Cerenkov Lab Setup & Testbeam Ideas

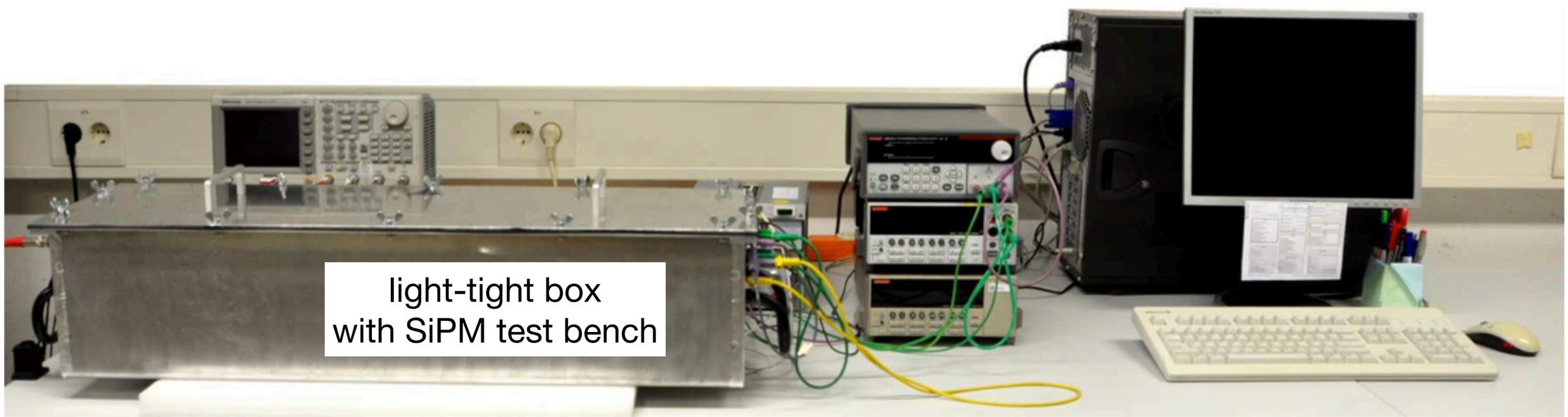
John Hallford, Louis Helary, Marius Hoffmann, Ruth Jacobs

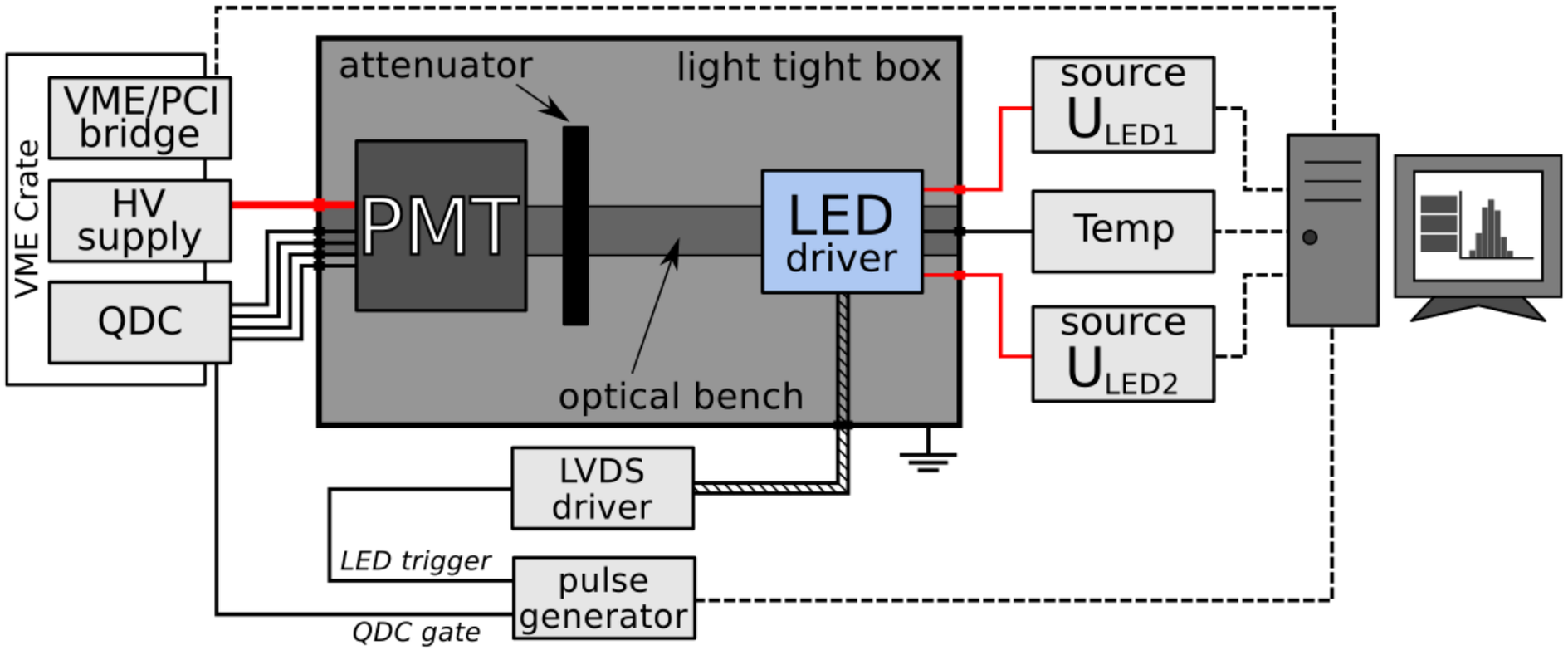
LUXE technical meeting
17th December 2020

HELMHOLTZ RESEARCH FOR GRAND CHALLENGES

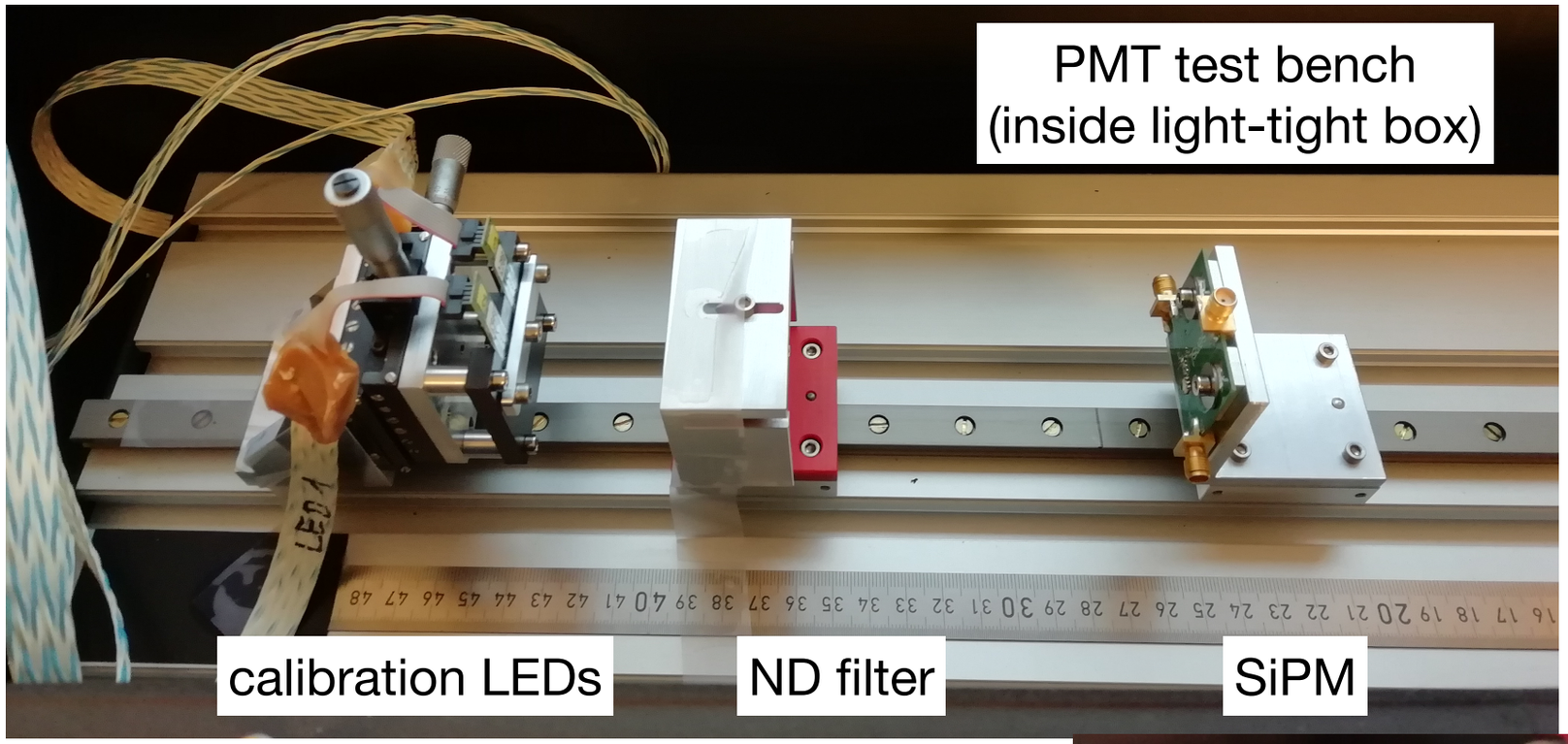
DESY.

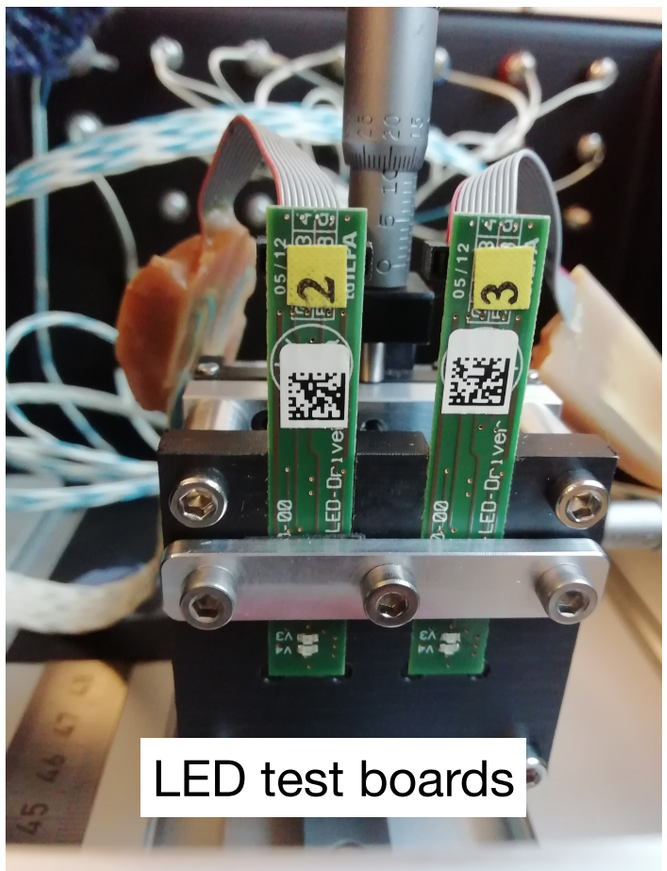
News from the lab…

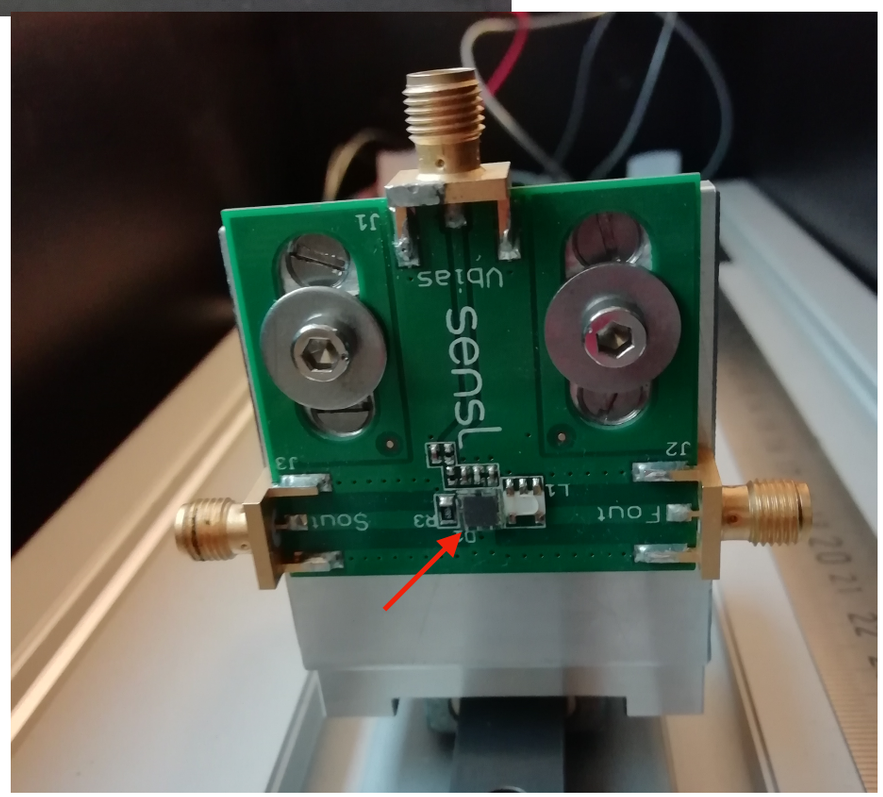




News from the lab…



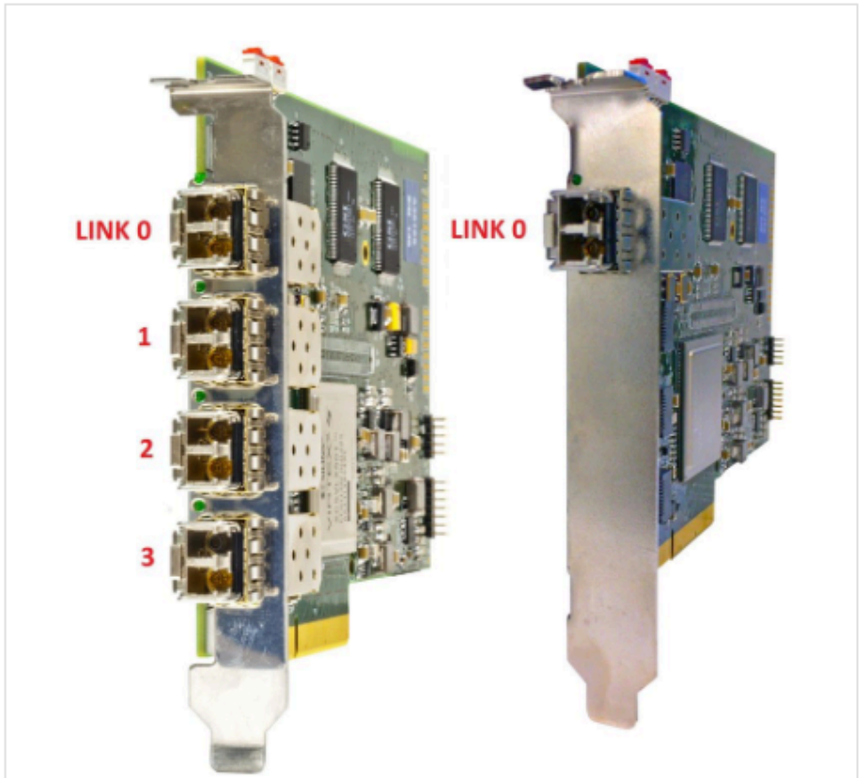




SiPM & Test board from Yan
on new mount

News from the lab…

Lab multimeter arrived



VME bridge optical link -> PCIe arrived

SiPM readout unit
order is out, arrives in January

News from the lab…

1) SiPM measurements

- using light tight box, new SiPM readout unit (expected in Jan)
- gain experience, determine dynamic range of SiPM
- SiPM linearity measurements
- ND filter linearity measurements
- “emulate” high light-yield environment

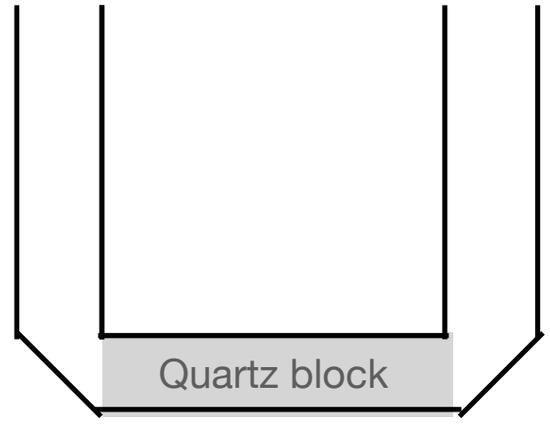
2) Preparing EUDAQ for Testbeam

- get the full EUDAQ software running on our lab PC
- test triggering with TLU and synchronization with Telescope
- eventually include new SiPM unit

TB @ DESY

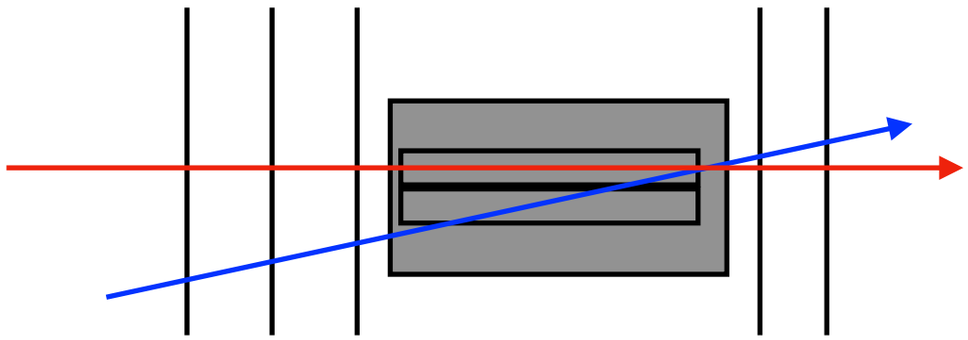
1) Stand-alone measurements

- using stand-alone readout software
- triggering via scintillator fingers/self-trigger
  → **functional tests, triggering**
- Single electrons!
  → may need the C4F10 gas to see signal (34ɣ/primary), vs. Ar (7ɣ/primary)
  → we can try to “emulate” high rates by putting a quartz block in the channel (7000ɣ/primary) also potentially useful for hybrid setup



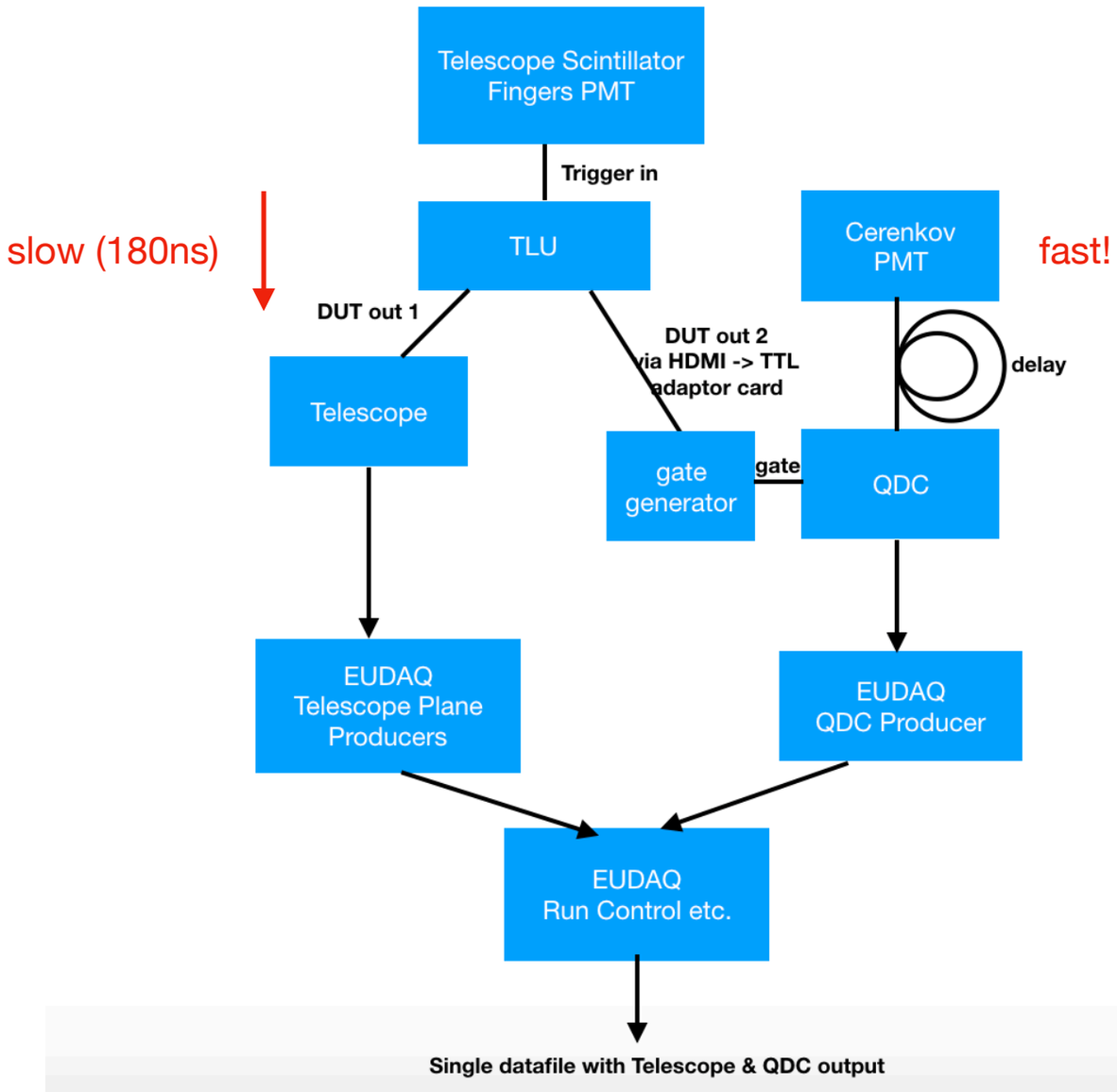
2) Measurement in sync with a Telescope

- using EUDAQ readout software
  → **effect of mis-alignment/channel sharing**
  → **interactions in inter-channel wall**
  → **testing in-situ alignment strategies**
  → **test of synchronized data-taking with EUDAQ**
- triggering is non-trivial here

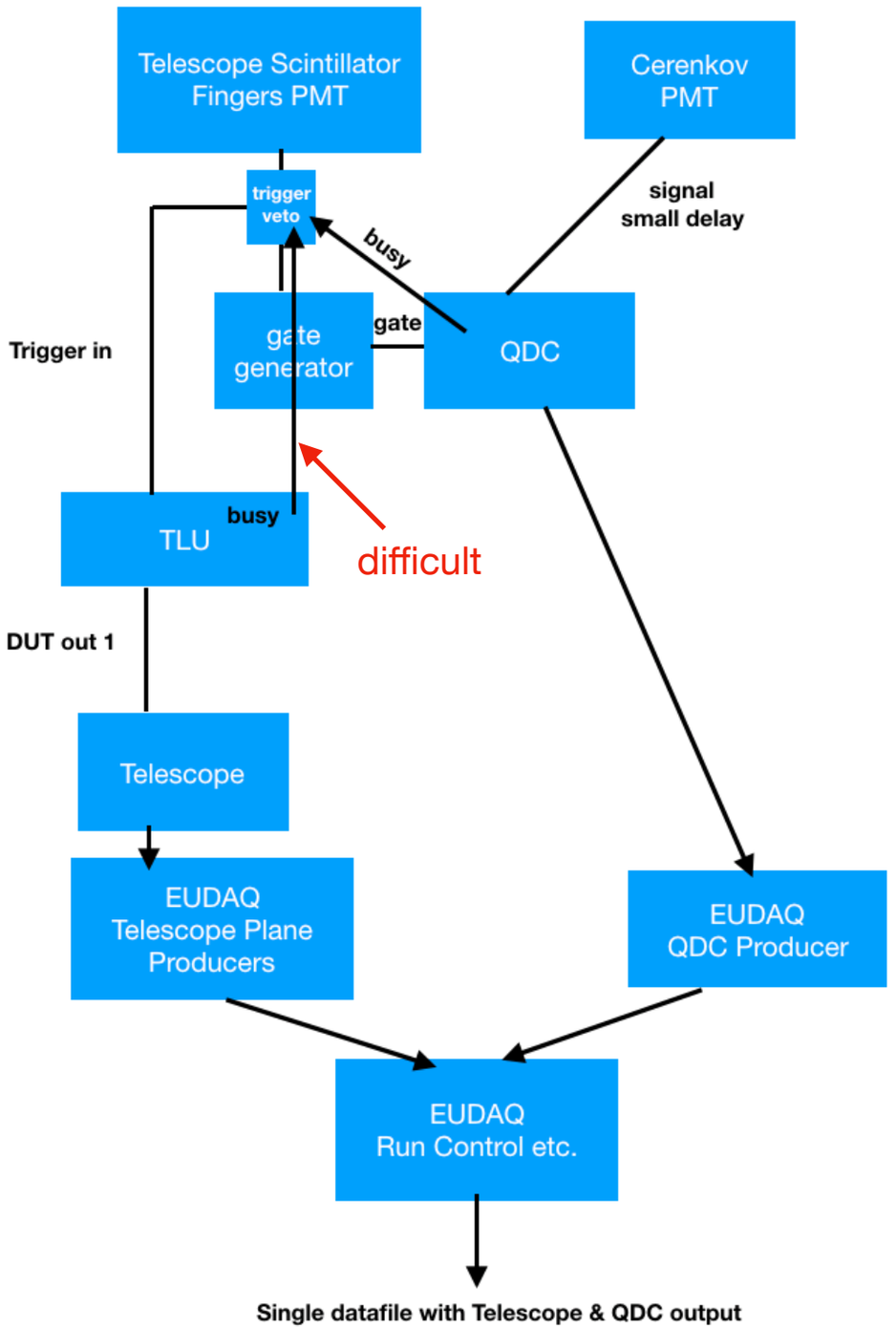


TB @ DESY: Triggering with TLU

Problem: TLU gate signal output is significantly delayed wrt to our PMT signal!



method 1: delay our signal (long cables, delay ~5ns/m)



method 2: gate QDC directly, but make sure we don't accept any new triggers, while TLU is processing

Once the EUDAQ software runs we can test this with pulse generators…

High-rate TB

Stand-alone measurements with entire electron bunches

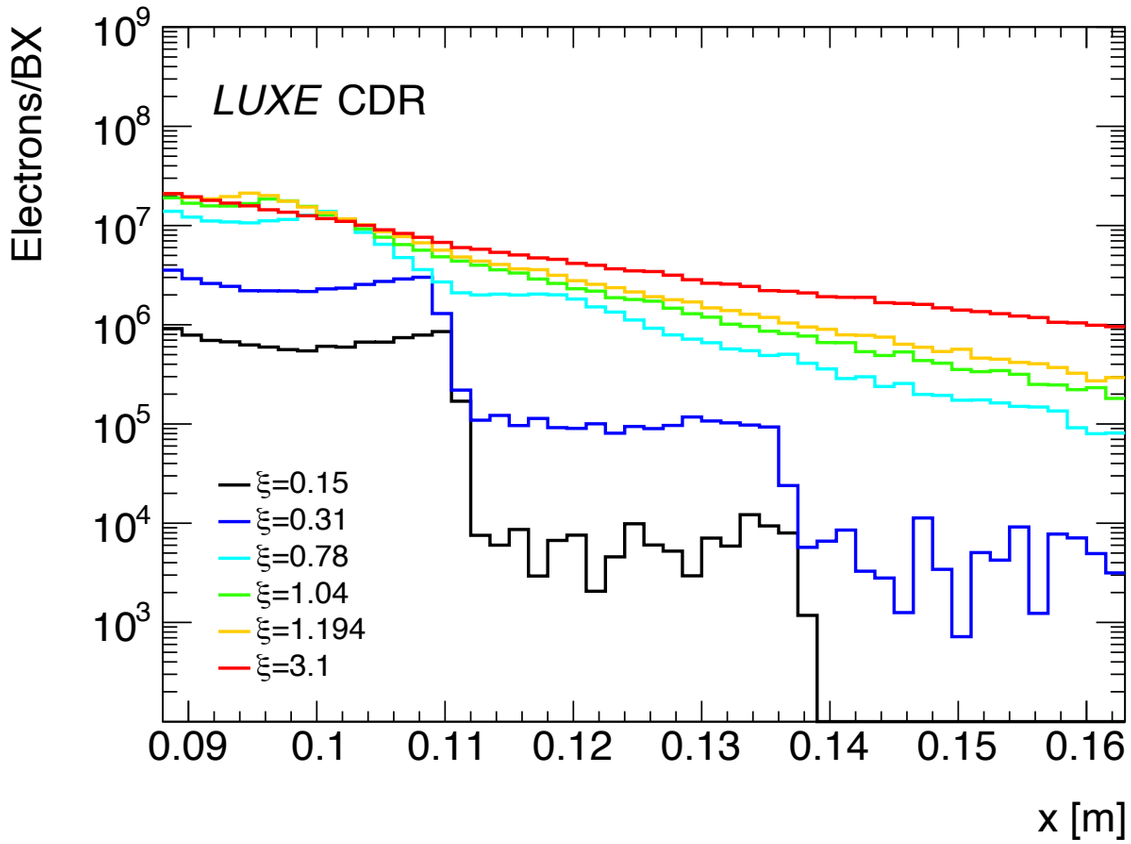
- testing an advanced prototype (smaller channels, SiPMs, Argon)
- testing different gases
- gas pressure scans
- linearity for high rates

ELSA (Bonn)

- electron bunches E≤3.2 GeV
- beam current: ≤250pA over 550ns cycle
  → 850e^- /shot

MAMI (Mainz)

- electrons E≤1.5 GeV
- “continuous” beam, 100μA beam current
- assuming same 550ns readout window
  → 0.3e9 e^- /shot



MAMI is in the LUXE electron rate regime (not sure how it works with continuous beam…)

Summary: Cerenkov Bucket List

1) Testbeam

- single electrons (DESY): - operation, triggering, alignment, synch with Telescope
- electron bunches (MAMI?): - Gas , dimensions, high-rate linearity

2) Calibration/Linearization (Testbox)

- are results from polarimetry applicable in our intensity regime?
- SiPM performance
- ND filters

3) “Technical”

- advanced protoype with smaller channels
  (mechanics? how to tile SiPMs? PCB?)
- get the Testbox suited to our needs (connectors)
- update stand-alone software (new PC, SiPM readout board)
- integrating our readout in EUDAQ & figure out sync
- long-term (~month) pressure test

We have lots of plans and new equipment! Lab work is challenging with COVID restrictions…
Should try to ramp things back up after CDR!