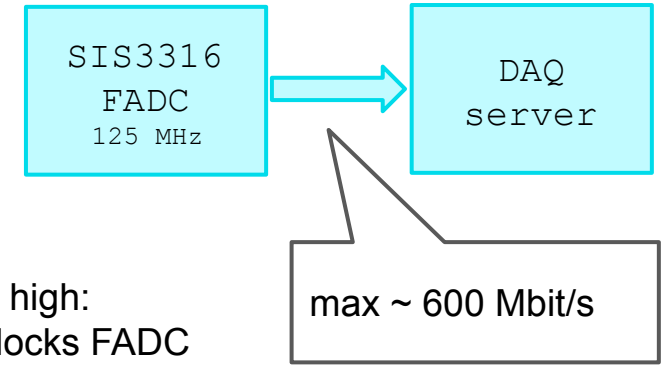
SIS3316 FADC 250 MHz

DAQ server

Separate Analysis

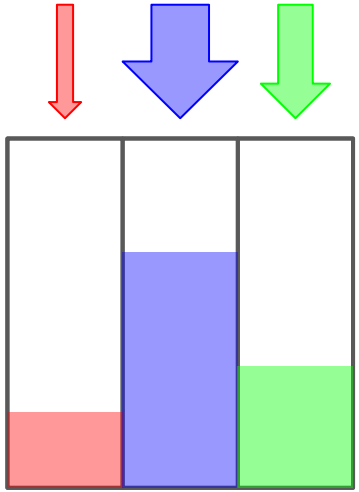
MIDAS

The bottleneck: ethernet speed



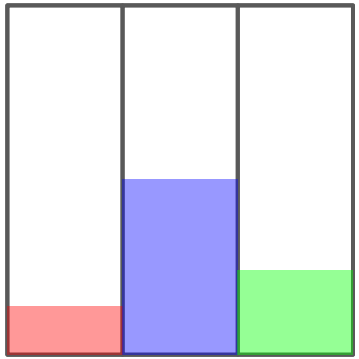
Problem:
when trigger rate is too high:
not yet read-out data blocks FADC

Sampled data

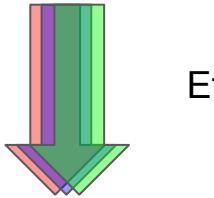


FADC
memory 1

Assume: too high trigger rate (3 Ge channels;
arrow widths symbolize rate)

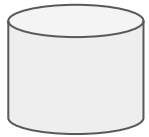


FADC
memory 2



Ethernet

Server



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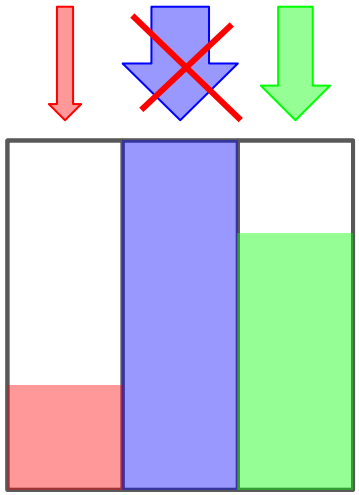

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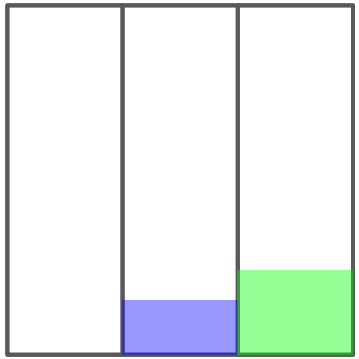
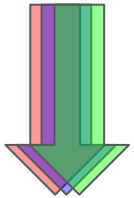
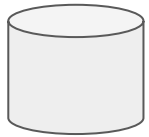


FADC
memory 2

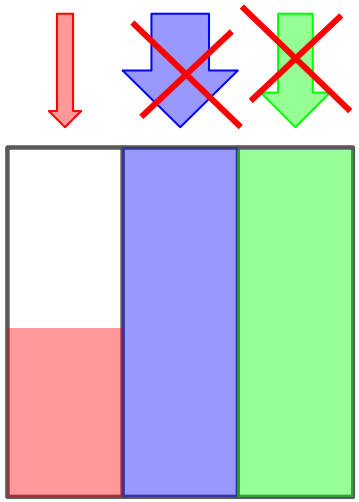


Ethernet

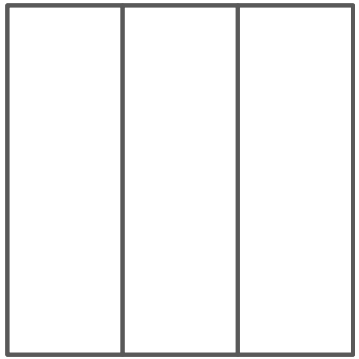
Server



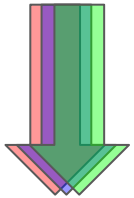
Sampled data



FADC
memory 1

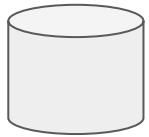


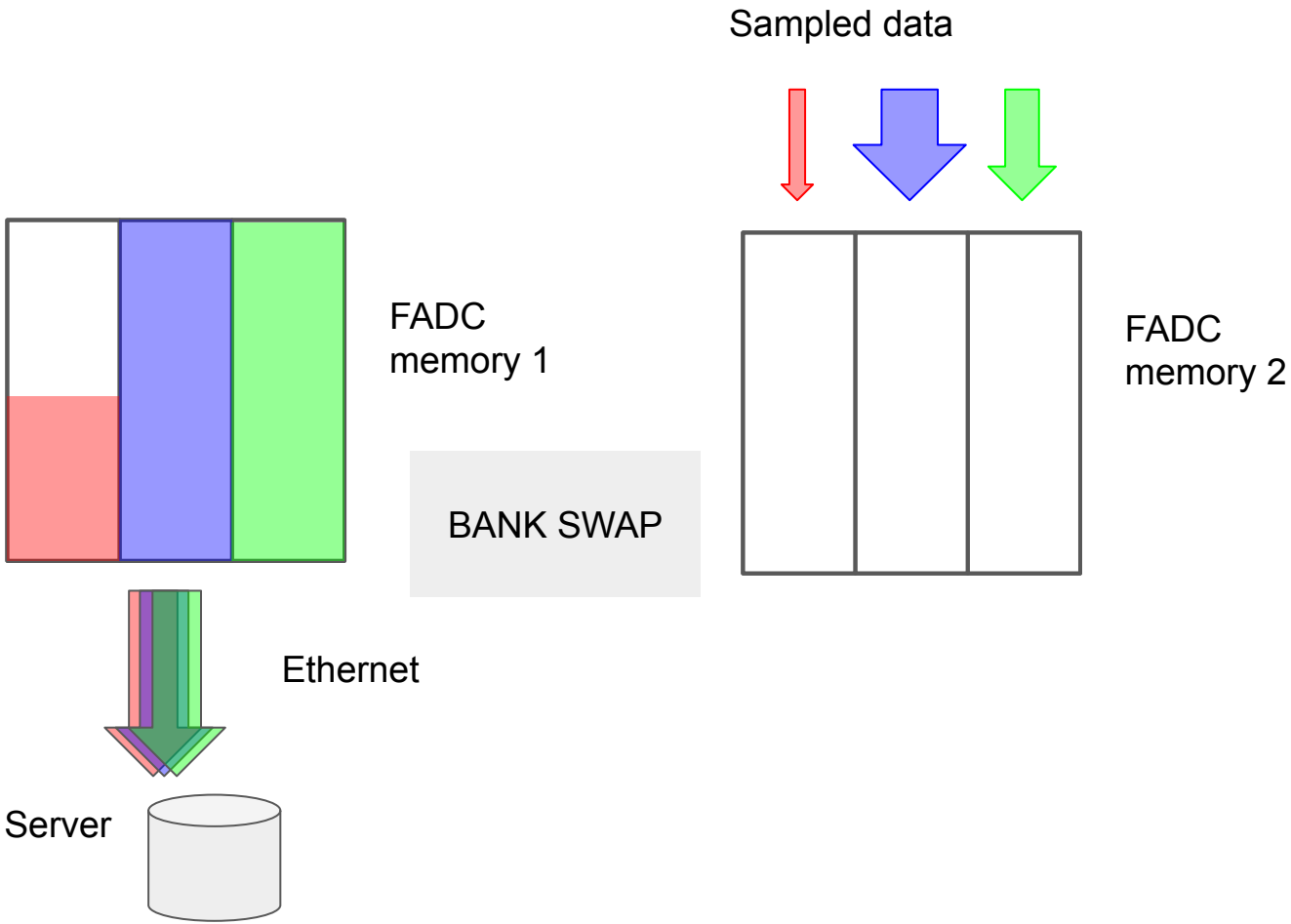
FADC
memory 2

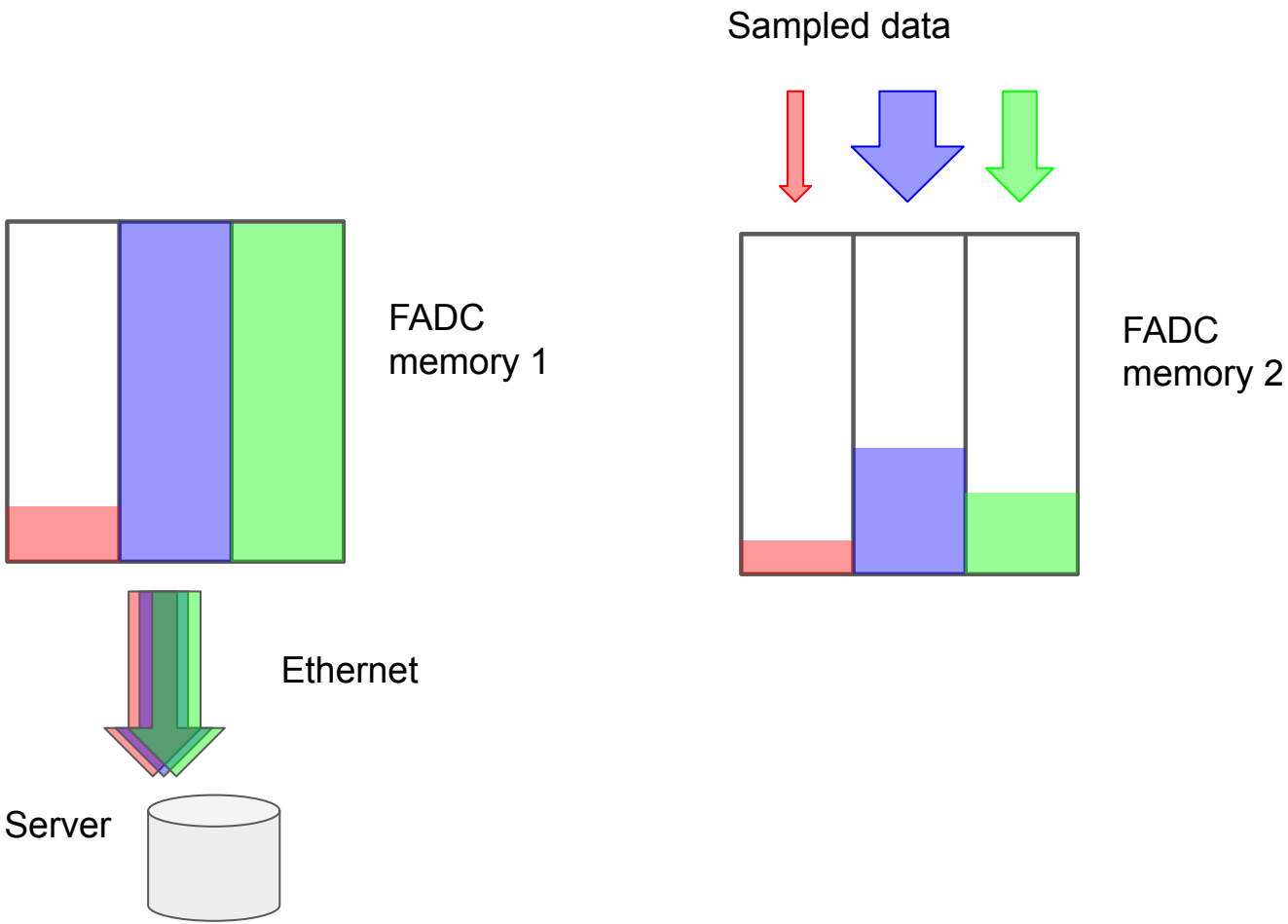


Ethernet

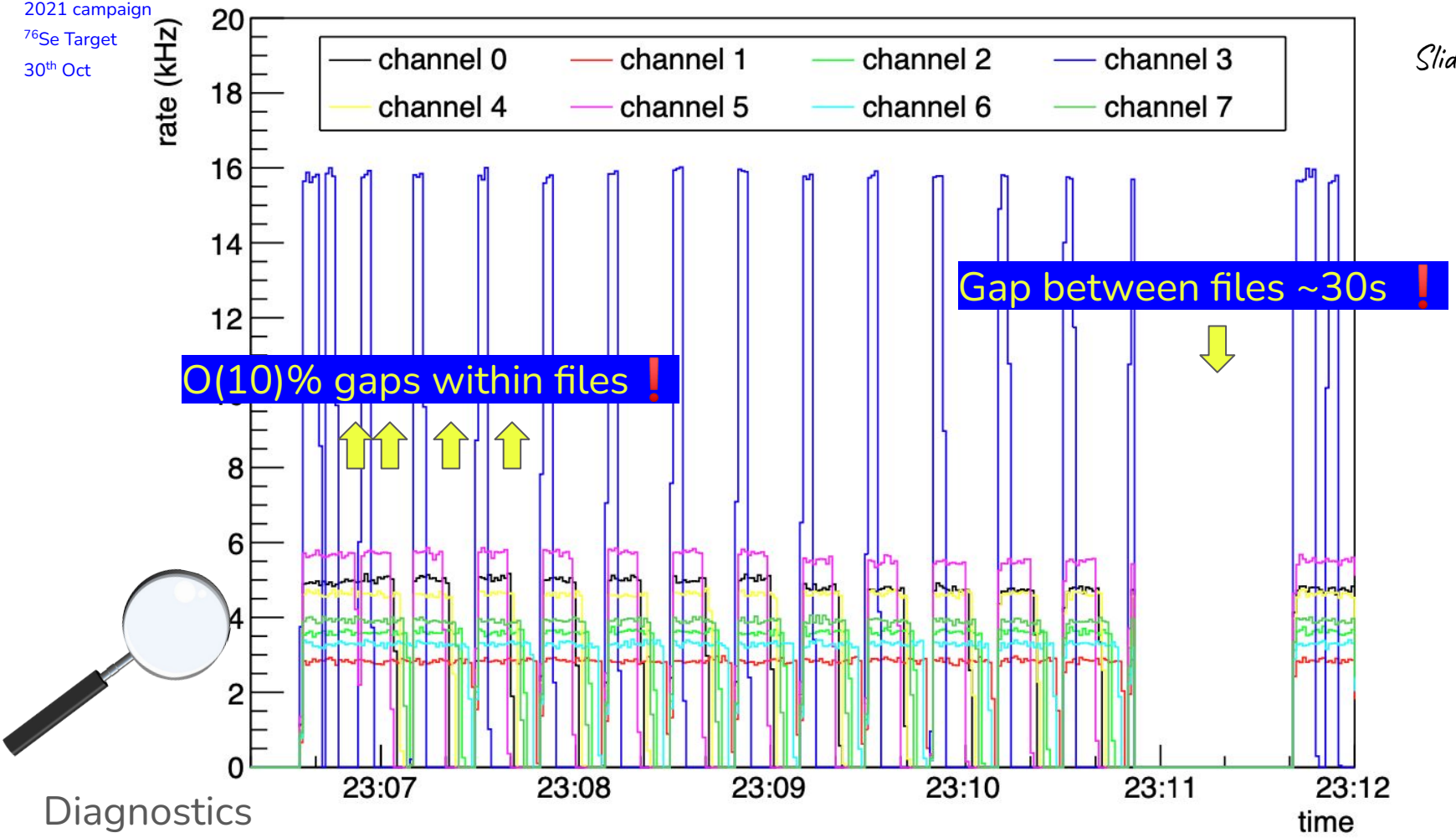
Server




Sampled data
FADC
memory 1
FADC
memory 2
BANK SWAP
Ethernet
Server


Sampled data
FADC
memory 1
FADC
memory 2
Ethernet
Server

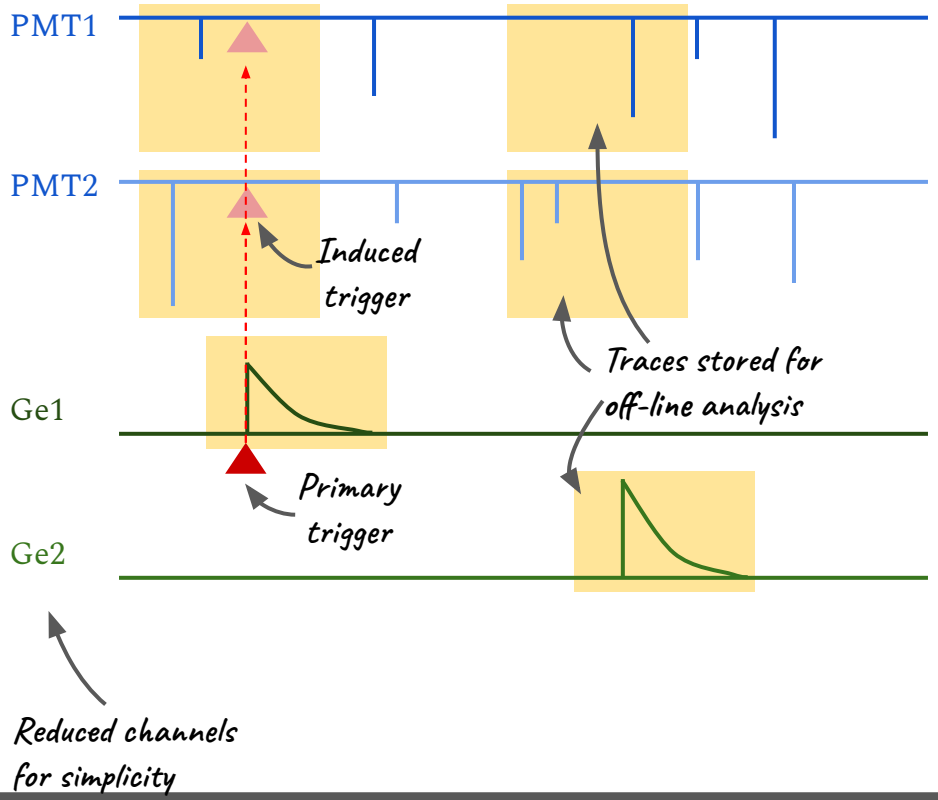
2021 campaign
^{76}Se Target
30th Oct

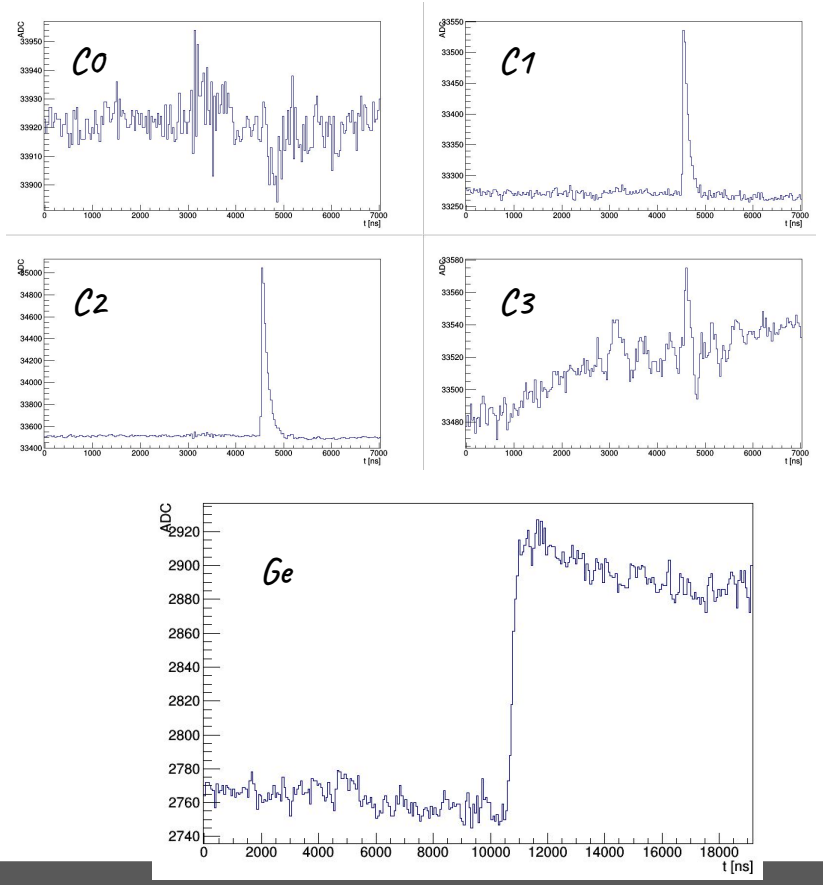


Slide by Eli

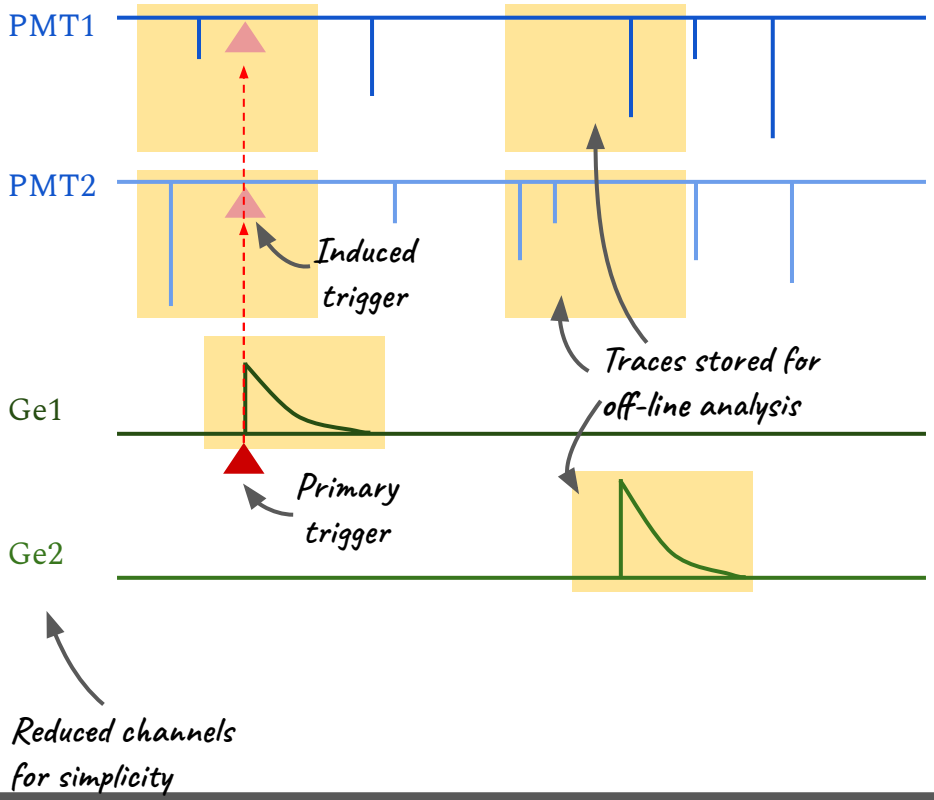
Diagnostics

Quick recap: ALPACA trigger scheme





Quick recap: ALPACA trigger scheme



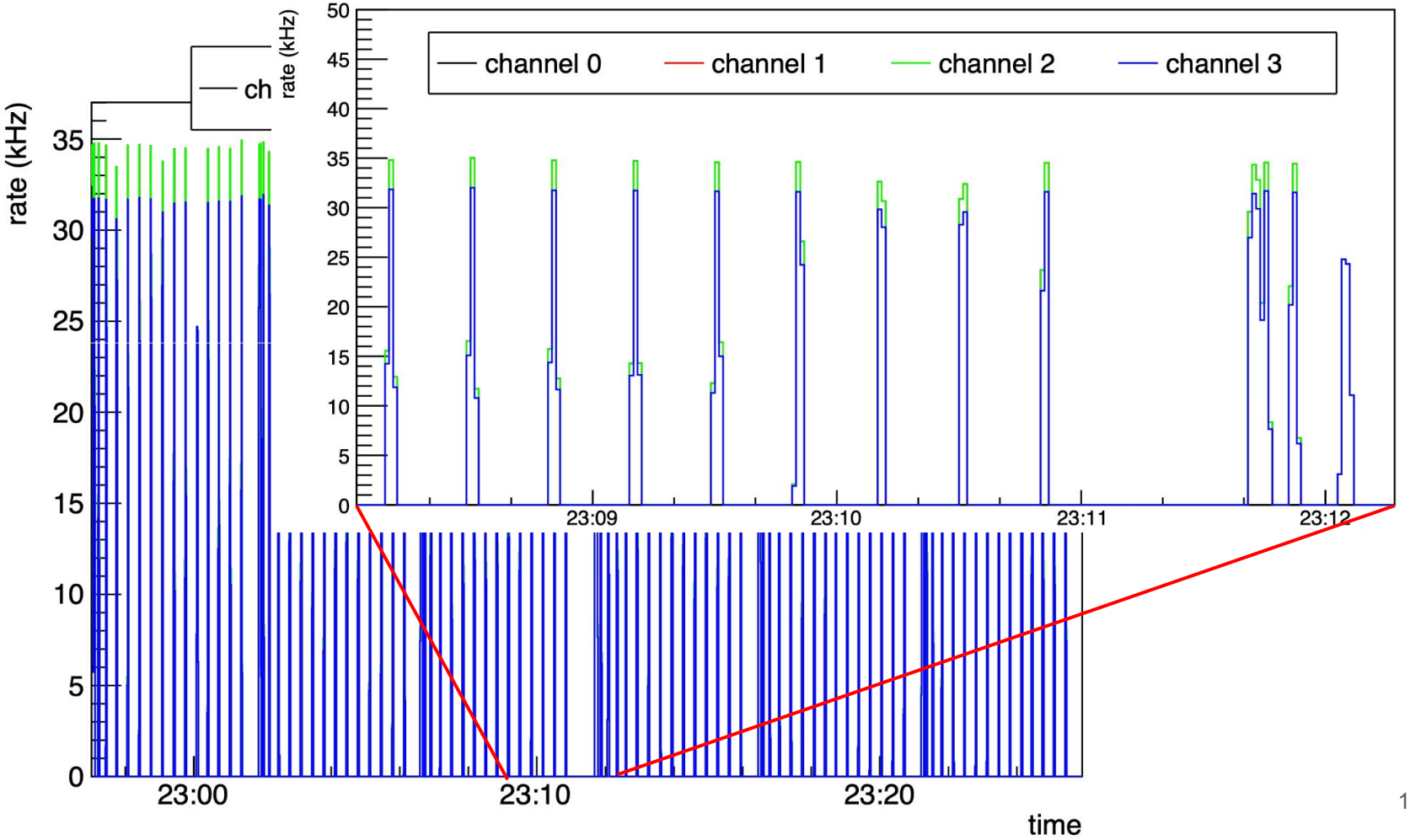
EVERY Ge pulse tries to trigger PMT channels:
→ expect much worse situation for PMTs!

2021 campaign

^{76}Se Target (PMTs)

30th Oct

Slide by Eli

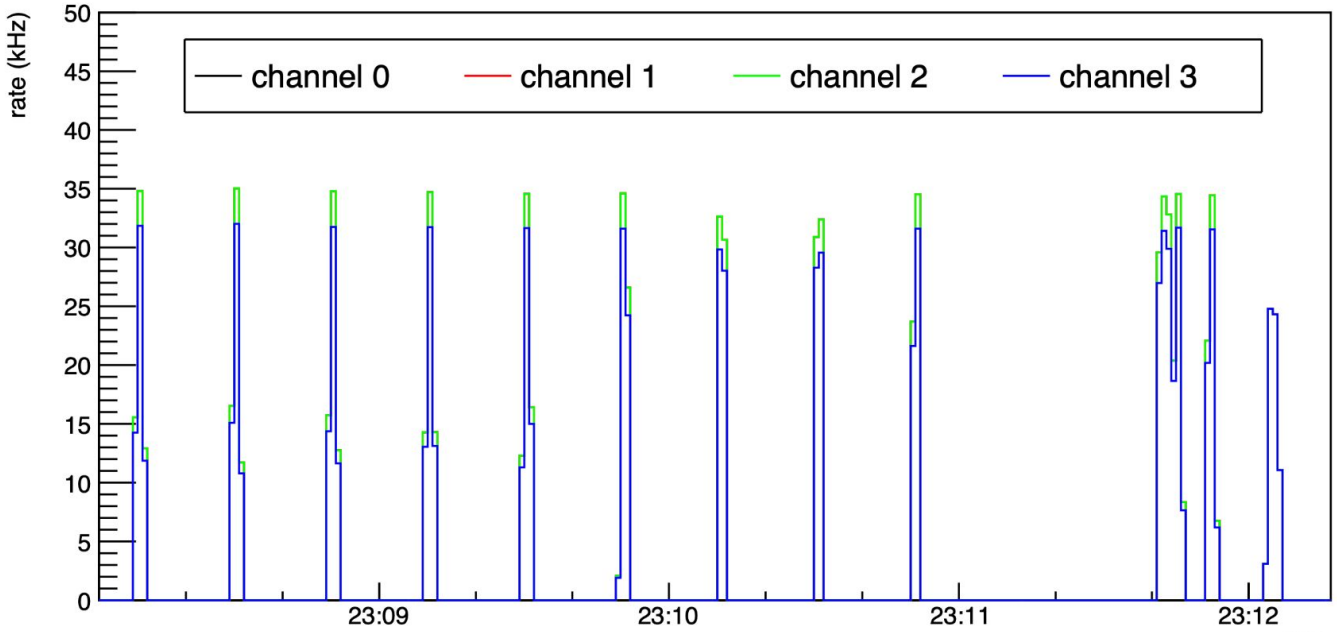


2021 campaign

^{76}Se Target (PMTs)

30th Oct

Plot by Eli



- Only portion of data with PMT usable at all
- Expect same rate for all 4 PMT channels; reason still unclear.

Conclusions

- Very high rates for some Ge detectors in 2021 beam time caused dead-times in ALPACA
- dead-times different for individual detectors
- PMTs much more affected → only fraction of data usable
- Rate differences in individual PMT channels

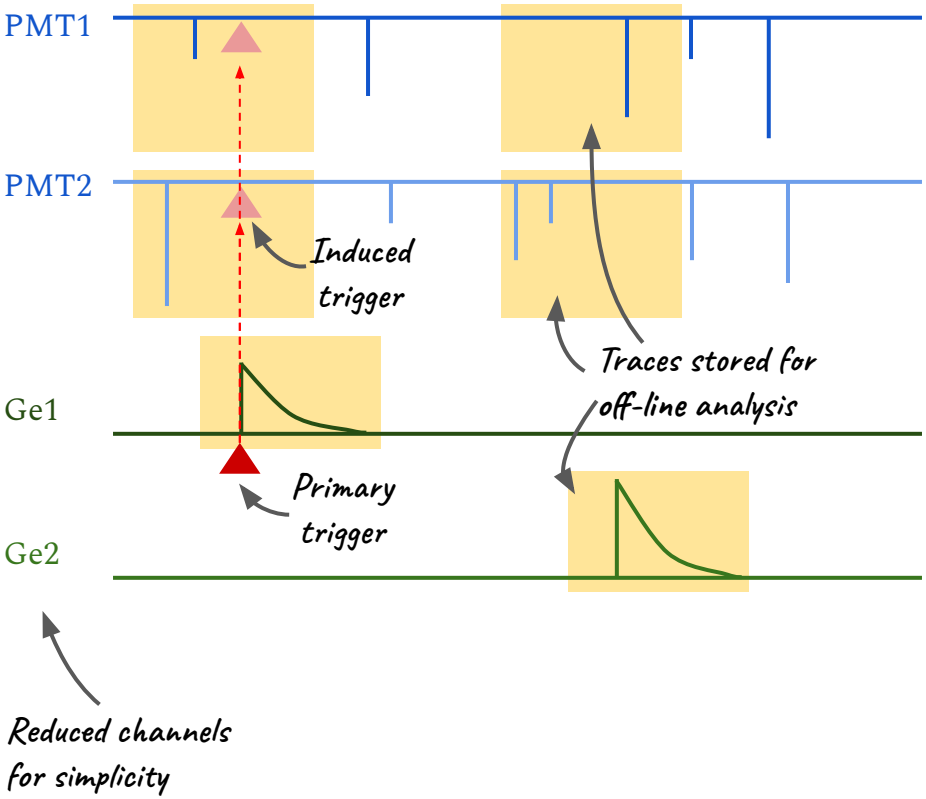
Outlook

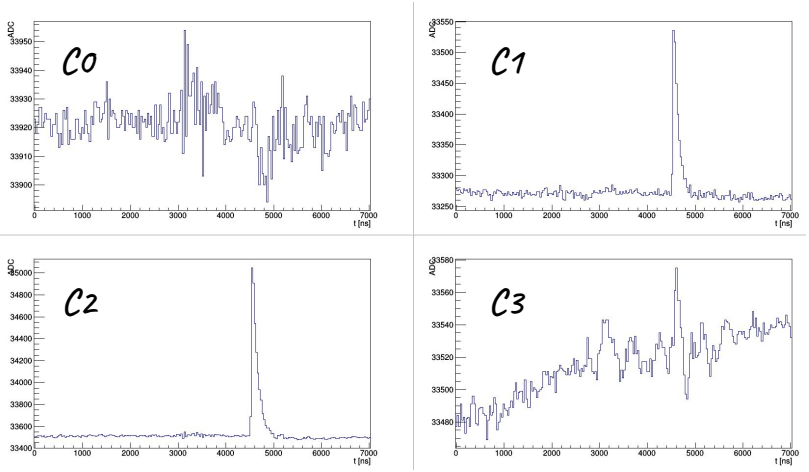
- Thorough testing and benchmarking required for next beam time
- Additions in ALPACA-DAQ:
  - on-line information of dead-time
  - Integrate pulser with more efficiency
- Investigate rate differences in PMT channels
- Next beam-time:
  - Thorough tuning and monitoring to keep rate under control
  - If that turns out impractical: consider running with MIDAS only

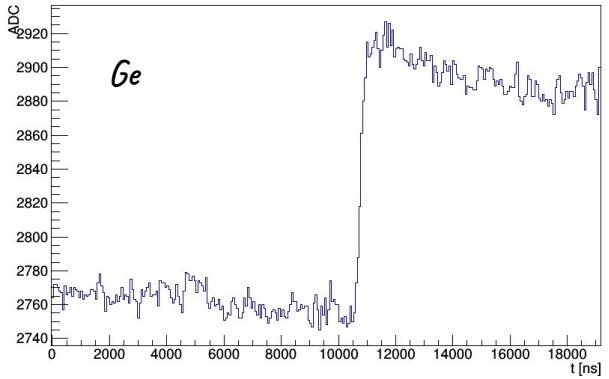
Testing campaign requires additional work-force

Backup

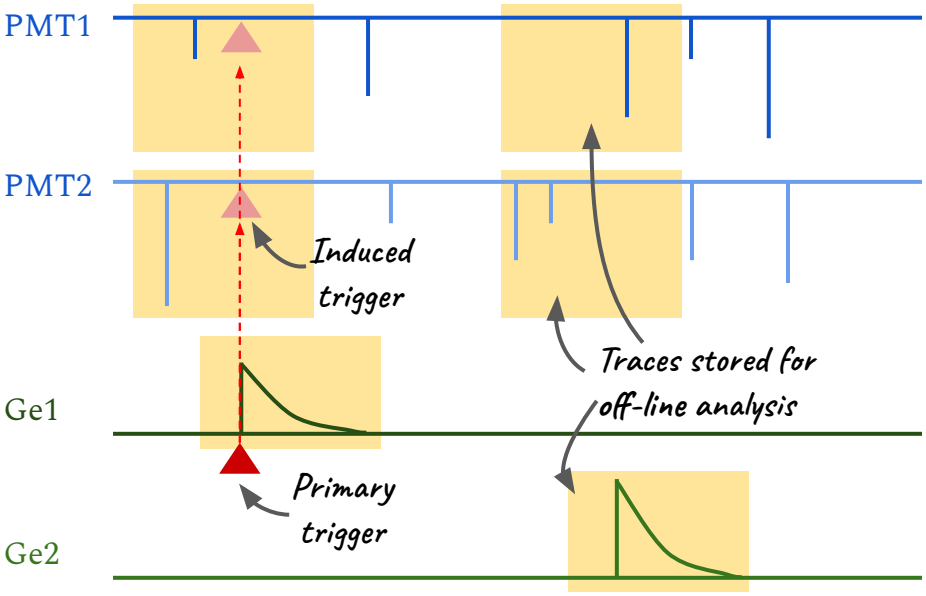
ALPACA


PMT1
PMT2
Induced trigger
Traces stored for off-line analysis
Ge1
Primary trigger
Ge2
Reduced channels for simplicity


C0
C1
C2
C3
ADC
t [ns]


Ge
ADC
t [ns]

ALPACA

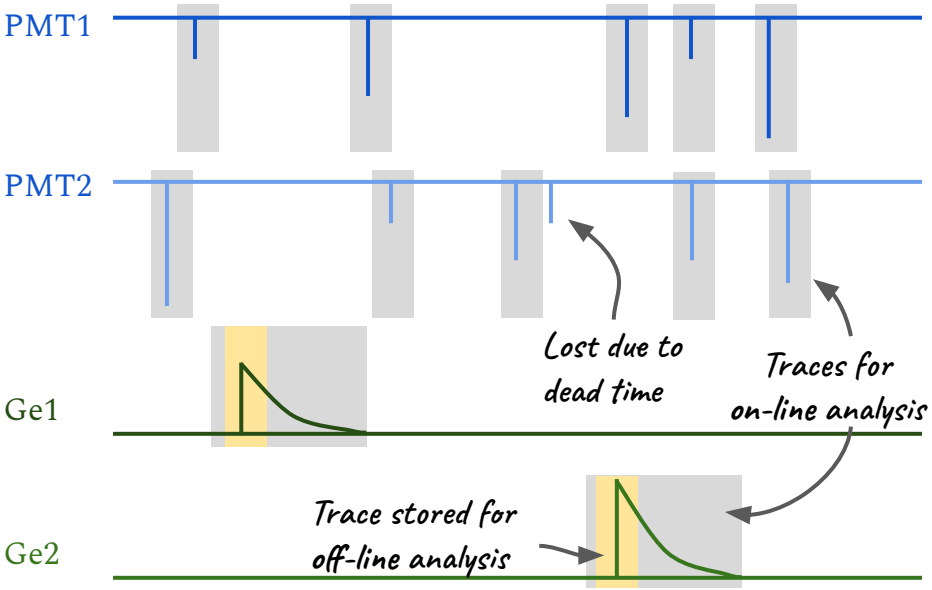


✔ Dead time unproblematic for PMTs

✔ Off-line tuning of energy and time reconstruction

! **Need a lot of fast storage**

MIDAS

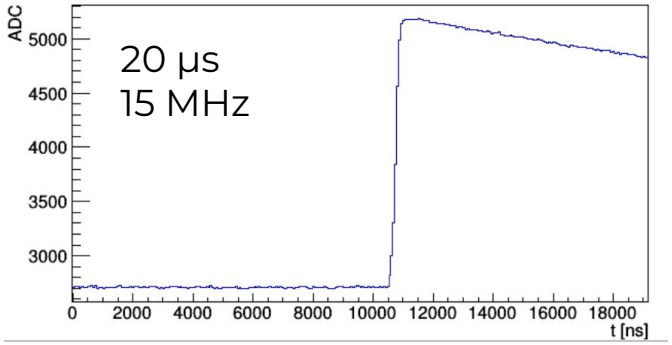


✔ Can handle huge data rates

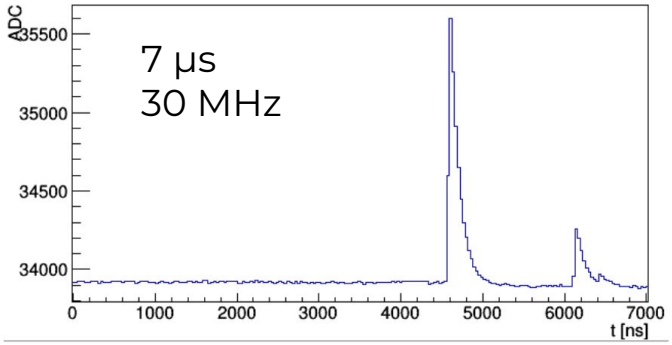
✔ No need for fast storage server

ALPACA traces

Germanium



PMT

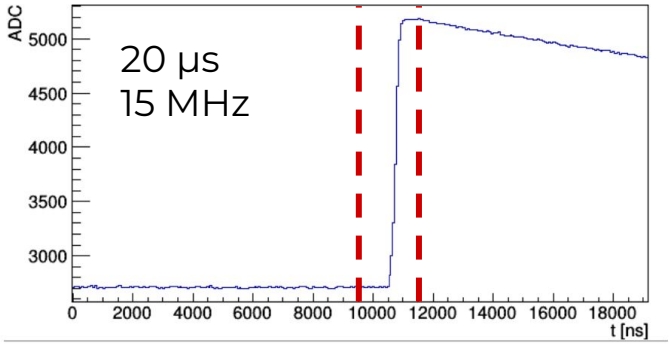


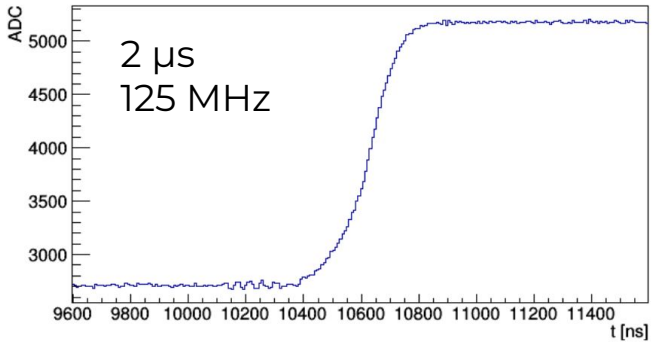
Low Frequency (LF trace)

→ Ge energy determination
→ data reduction

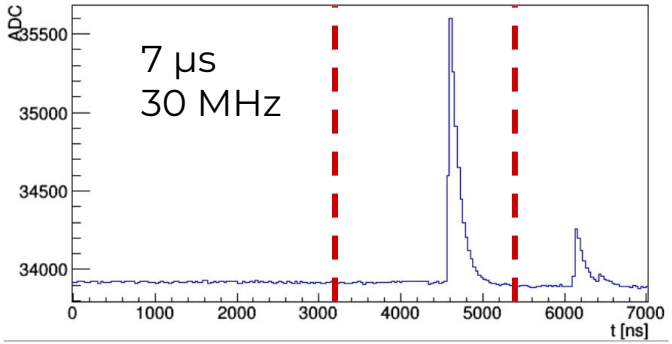
ALPACA traces

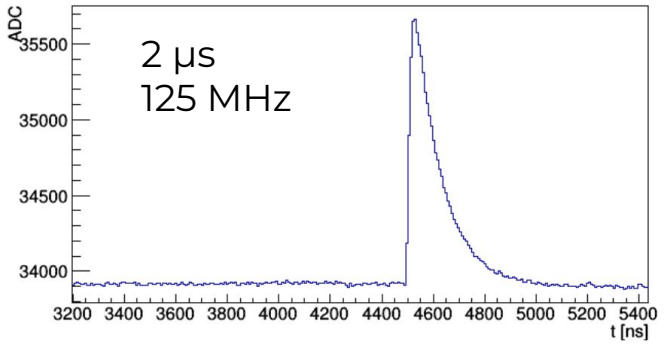
Germanium





PMT





Low Frequency (LF trace)

→ Ge energy determination
→ data reduction

High Frequency (HF trace)

→ Precise timing

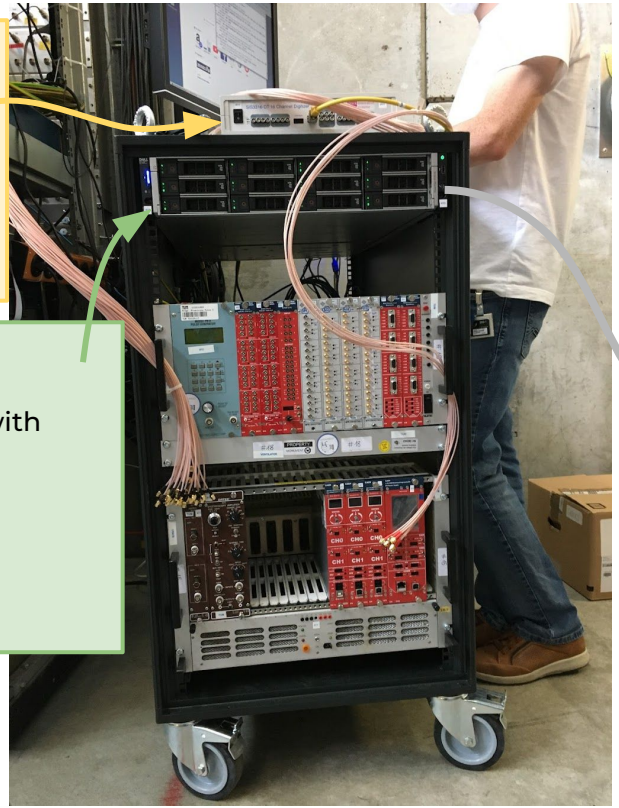
ALPACA-DAQ Hardware

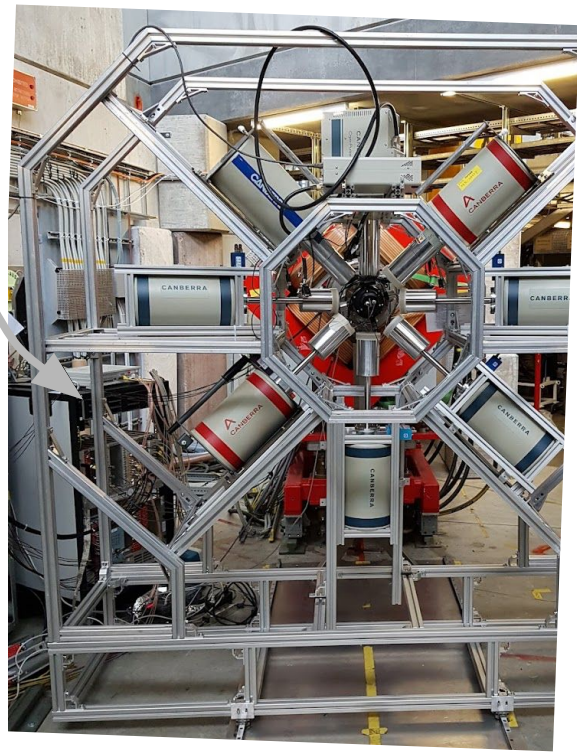
FADC: SIS3316-125-16 from Struck

- standalone device
- read out via Ethernet, data rate up to 700 Mbit/s tested
- 16 input channels
- 125 MHz, 16 bit

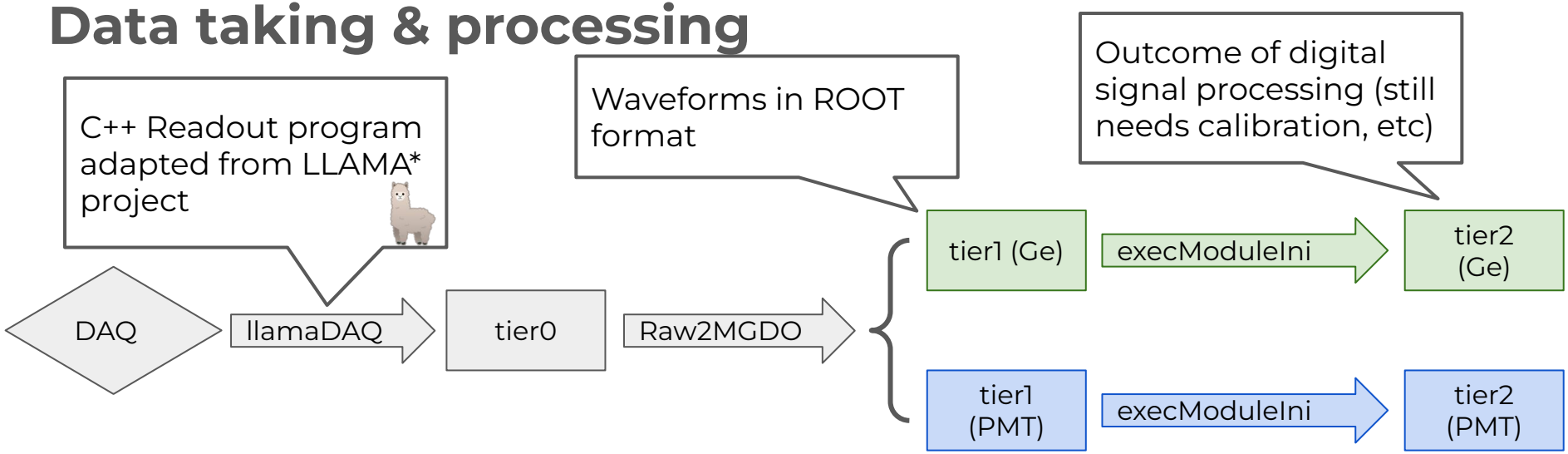
Server

- dedicated ethernet interface for communication with FADC
- ~ 160 TB on HDDs capable of writing raw data with > 700 Mbit/s
- RAID 6 configuration → redundancy
- Data backed up at TUM now





Data taking & processing



* **L**EGEND **L**iquid **A**rgon **M**onitoring **A**pparatus

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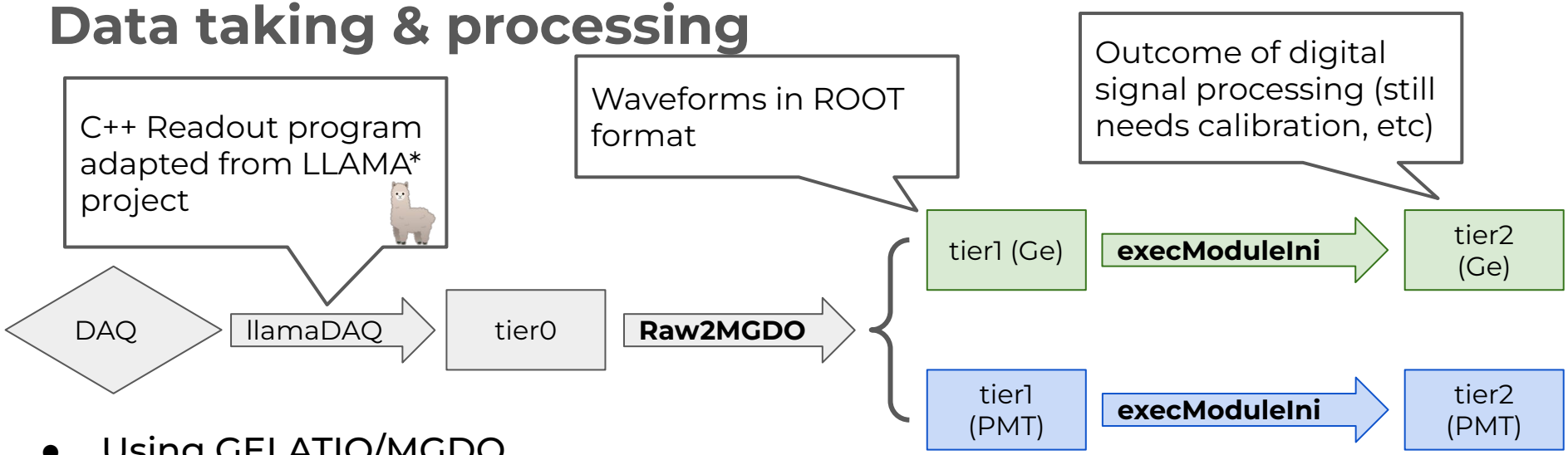


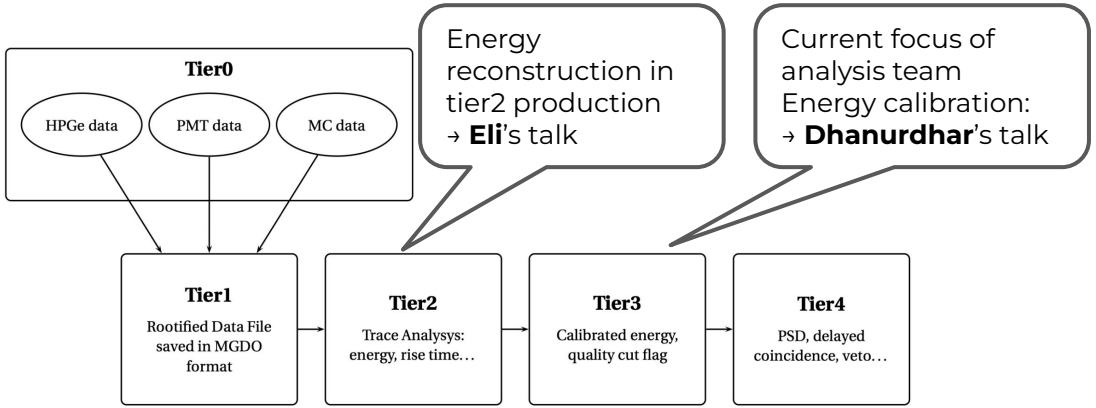
- Using GELATIO/MGDO
- Implementation of custom digitizer module necessary for technical reasons
  - Implemented “ALPACA” and “ALPACAPPM” modules** for Ge and PMT channels
  - available as container in monument server

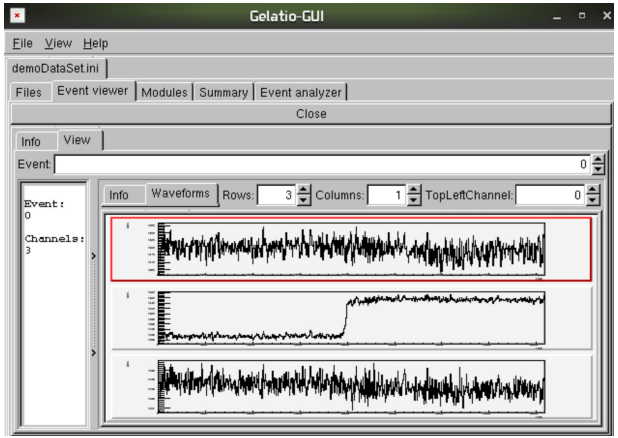
Data structure → **Elisabetta**’s talk

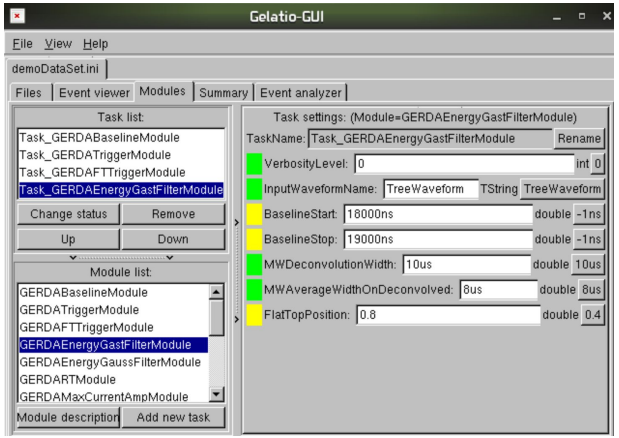
* **L**EGEND **L**iquid **A**rgon **M**onitoring **A**pparatus
** **A**dapted **L**lama **P**rogram for **AC**celerator **A**pplications

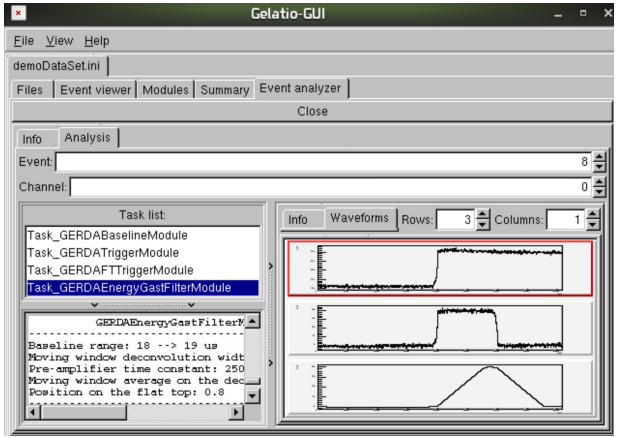
Data processing

á la Gerda









[M Agostini *et al* 2011 JINST 6 P08013]

DAQ Channel map

… of a late run, e.g. Se^{76}

Channel	Device	Triggers PMTs?
1	Ge 1	yes
2	Ge 2	yes
3	Ge 3	yes
4	Ge 4	yes
5	Ge 5	yes
6	Ge 6	yes
7	Ge 7	yes
8	Ge 8	yes
9	Detector 9 (background)	no
10	Proton counter	no
11	Pulser	no
12	<empty>	no
13	C0	-
14	C1	-
15	C2	-
16	C3	-

2021 DAQ Channel map

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