

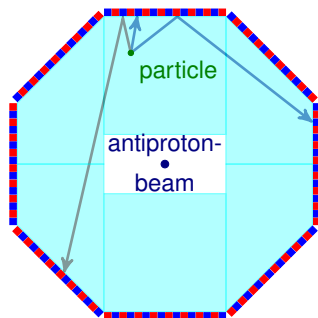
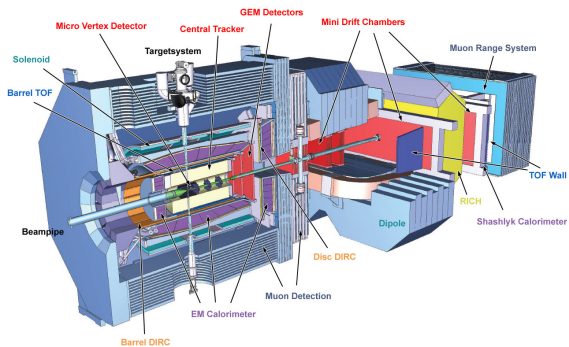
Test of the focussing TOP design using G-APDs at the GSI test beam

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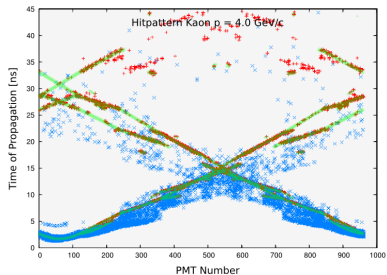
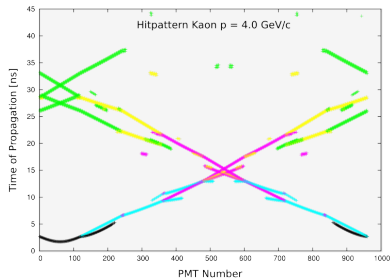
Justus Liebig Universität Gießen, Germany

PANDA Collaboration Meeting, December 2009

TOP Disc DIRC for PANDA Detector

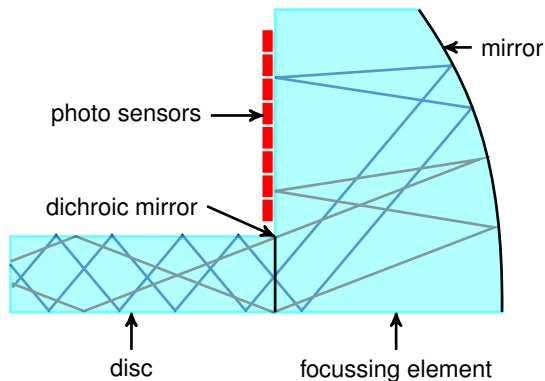


Background from δ -rays



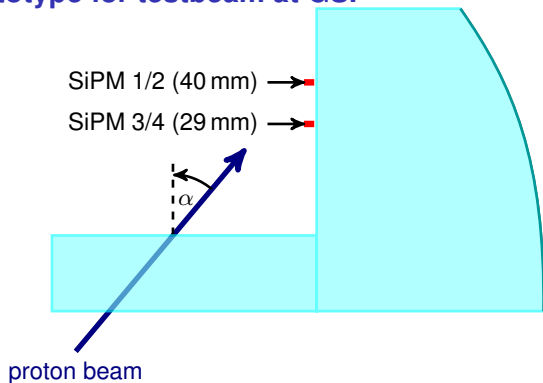
- ▶ Left: Calculated hitpattern
- ▶ Right: Knock-on electrons cause background (blue points)

Focussing TOP design



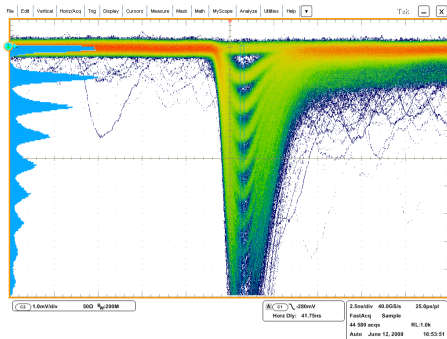
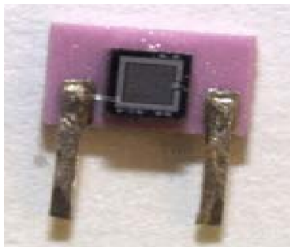
- ▶ Time of propagation to determine Cherenkov angle
- ▶ Simple focussing elements for background elimination
- ▶ Dichroic mirrors for dispersion correction

Prototype for testbeam at GSI



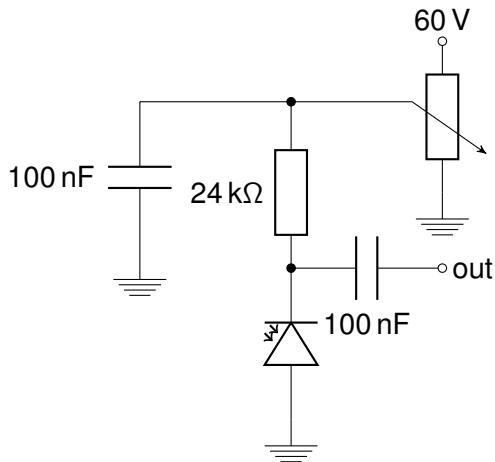
- ▶ Radiator bar (simplified disc): plexiglass, 70 mm × 20 mm × 15 mm
- ▶ Focussing element: plexiglass
- ▶ Mirror: reflective foil
- ▶ Photo sensors: 4 SiPMs (G-APDs) from Moscow Engineering Physics Institute (MEPhI)

MEPhi SiPM



- ▶ Active chip size: 1 mm × 1 mm
- ▶ Laser test: signals for 0, 1, 2, . . . , 8 detected photons

Boards for MEPhi SiPM



- ▶ Passive quenching circuit
- ▶ Bias voltage: ≈ 40 V

Readout chain

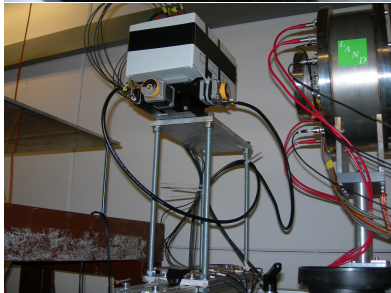
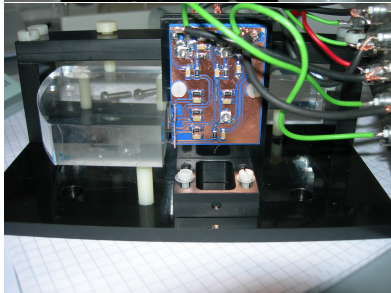
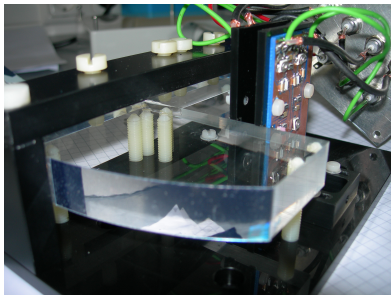
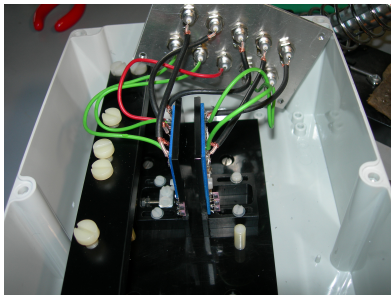


- ▶ Time measurement with TDCs
- ▶ Readout by Glasgow group (Thank you!)

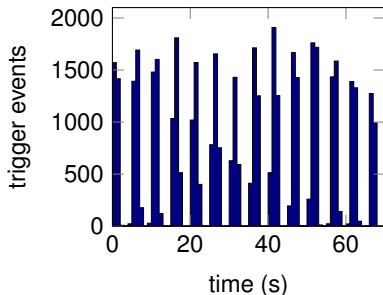
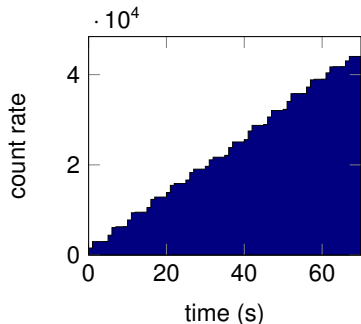
Devices:

- ▶ SiPM: MEPhl
- ▶ Preamp: Ortec VT 120
- ▶ CFD: Ortec Quad CFD 935
- ▶ TDC: CERN HPTDC
- ▶ DAQ: Tibor

Some photos

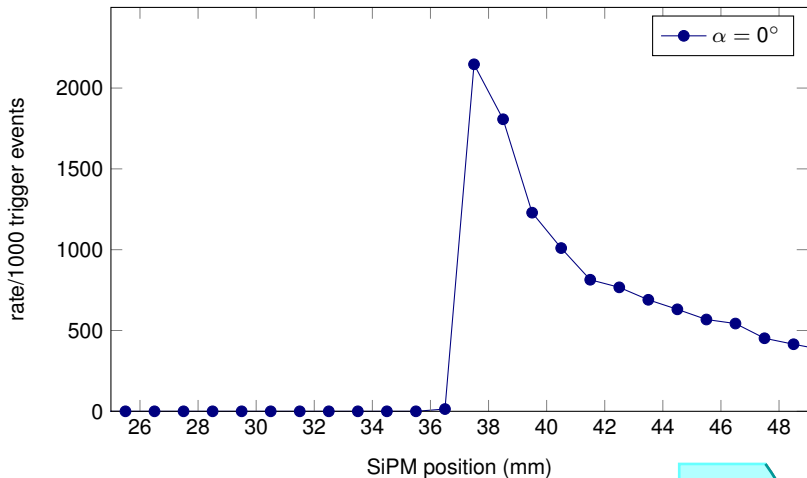


Beam Profile



- ▶ Run 386
- ▶ 44029 Events
- ▶ Spill on/off duration: 2.5 s/2.5 s
- ▶ Mean: ≈ 3145 registered protons per bunch
- ▶ Kinetic energy: 2 GeV
- ▶ Beam diameter: few cm

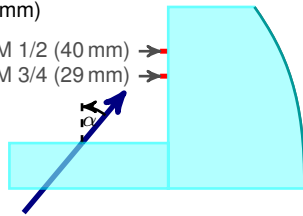
What we expect



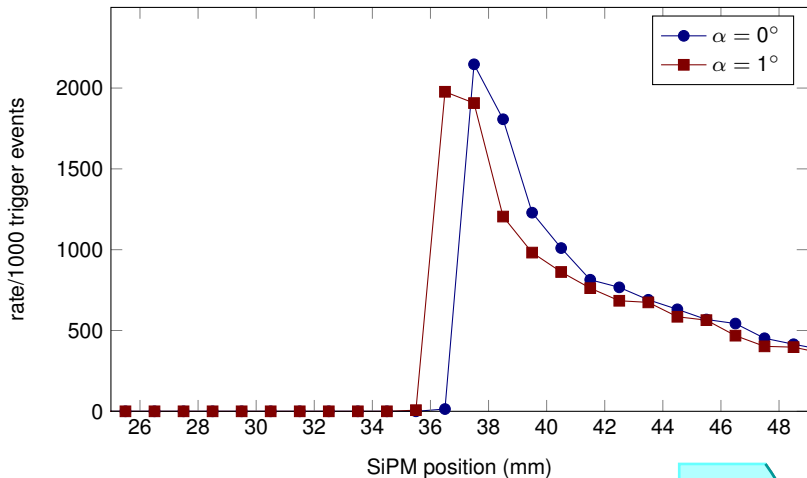
- ▶ Simulation for different incident angles

SiPM 1/2 (40 mm) →

SiPM 3/4 (29 mm) →



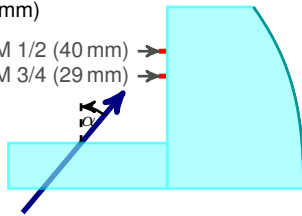
What we expect



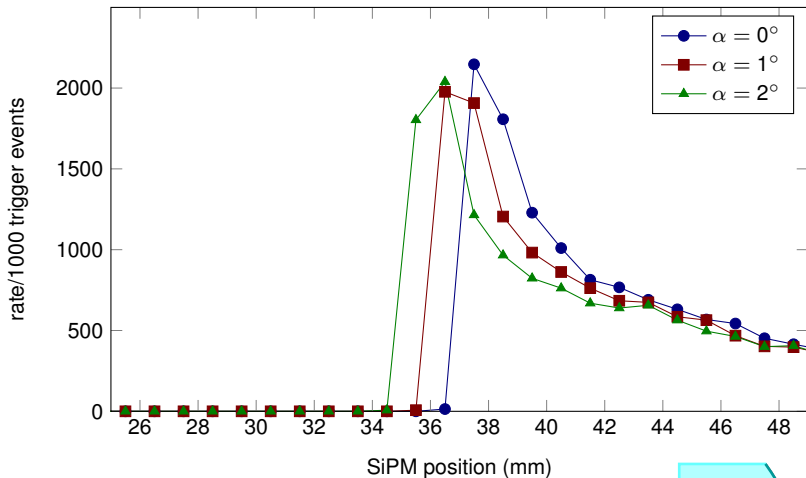
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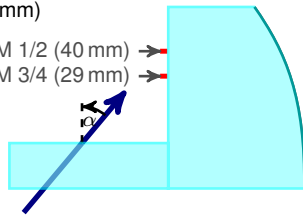
What we expect



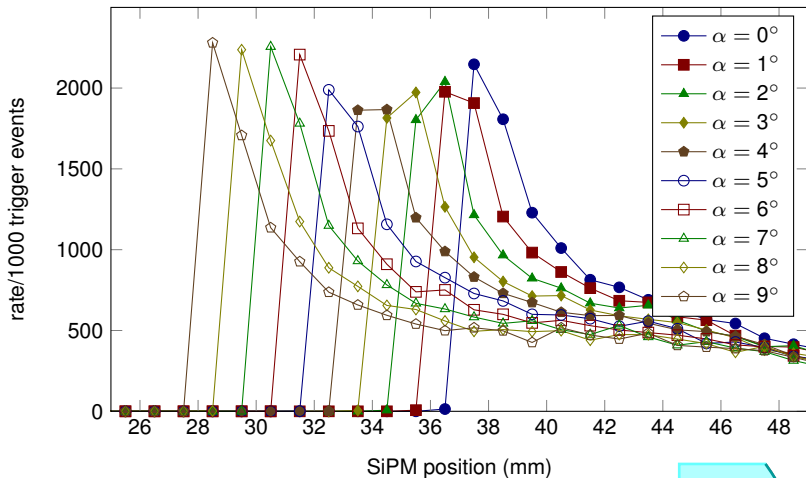
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SiPM 3/4 (29 mm) →



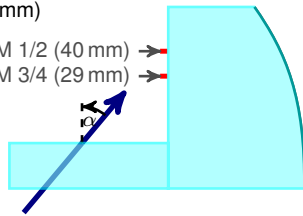
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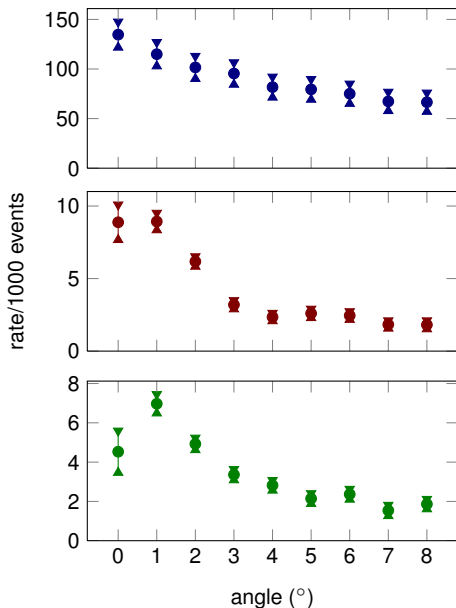
► Simulation for different incident angles

SiPM 1/2 (40 mm) →

SiPM 3/4 (29 mm) →

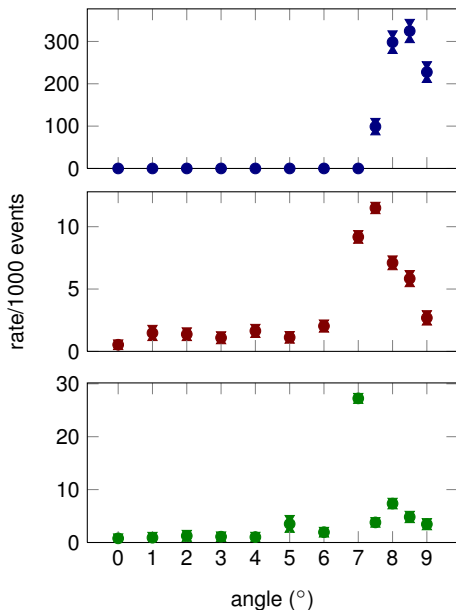


Experiment: SiPM 1 and SiPM 2 (40 mm from radiator)



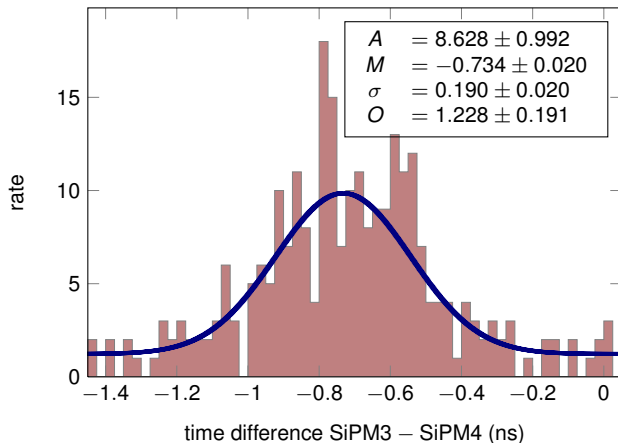
- ▶ **Top:**
Simulation with 20 %
photon detection
efficiency
- ▶ **Middle:**
Measurement with
SiPM 1
- ▶ **Bottom:**
Measurement with
SiPM 2
- ▶ Yield for 1000 trigger
protons

Experiment: SiPM 3 and SiPM 4 (29 mm from radiator)



- ▶ **Top:**
Simulation with 20 %
photon detection
efficiency
- ▶ **Middle:**
Measurement with
SiPM 3
- ▶ **Bottom:**
Measurement with
SiPM 4
- ▶ Yield for 1000 trigger
protons

Time resolution



- ▶ Coincidence plot for 3218087 triggered events
- ▶ Time resolution per readout channel $\sigma \approx 134$ ps

Conclusion/Outlook

- ▶ We have seen Cherenkov light on the focal plane.
 - ▶ Further tests with G-APDs should help to understand why the rates were low.
 - ▶ Tests with higher statistics should result in a better time resolution.
 - ▶ Research and simulations will show us how to optimize the focussing elements.
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- ▶ Thanks to the people from GSI and Glasgow who helped us with the experiment.