# LUXE Cerenkovs: Testbeam Report

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many thanks to shifters and everyone who helped!

LUXE technical meeting

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# Setup & Principle

- LUXE: use finely segmented air-filled Cherenkov detectors for high-rate electron detection
- Idea: use reflective straw tubes as light guides
- TB aims: see if we can see a signal
  - different straw types, active media, geometries
  - ideally: get precision information using beam telescope
- DESY TB produces 1-6 GeV electron
- Rate is not nearly as high as in LUXE
  - → use Paraffine oil as active medium to increase Cherenkov light yield!





#### **Setup in TB Area 24**











## **Turning on the beam**





#### See a clear signal in time with Scintillator coincidence :)

## Signal Spectrum with Oil & NA 62 Straw



- · clear difference between spectra with and without beam
- no beam: readout triggered by Pulse generator
- periodic structure: N-photon peaks due to discrete pad structure of the Silicon PM
- slightly visible also in dark spectrum: cross-talk
- need to discuss with SiPM experts how to properly analyse this





#### **Position & Angle Scans**



- Straw mounted on moveable xy stage in between Telescope planes
- vertical scan: the further beam passes away from the SiPM through the straws, the more reflections
  are necessary to reach it
- horizontal scan: cylindrical straw moving out of the beam, shorter path length of elecrons through medium
  - $\rightarrow$  not sure, when beam is masked by Telescope planes

#### With telescope data can study this in much more detail!

## **Angle Scans**





- straws mounted on angled plane
- beam hitting straw perpendicularly: short pathlength in active medium and many reflections
- beam hitting straw at an angle: long wavelength and few reflections
- Cherenkov cone in oil has opening angle of 50°, so we might even get some direct light

# **Straw Comparisons**



- tetst different types of straws with Paraffine Oil
- NA62: 10mm diameter copper-gold-coated kapton foil
- Stainless steel straws: 10, 8, 6mm
- ATLAS TRT straw: 4mm Carbon-fibre
   → was very hard to fill, results not conclusive

#### Clearly see diameter influence, study scattering with telescope





# **Active Medium Comparisons**



- test different active media: Paraffine oil, water, air
- amount of light depends on refractive index
- water turned out difficult (leaks...)
- used shorter straw with water



#### First look at Telescope synchronization

TLU∆ t<sub>N,N-1</sub>

Delta t TLU	FEB:	0   0	
Delta t TLU	FEB:	661196	754955
Delta t TLU	FEB:	78361892	661198
Delta t TLU	FEB:	131849	78362168
Delta t TLU	FEB:	1575346	131851
Delta t TLU	FEB:	854579	1575351
Delta t TLU	FEB:	191419	854582
Delta t TLU	FEB:	76878337	191419
Delta t TLU	FEB:	2280488	76878609
Delta t TLU	FEB:	130874	2280496
Delta t TLU	FEB:	597710	130875
Delta t TLU	FEB:	76416399	597712
Delta t TLU	FEB:	1293092	76416669
Delta t TLU	FEB:	1252071	1293096
Delta t TLU	FEB:	691472	1252075
Delta t TLU	FEB:	79547407	691475
Delta t TLU	FEB:	283235	79547688
Delta t TLU	FEB:	441445	283236
Delta t TLU	FEB:	1501116	441447
Delta t TLU	FEB:	66413	1501123



- despite using a busy and TLU as validation trigger we saw some de-synchronization between TLU (Telescope) and our DT5702 board
- main reason (we think): DT5702 board cannot handle too high data rates, overwrites ring buffer
   → event loss
- took data at fairly low rate (5.8GeV) and with longer busy
- first try at offline synchronization using event timing looks hopeful

#### Arduino

- Ins second half of the week, Stefan designed and programmed an Arduino to mitigate the buffer overwrite problem
- Arduino counts the events and TLU trigger numbers and holds the trigger after 256 events to give the DT5702 enough time to get the events out of the buffer
- Offline sync with this additional information seems to work



### Conclusion

- Long, exhausting, but sucessfull TB week :) We learned a lot!
- Managed to establish a clear signal in the Straw Cherenkovs!
- · Were able to test different configurations, geometries etc. in a systematic way
- Telescope data will need some work, but will enable very nice studies!
- We are still running parasitically with FCAL in a reduced standalone setup





**Big Thank You to everybody who helped!**