First Results from the Recoil Detector at HERMES

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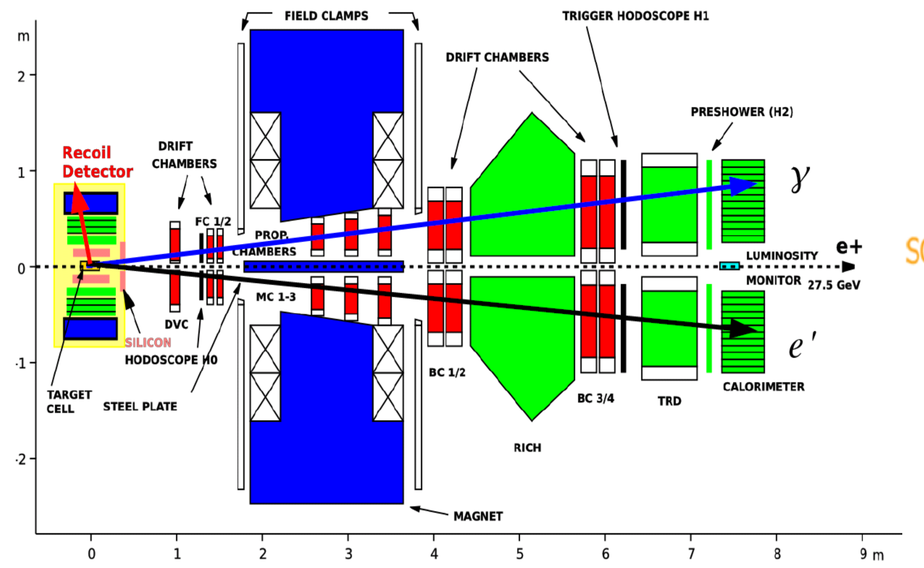
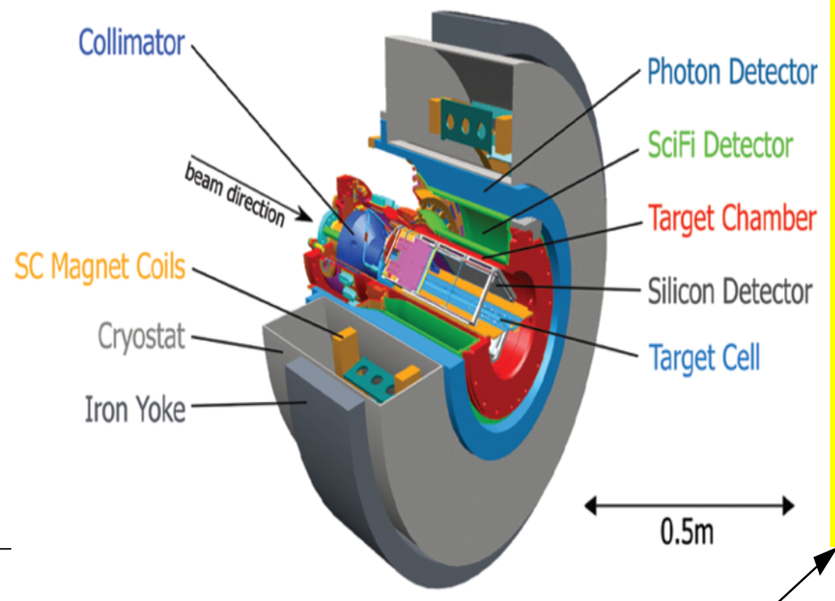
on behalf of the HERMES Collaboration

Recoil Detector at HERMES





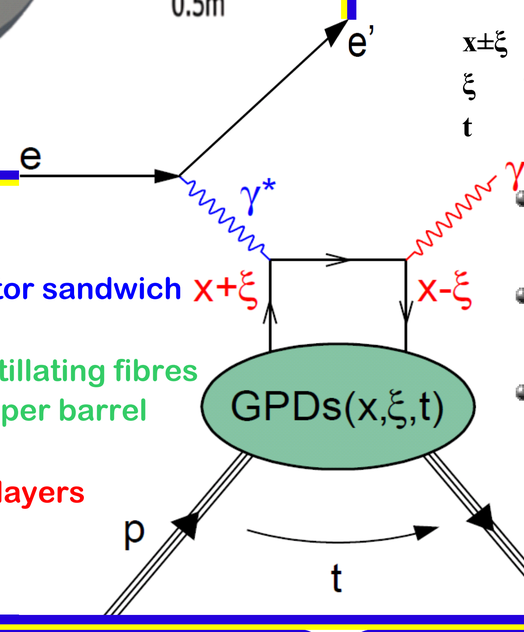
- The primary goal of HERMES is to explore the spin of nucleon, disentangle different contributions to the nucleon's spin

$$\frac{1}{2} = \underbrace{\frac{1}{2}\overbrace{(\Delta u + \Delta d + \Delta s)}^{\Delta\Sigma} + L_q}_{J_q} + \underbrace{\Delta G + L_g}_{J_g}$$

- The generalized parton distributions (GPDs) offer a possibility to derive the orbital angular momentum of the quarks L_z^q
- Deeply Virtual Compton Scattering (DVCS) process one of the cleanest hard exclusive process to access GPDs
- Exclusive ρ^0 sensitive to $H_{q,g}$ and $E_{q,g}$ at the same order in α_s

Ji Relation: $J_{q,g} = \lim_{t\to 0}\int_{-1}^{1} dx\, x \underbrace{\{H_{q,g}(x,\xi,t) + E_{q,g}(x,\xi,t)\}}_{\text{GPDs}}$

- $x\pm\xi$ parton longitudinal momentum fractions,
- ξ fraction of the momentum transfer,
- t invariant momentum transfer,



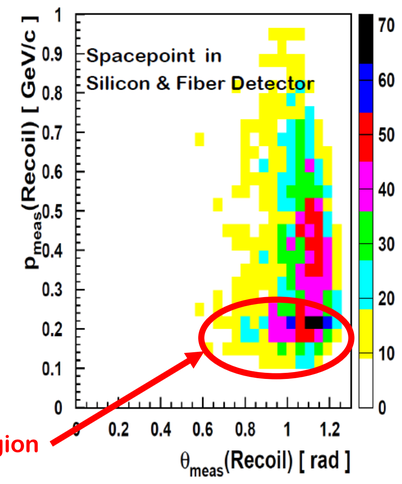
HERMES at DESY

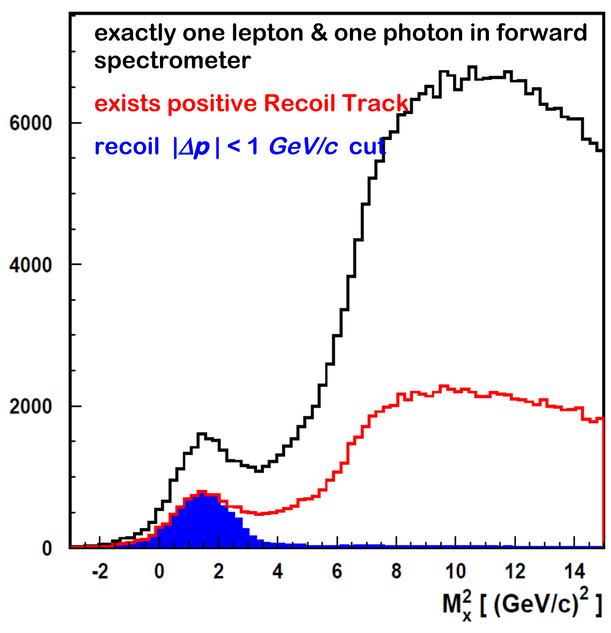
- 27.6 *GeV/c* electron/positron beams with polarization up to 65%
- Unpolarized internal gas targets
- Tracking:
  - $\Delta p/p < 2\%$, $\Delta\theta < 0.6$ mrad
- Particle ID:
  - TRD, Preshower, Calorimeter (hadron/lepton separation)
  - RICH (π,K,p separation)
- Energy/momentum measurement
- Superconducting Solenoid (1T)
- Photon Detector (PD)
  - 3 layers of Tungsten/Scintillator sandwich
- Fibre Detector (SciFi)
  - 2 barrels with 4 layers of scintillating fibres
  - 2 parallel and 2 stereo layers per barrel
- Silicon Detector (SSD)
  - 16 double-sided sensors in 2 layers
  - inside HERA beam vacuum
  - 5cm close to beam
- The Recoil Detector can measure recoiling protons (135-1400 *MeV/c*), improve t-resolution and suppress background
- To improve the measurement of exclusive processes a Recoil Detector was built for the HERMES experiment
- Recoil detector installed for the last two years of data taking:
  - Unpolarized hydrogen target : 38 Mio DIS (41.000 DVCS)
  - Unpolarized deuterium target: 10 Mio DIS (7.500 DVCS)
  - 2 Beam helicities, positron beam

DVCS with Recoil Detector

$e\,p \rightarrow e'\,p'\,\gamma$

- HERMES DVCS analysis:
  - detect exactly one lepton and one photon in forward spectrometer
- Calculate kinematics of recoiling proton track
  - from the kinematics in the forward spectrometer
- Select a correlated track in Recoil Detector
  - use track with highest momentum and positive charge
  - for the moment, no PID used to select protons
  - all track types: SSD only & "long" tracks
    - $\Delta\Phi = \Phi_{measured} - \Phi_{cal.}$
    - $\Delta p = p_{measured} - p_{cal.}$
    - $|\Delta p| < 1$ *GeV/c*

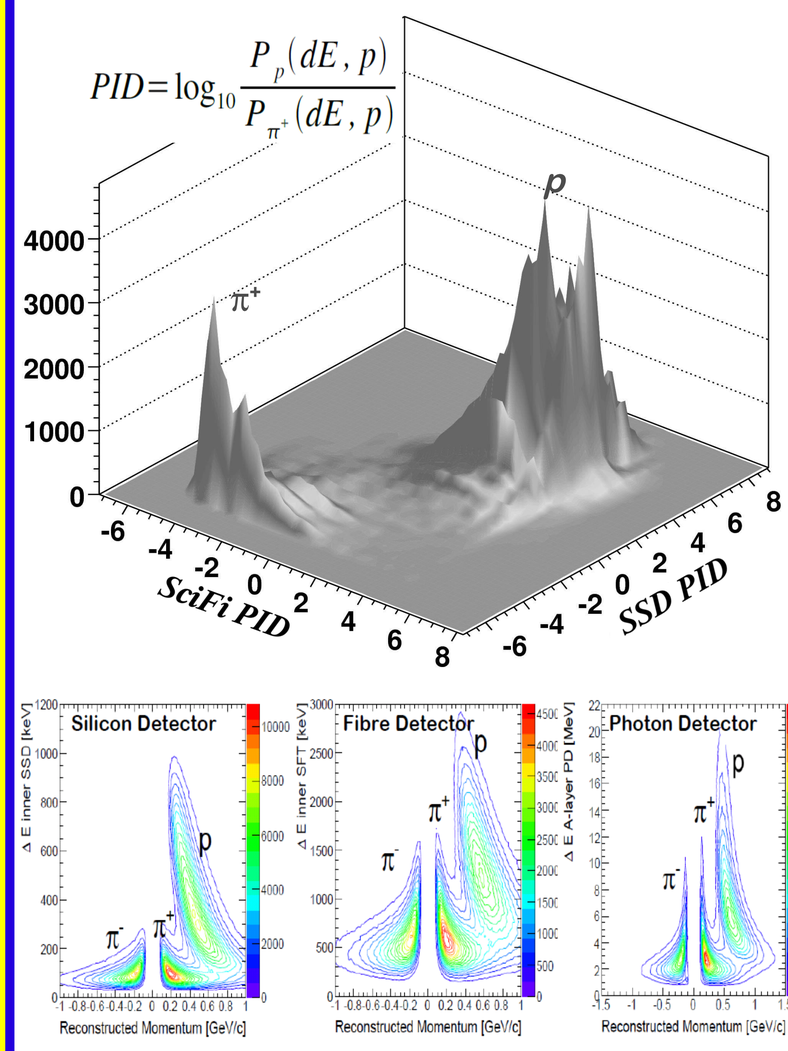




Recoil Detector Particle Identification

- p/π^+ separation via energy deposits and parent distributions
- $p<\sim 0.6$ *GeV/c* : Silicon & Fibre Detector
- $p>\sim 0.6$ *GeV/c* : Silicon, Fibre & Photon Detector

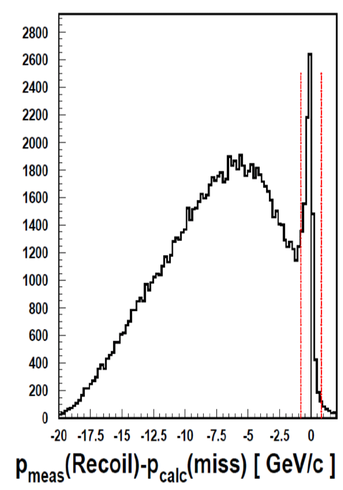
$$PID = \log_{10}\frac{P_p(dE,p)}{P_{\pi^+}(dE,p)}$$

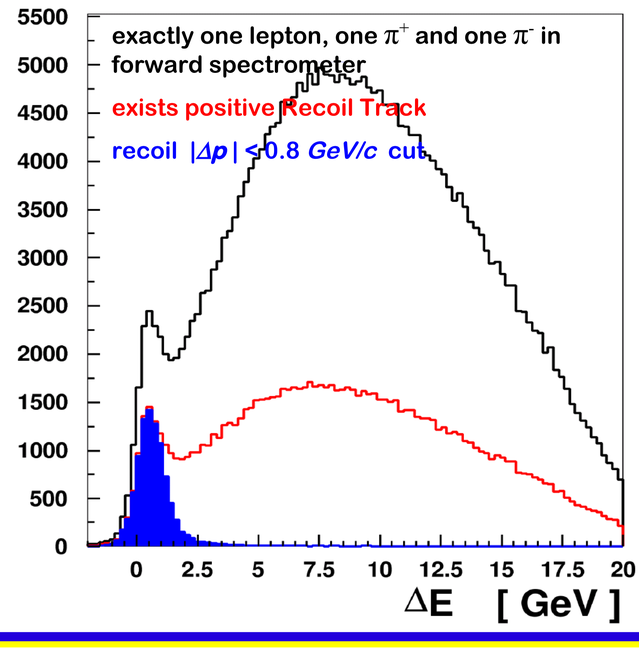


Exclusive ρ^0 – Production

$e\,p \rightarrow e'\,\pi^+\,\pi^-\,p'$

- HERMES ρ^0 analysis:
  - detect exactly one lepton, one π^+ and one π^- in forward spectrometer
- Calculate kinematics of recoiling proton track
  - from the kinematics in the forward spectrometer
- Select a correlated track in Recoil Detector
  - use track with highest momentum and positive charge
  - for the moment, no PID used to select protons
  - all track types: SSD only & "long" tracks
    - $\Delta\Phi = \Phi_{measured} - \Phi_{cal.}$
    - $\Delta p = p_{measured} - p_{cal.}$
    - $|\Delta p| < 0.8$ *GeV/c*





Outlook

- First look at physics using Recoil Detector tracks
- Exclusive physics
  - Improve event selection
  - Use PID to select recoiling proton
  - Further separation of associated background by using PD
  - Include single hits in inner SSD to extend to lower t