
Progress for the Endcap Disc-DIRC-Detector

Friday Group Seminar

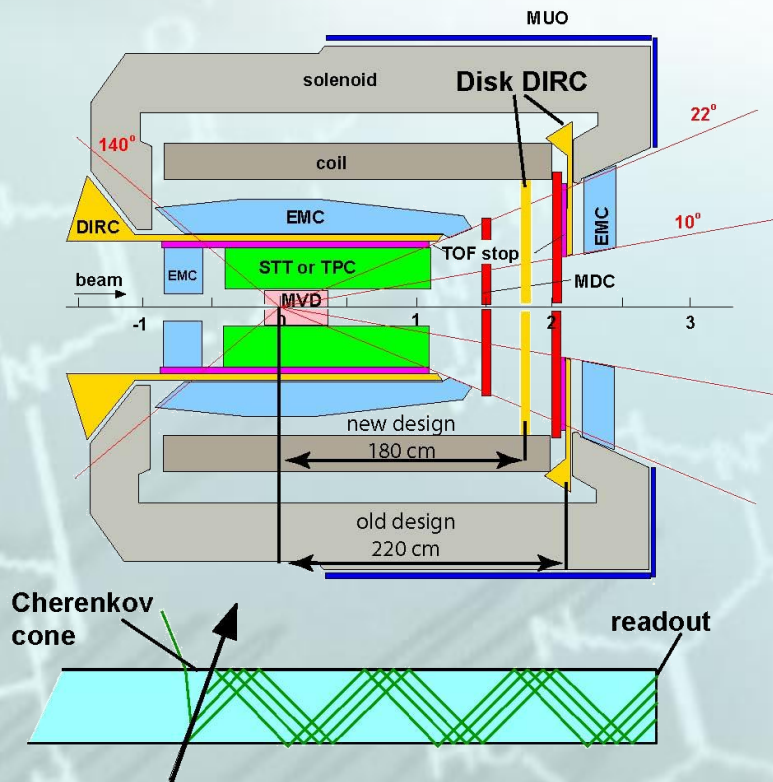
Roland Schmidt, Giessen

07.12.2007

Overview

- **Introduction**
- **Software**
 - 2D- DIRC
 - ToP DIRC
- **Hardware**
 - Material Test
 - Cosmics Test
- **Outlook**

Introduction



- PID detector for PANDA
- Disk shape
- Separation of Pions and Kaon (Protons)
- Two possible positions in forward direction
- Covers 5° to 22° (10° to 22°)
- Hole in center for beampipe and the acceptance of the forward detectors

Introduction

The Group made extensive studies during the last two years in Software and Hardware

Software

- Simulation studies to optimize design
- Simulation of smearing influences
- Identification of the particle with root
- External reconstruction software
- Connection to PandaRoot

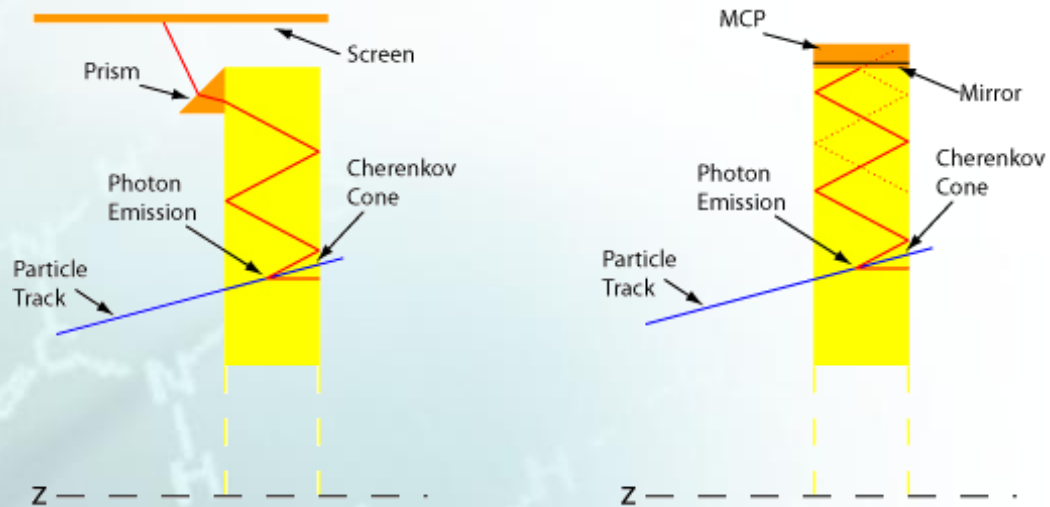
Hardware

- Optical test of the dichroic mirrors
- Material test with γ -radiation with ^{60}Co
- Material test in real Proton beam
- Cosmics experiment to investigate MCP coincidences

Software

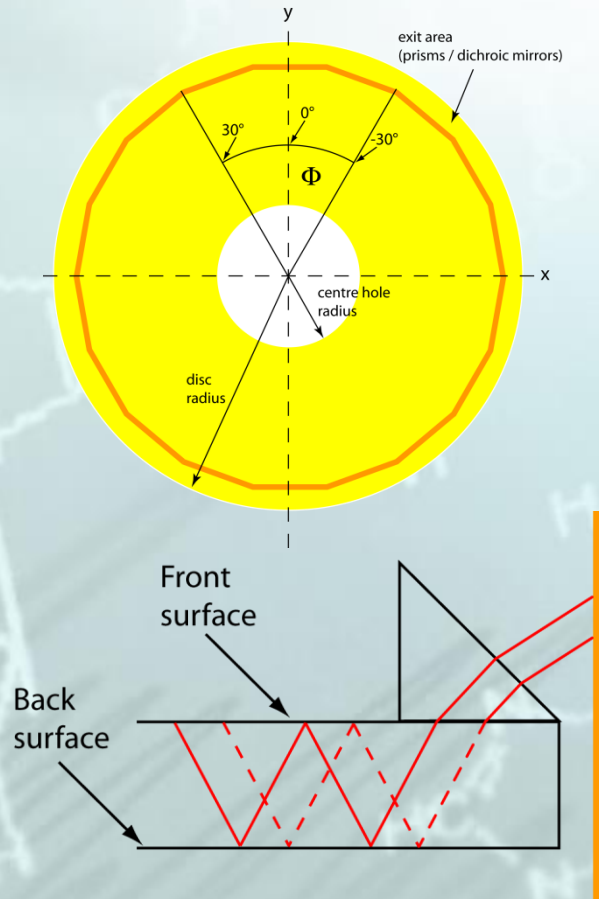
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The designs



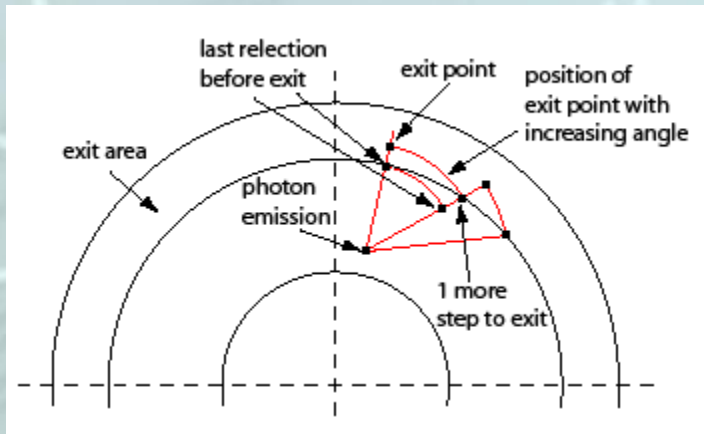
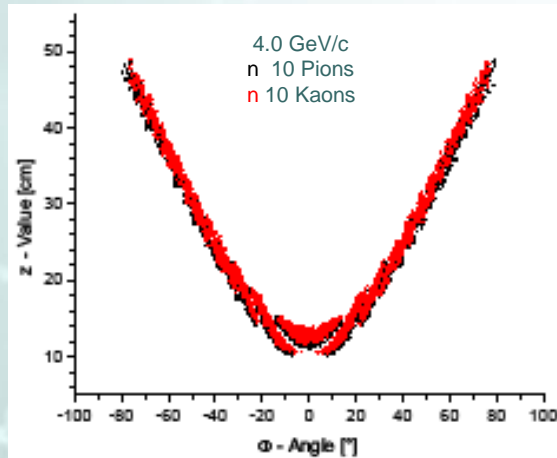
- Readout of two space coordinates
 - The propagated photon is exited with a prism. The z-coordinate of the screen hit point is the observed value.
- Readout of one space and one time coordinate
 - The propagated photon is detected or reflected at the disc rim. The time from emission to detection is the observed value.

2D-DIRC



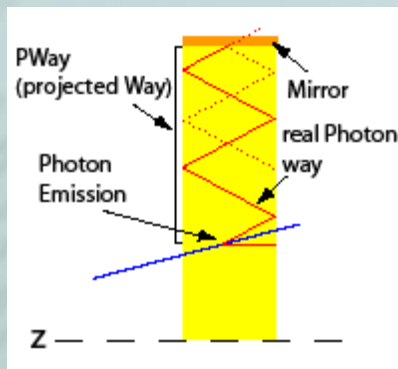
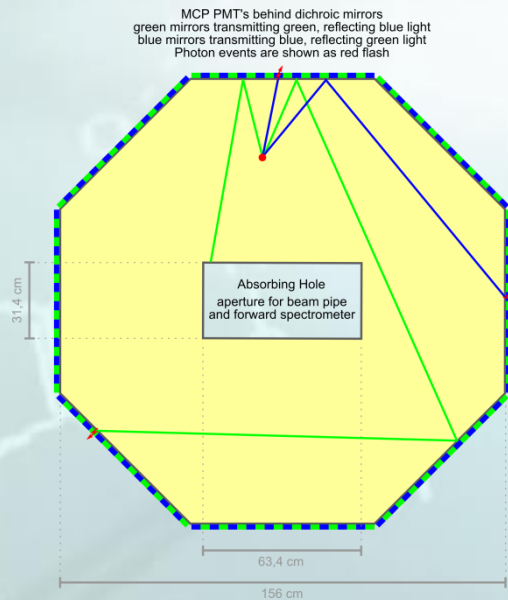
- Cherenkov photons are propagated to the rim of the disc
- Photons exit the disc through a Prism, to break total reflection
- The hit point on an observation screen is the first result value
- The Φ -angle of the disc defines the second result value
- Resolution is strongly depending on the distance between disc and screen
- The amount of readout channels is huge

2D-DIRC



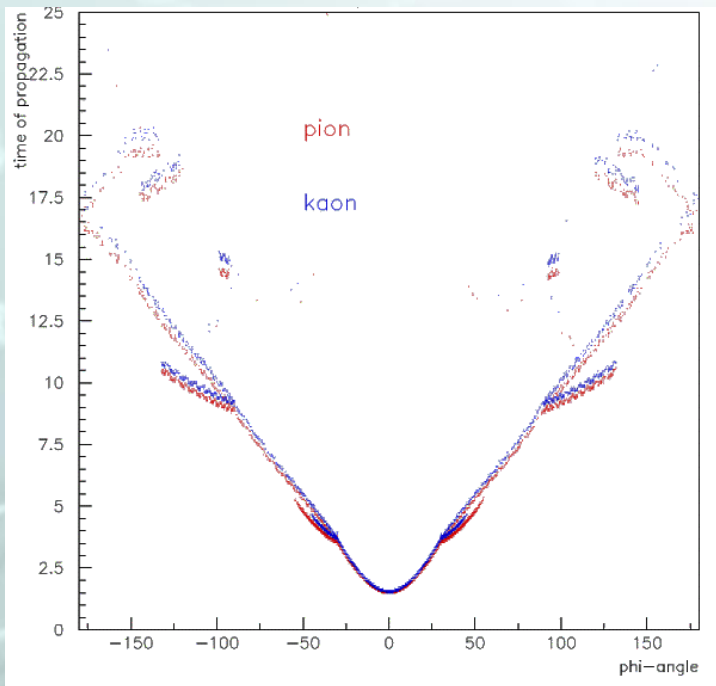
- Shape looks easy but is complex in detail
- A large number of readout channels is needed
- Photons of Kaons and Pions are overlapping very much
- Complex substructure, created by additional steps
- Separation for 4GeV/c is bad even for no smearing influences

ToP-DIRC



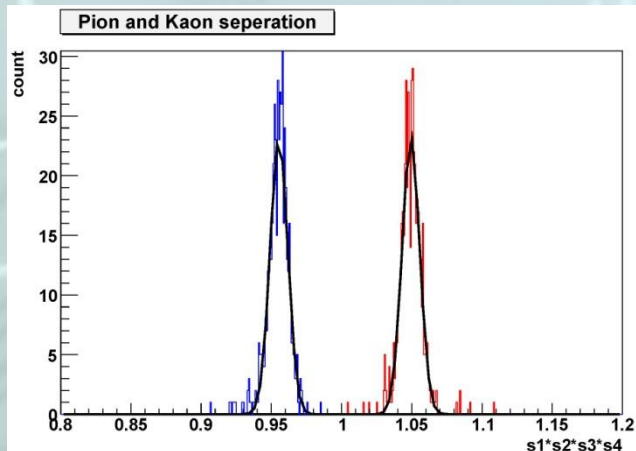
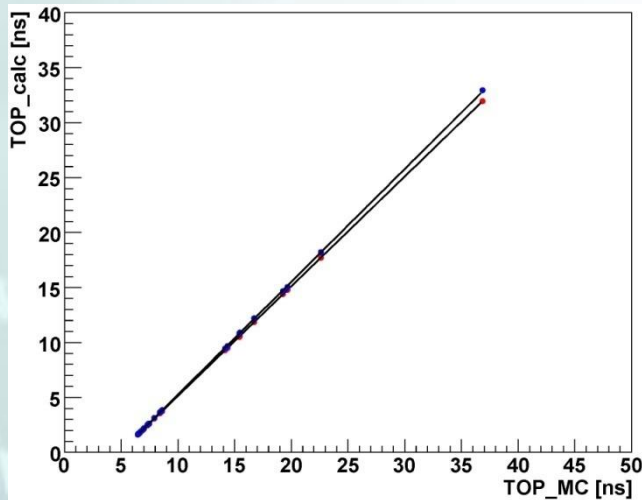
- Cherenkov photons are propagated to the rim of the disc
- Photons hit a dichroic mirror at the disc rim
- Depending on the wavelength, photons are reflected and cross the disk again or transmitted
- Detection with 960 fast readout channels
- Time from emission to detection is the observed value ToP
- Detector number and ToP are the coordinates

ToP-DIRC



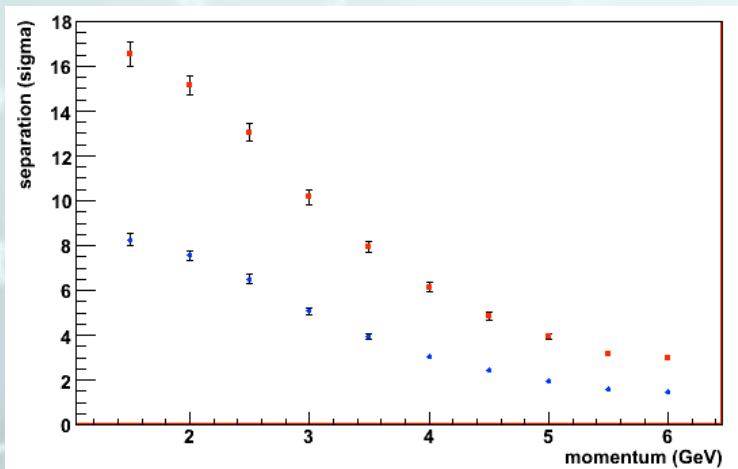
- Shape of the hit pattern seam to be very complex
- Without smearing clear separation between Pion and Kaon pattern
- Possibility to improve separation results by further calculations
- Overall good results even with smearing

ToP-DIRC



- Calculating the Cherenkov angle and comparing it to the real leads to slopes
- Calculation with assuming the particle to be pion or kaon and separating for wavelength
- Result are 4 Slopes, giving a characteristic value by multiply
- If value >1 pion and <1 kaon
- Reconstruction is independent of a constant time shift (no real trigger)

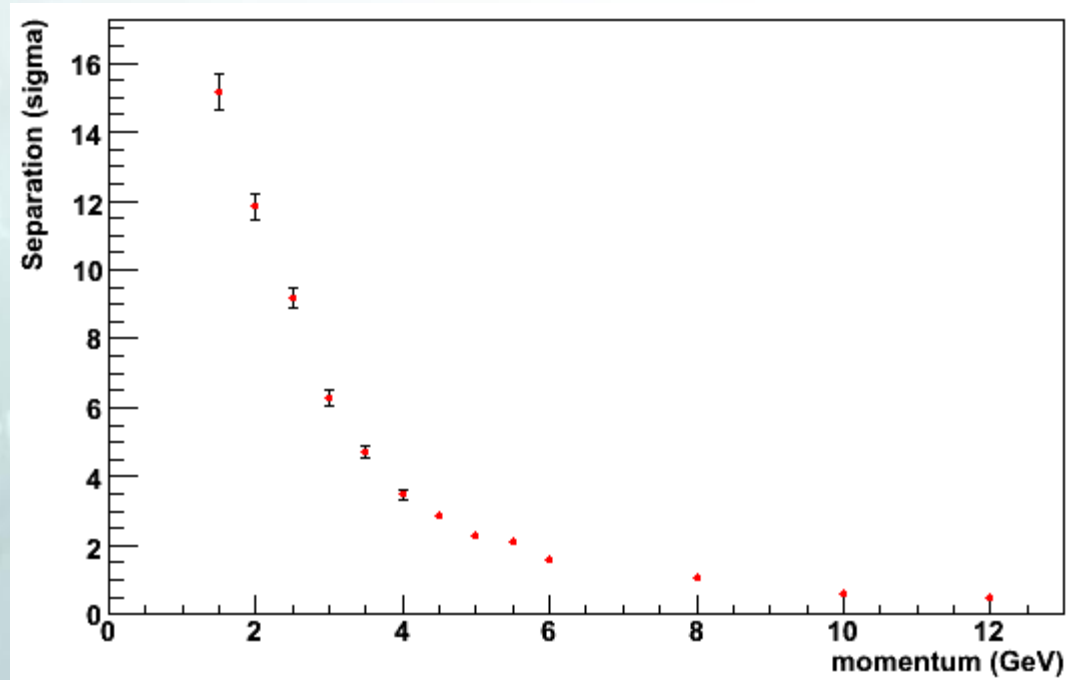
ToP-DIRC



- Results can be calculated with different formulas
- Giessen formula gives $\frac{1}{2} \sigma$ as Glasgow formula
- This version doesn't show last results
- Newest results are little worse.
- Possibly improvable by tuning the roughly chosen values

- Problem: looks like the separation power approach toward 2

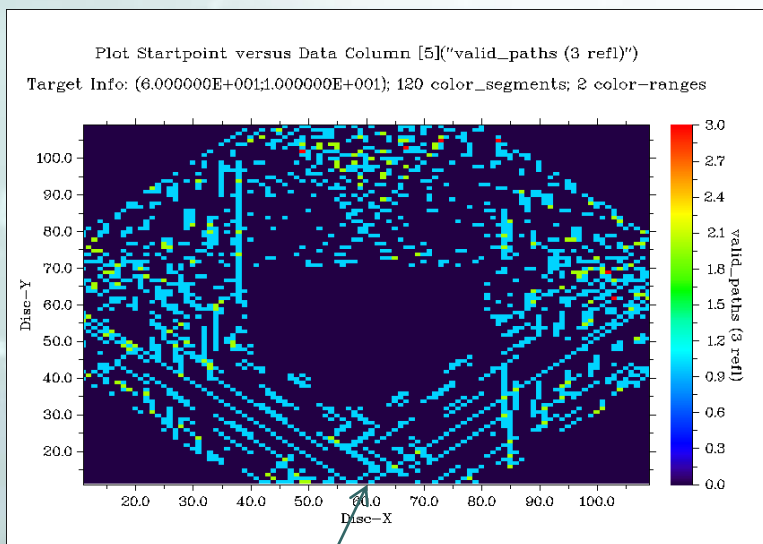
ToP-DIRC



Further studies with higher momentum shows:

As expected, the separation approaches to 0

ToP-DIRC

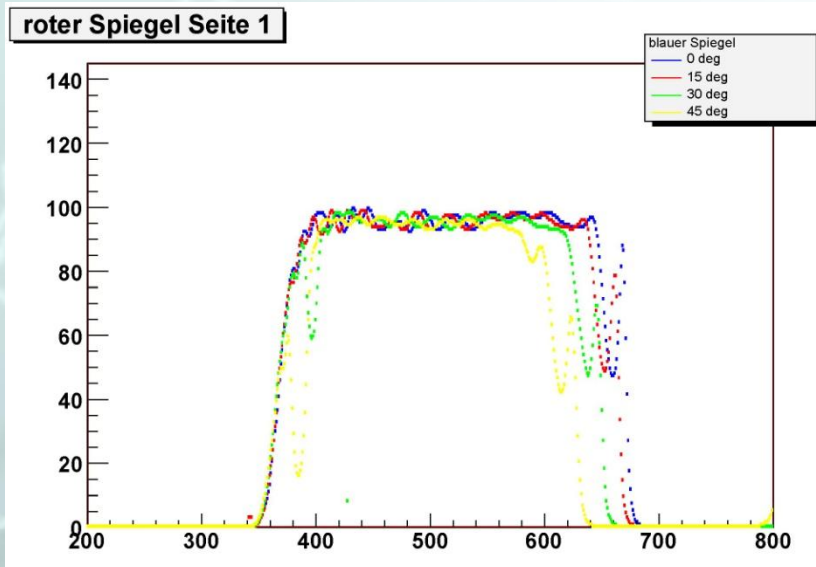


Point of detection

- Standalone reconstruction of the projected way
- Calculating of the number of all possible paths from all possible start points
- Enables to study various ways to reduce the possible paths
- 1st step towards a complete standalone reconstruction solution

Hardware

Material Test

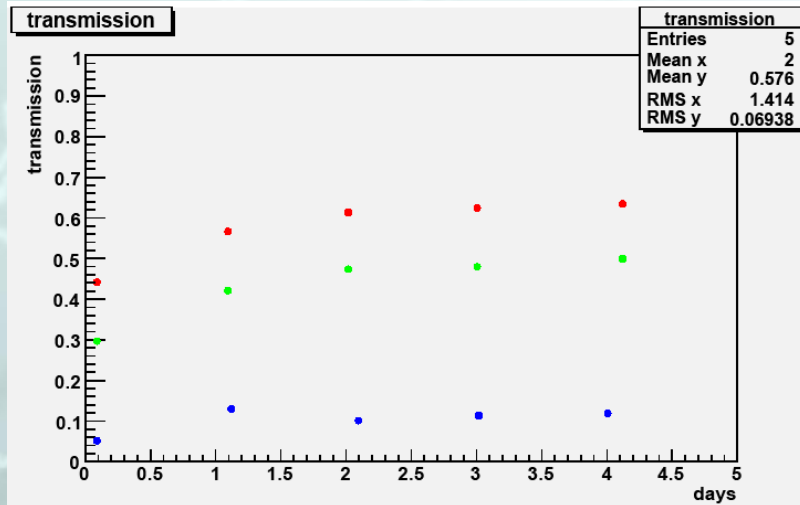


Test of the dichroic mirrors

- Test confirms the expected behaviour regarding to different solid angle
- Shown red mirror is not likely to use for the Disc
- Shape change few for small angles
- 45° optimized mirror should be observed

Material Test

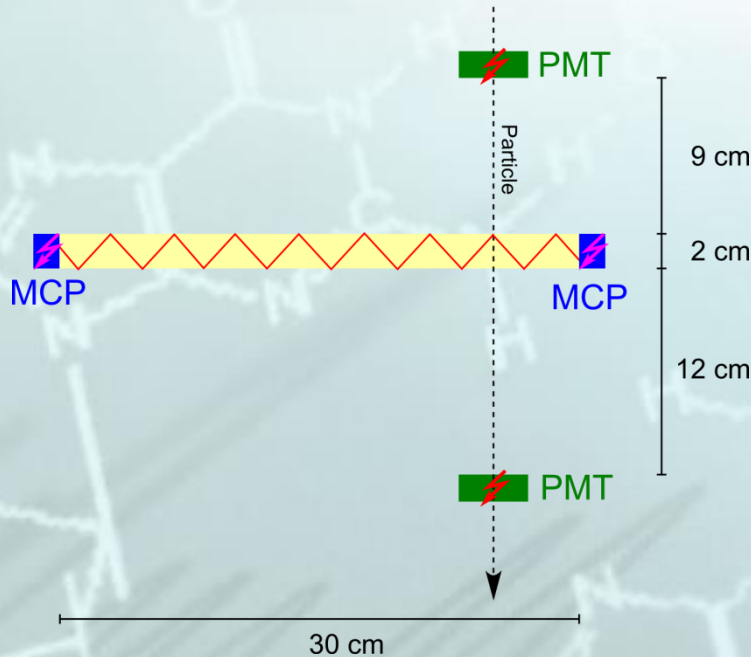
^{60}Co test in Strahlencentrum



- Test for possible prototype radiator material (Schott B270)
- 100 kRad γ radiation doses within 8 hours
- Material becomes brown (decrease of transmission)
- Interesting: transmission becomes better after a few days

Cosmics Test

Test with cosmic myons



- Measurement of coincident events
- First coincidences are observed between one PMT and one MCP
- Enhancements with new electronics is the next step
- Possibly real time differences between MCPs as final result
- The important step on the way to a real prototype

Outlook

Software

A complete external reconstruction
Integration of all packages to PandaRoot

Hardware

Final results of the Cosmics test
A real prototype in octagonal shape

**Decision of the Panda Collaboration for the
Giessen ToP DIRC**