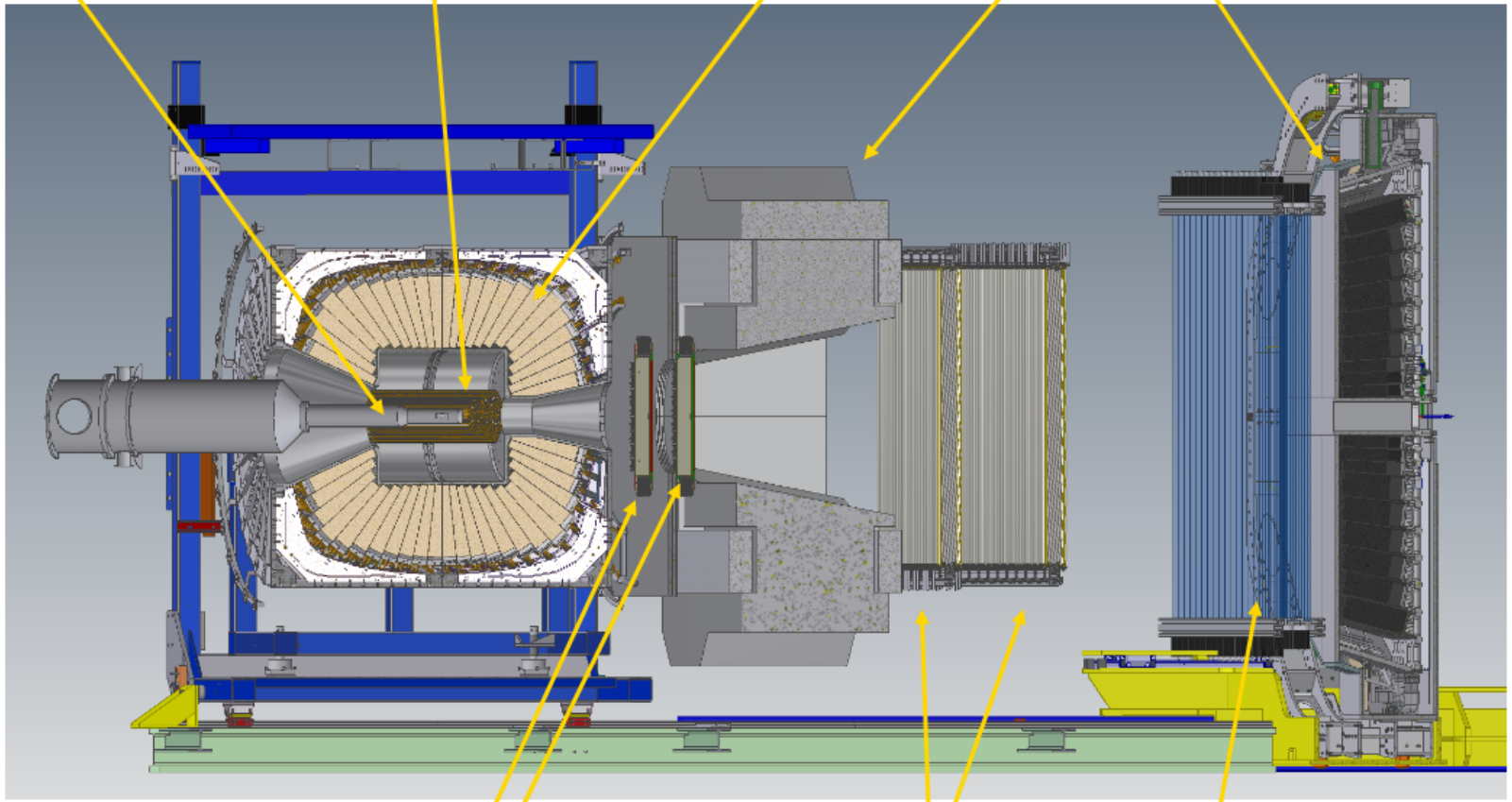
The Time of Flight detector

color meets flavor

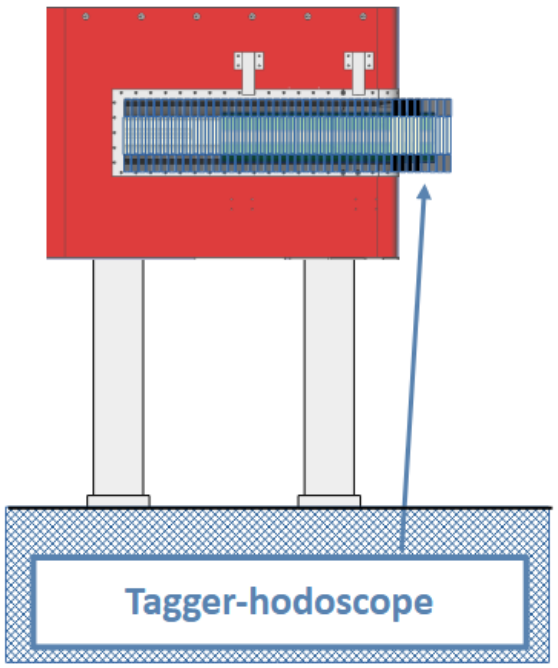
@ELSA INSIGHT

Investigation of the strong interaction in the light flavor sector

Polarized target | Si-pixel detector | Crystal Barrel | Magnet | PANDA-FWEC-EMC



Tagger Magnet



Tagger-hodoscope

Gas Electron Multiplier detectors

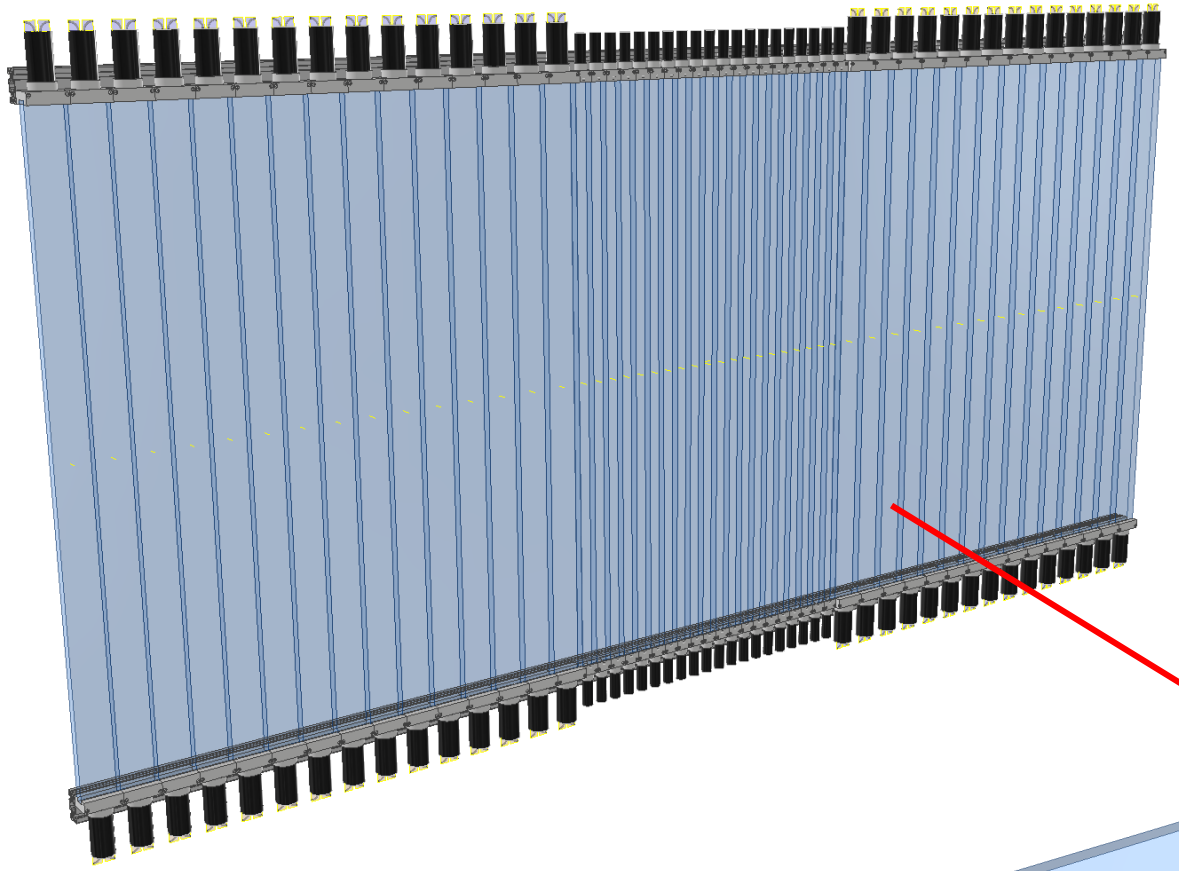
Straw tube detectors

Time of Flight detector

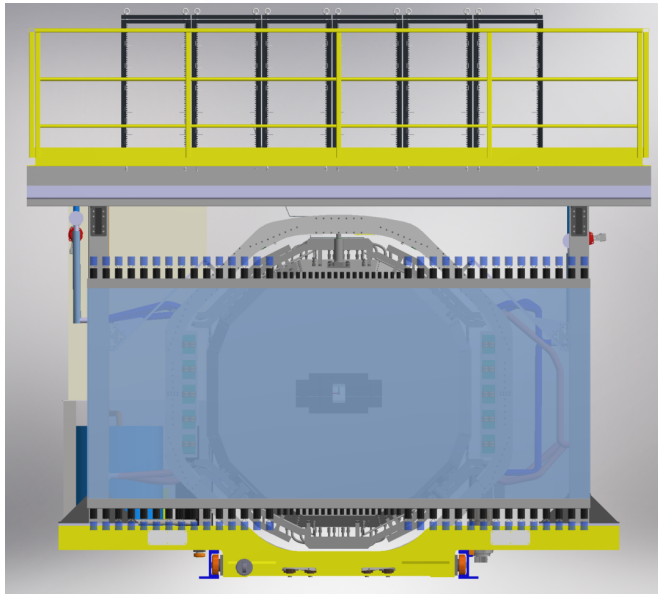
Status experimental hall / ToF setup at ELSA

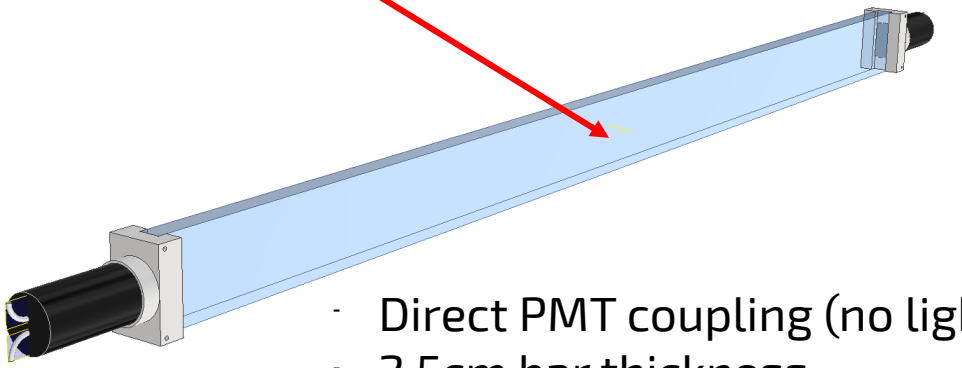
First design:

- Area : 400 (15x10cm + 10x5cm + 10x5cm + 15x10cm) x 170 cm²
- 2.5cm bar thickness
- 2 walls shifted



downstream view





Goals:

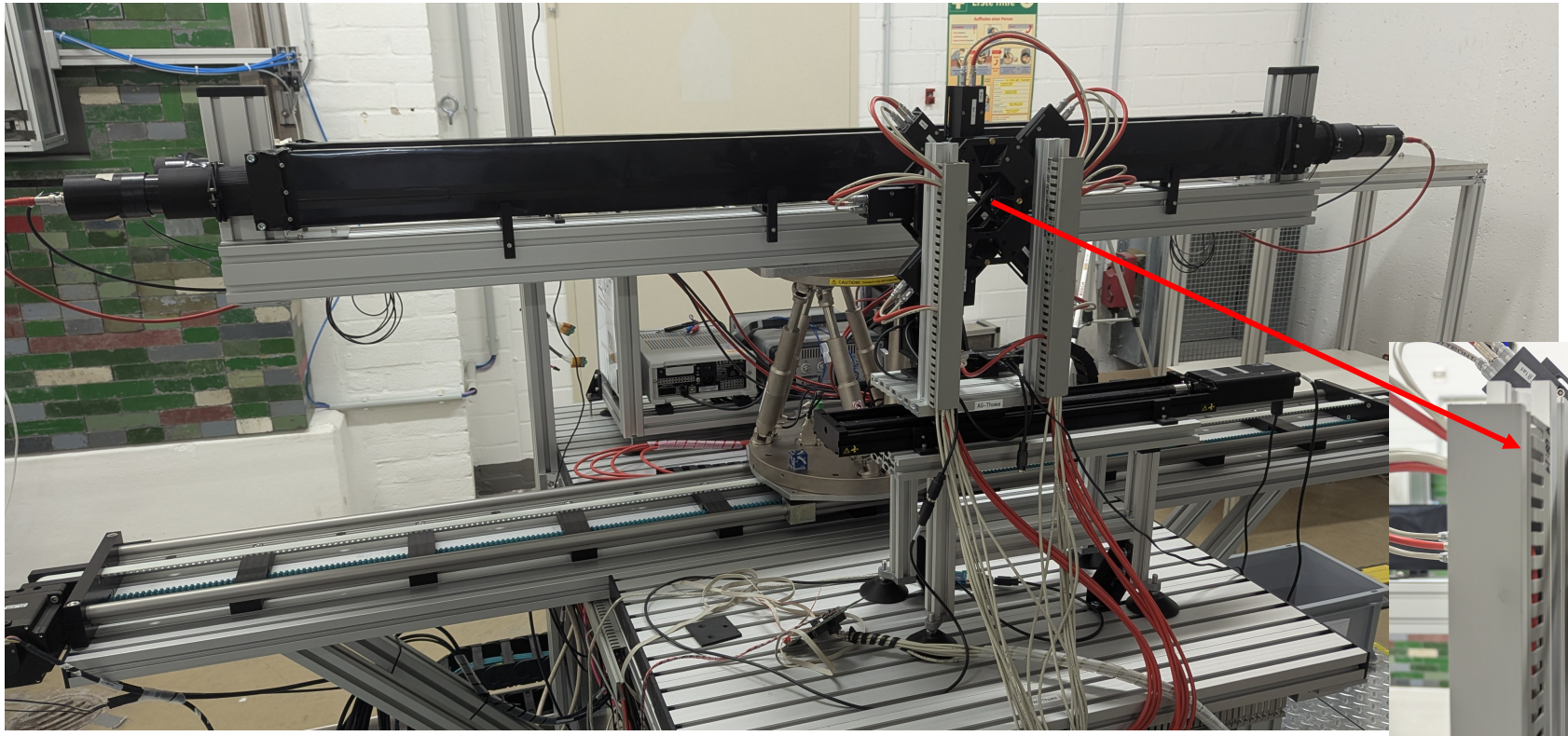
- Measuring time of flight below 100ps
  (incl. reso. Tagger, ToF, Sync-System, TDC)
- Thin as possible → keep impact on calorimeter small

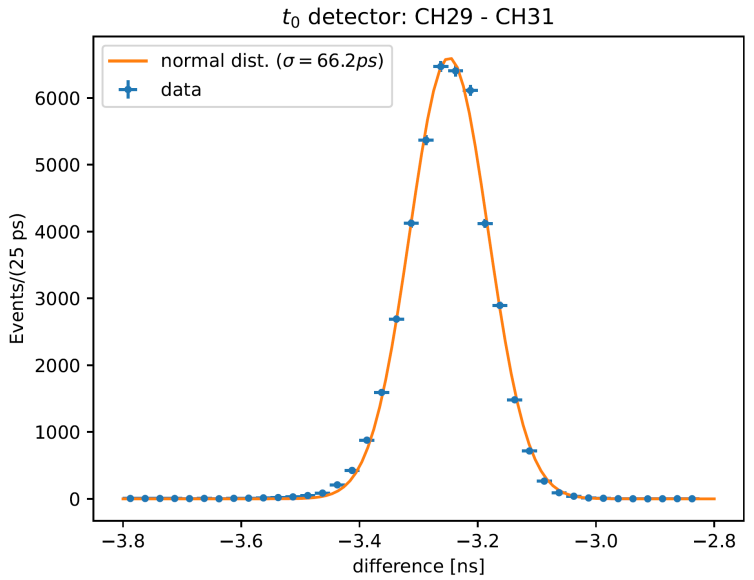
- Direct PMT coupling (no lightguide)
- 2.5cm bar thickness

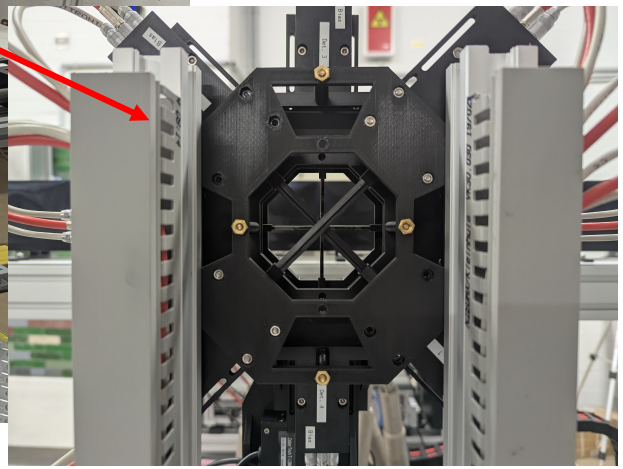
Prototyping / Evaluation of Parts / Tests

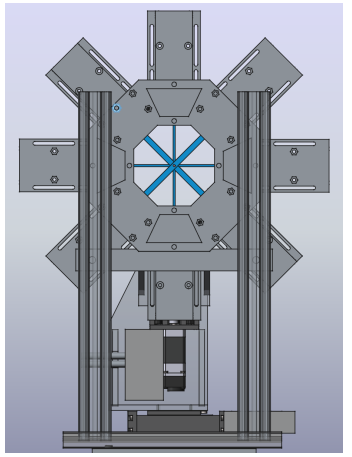
Started evaluation of parts and built a teststation in E3 prior to the approval of the cluster (Master Thesis):

- positioning device for DUT
- position- and t_0-detector (2mm, σ_{diff} ~ 70ps)
- DOGMA-tdc σ~15ps (GSI, TRB5/3 successor)
- Sync-system



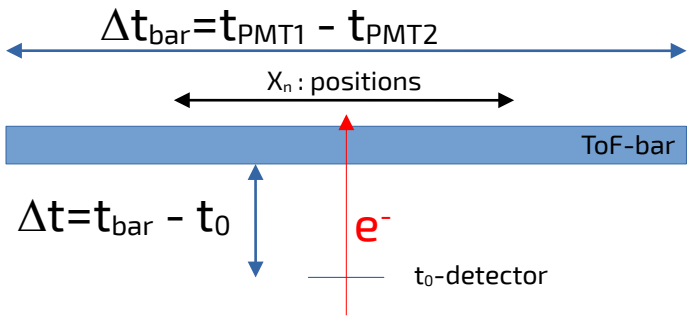






Prototyping / Evaluation of Parts / Tests

E3 testbeam data of the last month for 170cm long bars (Eljen EJ-204, Hamamatsu R13435-100-10)



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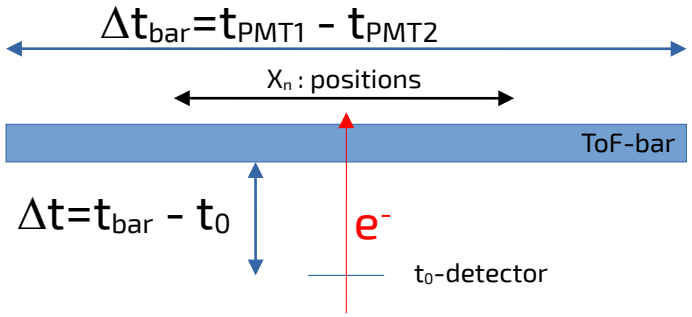


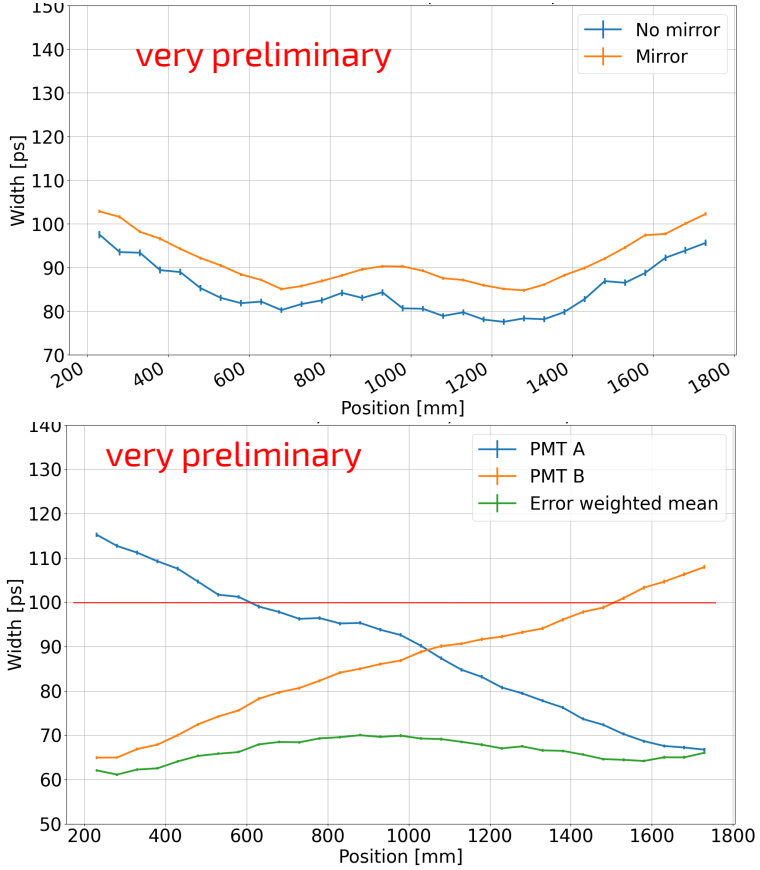
First view into data. Things not completly understood.

Time resolution Δt_{bar}
- No corrections

Green: Overall time resolution Δt (incl. σ_{TDC}, σ_{t0}, σ_{bar})

PMT-time incl.
- Error weighted mean
- Timewalk correction

50x25mm²



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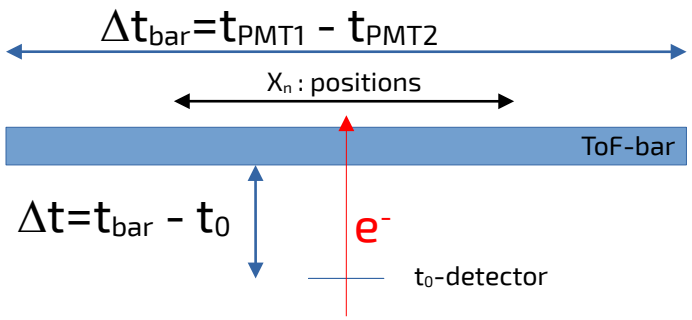

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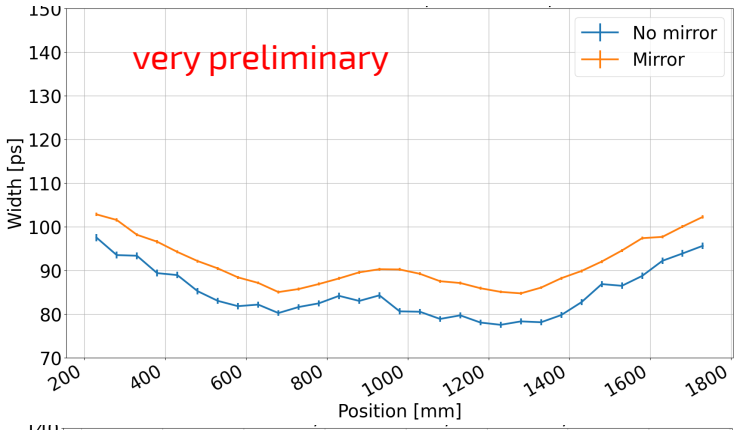
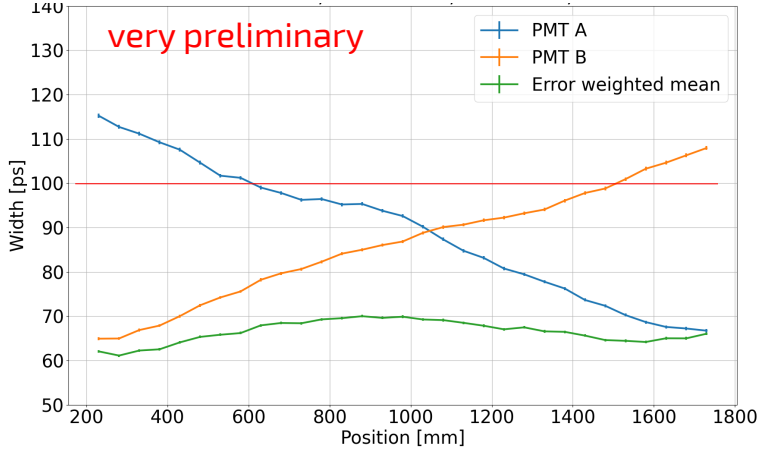
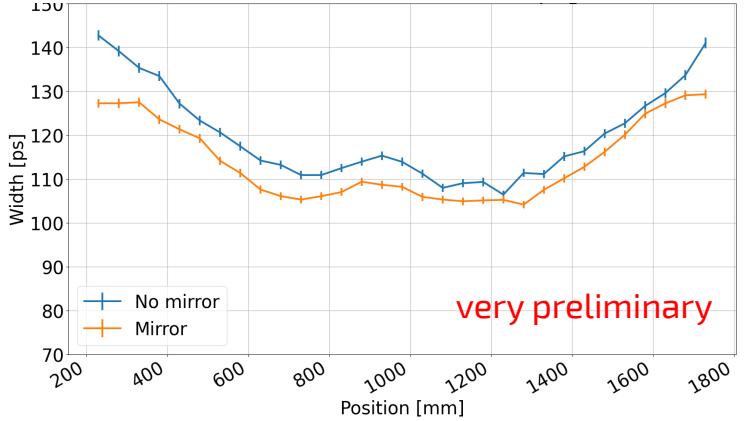
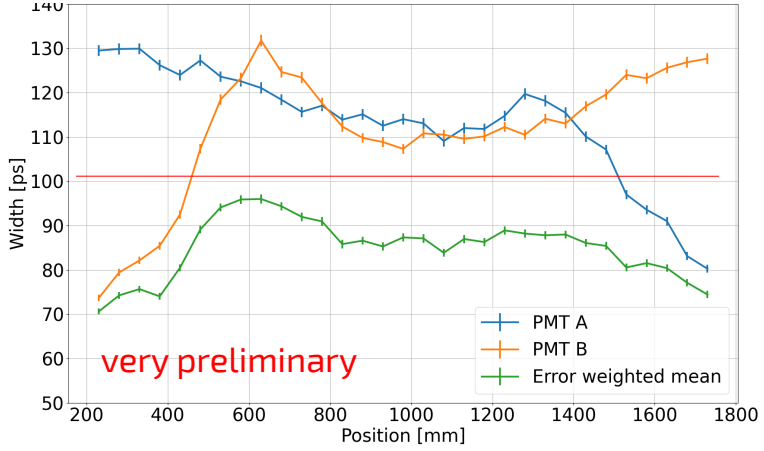




100x25mm²

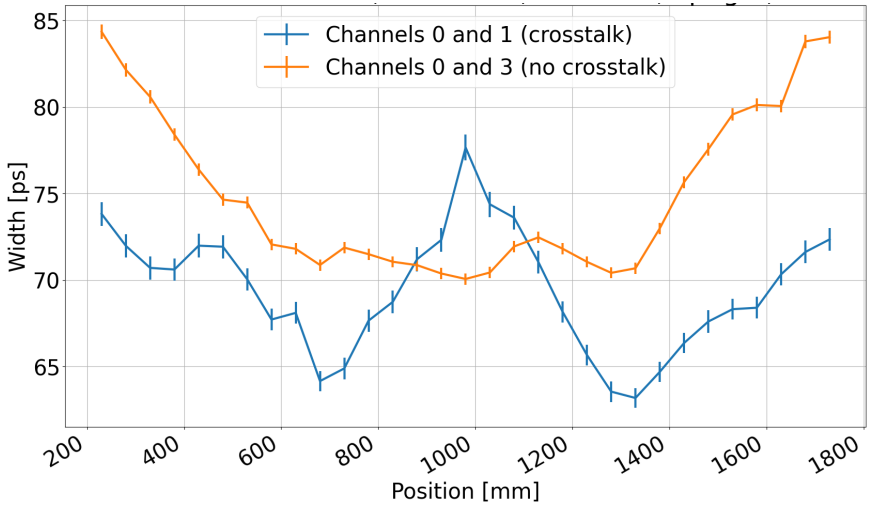




Prototyping / Evaluation of Parts / Tests

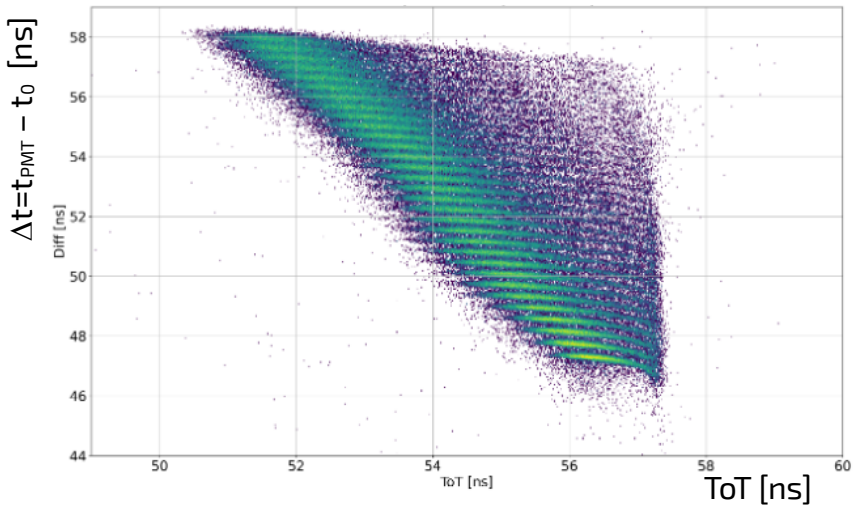
Currently using not optimized frontend electronics for our case

- Handling of high signals (~5-7V) → Cross talk issues



- Time walk correction → find suitable settings for ToT

ToT vs time of PMT usefull case



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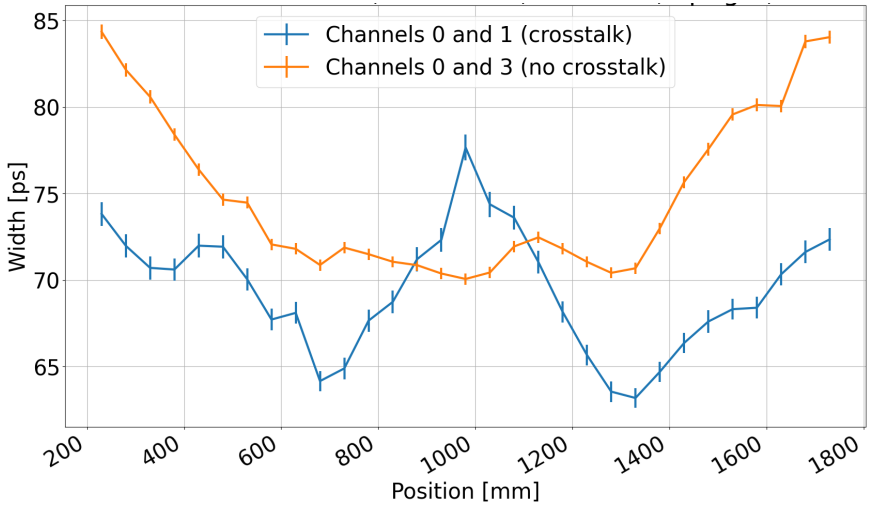

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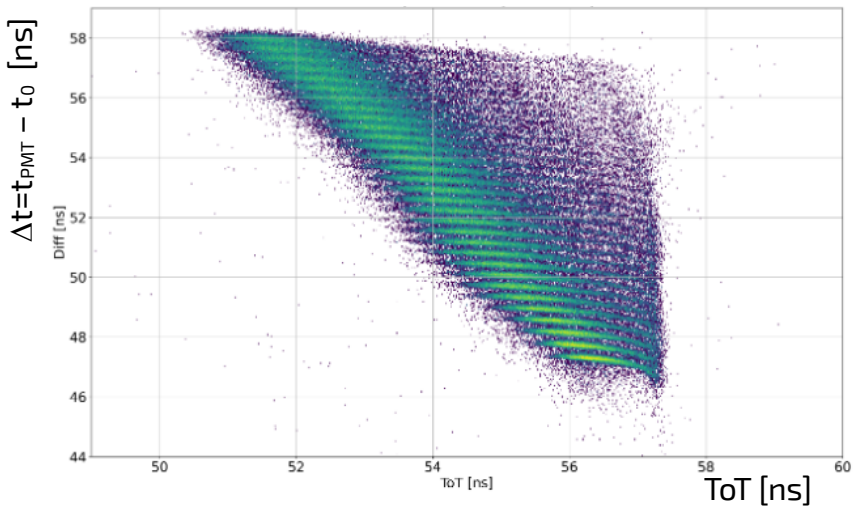

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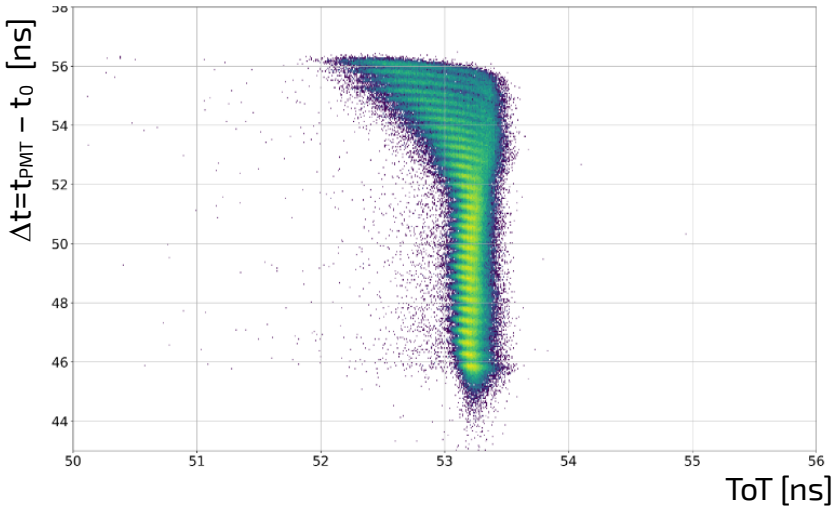

TODOs

Prototyping / evaluation of parts / tests
- frontend electronics (Cross talk, ToT)
- MC-Simulations
- PMT-evaluation (try SIPM alternativ?)
- Light collection (wrapping, coupling)
- Eval. parameter set for best time resolution

Mechanical design
- Clamps for holding bars
- Movable structure

Manufacturing
- Purchase of parts
- Setup production line for reproducable quality
- Produce mech. parts

Quality assurance
- Setup test station in lab
- Calibration (pos. dependency?)

Installation
- Produce transport boxes (FTD→ELSA hall)
- Tools for installation

Readout/Infrastructure
- Purchase of components (TDCs, HVs,…)
- Implementation of data-readout