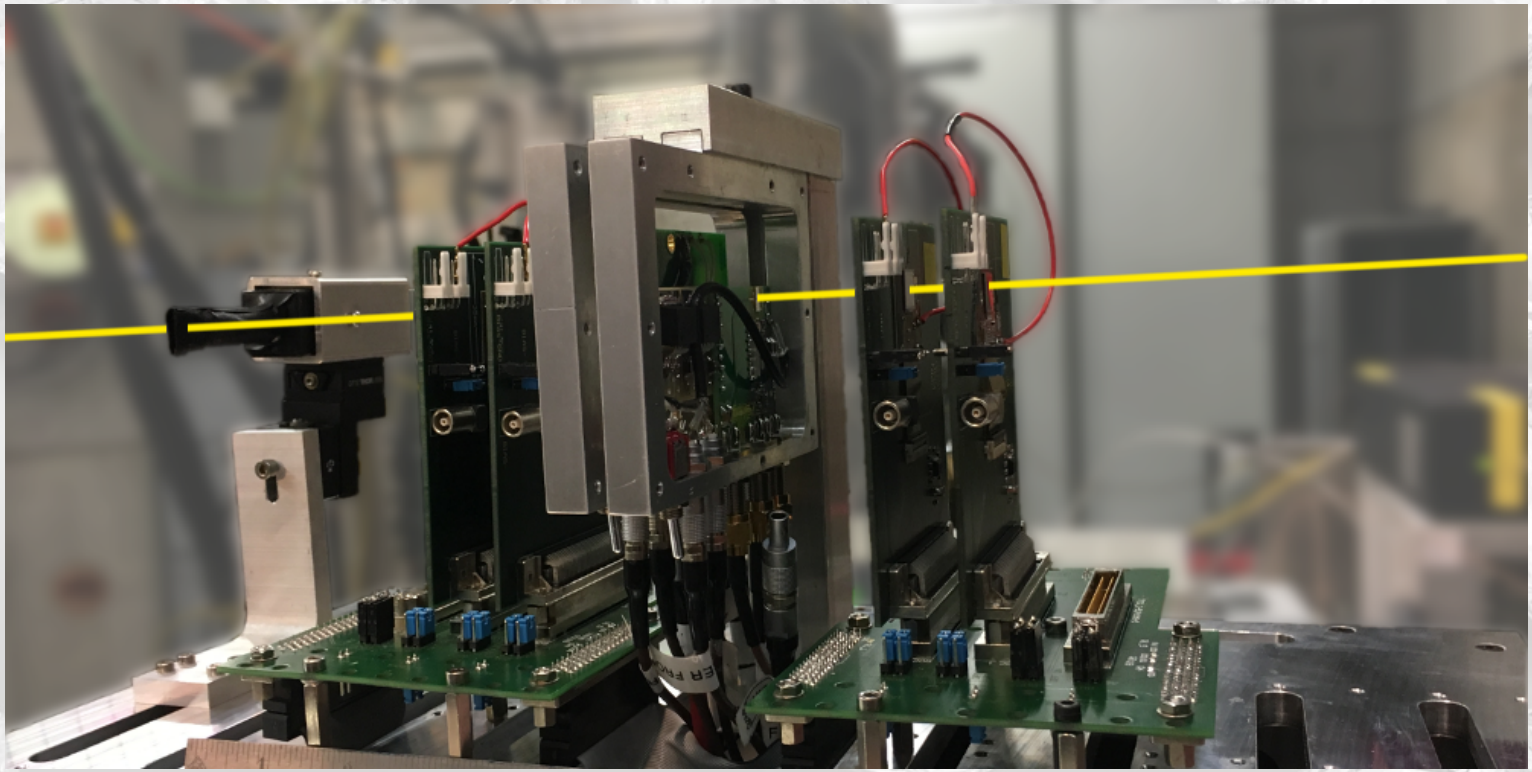

High Rate Beam Telescope Based on CMS Pixels

Michael Reichmann

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Section 1

Motivation

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- High Luminosity LHC requires more radiation hard detector material or design for innermost layers
- diamond detectors possible candidate $\rightarrow$ very promising properties
- BUT: rate dependence of the signal in single crystalline diamonds (PLT in CMS)

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- beam line πM1 with 260 MeV/c positive pions (π^+) at Paul Scherrer Institut (PSI)
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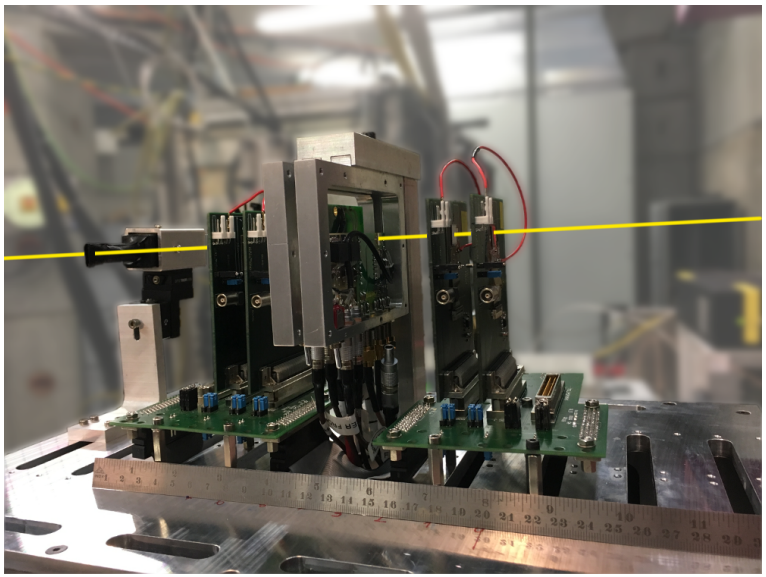
Requirements:

- small, modular and flexible beam telescope
- high rate continuous data taking
- precise trigger timing

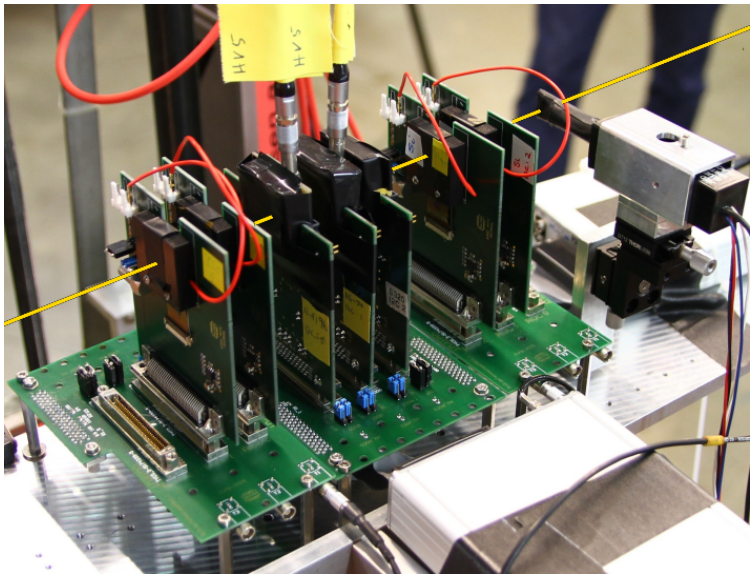
Section 2

Telescope Hardware

Setups



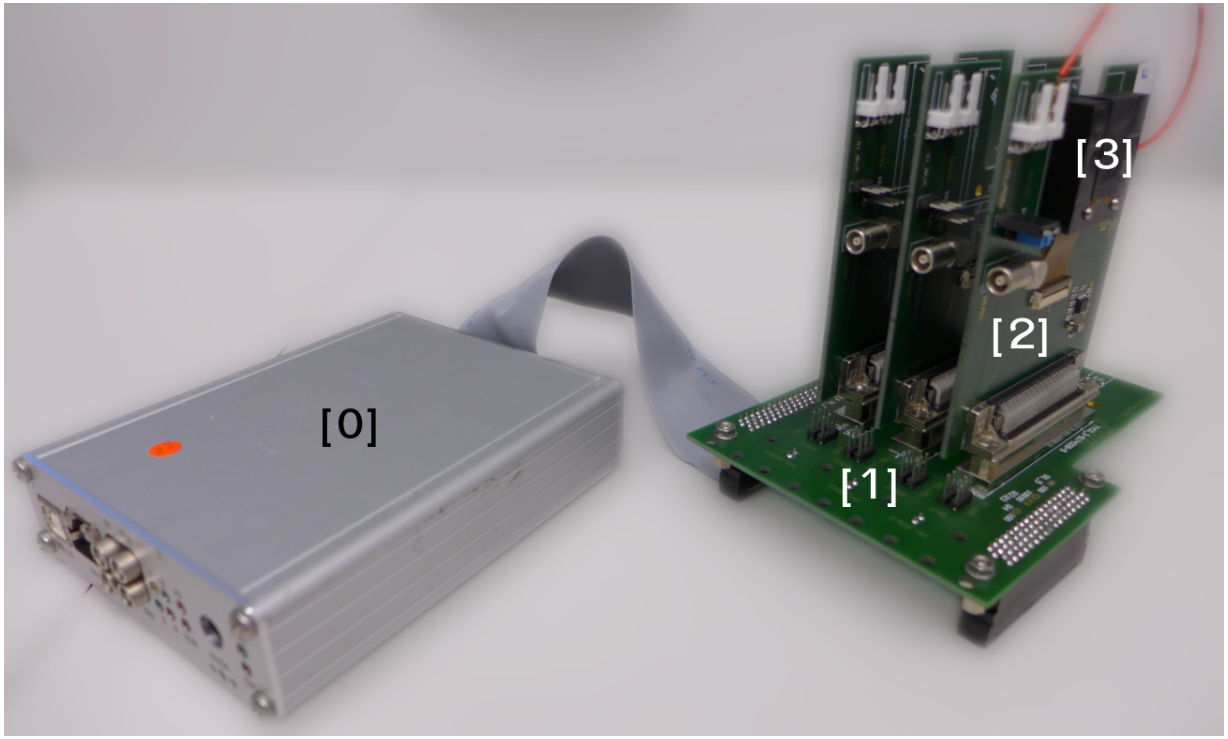
(a) pad setup



(b) pixel setup

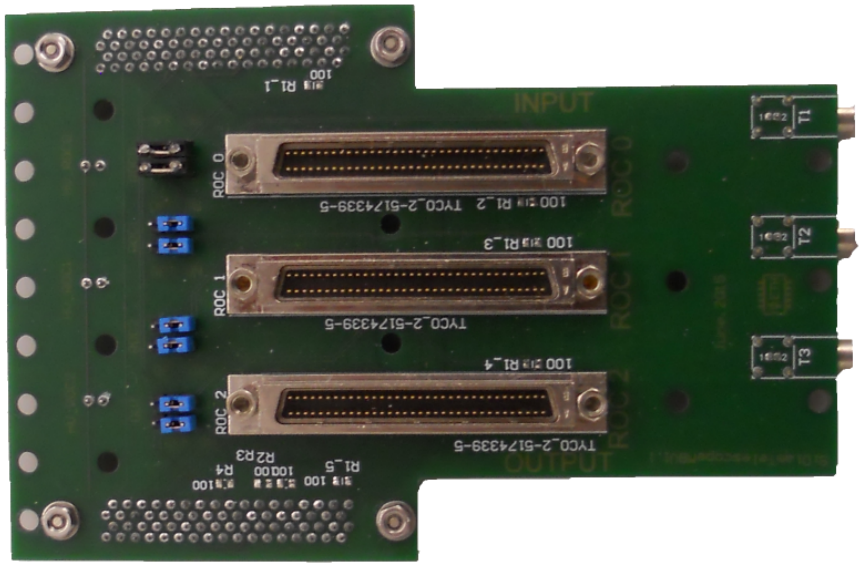
- pad setup: testing whole diamond as a single readout device
- pixel setup: testing diamond as sensor material on CMS-Pixel Chips

Telescope Module

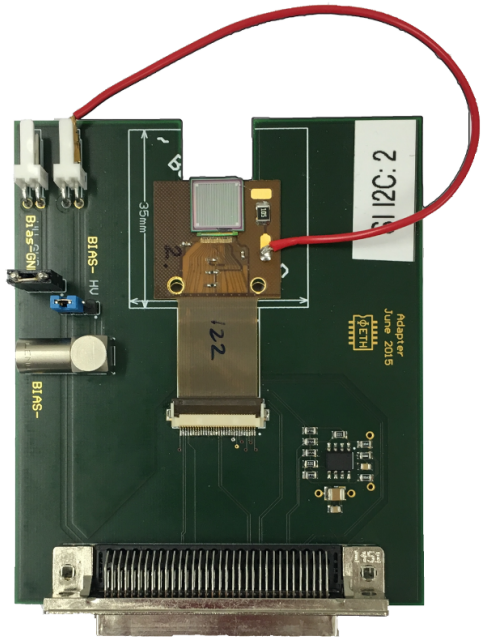


- [0] Digital Test Board (DTB): interface to a computer
- [1] Motherboard: main frame of the telescope
- [2] Adaptor Planes: interface to the single pixel chips
- [3] CMS Pixel Chip

Telescope Parts



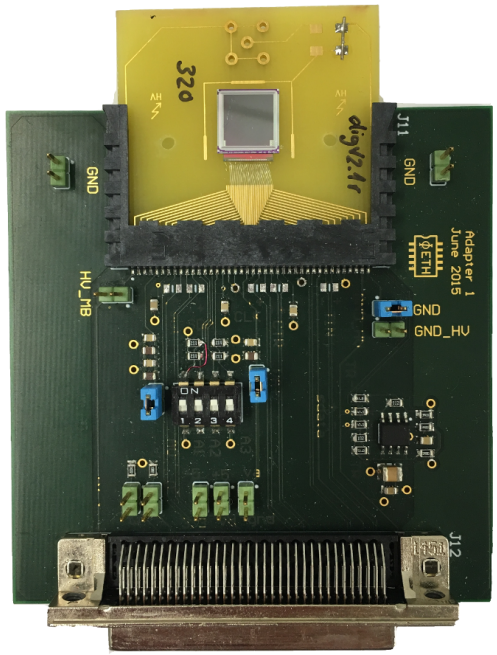
(a) motherboard



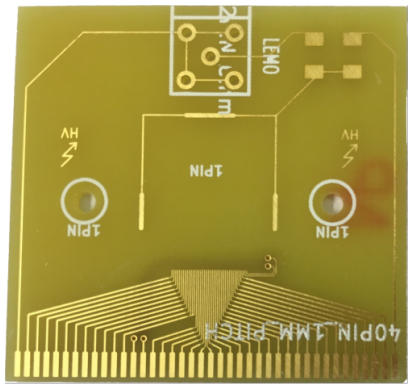
(b) adaptor plane with pixel chip

- up to 3 adaptor plane can be mounted on a single motherboard
- **NEW:** electrical design of both → fixing small bugs from version 1

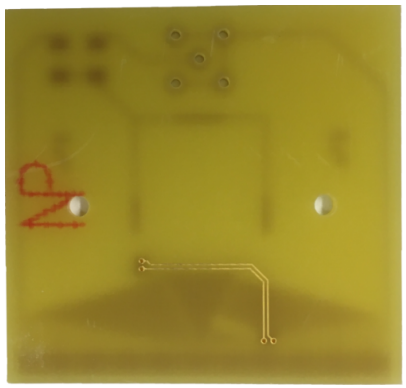
Telescope Parts



(a) digital adaptor plane



(b) carrier board front



(c) back

- redesigning carrier board for digital pixel chip
  - using fast-OR trigger of the newest version of the CMS Pixel Chip (pROC600)

Telescope Schematics

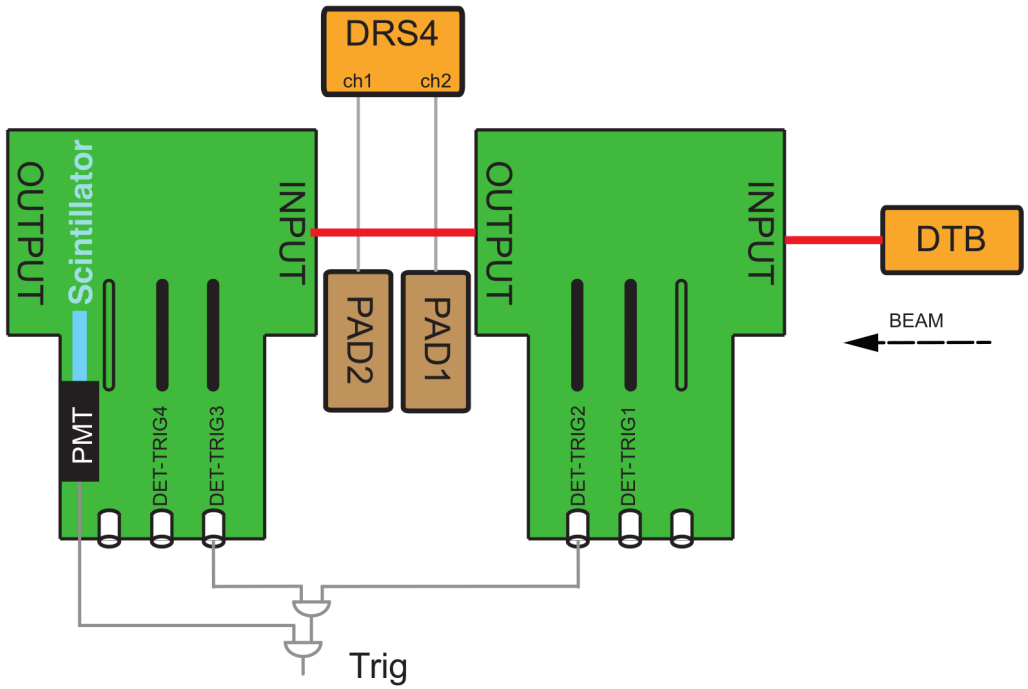


Figure: pad setup

- using PSI DRS4 Evaluation Board as digitizer for the pad waveforms
- using Digital Test Board (DTB) and pXar software for the telescope readout
- global trigger as coincidence of fast-OR self trigger and scintillator signal
- EUDAQ as DAQ framework

Telescope Schematics

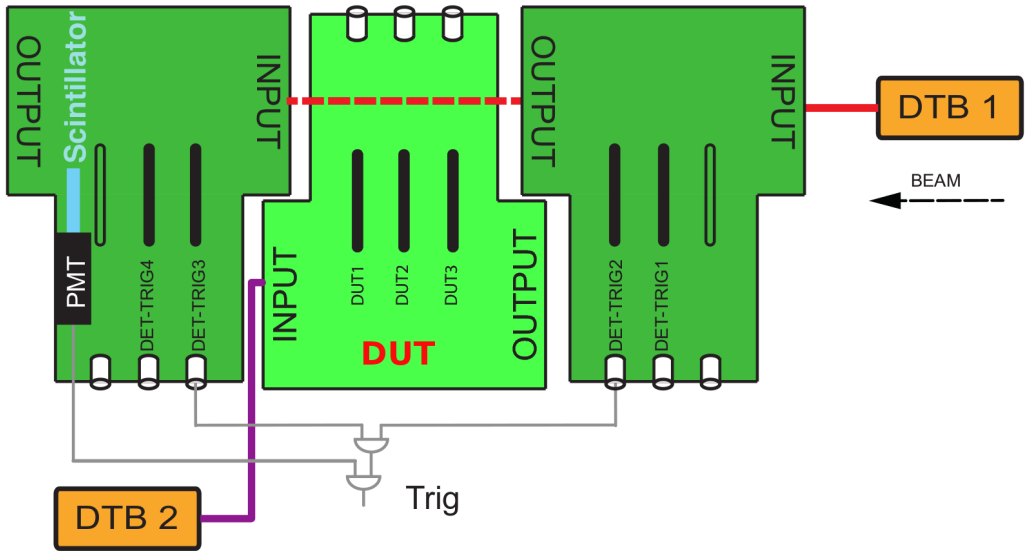
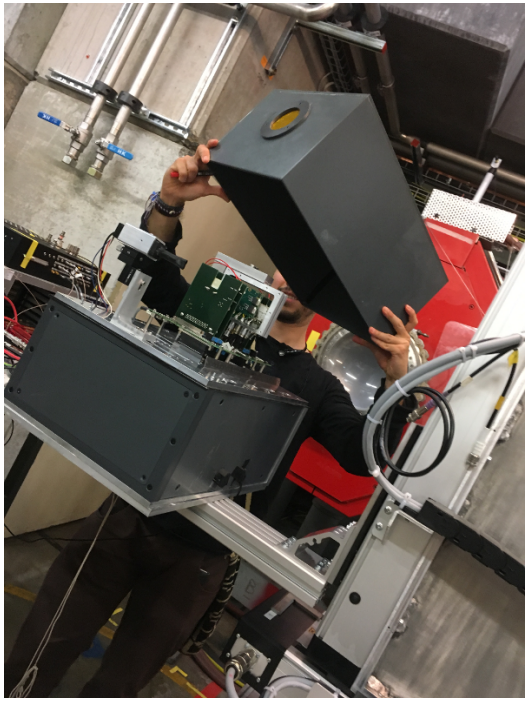


Figure: pixel setup

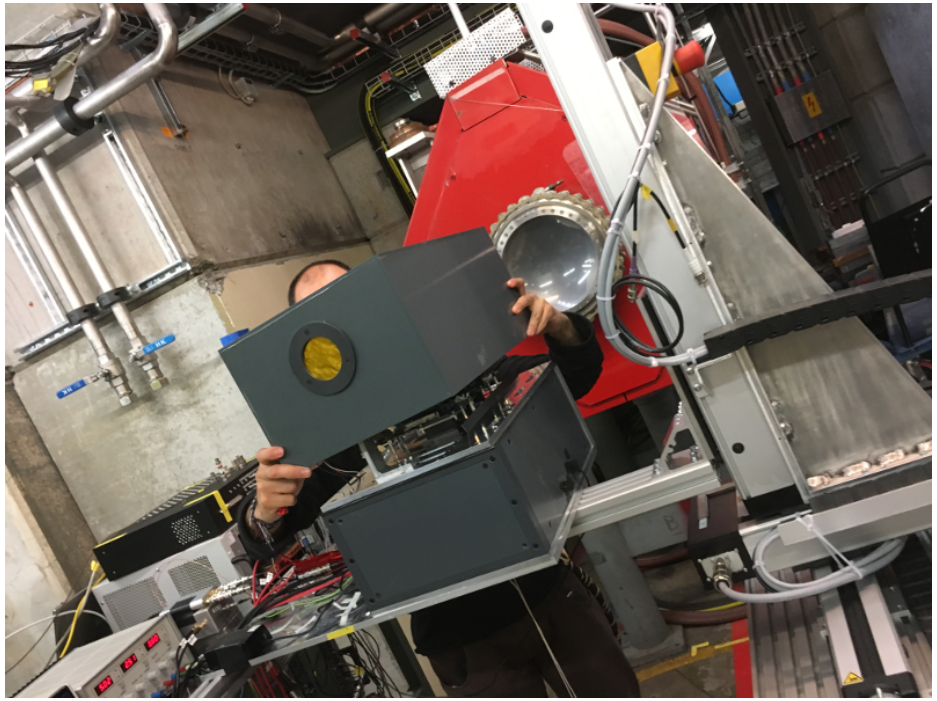
- using independent telescope module as DUT
- using Digital Test Board (DTB) and pXar software for the telescope readout
- global trigger as coincidence of fast-OR self trigger and scintillator signal
- EUDAQ as DAQ framework

Mounting Frame



- building completely new mounting frame
- all cables and some electronics stored inside the box underneath
- absolute light tight setup $\rightarrow$ removing all single covers from the detectors

Mounting Frame



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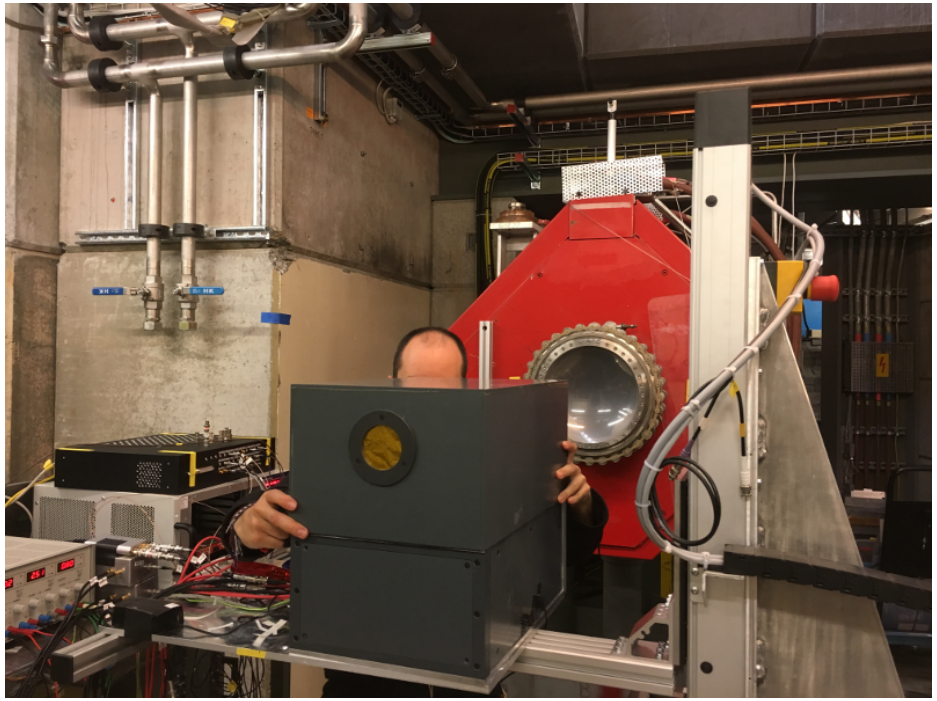

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Section 3

Data Acquisition

Trigger Logic

- complicated trigger logic
- more in Christian Doofers talk

Data Acquisition

- using EUDAQ as data acquisition software
- combining event streams from telescope, dut and trigger unit
- own extension

Section 4

Analysis & Results

Data Acquisition

bla

Section 5

Conclusion

Conclusion

- signal in pixel most likely slightly smaller than expected
- higher signal in pixel compared to expectation than in pad
- pulse heights of the two silicon diodes match pretty well

Section 6

Outlook

Data Acquisition

bla