The HERMES Spectrometer

- Tracking: \( \frac{p}{\Delta p} < 2\% \), \( \Delta \eta < 0.6 \) mrad
- Particle ID:
  - TRD, Phototube, Calorimeter (hadron/lepton separation)
  - SKM (K, p separation)

2 Barrels of 8 layers of Kuray SC57-80 1 mm mirrored end scintillating fibres
- Each barrel has 2 parallel layers and 2 stereo layers (10° with respect to parallel layer) for space point reconstruction
- Momentum measured from 250-1400 MeV/c in full azimuthal angle and reconstructed by bending a 1T magnetic field
- Particle Identification comes from \( \pi / K \) separation
- Use HAMAMATSU H-75469 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 GASSPLEX chips, 64 channels per board
- Dynode signal used for timing

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 \( L_z \), which can be cleanly accessed by studying Deeply Virtual Compton Scattering (DVCS) process
- To test 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 st and to reduce Møller background in ssd

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^-10 bar)
- 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 μm thick
  - 99x99 mm² active area
  - 128 strips/side with
  - - 758 μm pitch

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

Readout based on HELEX 128-3.0 chips
- Each strip is connected to 2 readout channels with different gains to cover a dynamic range from 86 KeV (1Mip in 350 μm silicon) to 6.0 MeV (a stopped proton in 350 μm silicon)

Scintillating Fibre Tracker (SFT)

- 2 Barrels of 8 layers Kuray SC57-80 1mm mirrored end scintillating fibres
- Each barrel has 2 parallel layers and 2 stereo layers (10° with respect to parallel layer) for space point reconstruction
- Momentum measured from 250-1400 MeV/c in full azimuthal angle and reconstructed by bending a 1T magnetic field
- Particle Identification comes from \( \pi / K \) separation
- Use HAMAMATSU H-75469 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 GASSPLEX chips, 64 channels per board
- Dynode signal used for timing

SFT Alignment measurement

- 5.6 GeV e^+/e^- test beam was used with Zeus S-S Reference system
- \( x / y \) reconstruction < 100 μm
- Parameterizes fibres with polynomials O(4)

Energy response test for Silicon Strip Detector

- Tested at Erlangen Tandem Accelerator
- The Residuals for silicon detector are 0.372 strips
- Layer efficiency : ~80%

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

Event Display for a cosmic particle

The installation and commissioning of the Recoil Detector

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

The ADC spectrum of inner most SFT layer

The stable performance of GMS from PD

The stable performance of GMS from PD