

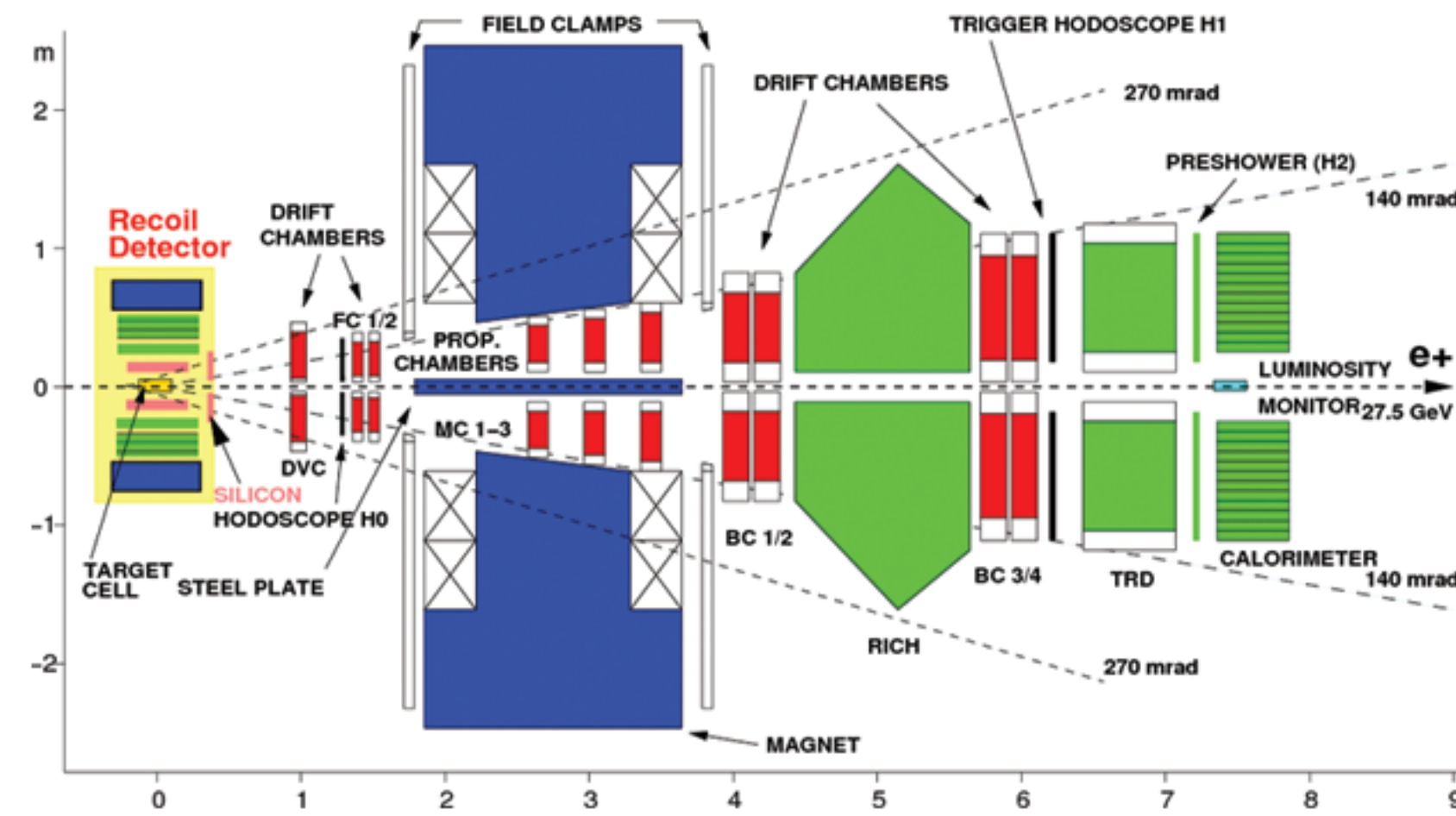
## HERA @ DESY



- 27.6 GeV  $e^+/e^-$  beam with polarisation up to 65%
- unpolarized internal gas targets

## The HERMES Spectrometer

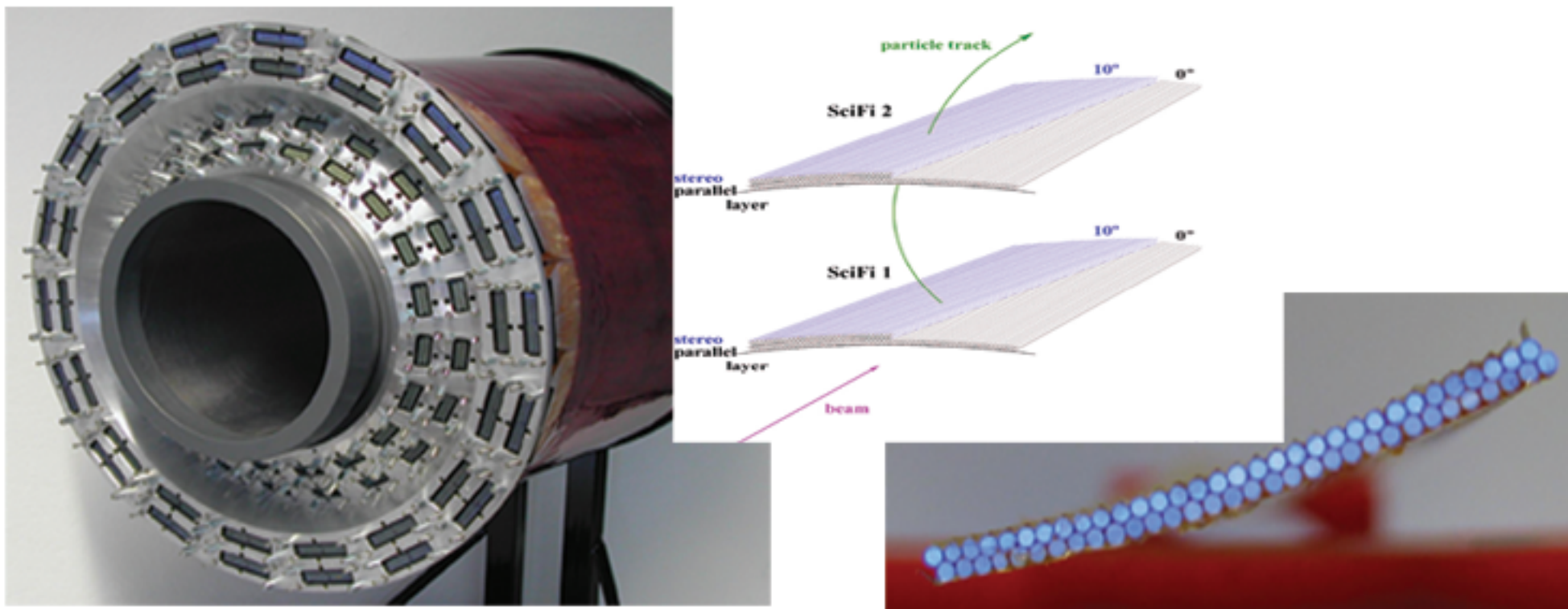
- Tracking :  $\Delta p/p < 2\%$ ,  $\Delta\theta < 0.6$  mrad
- Particle ID :  
TRD, Preshower, Calorimeter (hadron/lepton separation)  
RICH ( $\pi, K, p$  separation)



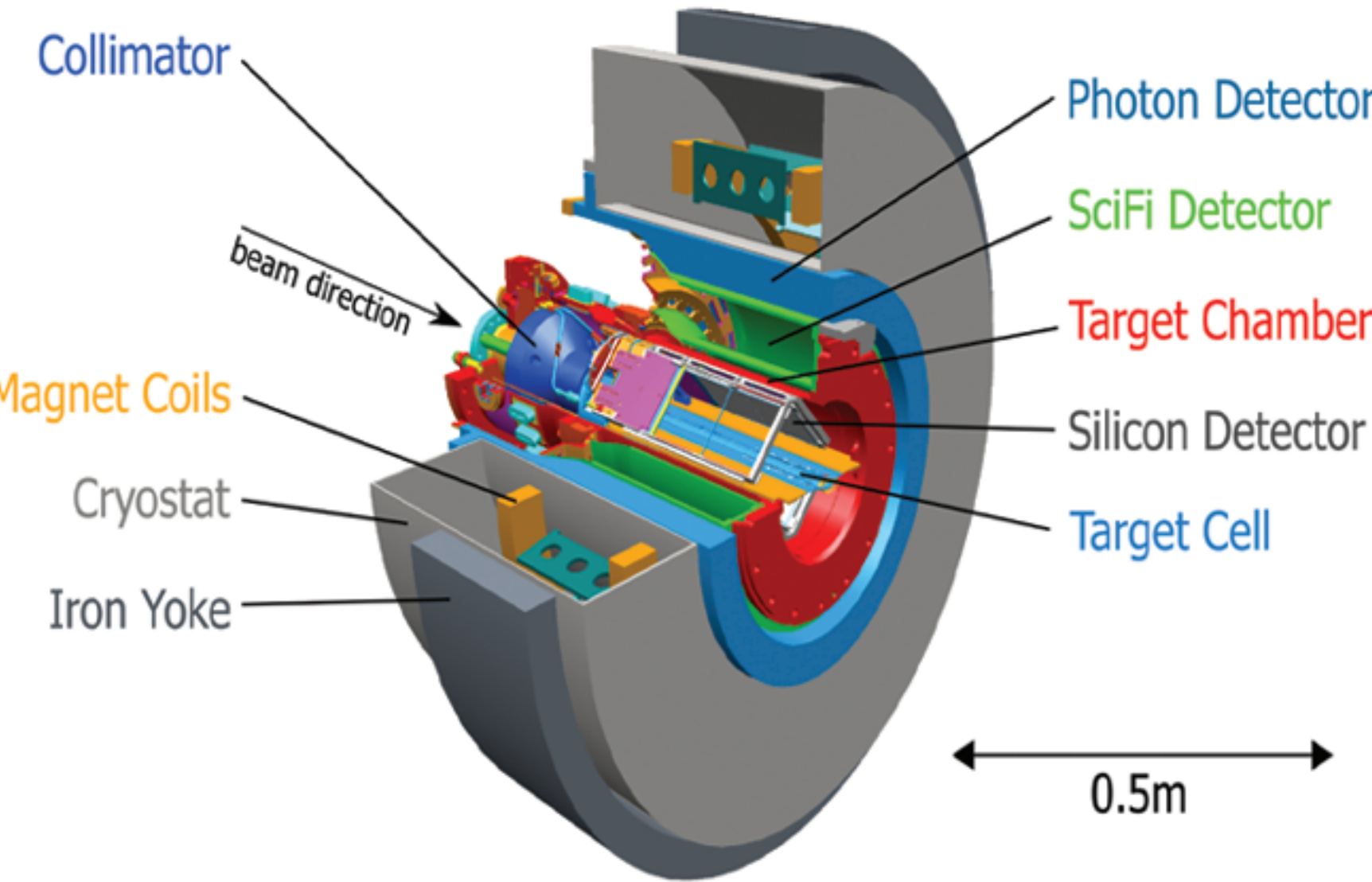
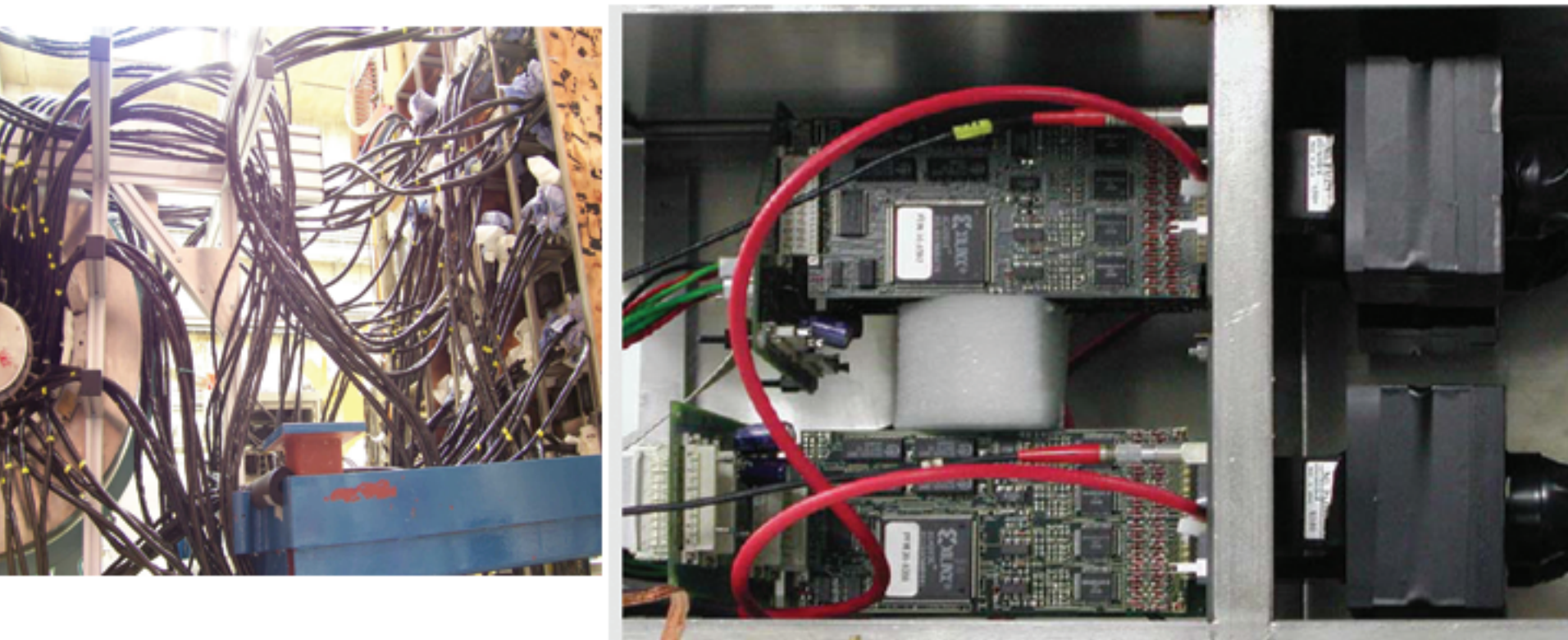
## The Recoil Detector for HERMES

- The primary goal of HERMES is to explore the spin of nucleon, disentangle the different contributions to the nucleon's spin
- The Generalised Parton Distributions (GPDs) offers a possibility to derive the orbital angular momentum of quarks  $L_z^q$ , which can be cleanly accessed by studying Deeply Virtual Compton Scattering (DVCS) process
- To well study DVCS, a Recoil Detector was built for the HERMES experiment to improve the measurement of exclusive processes
- The Recoil Detector can detect recoiling proton (135-1400 MeV/c), improve t-resolution and suppress background
- The Recoil Detector consists of a silicon strip detector (ssd), a scintillating fibre tracker (sft) and a photon detector (pd), a solenoid magnet provides a 1T longitudinal magnetic field for the momentum measurement of sft and to reduce Møller background in ssd

## Scintillating Fibre Tracker (SFT)



- 2 Barrels of 8 layers Kuraray SCSF-78 1mm mirrored ending scintillating fibres
- Each barrel has 2 parallel layers and 2 stereo layers ( $10^\circ$  with respect to parallel layer) for space point reconstruction
- Momentum measured from 250-1400 MeV/c in full azimuthal angle and reconstructed by bending 1T magnetic field
- Particle Identification comes from  $dE/dx$
- Use HAMAMATSU H-7546B 64-channel PMTs for high channel density, with 4992 channels in total
- Scintillating fibres connected to PMT by 3.5m long light guides (Kuraray clear fibres)
- Readout by VME boards based on GASSIPLEX chips, 64 channels per board
- Dynode signal used for timing



## Photon Detector (PD)

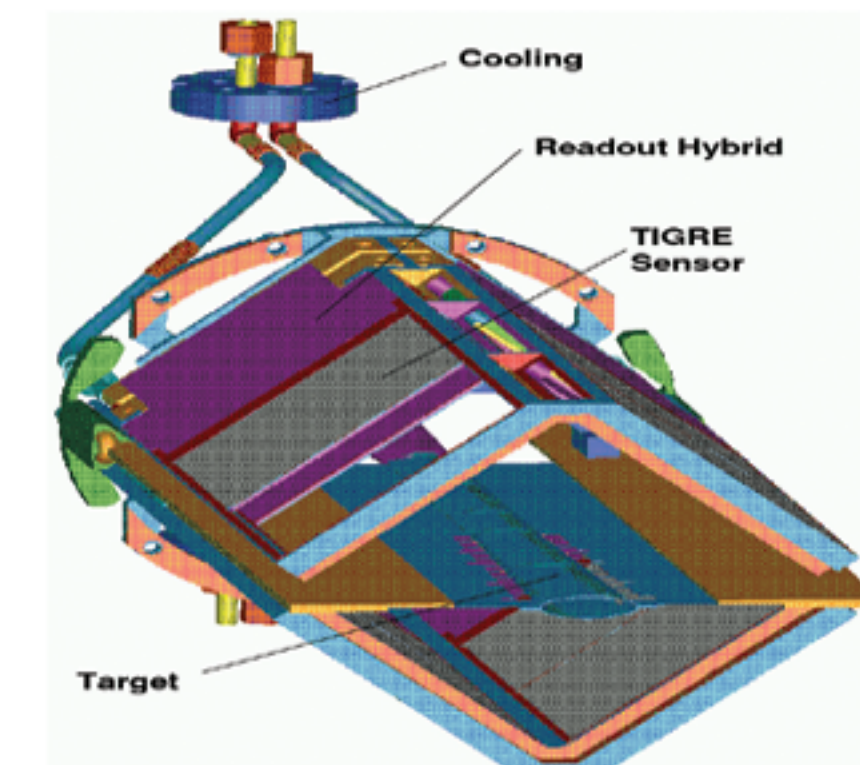
- Detects photons from intermediate  $\Delta$  resonances
- Reconstructs  $\pi^0$  if both photons are detected
- Contributes to  $\pi/p$  PID separation (together with SFT) for momentum  $> 600$  MeV/c
- 3 layers' construction with parallel and stereo strips:
  - A layer : 60 strips along z axis
  - B layer : 44 strips  $-45^\circ$  stereo angle
  - C layer : 44 strips  $+45^\circ$  stereo angle
- 2 WLS on both sides of each strip
- Dimensions of strips: 2cm x 1cm x 28cm
- Provides cosmic triggers



|                        |
|------------------------|
| 6mm Tungsten           |
| 11mm Scintillator Bars |
| 3mm Tungsten           |
| 11mm Scintillator Bars |
| 3mm Tungsten           |
| 11mm Scintillator Bars |

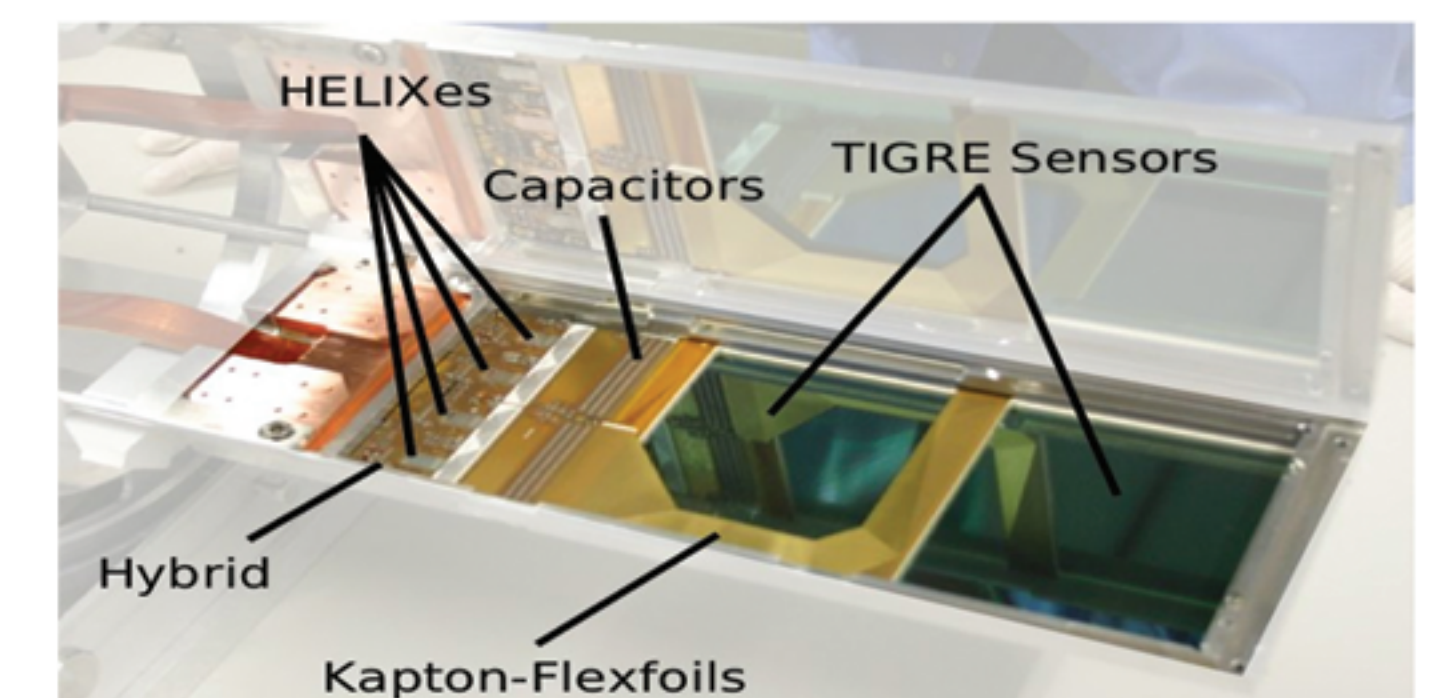
## Silicon Strip Detector (SSD)

- 8 modules with 2 double-sided silicon strip detectors (TIGRE) arranged in two layers around the target cell at a distance of 5cm to the electron beam inside the accelerator vacuum ( $10^{-9}$  mbar)
- Position and energy measurement and identification of low momentum protons (135-450 MeV/c)
- Nearly complete coverage in polar angle, 76% coverage in azimuthal angle



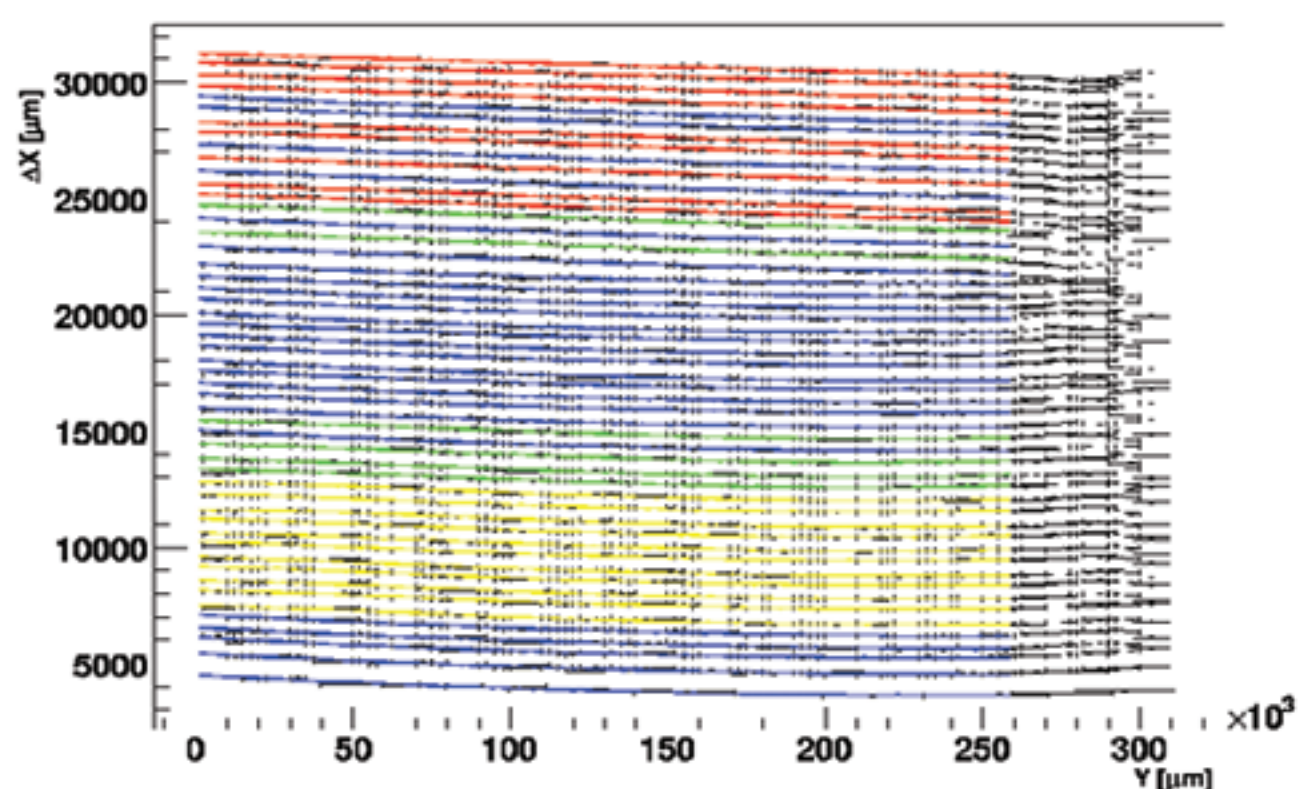
- TIGRE sensor (MICRON):  
300  $\mu$ m thick  
99x99 mm<sup>2</sup> active area  
128 strips/side with  
~758  $\mu$ m pitch

- Strips on both sides perpendicular to each other for 2-dimensional position measurement



- Readout based on HELIX 128-3.0 chips
- Each strip is connected to 2 readout channels with different gains to cover a dynamic range from 86 KeV (1 Mip in 300  $\mu$ m silicon) to 6.0 MeV (a stopped proton in 300  $\mu$ m silicon)

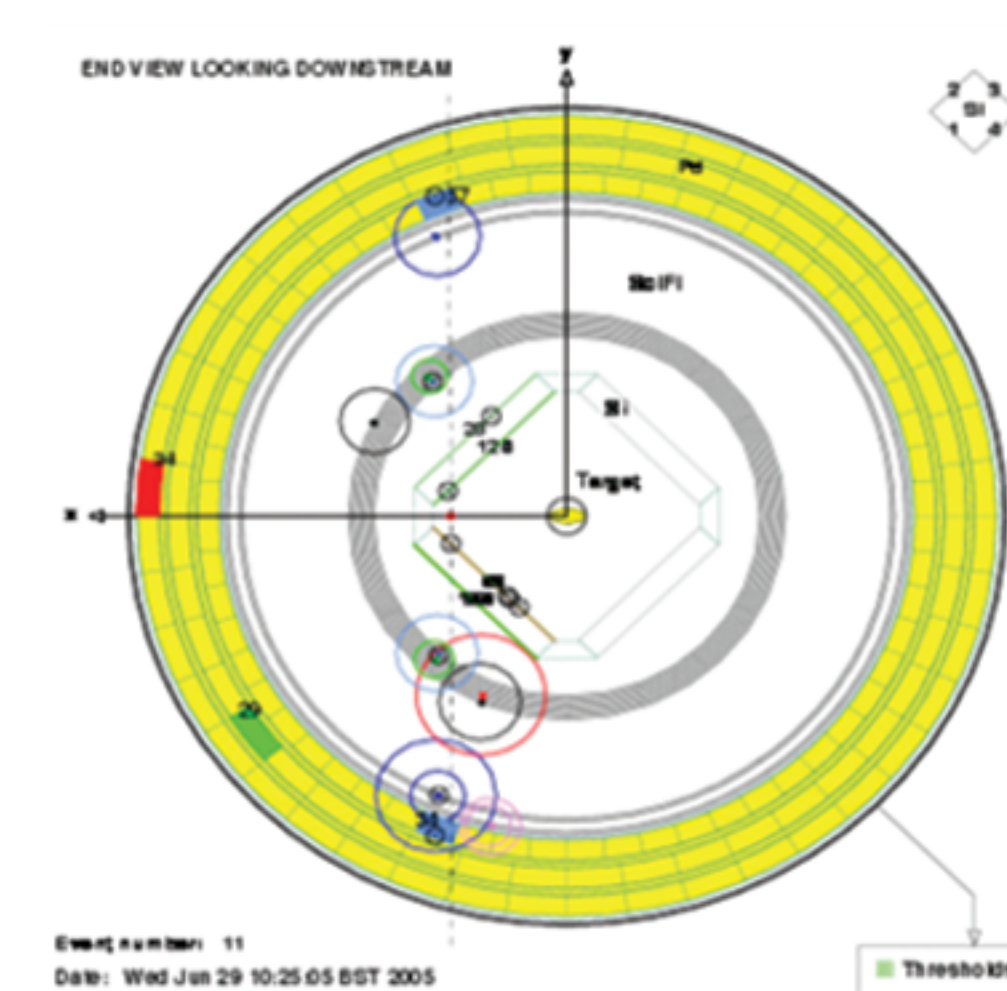
## SFT Alignment measurement



- 5.5 GeV  $e^+/e^-$  test beam was used with Zeus Si-Reference system
- x/y reconstruction  $< 100$   $\mu$ m
- parameterizes fibres with polynomials  $O(4)$

## Cosmics test for Recoil Detector

- The Recoil Detector was finished and tested with cosmic particles from June 2005 to September 2005
- The performance of the detector is fine and the cosmic particles can be clearly seen by all the three sub-detectors
- The efficiency of the detector is as expected



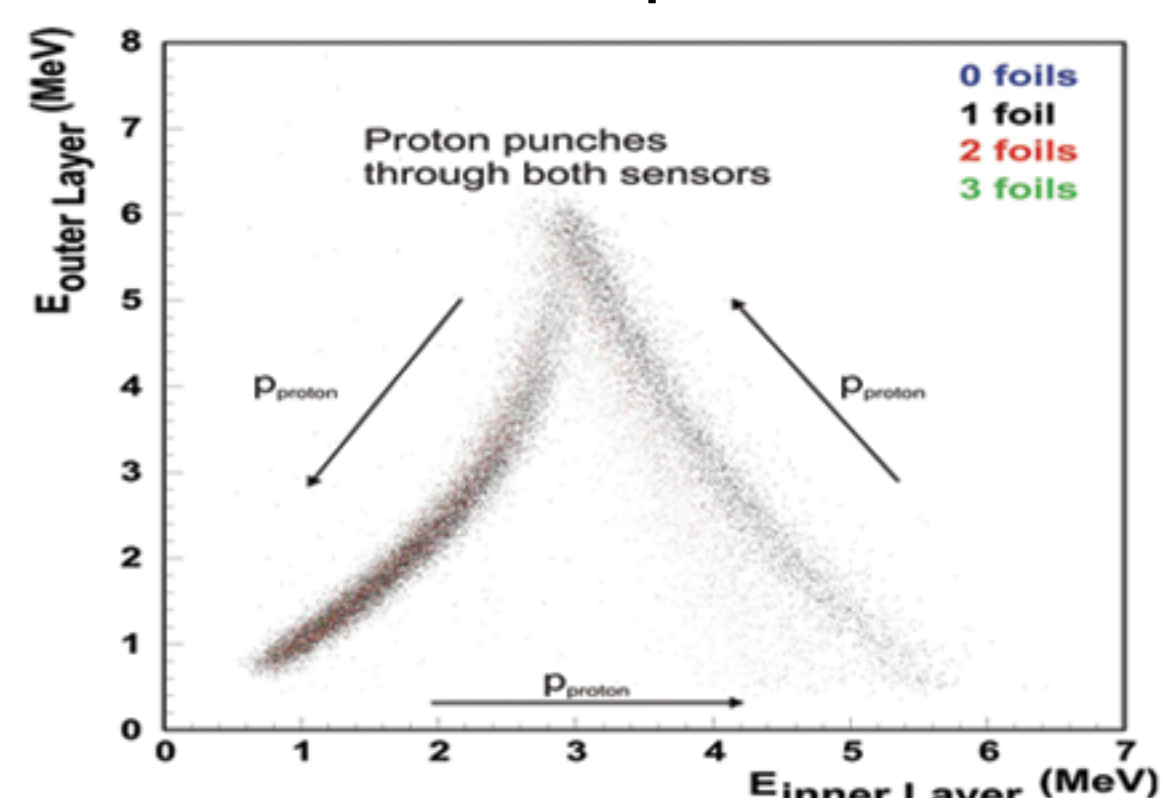
EventDisplay for a cosmic particle

## The installation and commissioning of the Recoil Detector

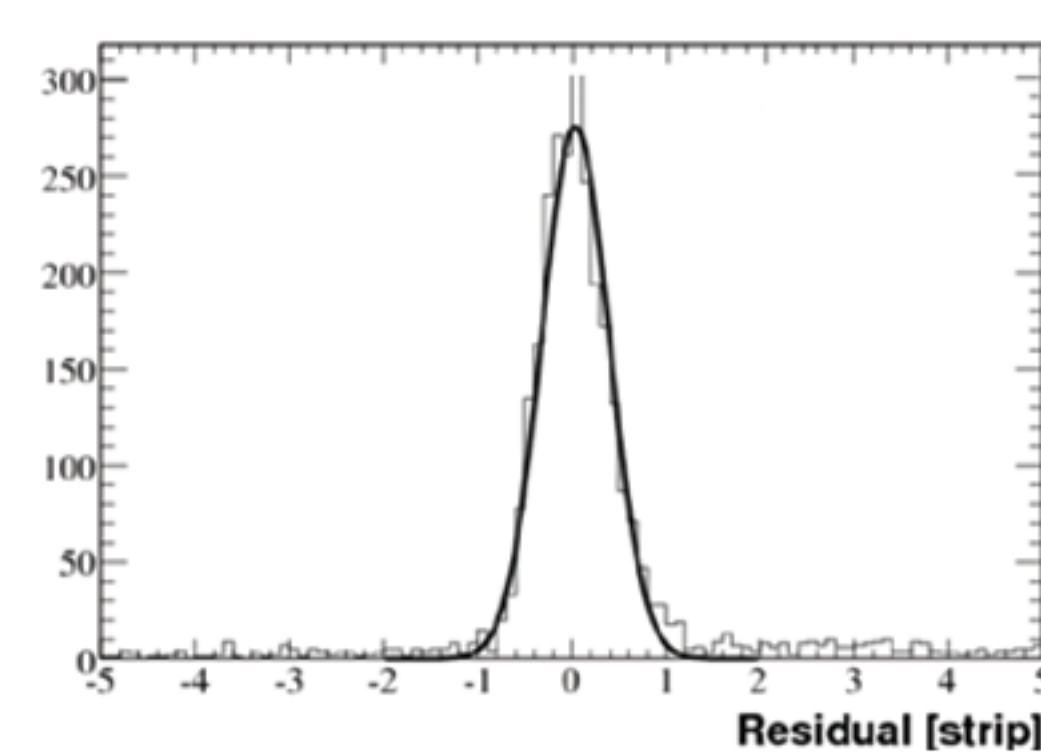


- Installed in January 2006
- Currently under commissioning
- Data taking will last till the final HERA shutdown end of July 2007

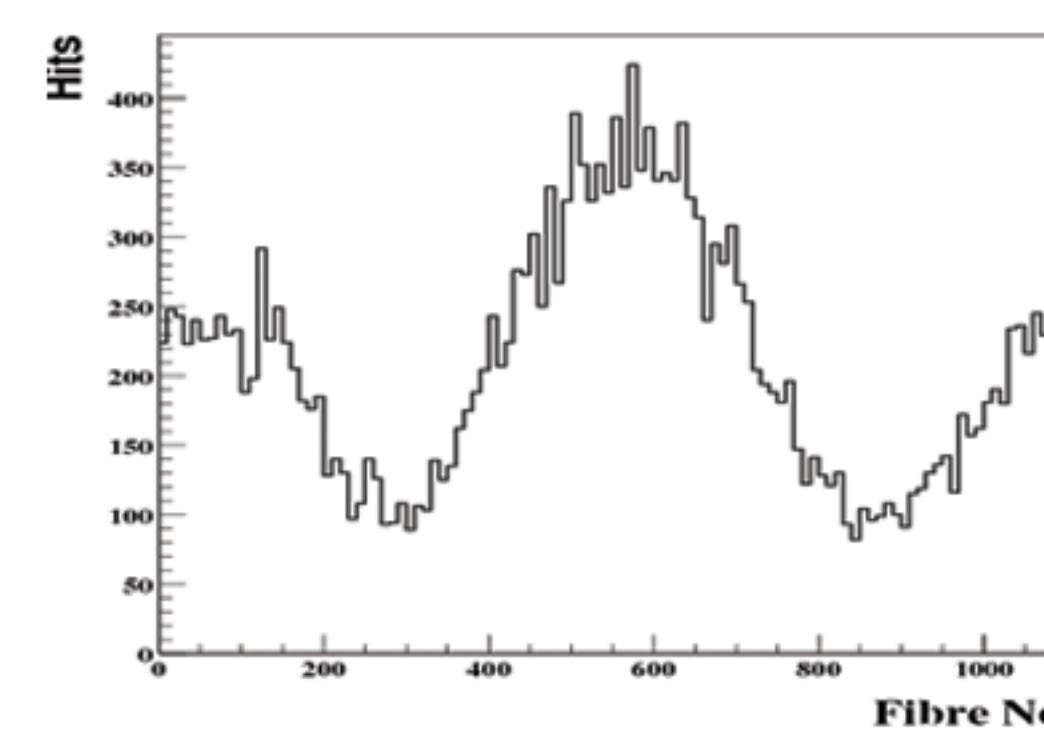
## Energy response test for Silicon Strip Detector



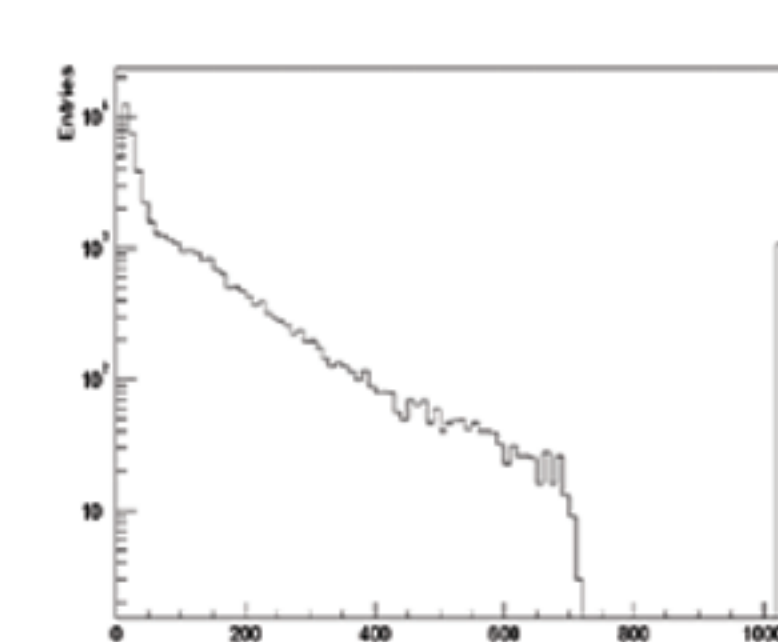
Tested at Erlangen Tandem Accelerator



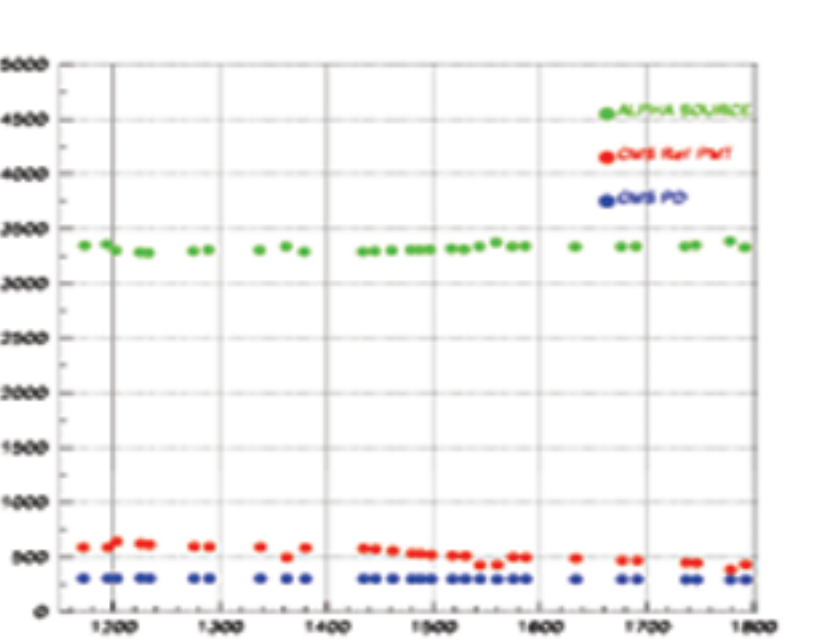
The Residuals for silicon detector  
 $\sigma_{\text{mean}} = 0.372$  strips  
Layer efficiency :  $\sim 80\%$



Cosmic hits from outer most SFT layer with 1098 fibres, fibre 1 and fibre 1098 nearby the top of the barrel



The ADC spectrum of inner most SFT layer



The stable performance of GMS from PD