

MCP-PMT studies for the Disc DIRC

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on behalf of the PANDA Cherenkov Group

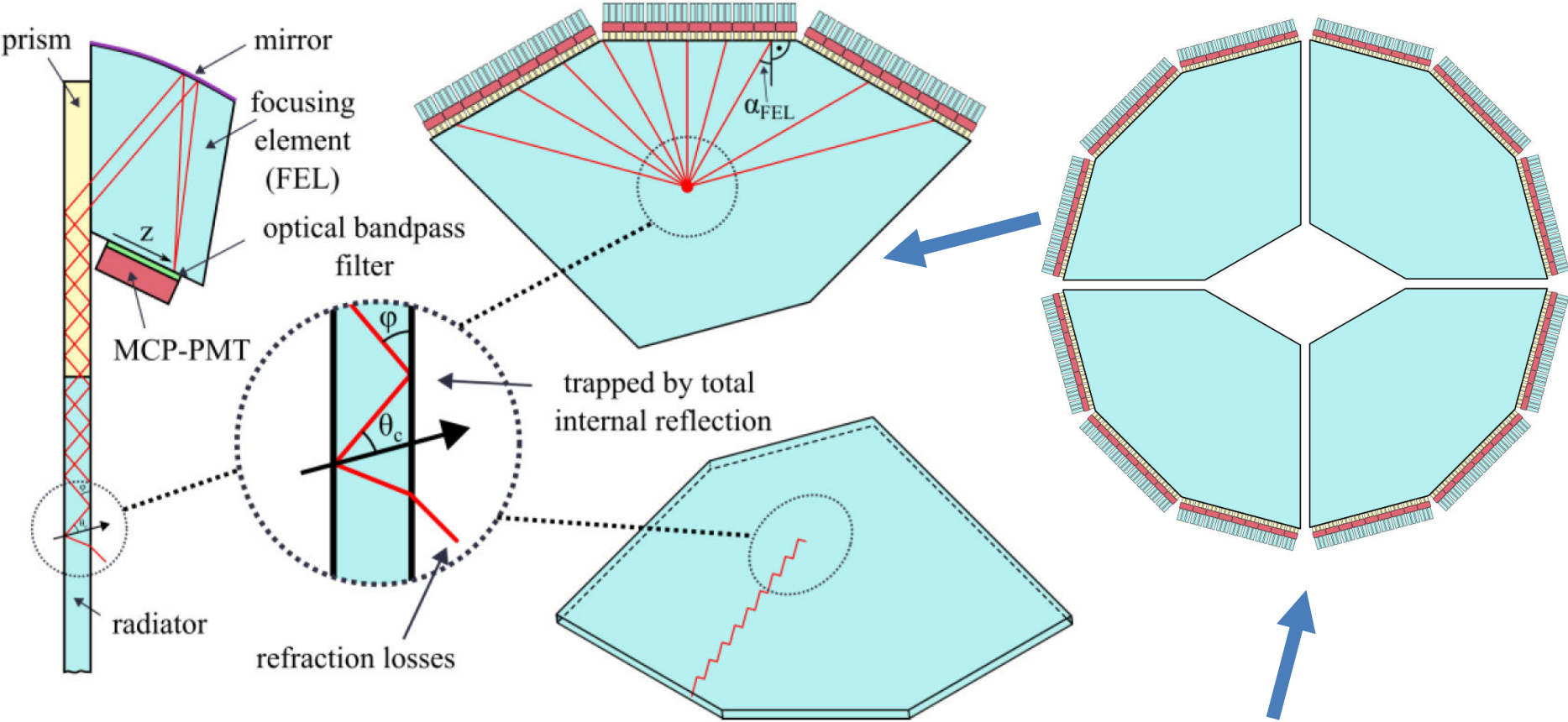
DIRC 2015, Castle Rauschholzhausen



HGS-HIRe *for FAIR*
Helmholtz Graduate School for Hadron and Ion Research

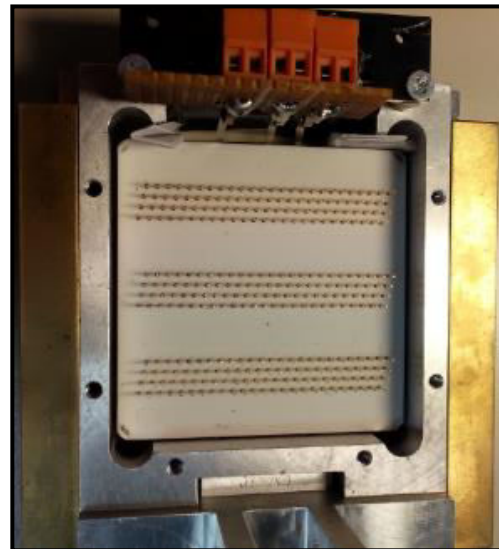
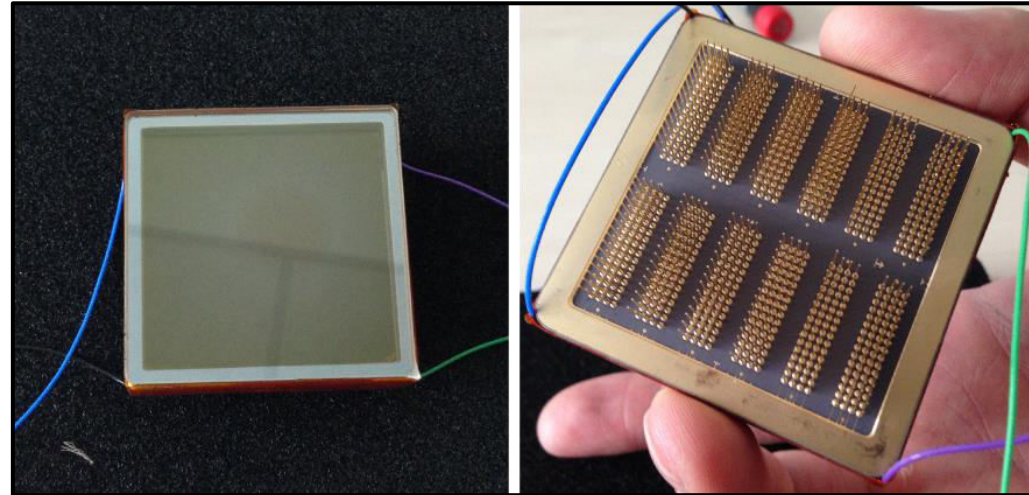
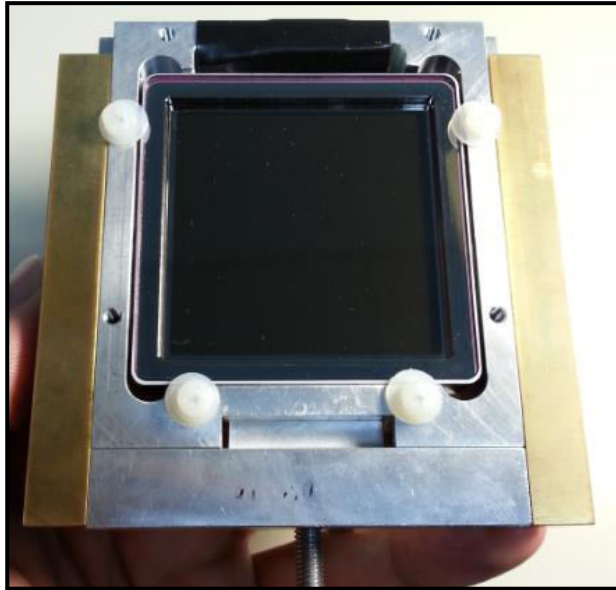
Endcap Disc DIRC

More info on the DISC Dirc talk by Mustafa Schmidt



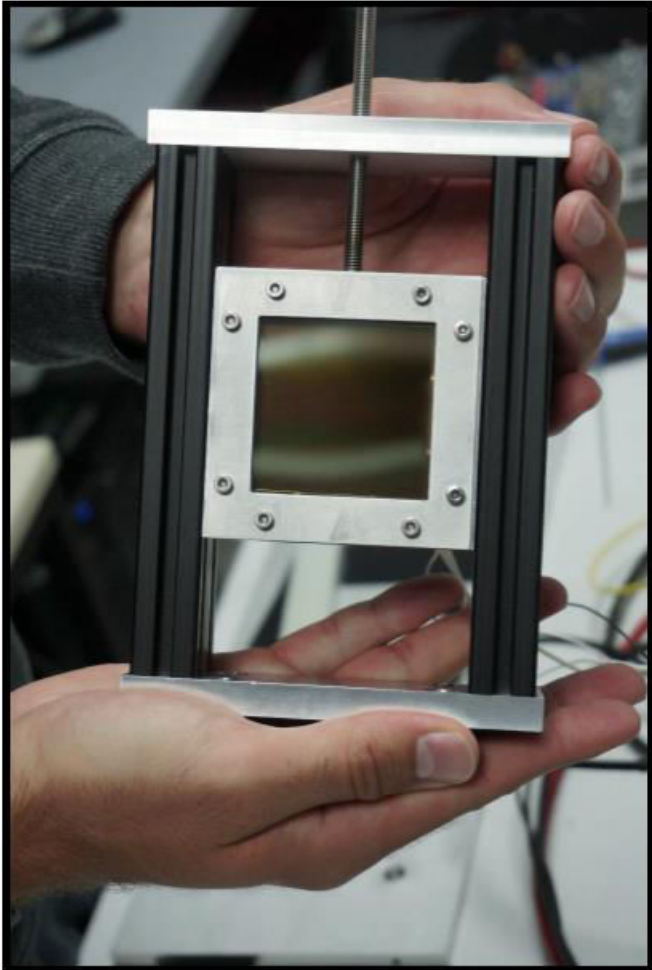
Detector consist of 4 independent quadrants

Our current “motor pool”

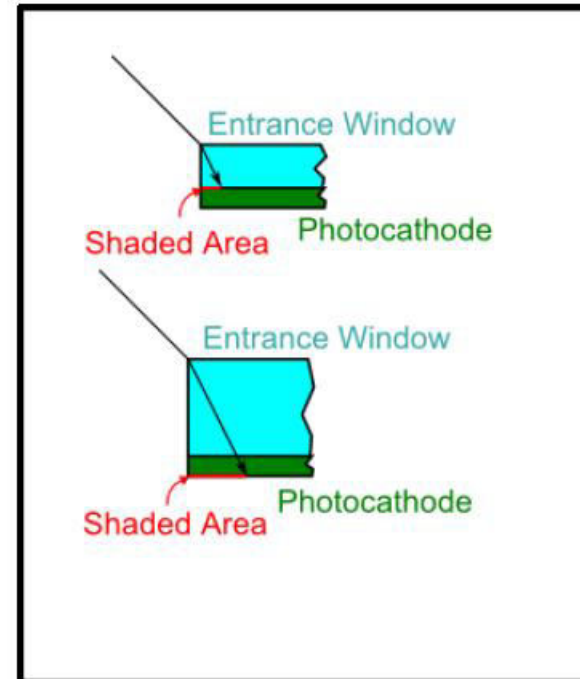


PHOTONIS	Hamamatsu
2 sensors with 3x100 pixels	1 sensor with 6x128 pixels
0.5mm anode pitch	0.4mm anode pitch
45x45mm ²	53x53mm ²
Suitable for single photon detection	

New Photonis Device



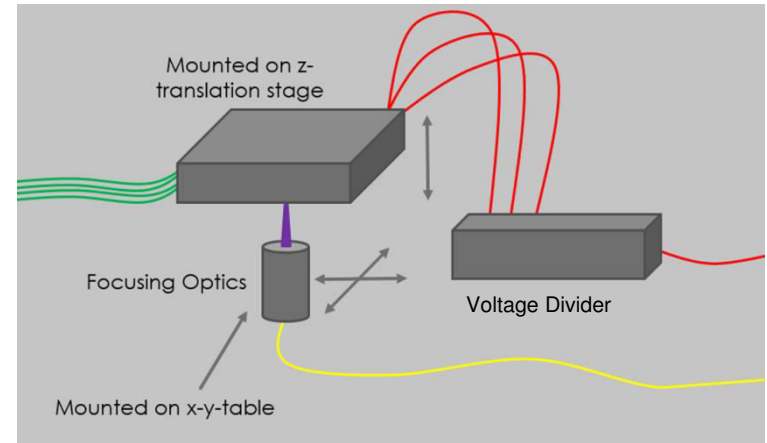
- Looks like the first prototype, but does not have prox. focus option
- i.e. MCP and anodes are further apart
- Position resolution without external fields should be worse compared to the prox. focus option
- Advantage: less shading effects and more active area
- Last years results show PHOTONIS device **with prox. focus** ($\sigma = 183 \mu\text{m}$, see next slide)



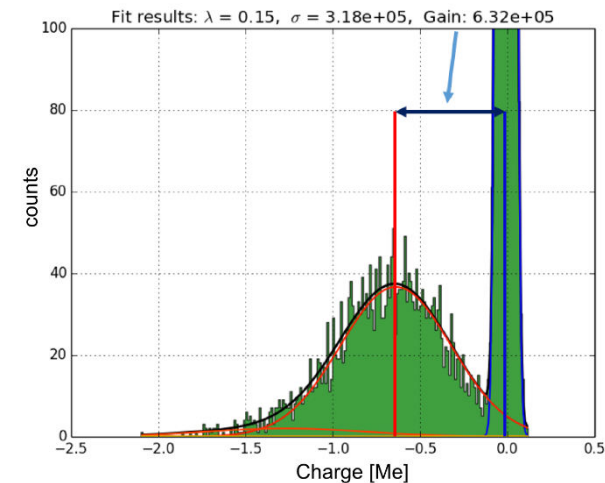
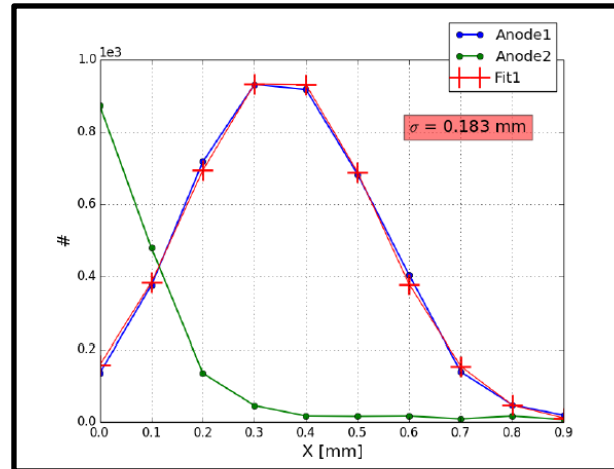
Reminder



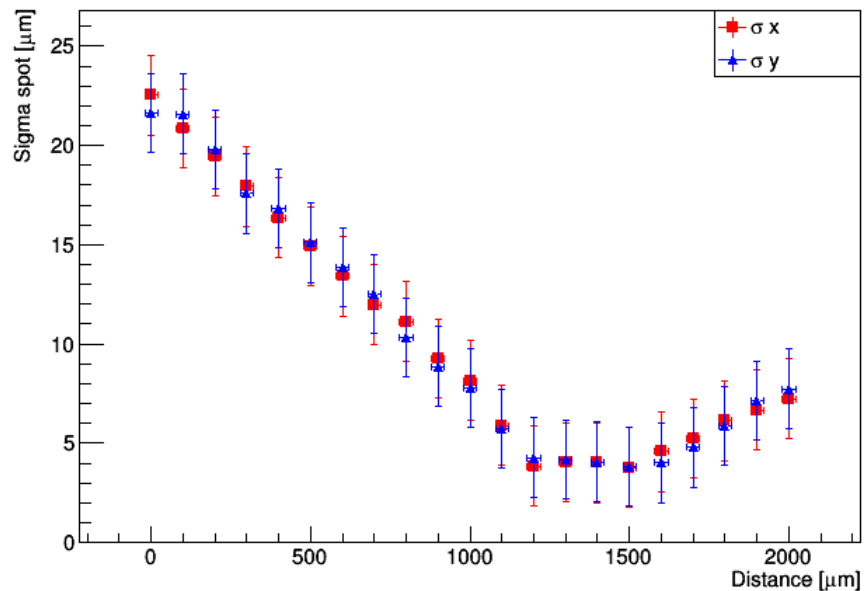
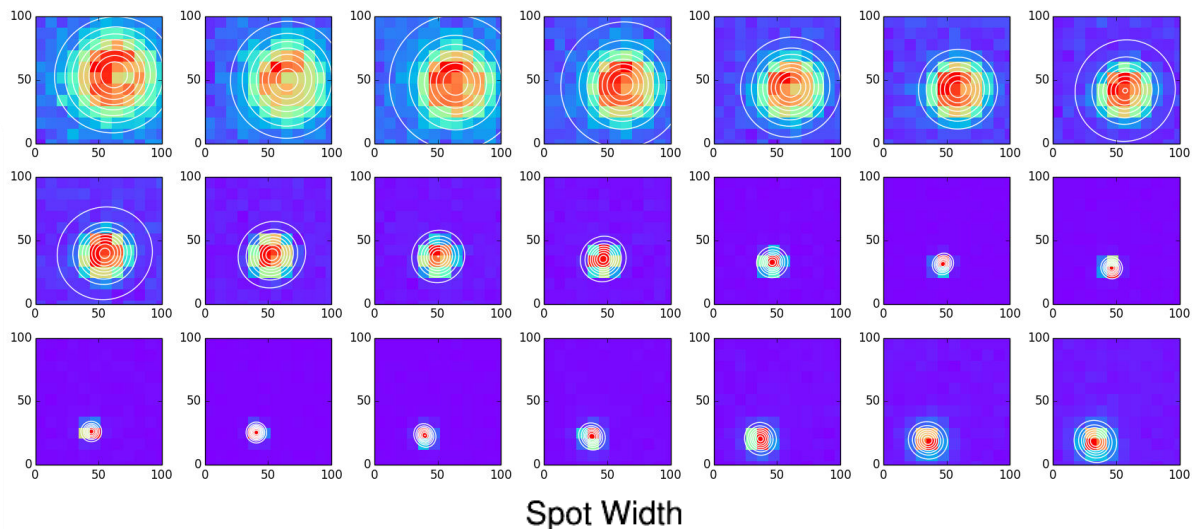
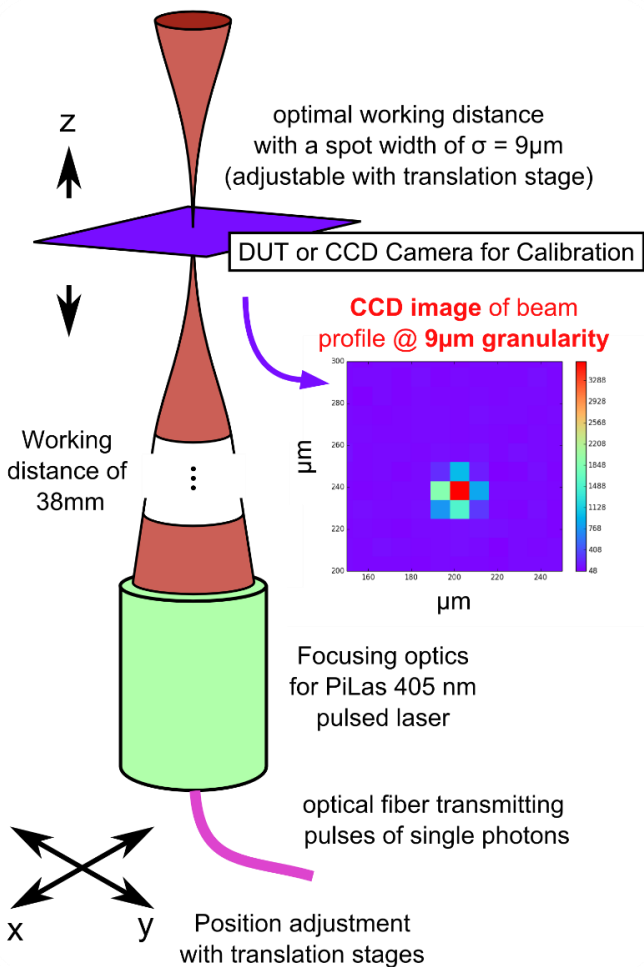
Measurements without magnetic field can be taken with our fully automated setup



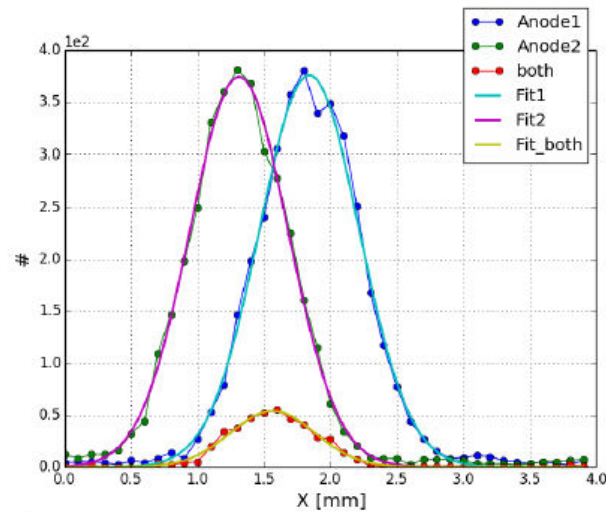
- Charge spectra
- position resolution
- Last years results show PHOTONIS device with prox. focus ($\sigma = 183 \mu\text{m}$)



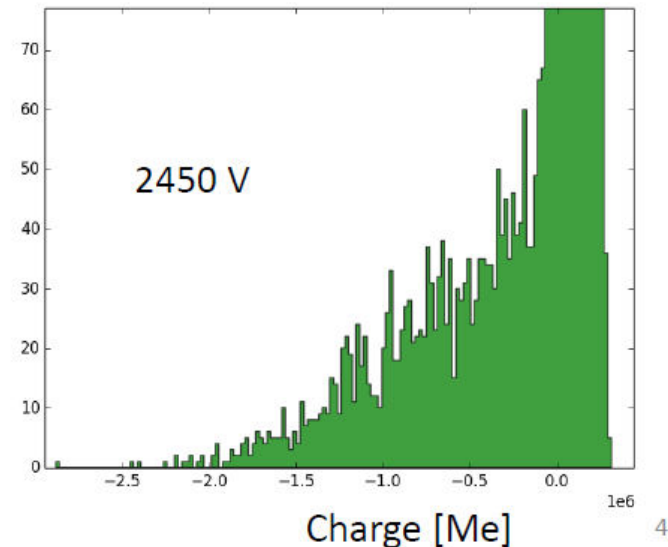
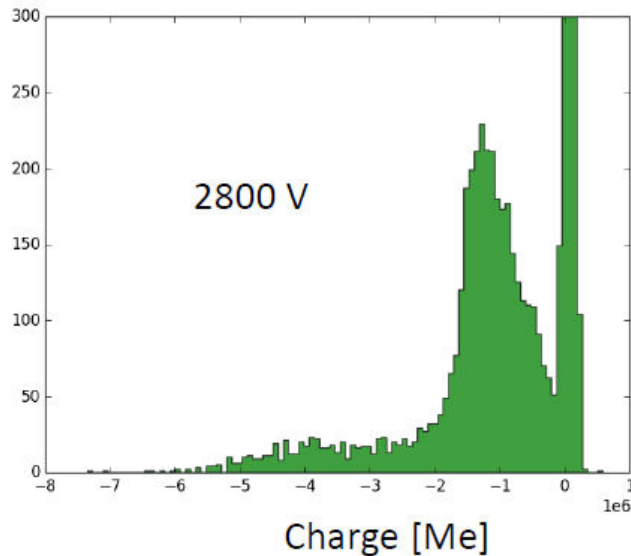
Spot width of laser



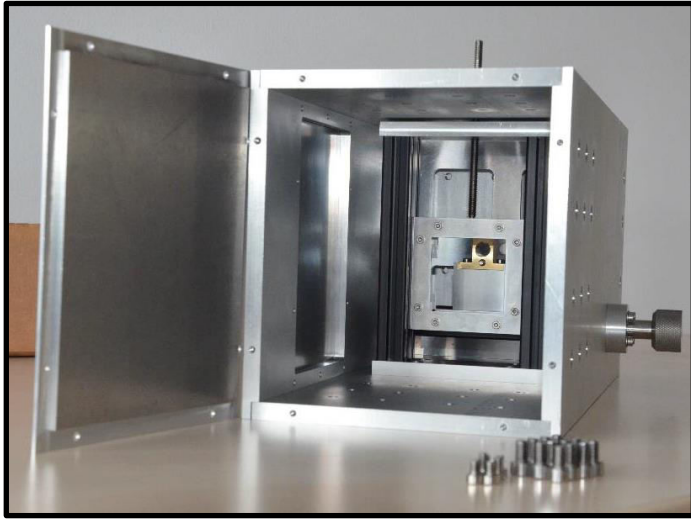
New Photonis Device



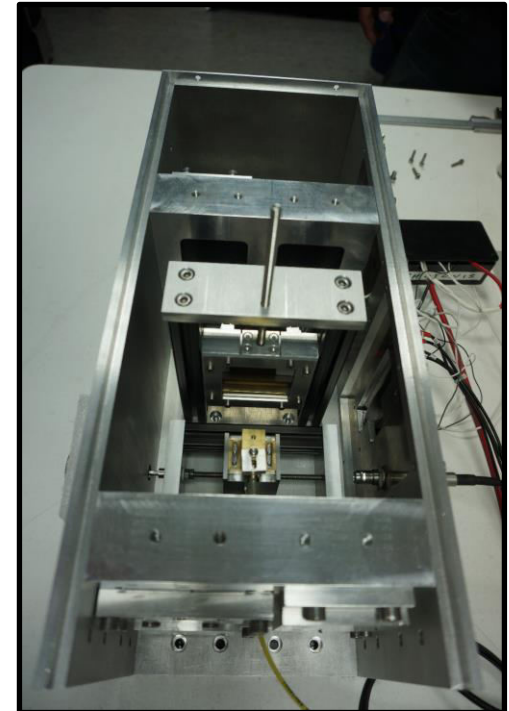
- Measured position resolution in automated setup
- $\sigma = 376 \mu m$
- Charge spectrum at 2450 V does not show nicely separated single photon peak (like prox. focus did)
- Increasing the voltage to 2800 V (max voltage) reveals single photon peak



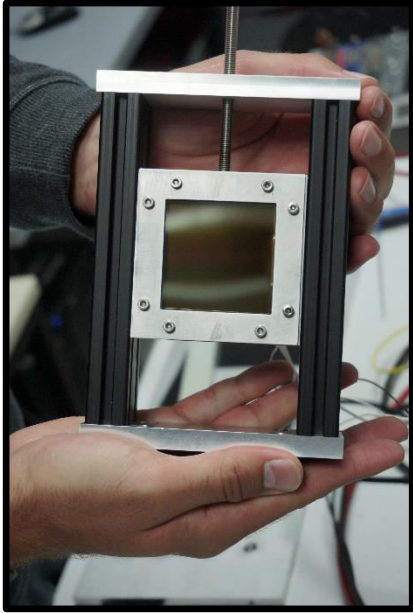
Magnet Box



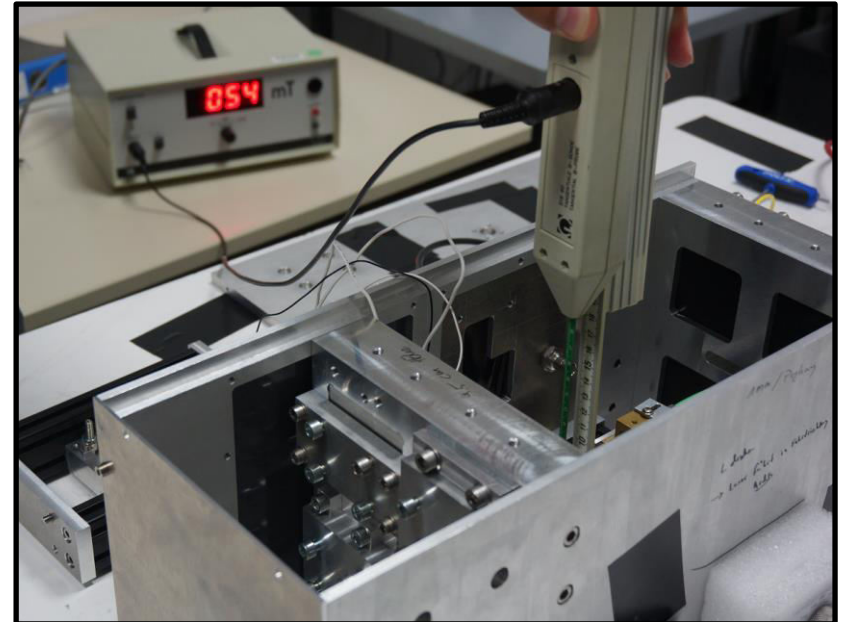
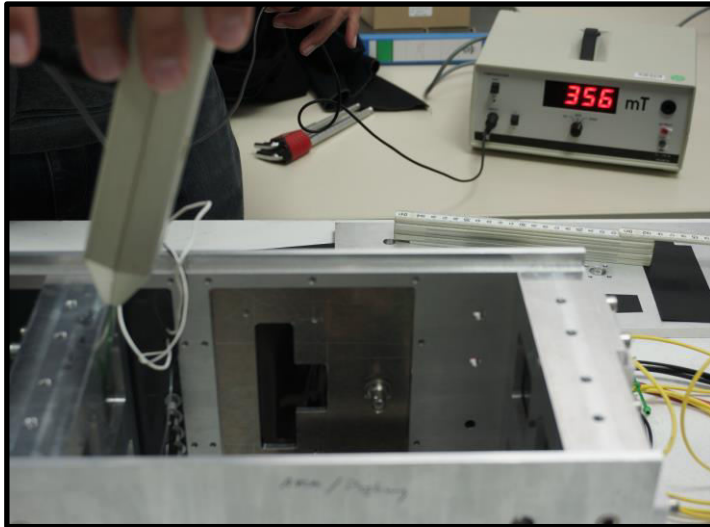
- In the next step the magnet box was used to do measurements with a magnetic field applied
- We use 8 very strong neodymium magnets in 2 x 4 magnet walls
- The walls can be moved to 6 different positions or can be removed completely

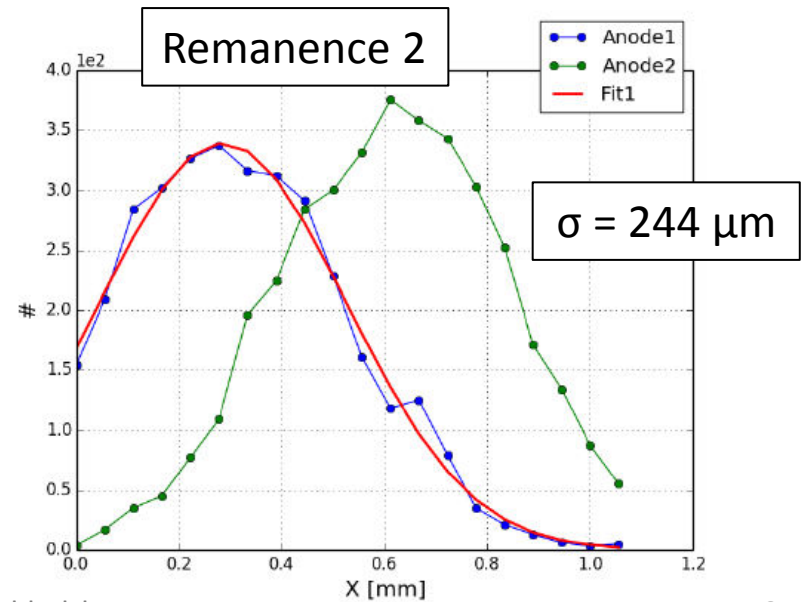
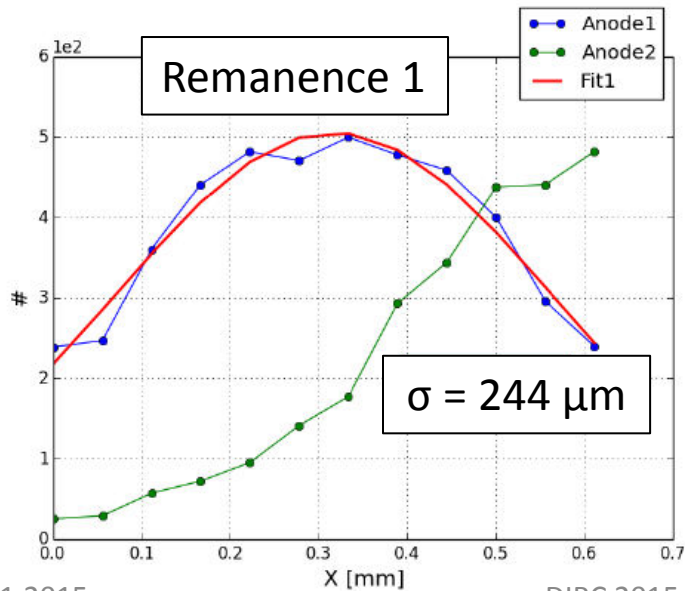
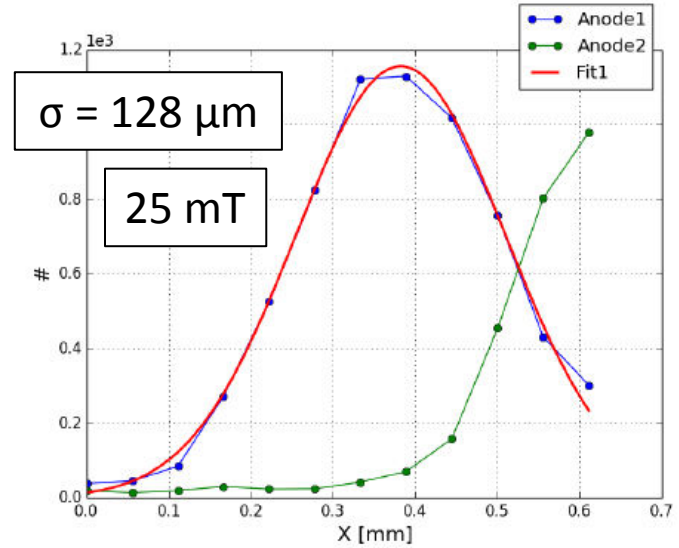
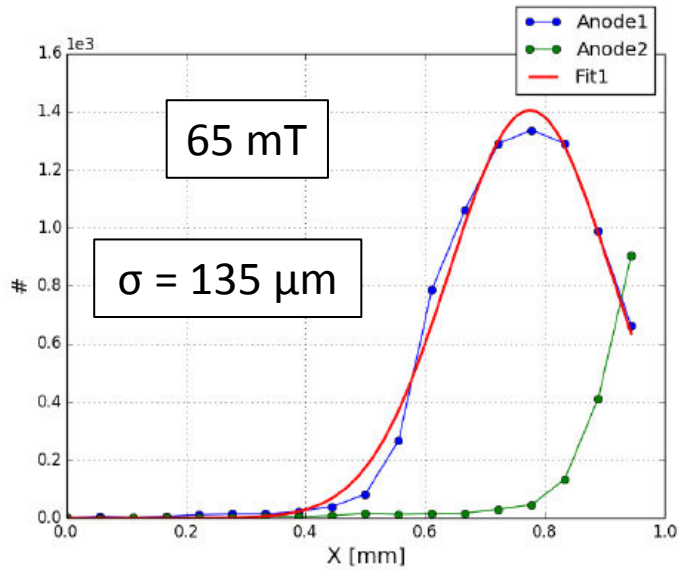


PHOTONIS in the magnet box



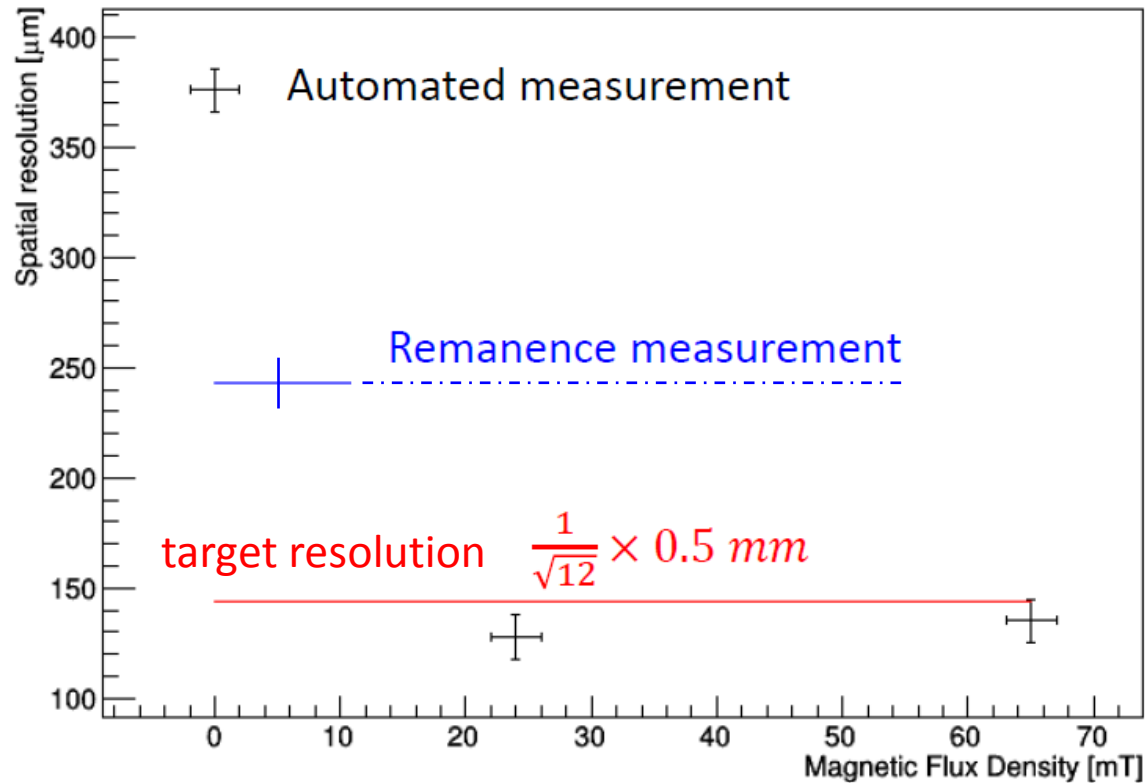
- The magnetic field is quite homogenous in the middle of the two magnet walls
- Field is measured in the absence of the sensor
- Different field strength can be dialed
 - (65, 55, 43, 34, 33, 24) mT





PHOTONIS overview PRELIMINARY

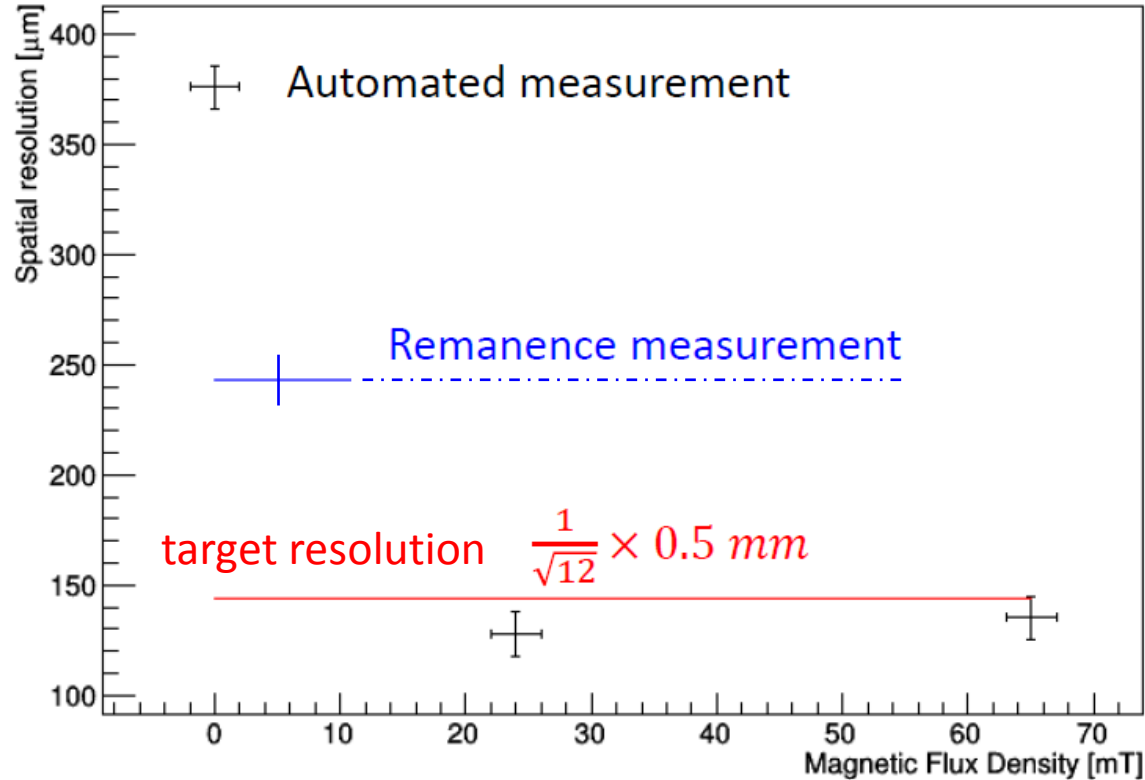
Photonis MCP-PMT



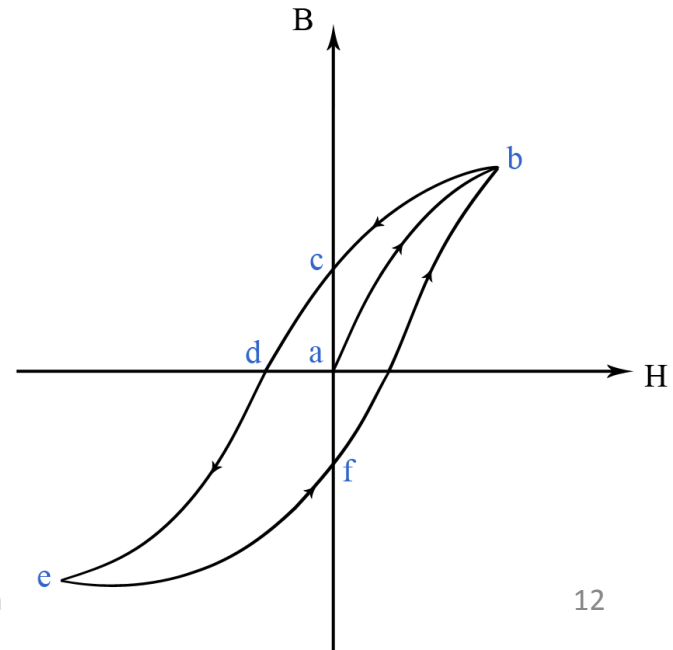
- The MCP-PMT contains ferromagnetic material
- Remanence field can be measured with Hall device, so the sensor is magnetized.
- Next step: Understand the effects more deeply:
 - Demagnetization
 - Change field from low to high values

PHOTONIS overview PRELIMINARY

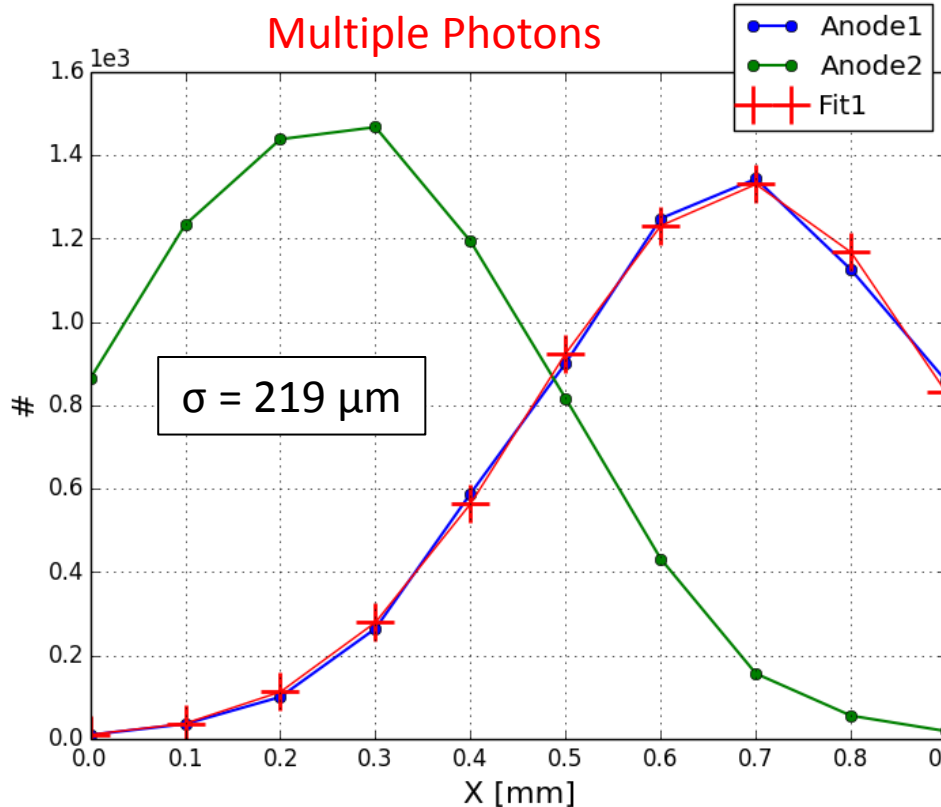
Photonis MCP-PMT



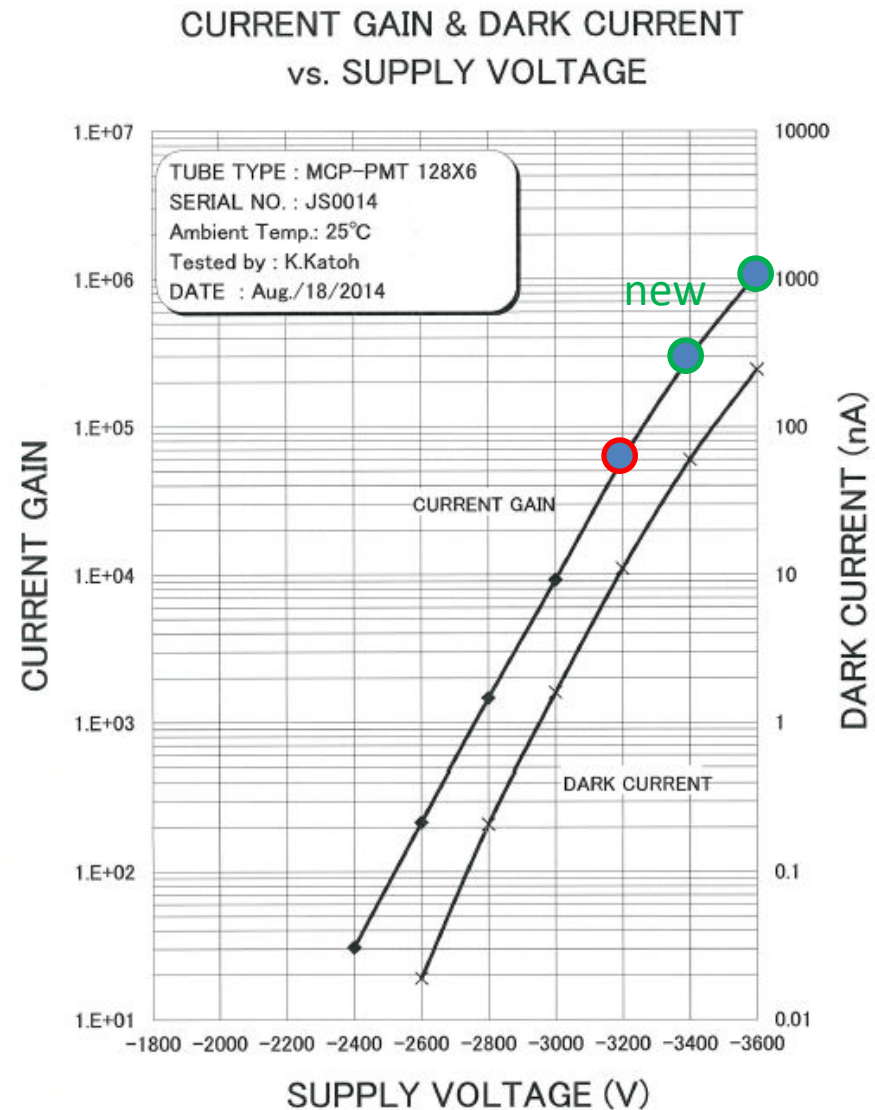
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Hamamatsu (Reminder)



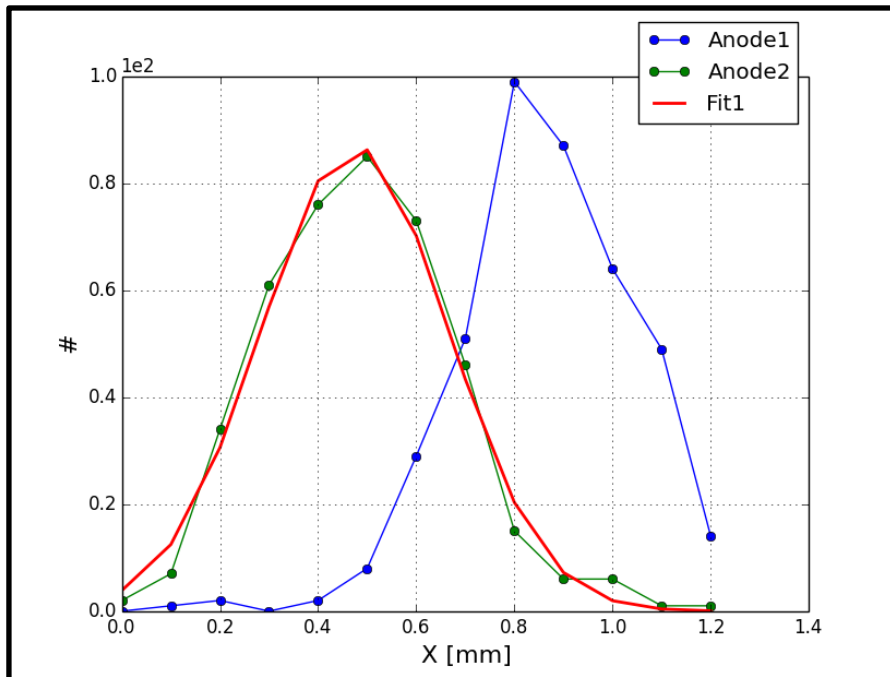
- Old measurements have been done with multiple photons at low gains ($< 10^6$)
- New measurements at suitable SP gains



Hamamatsu

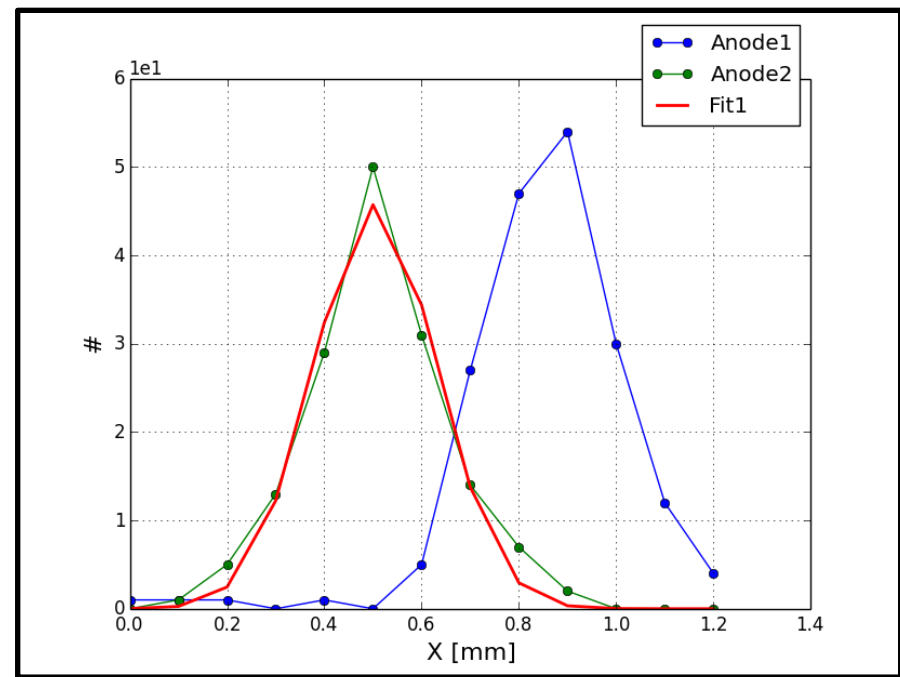
$\sigma = 190 \mu\text{m}$

3600 V



$\sigma = 120 \mu\text{m}$

3400 V

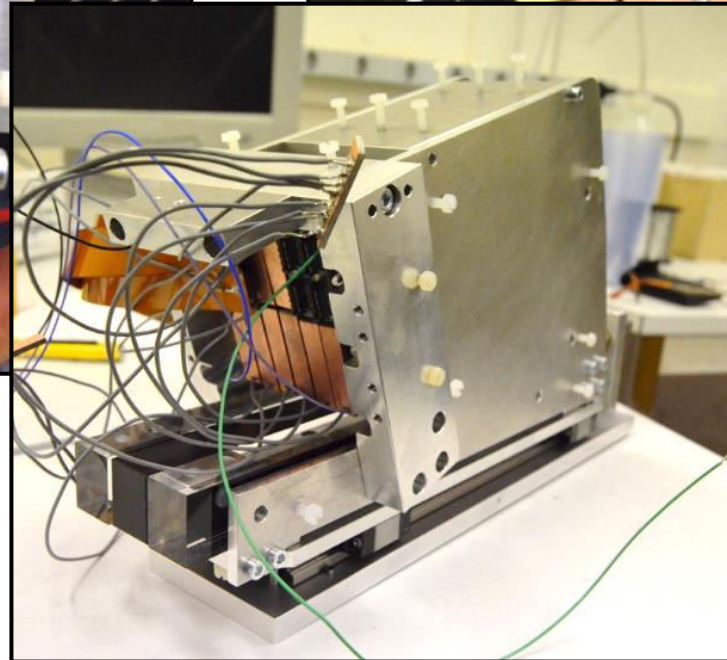
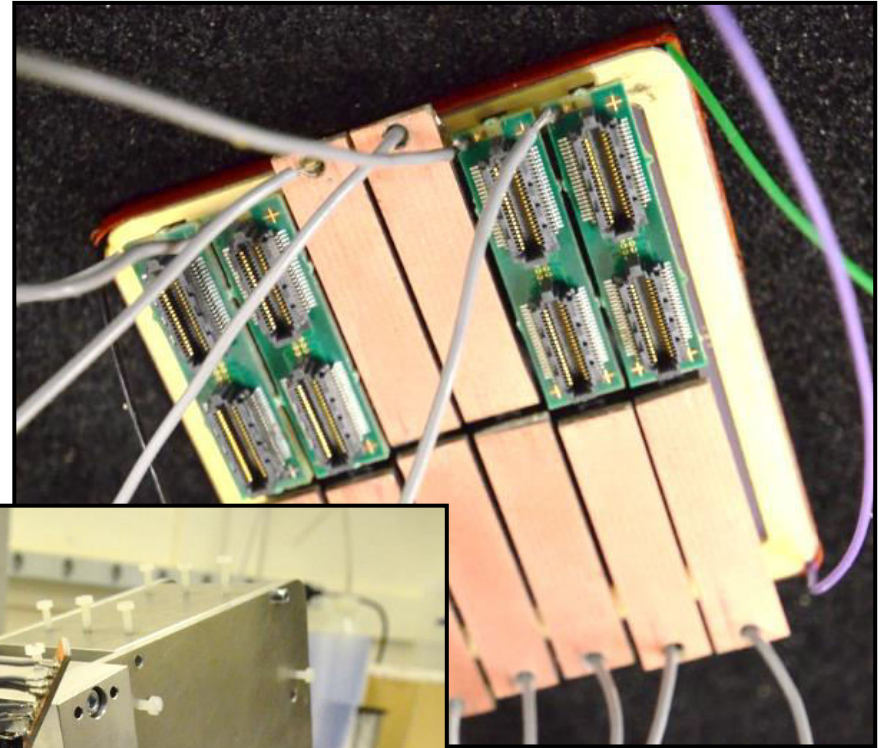
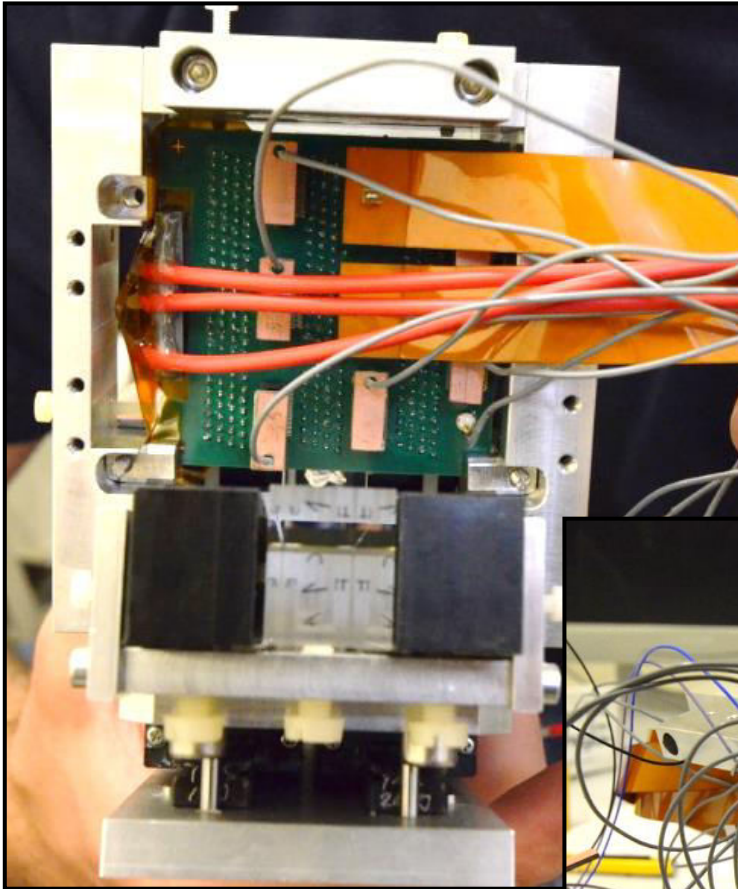


- Position resolution **without magnetic field**
- Anode pitch only 0.4 mm
- Next step: apply magnetic field

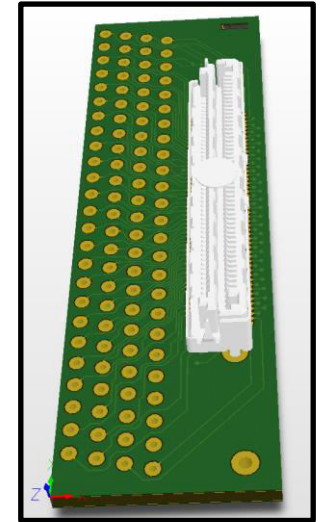
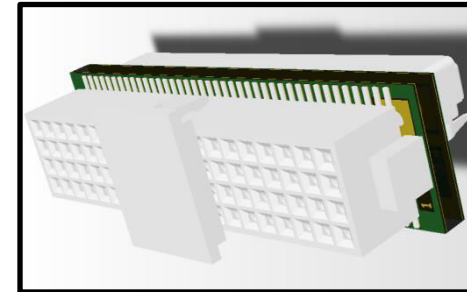
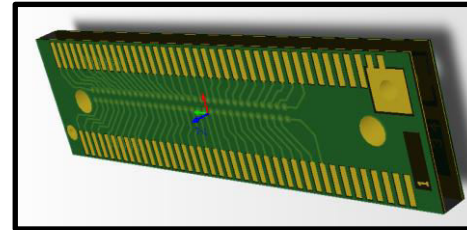
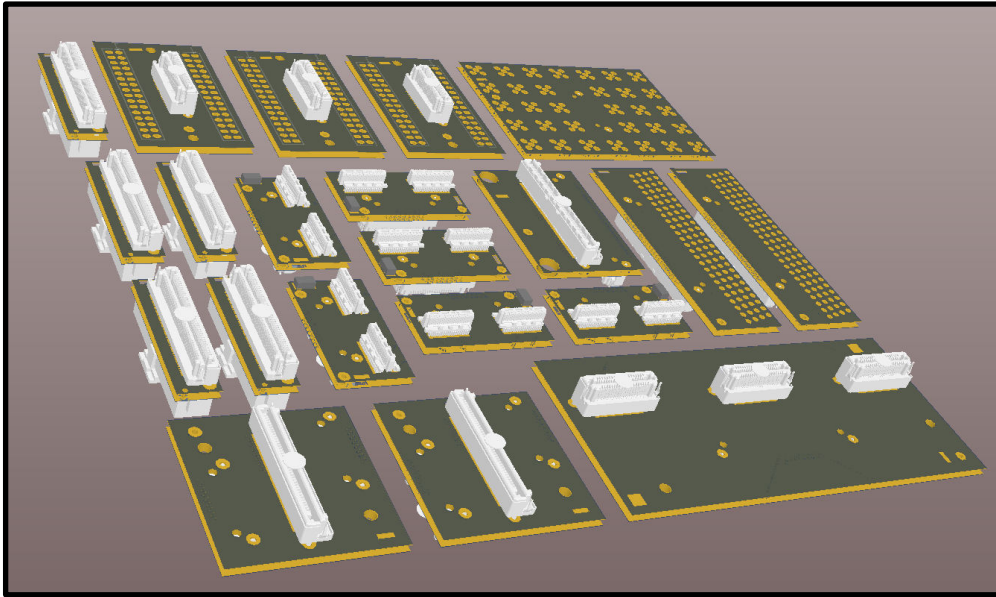
**Magnet box measurements
are one the way!**

Testbeam 2015 at CERN

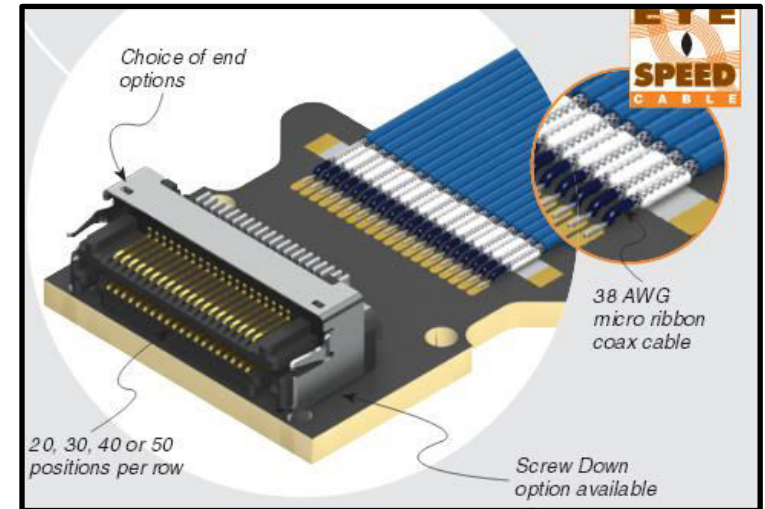
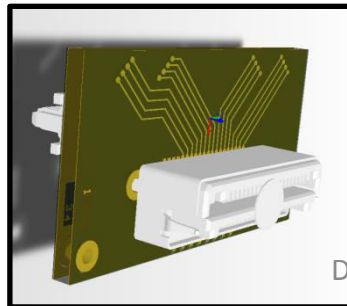
More info and results
in Erik's talk



New Prototype Hardware



- CERN testbeam was very successful with old hardware
- However, the TOFPET ASIC seems to be very sensitive when using the unshielded flex cables
- Flex cables pick up noise in the magnet box
- Mechanical stability of connections can be improved
- Impedance control of flex prints is inaccurate



Also used by Erlangen!

Summary

- Very promising (testbeam) results with both Hamamatsu and PHOTONIS tubes (see talk by Erik tomorrow)
- Ongoing research
 - Performance in magnetic fields
 - Compatability with the TOFPET ASIC
- New prototype on the way

Thank you

