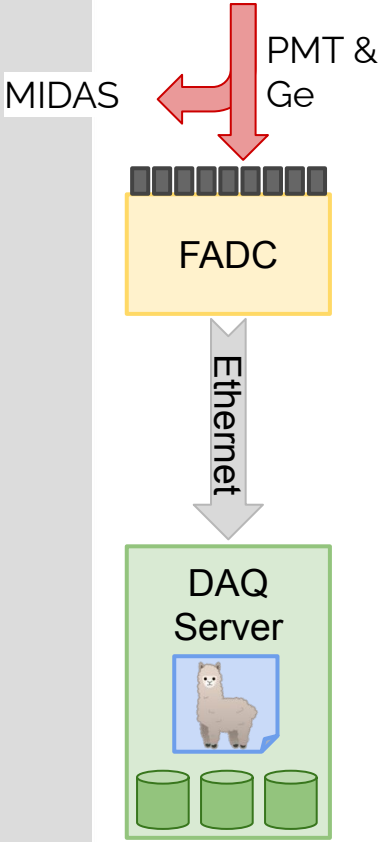
OMC4DBD:
DAQ and trigger scheme

Mario Schwarz for the OMC4DBD DAQ group

DAQ setup



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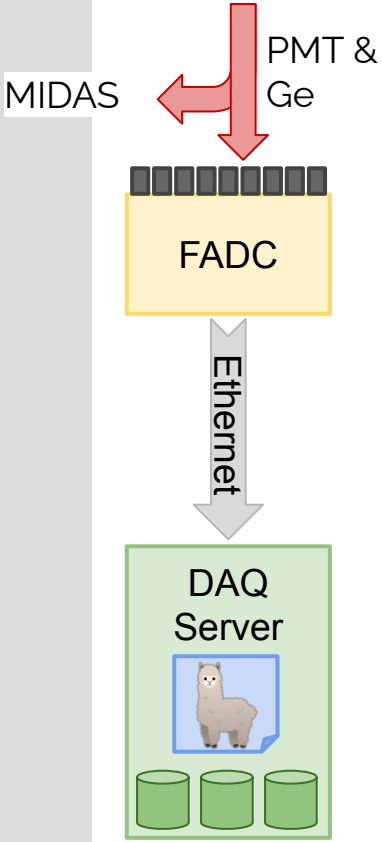
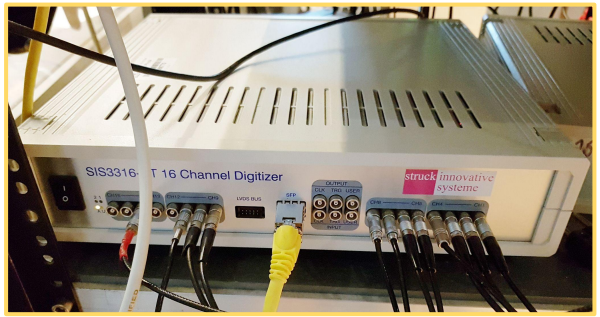


FADC: SIS3316-125-16 from Struck
- standalone device
- read out via Ethernet, data rate up to 700 Mbit/s tested
- 16 input channels
- 125 MHz, 16 bit



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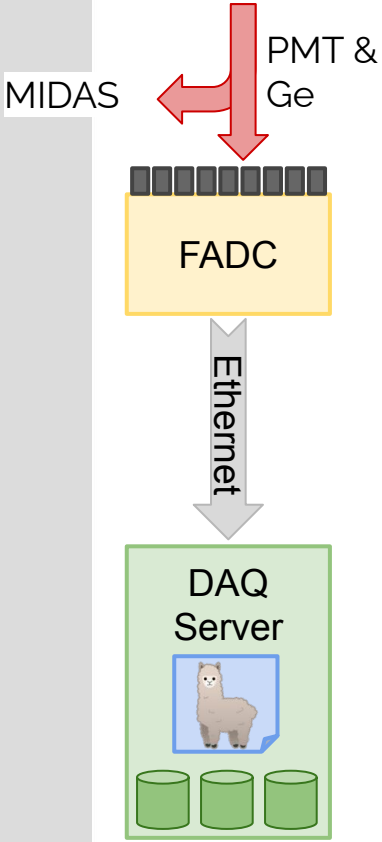

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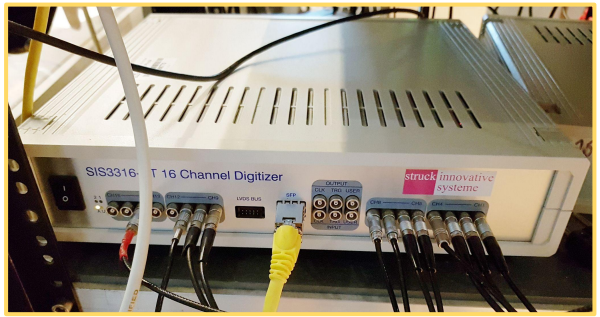

Server
- to be ordered soon
- dedicated ethernet interface for communication with FADC
- ~ 100 TB on HDDs capable of writing raw data with > 700 Mbit/s

700 Mbit/s x 150 hours
→ ~ 50 TB

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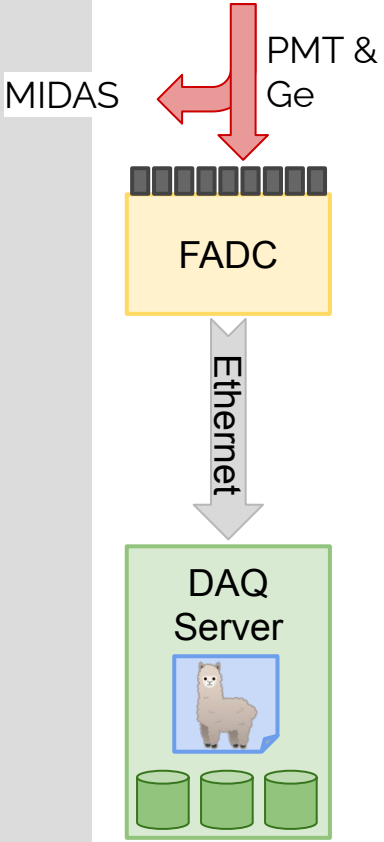

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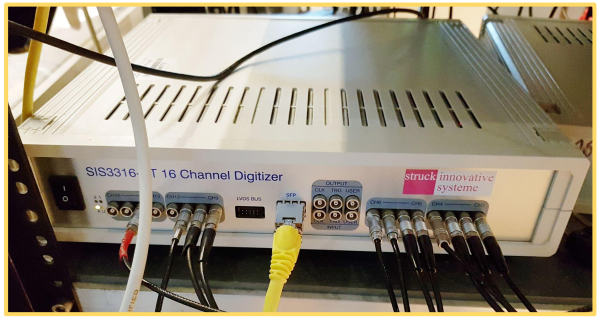

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Software: llamaDAQ program
- developed by myself for the LEGEND Liquid Argon Monitoring Apparatus (LLAMA)
- extensible, flexible, modular
- adjustments and thorough testing in upcoming weeks

Server choice - In contact with SysGen

Form factor		HDD space (gross)	HDD slots (3.5“) [spare]	Interfaces	Net price
Standalone		112 TB	8	1 x 1 GbE 1 x 10 GbE	4.5 k€
19” rack	1U	48 TB	4	?	3.3 k€
	2U	128 TB	12 [4]	1 x IPMI 2 x 10 GbE	4.75 k€ (+ 360 €)*
	3U	128 TB	16 [8]	1 x IPMI 2 x 10 GbE	4.95 k€ (+ 360 €)*
	4U	96 TB	24 [16]	1 x 1 GbE 1 x 10 GbE	5.2 k€

- All options have 8 Core CPU, 16 threads, ~ 3 GHz
- Hardware RAID for HDDs (considering level 6)
- ~ 3 Weeks delivery time

*for more RAM (96 GB, for performance reasons)

Data taking: what we expect to see

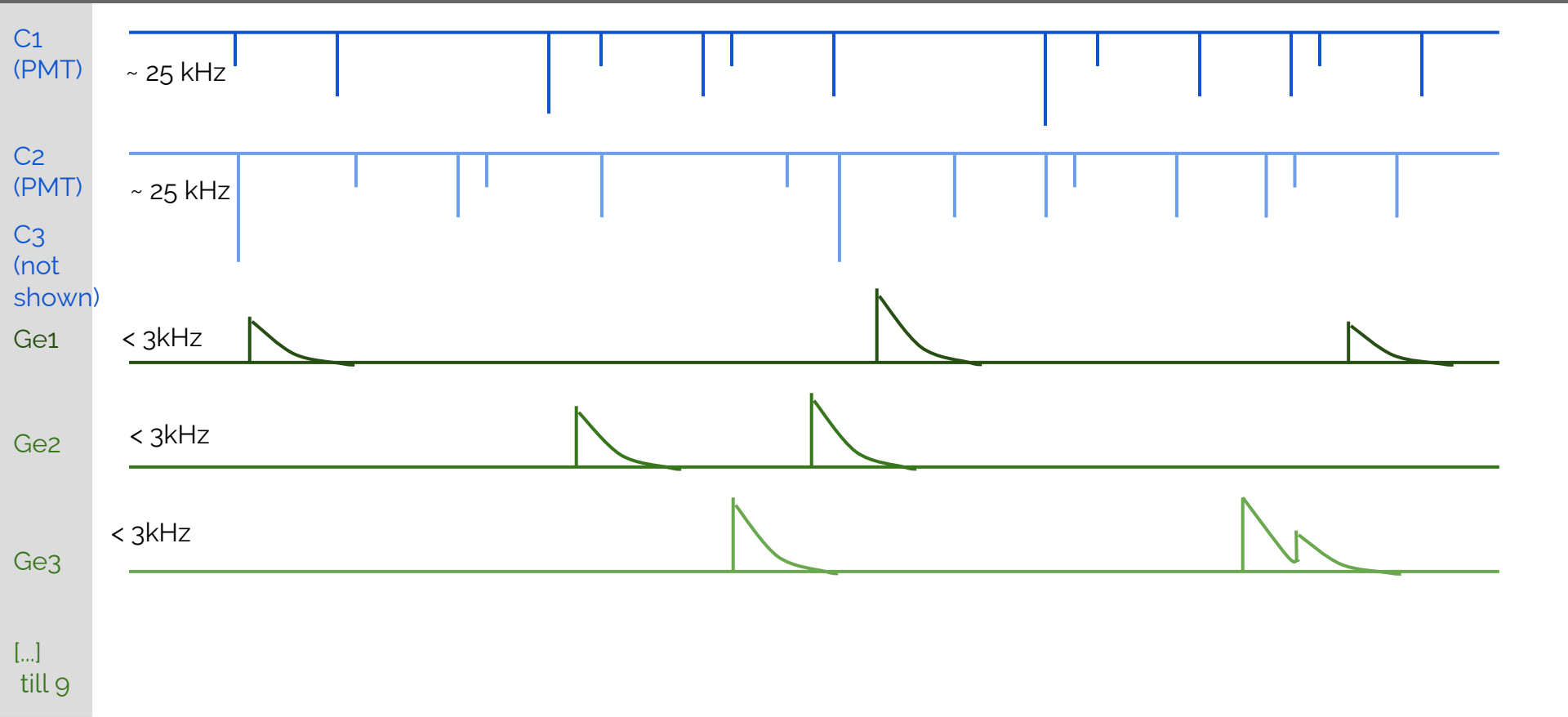
Table from Igor's talk at 16th of February

→ make conservative estimation, that each Ge sees not more than 3 kHz;

PMTs see about 25 kHz (from events)

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 ENTRANCE WINDOW	27586.7	113.969	0.00413132
DETECTOR	EVENTS PER SEC	PILEUPS PER SEC	%, PILEUPS/EVENTS

Data taking: what we expect to see



Trigger solutions

Investigating two different approaches:

1) “GERDA/LEGEND” style approach
   - record full waveforms of Ge and PMTs @ trigger in Ge → time & energy off-line
   - separation of waveforms in high- and low-frequency traces for rate reduction
   - baseline approach

2) “Beam experiment” style approach (MIDAS-like)
   - trigger Ge and PMT individually
   - only small traces; energy reconstruction online (maybe)
   - backup solution

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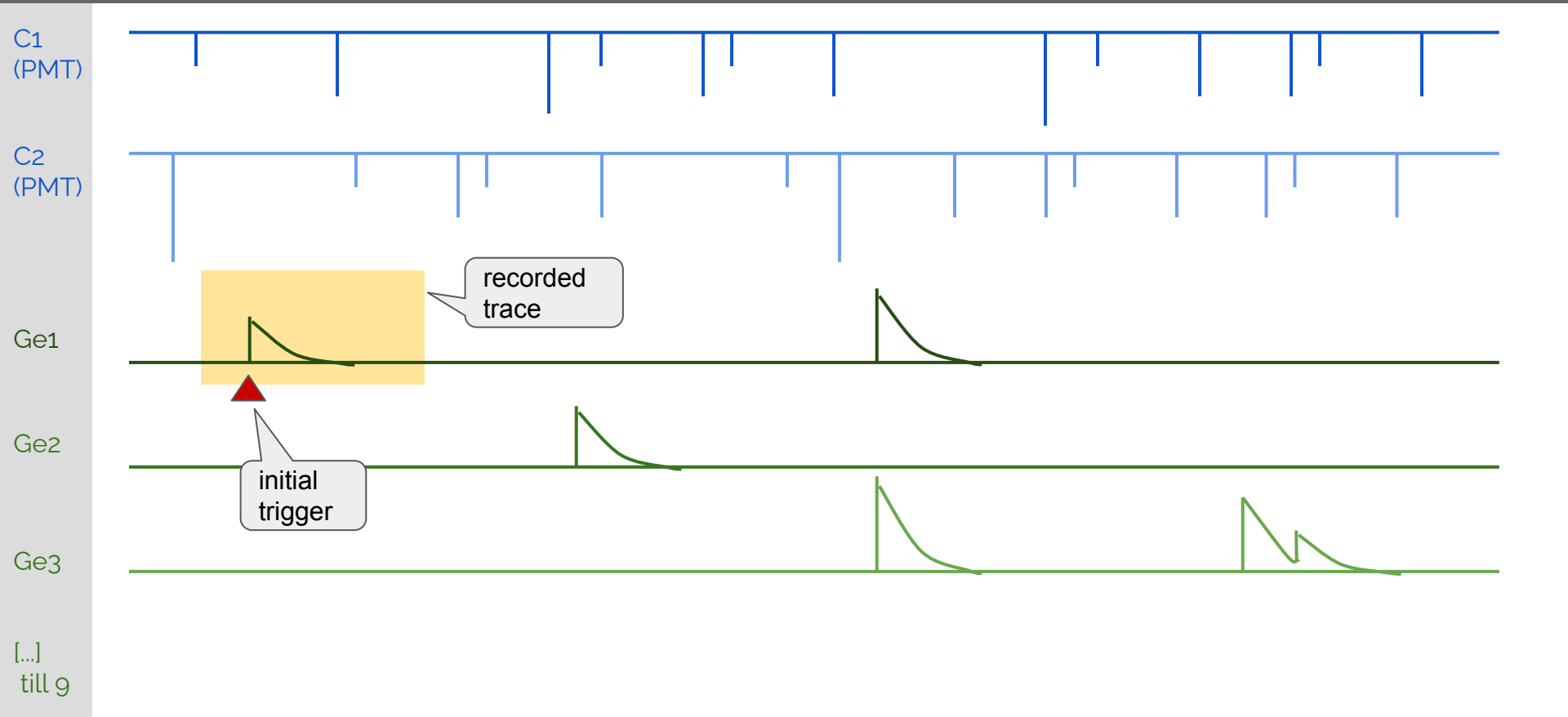
trigger solution 1: record PMT traces at Ge signal



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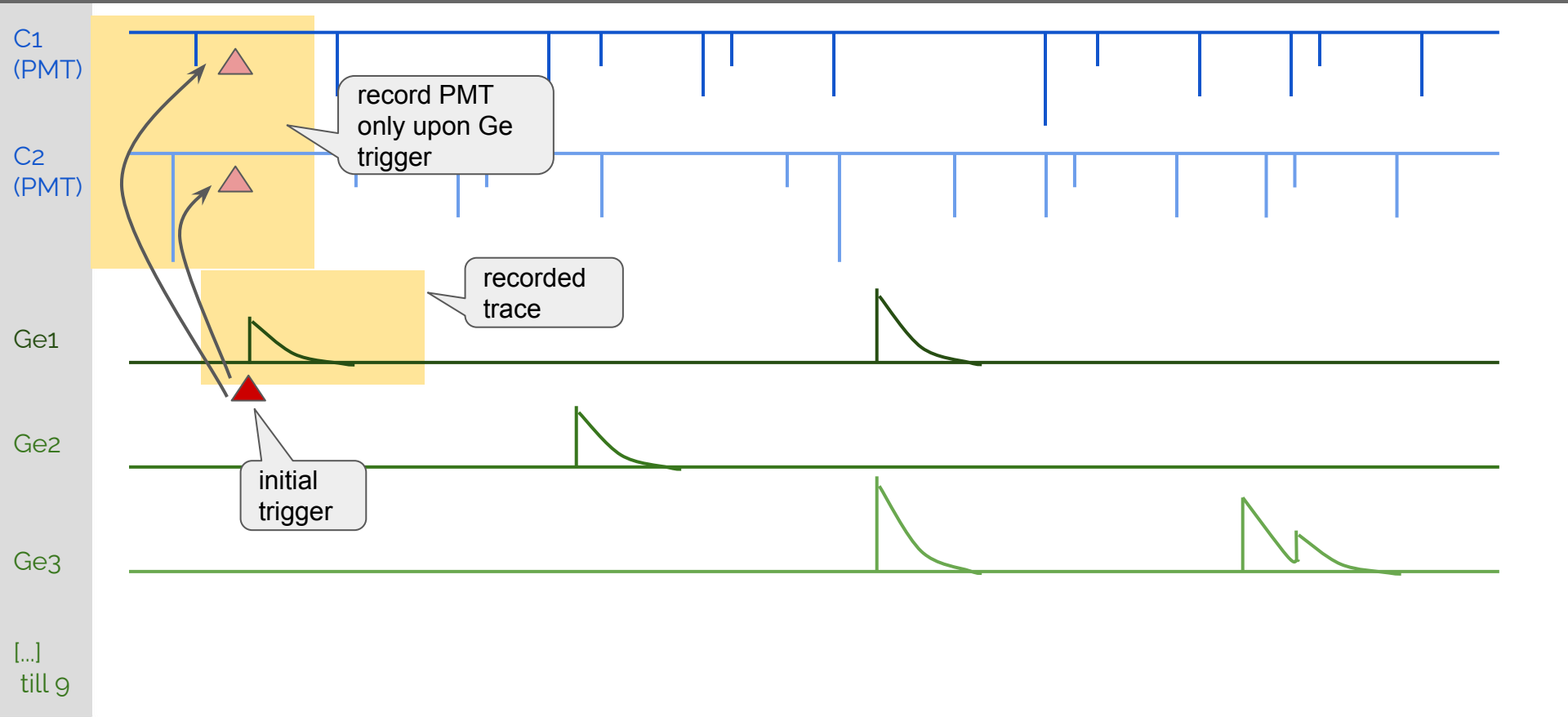

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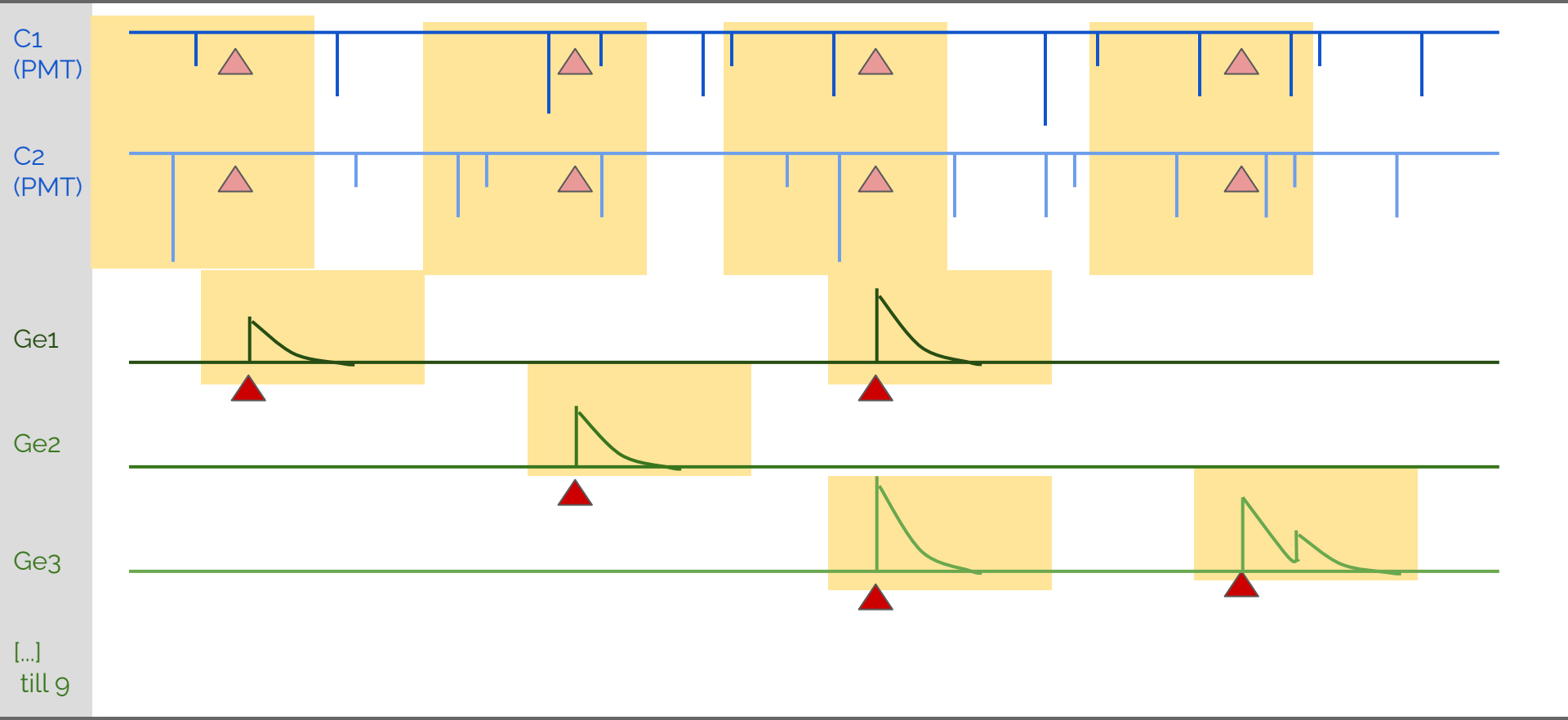
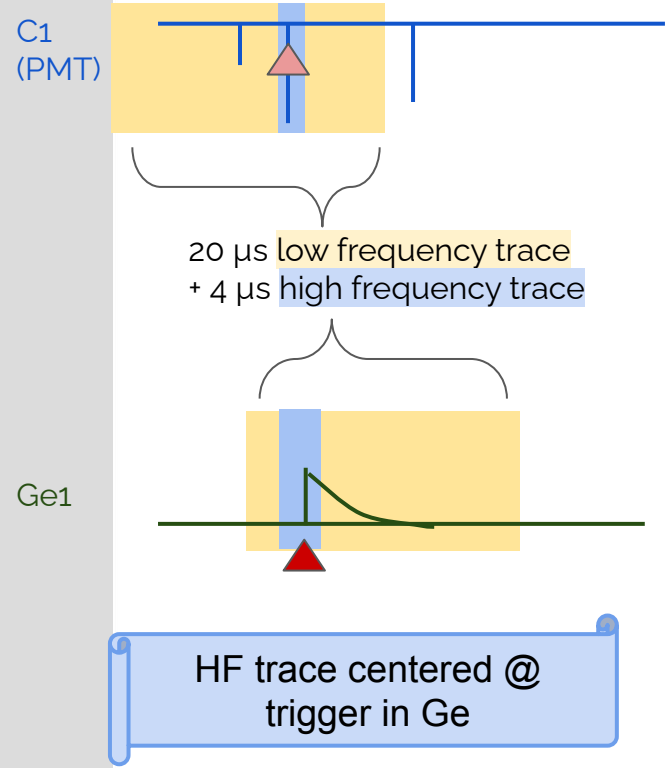


Record two traces per event and channel



Low frequency trace: ~ 30 MHz | 600 samples | 1.2 kB
High frequency trace: 125 MHz | 500 samples | 1 kB

For one **waveform** (two traces) = **2.2 kB**
For one **event** (Ge trigger): 2.2 kB x 4 = **8.8 kB**

1 Ge (triggered) + 3 PMT

Data rate (estimate): 9 x 3 kHz x 8.8 kB = **1900 Mbit/s**

Ge

Rate in Ge

1900 Mbit/s > 700 Mbit/s ...
→ in touch with Struck for on-board compression (saves factor >= 2)
→ sampling rate reduction possible
→ Ge rate (and number) over-estimated

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   - baseline approach

2) “Beam experiment” style approach (MIDAS-like)
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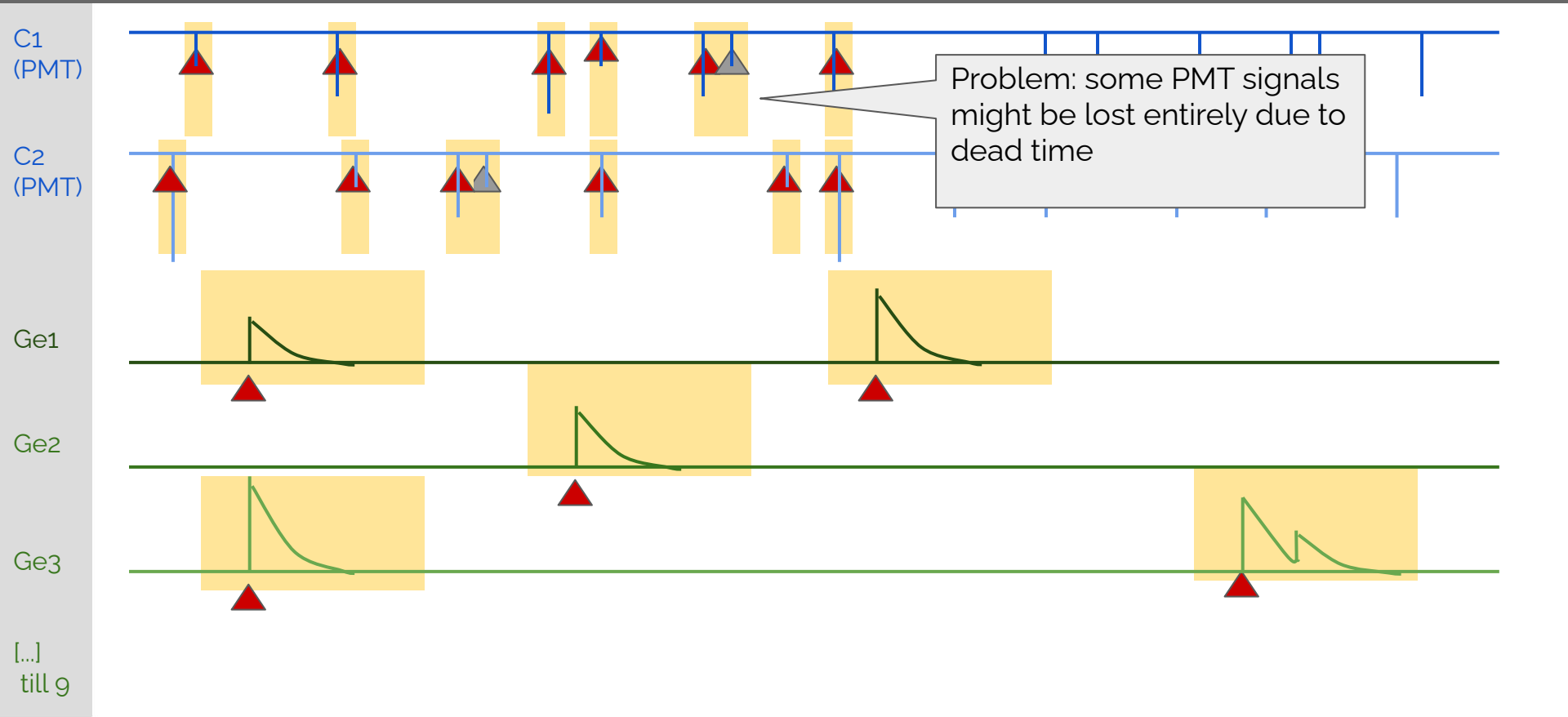
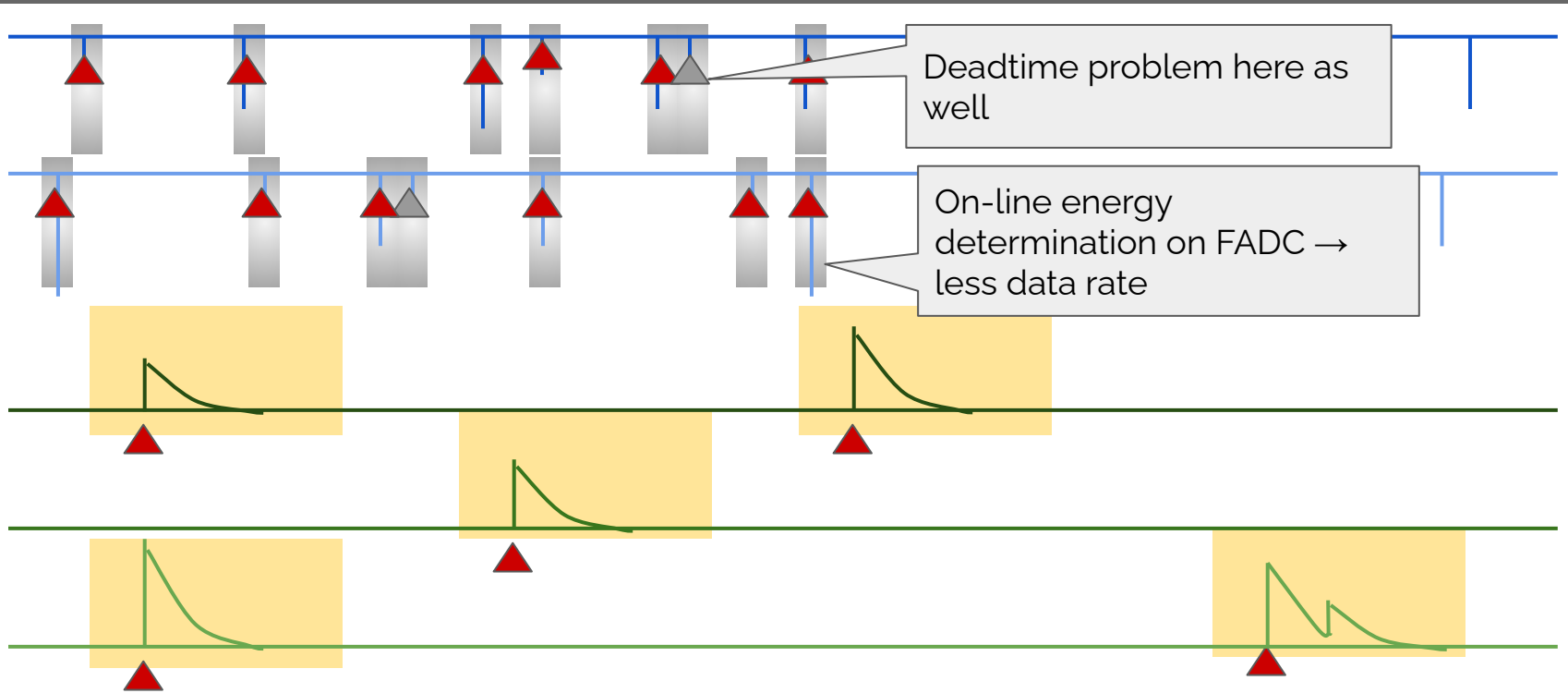
   - only small traces; energy reconstruction online (maybe)
   - backup solution

trigger solution 2: record PMTs individually as well



trigger solution 2.1: from PMTs only record on-line energy & timestamp



Conclusion

Developing DAQ for MONUMENT at TUM using

- SIS3316-125-16 FADC
- Standalone readout server (to be ordered soon)
- llamaDAQ software from LLAMA project

Two trigger/readout schemes

1) “GERDA/LEGEND” style as **baseline** solution
2) “Beam experiment” style as **backup** solution