PANDA Collaboration Meeting

Quality assurance test box

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Quality assurance for MCP-PMTs

- Quality assurance of MCPs for the barrel DIRC and disc DIRC at the PANDA experiment
- Surface scans with a 3-axis stepper using a PILAS Laser, data aquisition with TRB and PADIWA Amps
- Simultaneous measurement of gain, time resolution, crosstalk, darkcount rate and afterpulsing, all position dependent
- Quantum efficiency scans, Position dependent and wavelength dependent
- For selected tubes measurement of rate stability and accelerated aging
- Maybe measurement of gain and crosstalk inside magnetic field (up to ~1.5 T)

Current state

- Light tight and copper shielded box is built
- Stepper is built and running
- First measurements with TRB3 and PADIWA1 boards

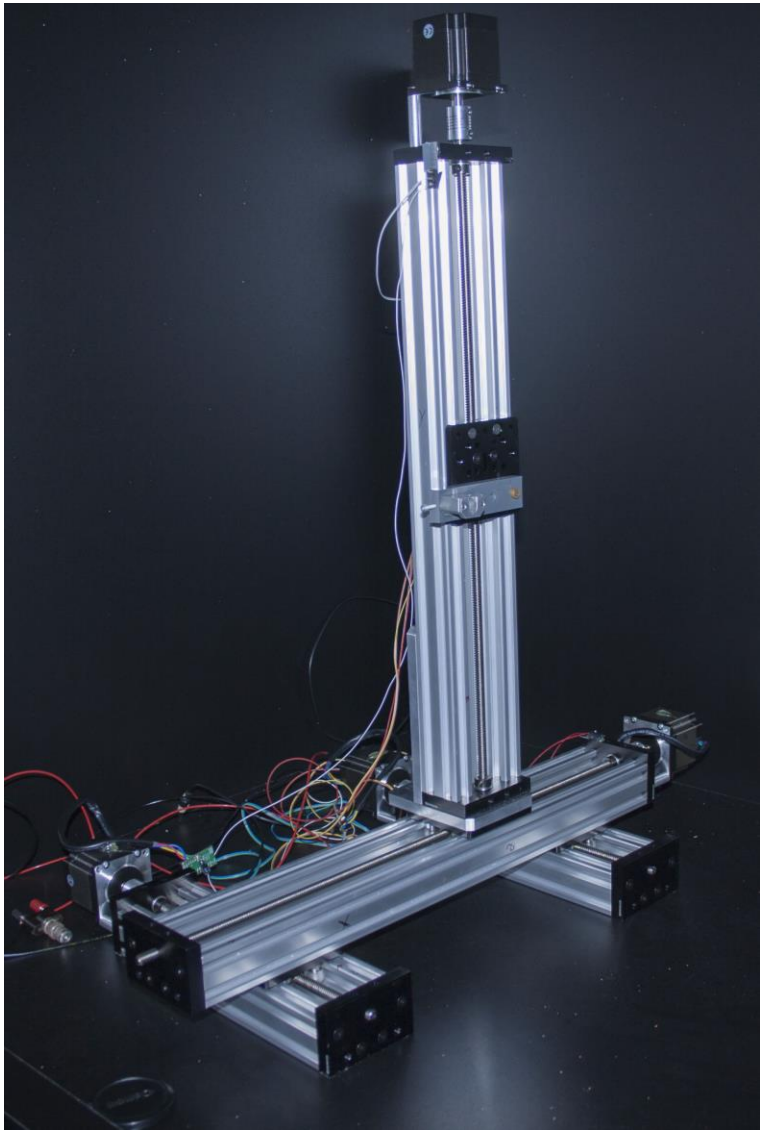
- Plans for the near future:
  - Reduce electronic noise level
  - Reach time resolutions below ~200 ps
  - Ordering Padiwa Amps v2

Measurement box

- Shielded with copper to block EMI

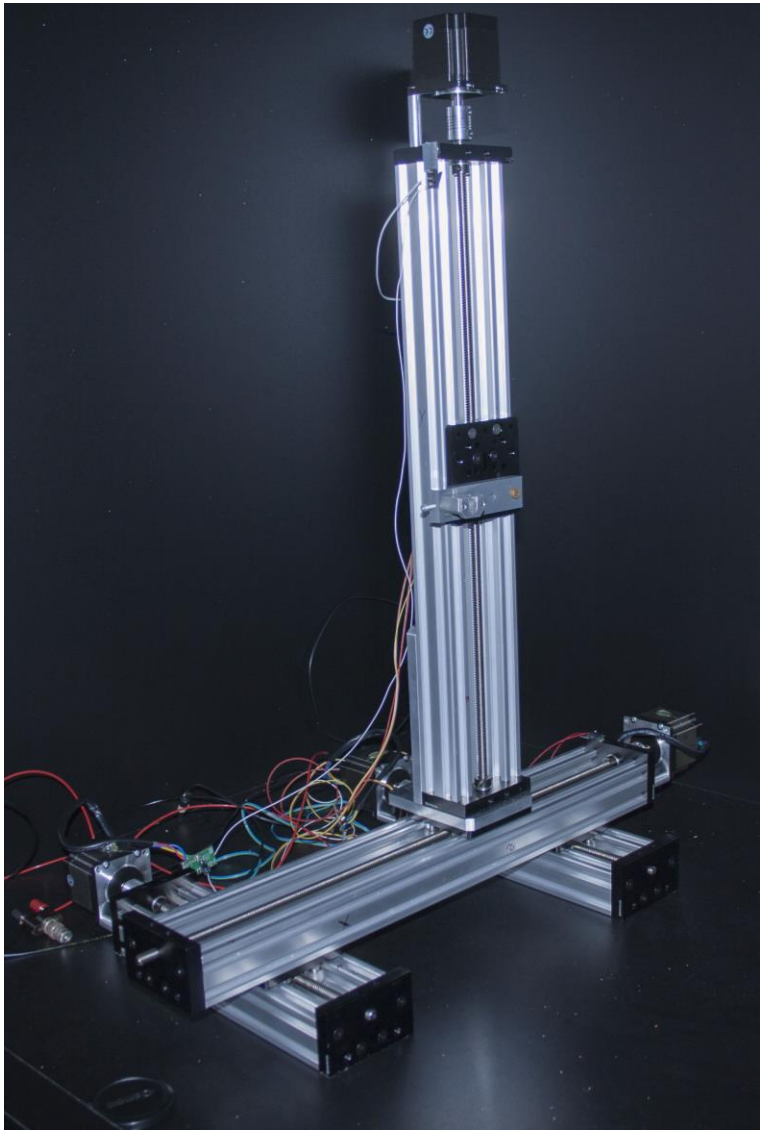
Stepper

- Total cost <500 €
- 3 axis stepper build from 4 linear actuators
- Controlled via USB with a Teensy board (Arduino clone) using AccelStepper library that controlls 4 Pololu A4988 stepper motor drivers
- X and Y axis for sensor scanning, ~40 cm to drive
- Z axis for focusing the laser, ~15 cm to drive



Stepper

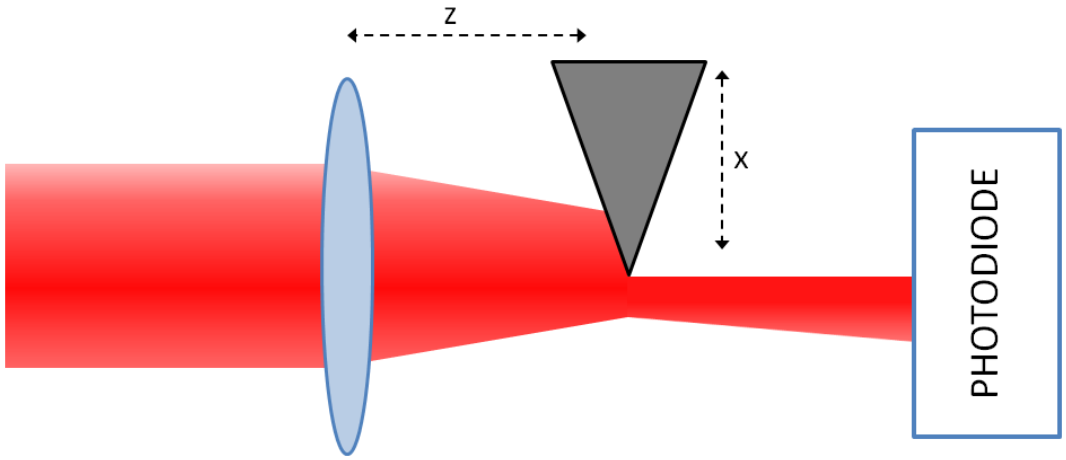
- Theoretical position accuracy between 5-40 µm
- Measured position repetition accuracy below ±6 µm (sigma)
- X and Y axis for sensor scanning, ~40 cm to drive
- Z axis for focusing the laser, ~15 cm to drive
- Laser with microfocus attached
- Spot size FWHM in focus <20 µm

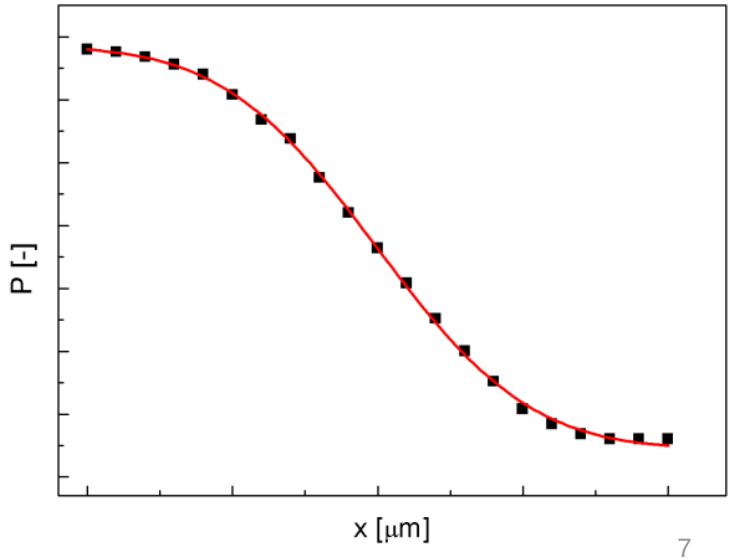


Benefits of controllable Z axis

- Measuring the distance, when the laser is in focus, not just hit and miss with the eye
- Measuring laser beam width using sort of knife edge method, but charge cloud has biggest impact on measured width

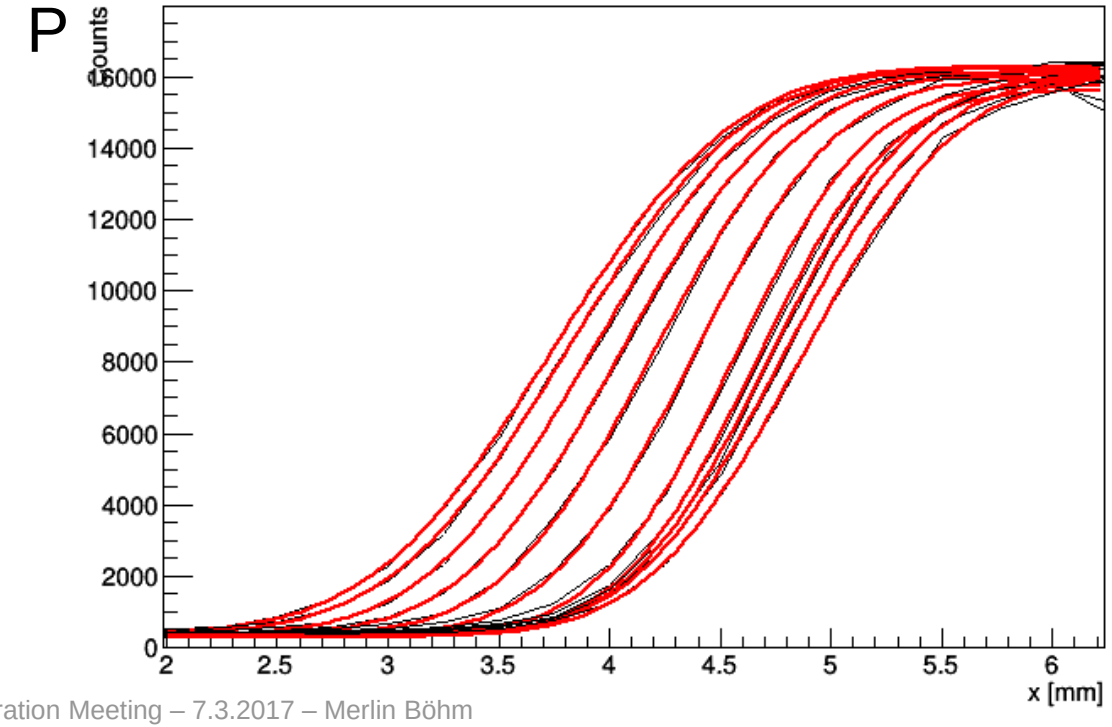
Measured Power: $P(x) = P_0 + \frac{P_{max}}{2}\left(1 \pm erf\left(\frac{\sqrt{2}(x - x_0)}{w}\right)\right)$





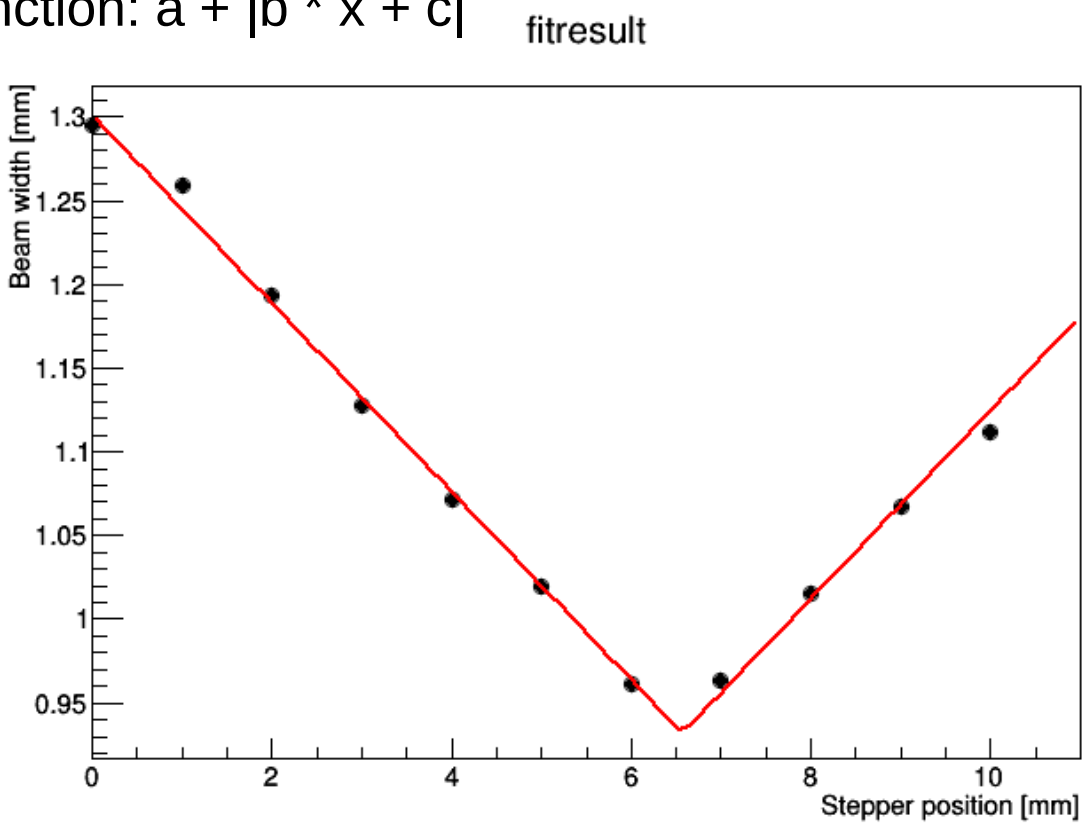
Measured laser profile

- Measured laser beam profile using 1 MCP pixel
- 1 mm steps in Z direction
- Fitted function: $P(x) = P_0 + \frac{P_{max}}{2}\left(1 \pm erf\left(\frac{\sqrt{2}(x - x_0)}{w}\right)\right)$



Calculating focus distance

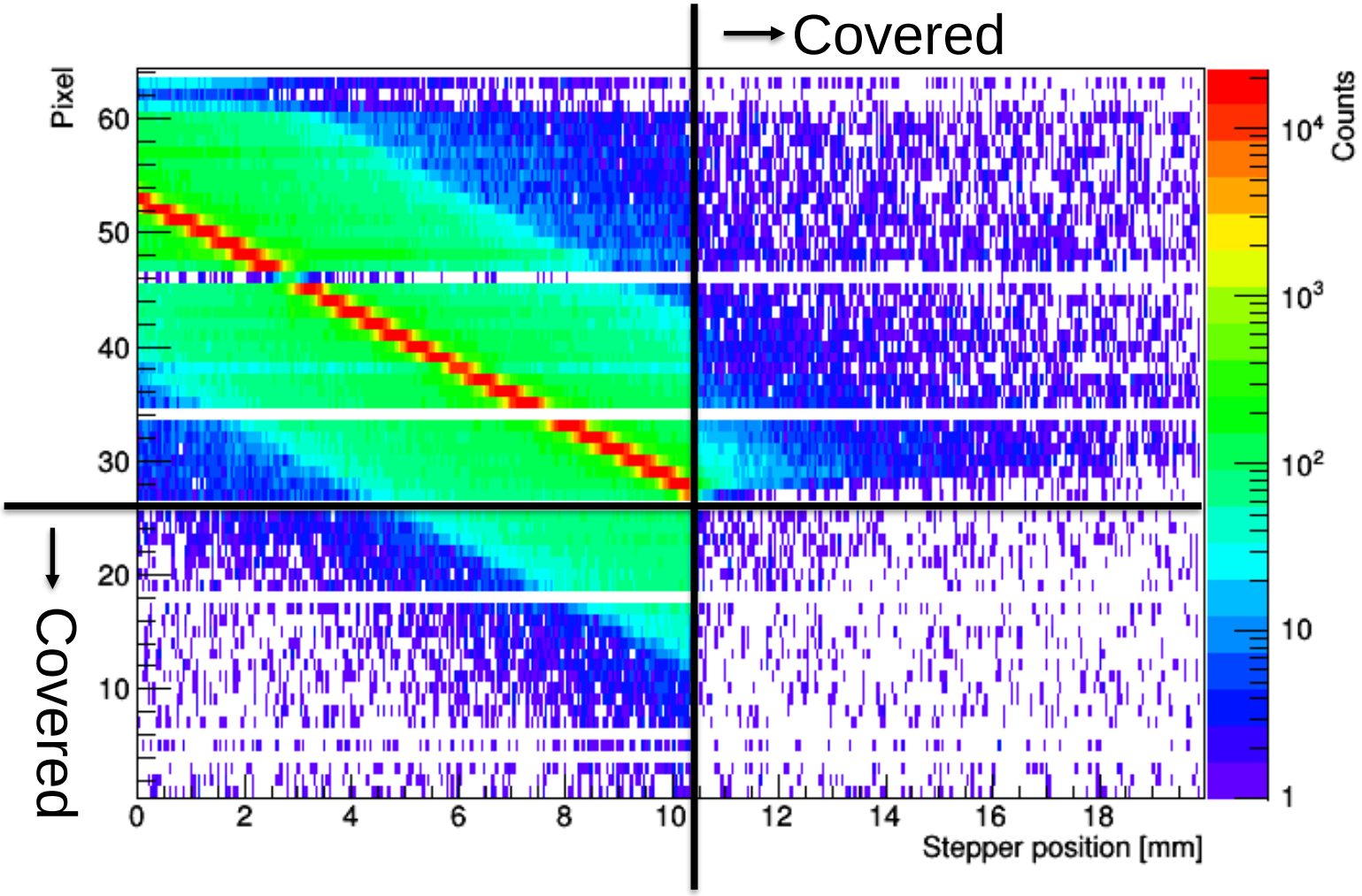
- Draw fitted beam widths
- Fitted function: a + |b * x + c|



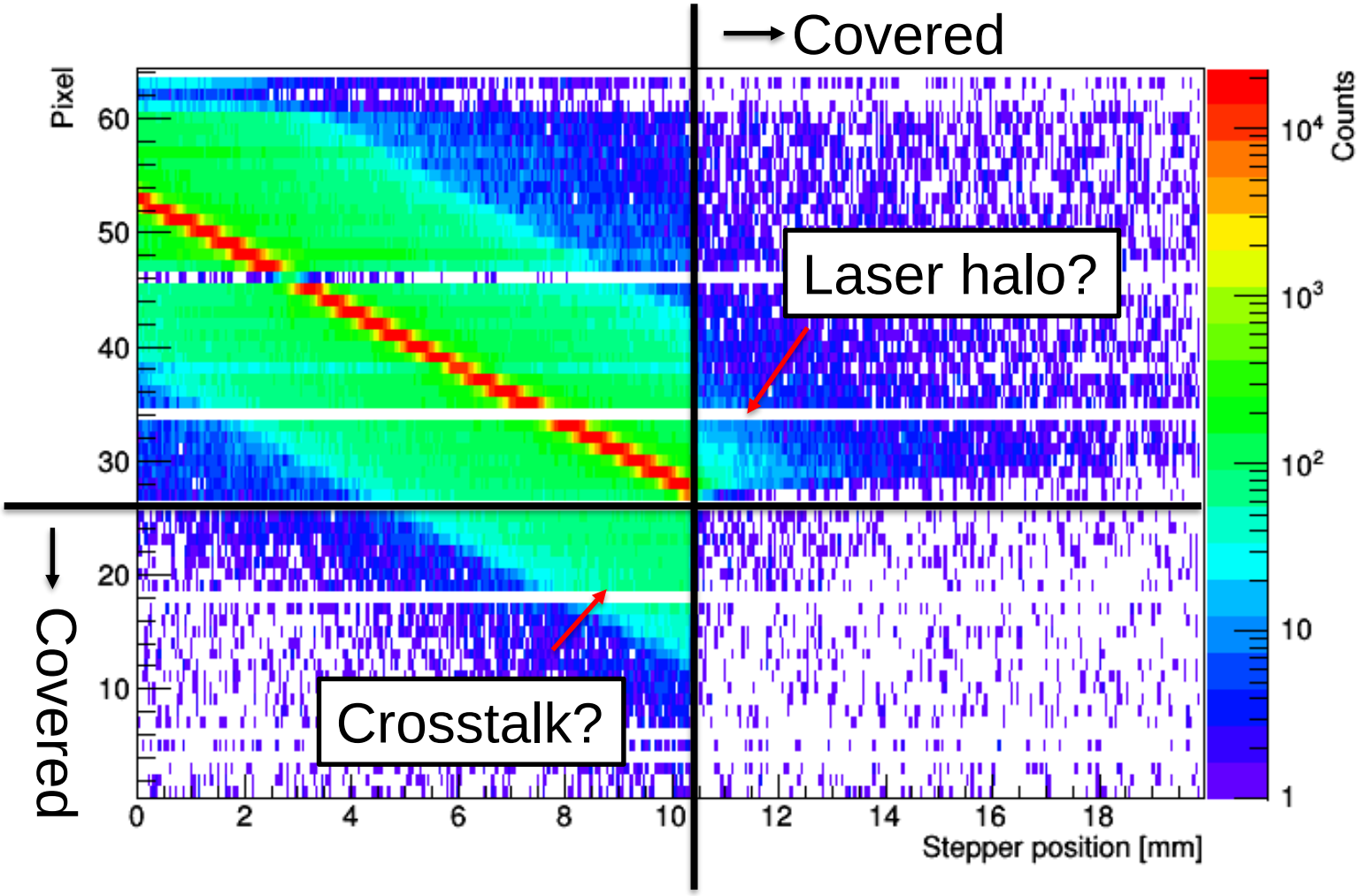
1D scan of high pixelated (6x128) Hamamatsu tube

- Measured tube: JS0027
- Scan over half row: 64 pixels
- 0.05 mm steps
- Half row covered
- Readout with TRB and PADIWAv1
- Only measure counted photons by the MCP
- Gain ~10^6

1D scan of high pixelated Hamamatsu tube

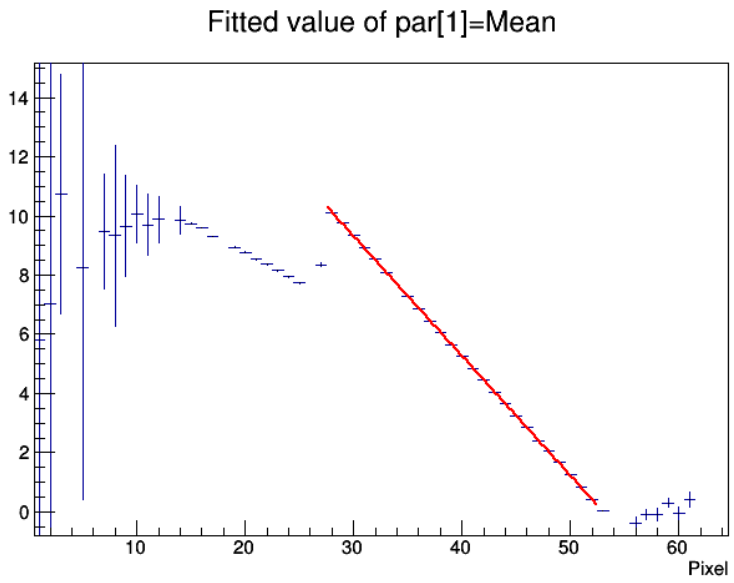


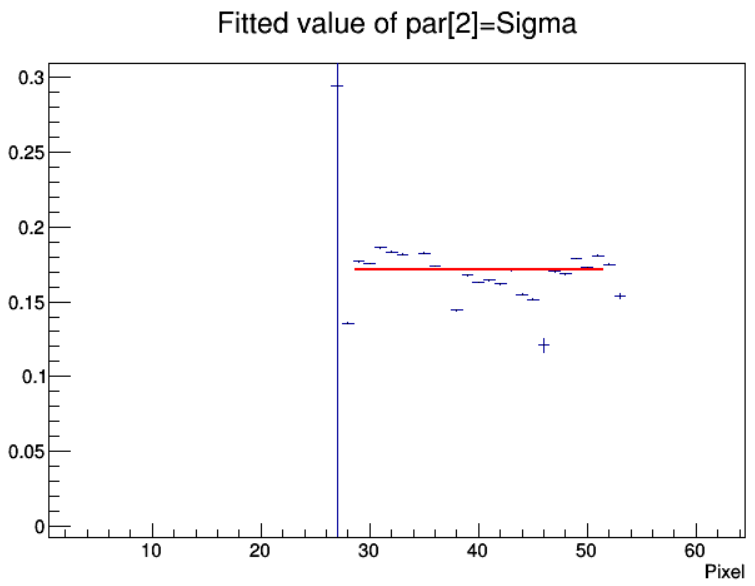
1D scan of high pixelated Hamamatsu tube



Results of 1D scan

- Crosstalk problem? Also seen on JS0018
- mm/Pixel: Fitted: 0.404, Datasheet: 0.4
- Pixel position resolution: 0.17 mm





Summary

- So far:
  - Test box is build
  - Stepper is running and has good position resolution
  - Automated focusing of the laser works
  - Measuring charge not possible so far, only time over threshold

- Todo:
  - Continue to build readout system
  - Padiwa Amps v2 still missing
  - Writing analysis scripts
  - Reaching time resolutions <200 ps

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