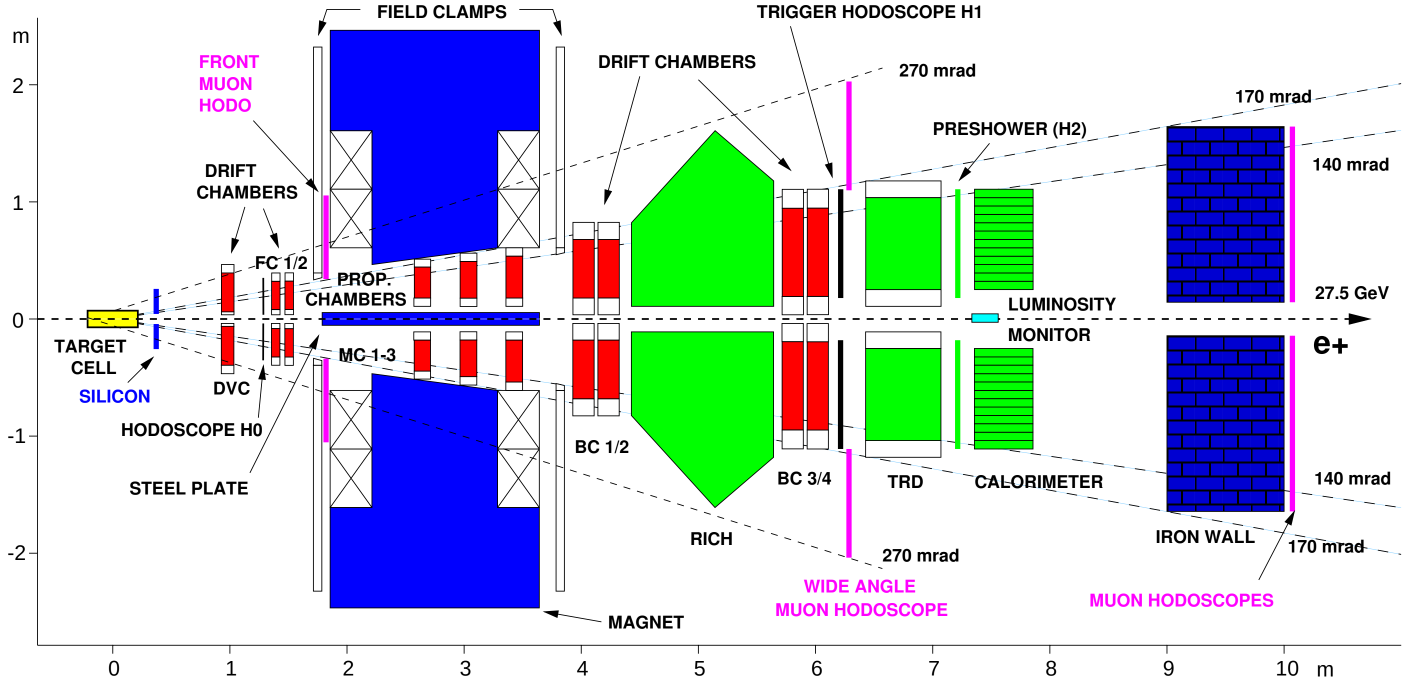
HERMES Experiment

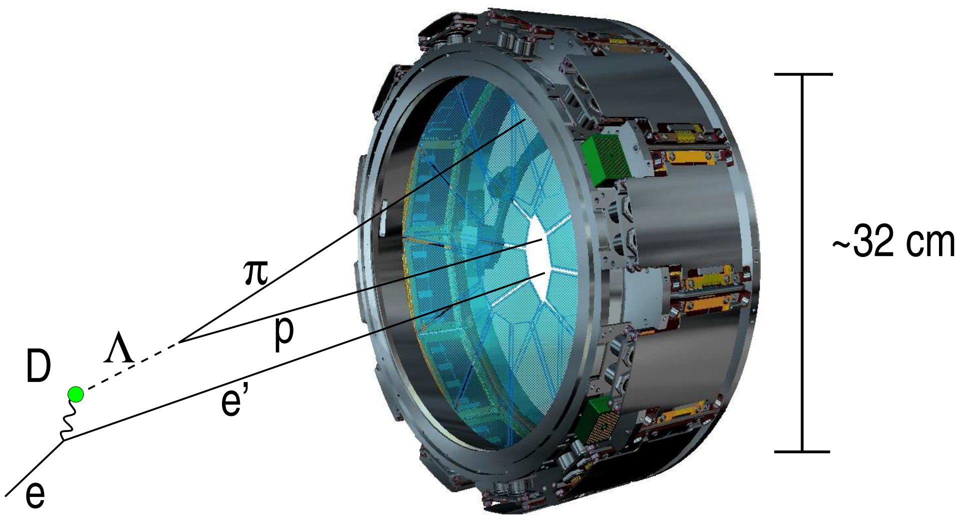
- Status Report
  - ⇒ Hardware upgrades
  - ⇒ Physics results
- Physics Plans for Run-II
- Recoil Detector



Upgrades: Lambda-wheels

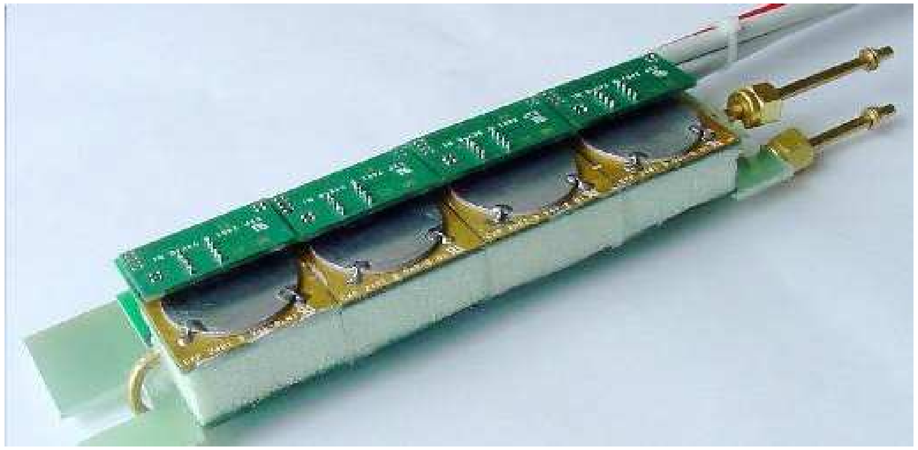
Si-detector close to target region. Significantly increases acceptance for Λ's

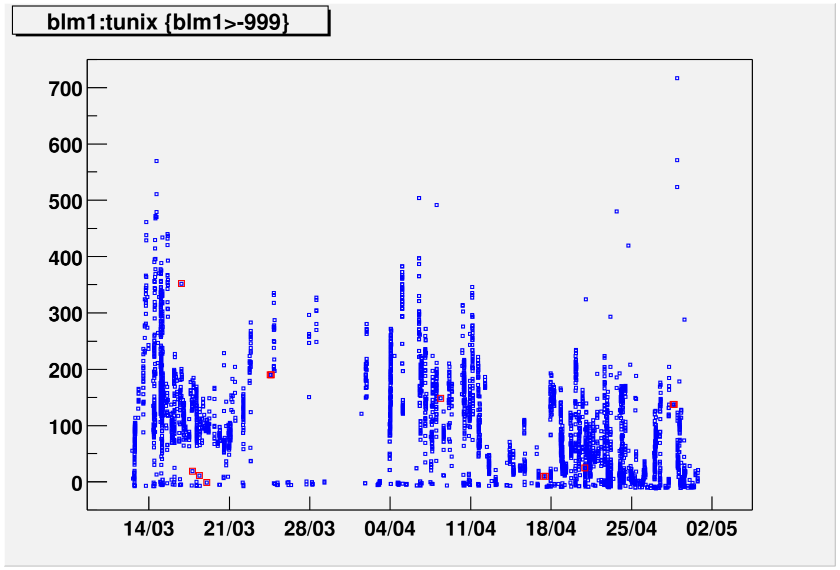
- Detector in HERA-vacuum
- Double-sided Si; pitch=150μm; thickness=300 μm
- Installed in March 2002
- All 24 modules operational
- Commissioning under way

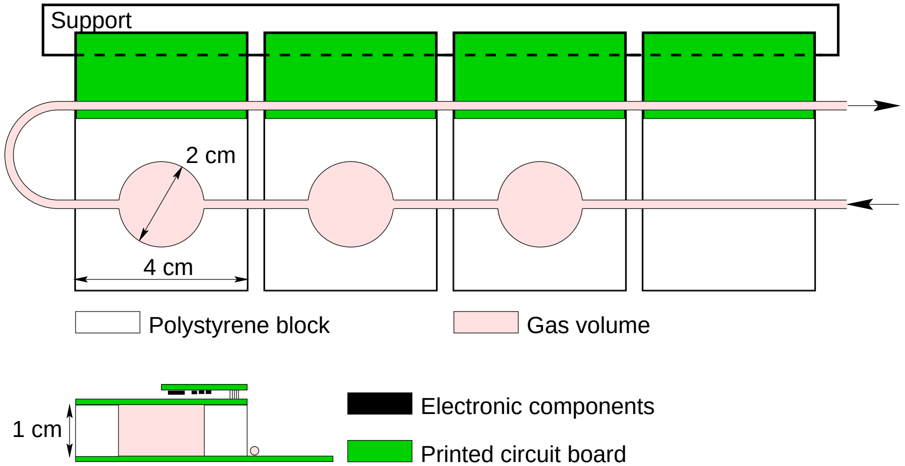


Upgrades: Beam Loss Monitor

- Initiates fast beam dump
- BLM's installed; being commissioned
- Fast beam dump not yet active



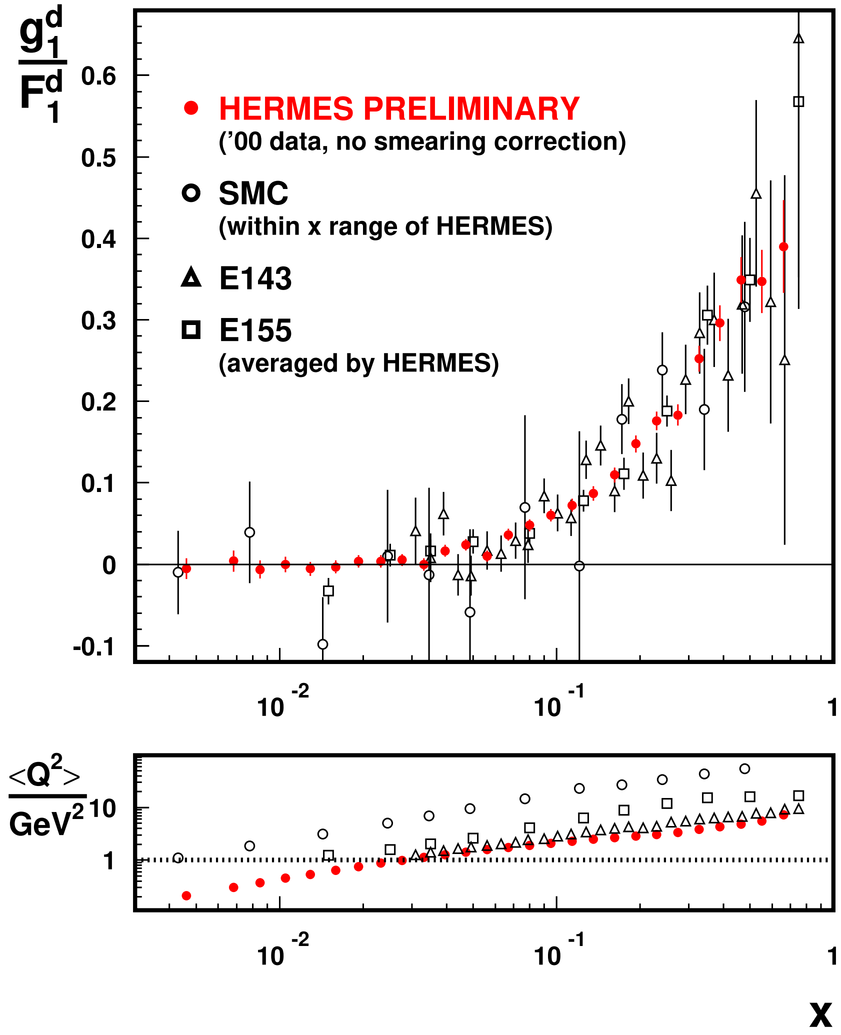




Double Spin Asymmetries in Inclusive DIS

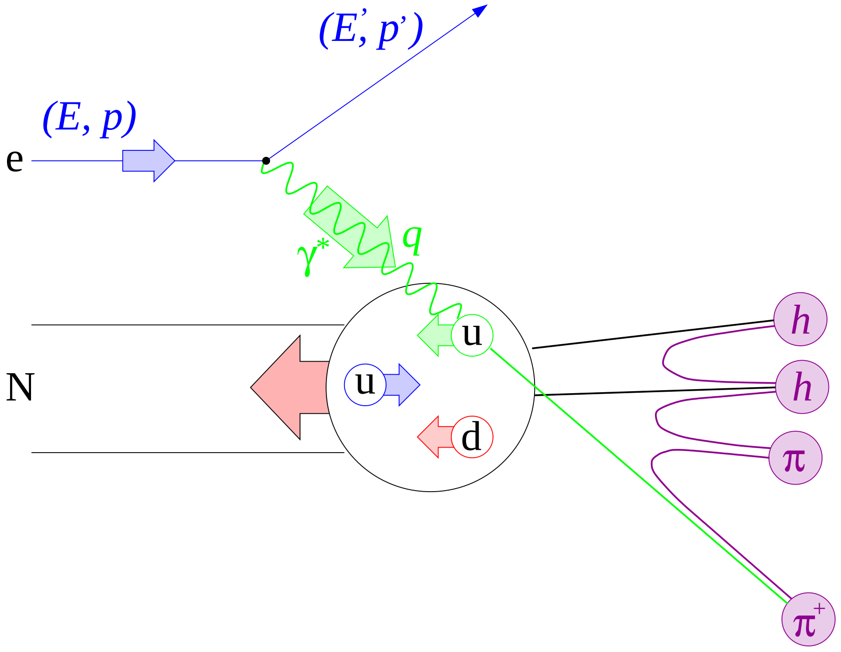
New results from large 2000 data set on longitudinally polarized D-target

- Much improved precision
- Different Q^2 from SMC



Double Spin Asymmetries in SI DIS

Detect hadron h in coincidence with scattered lepton



$z = E_h/\nu$

Flavour tagging: fast hadron contains (information on) struck quark
$\longrightarrow$ Leading Order QCD:

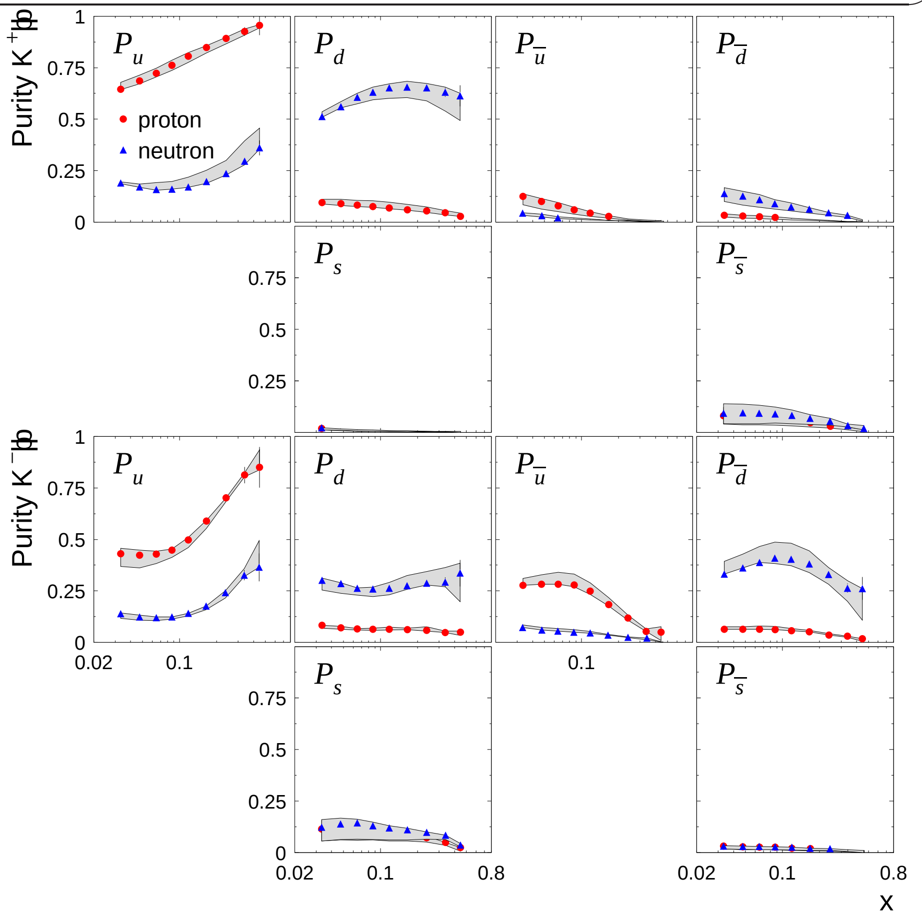
$$A_1^h(x) = \frac{\int_{z_m}^{0.8} dz \sum_q e_q^2 \Delta q(x) D_q^h(z)}{\int_{z_m}^{0.8} dz \sum_q e_q^2 q(x) D_q^h(z)}$$

Polarized quark distribution $\Delta q(x)$
Fragmentation functions $D_q^h(z)$

Purities using the RICH Detector

$$A_1^h(x,z) \quad = \quad \sum_q P_q^h(x,z)\frac{\Delta q(x)}{q(x)}$$

Purities P_q^h can be calculated in Monte Carlo

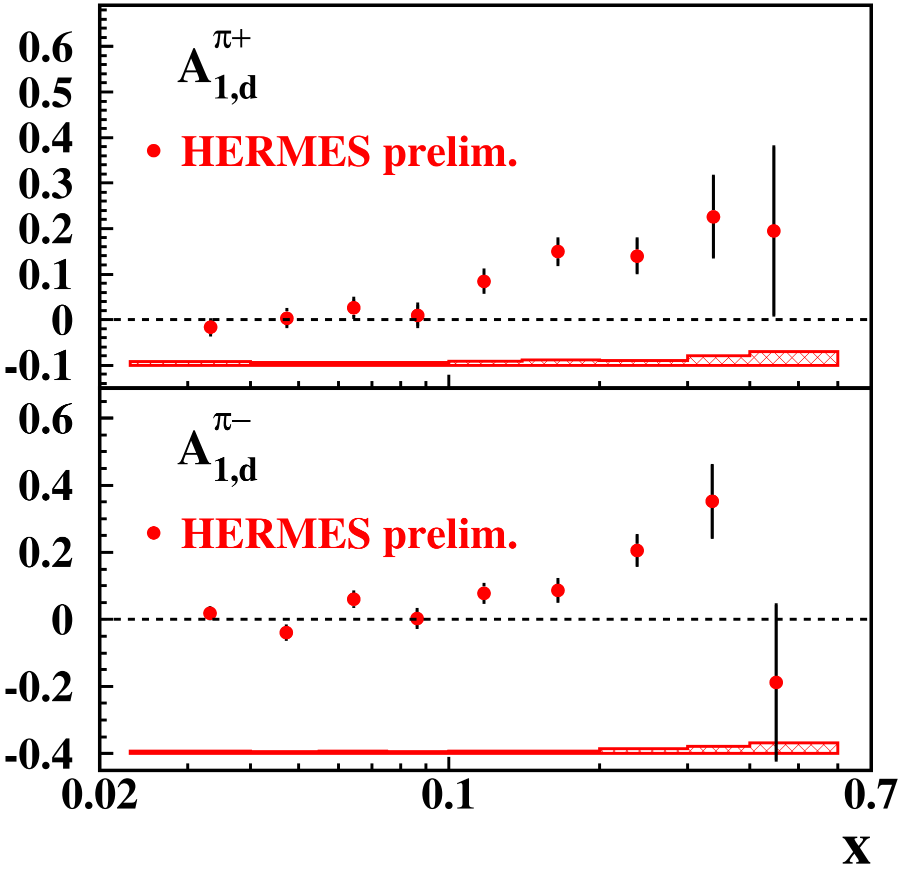


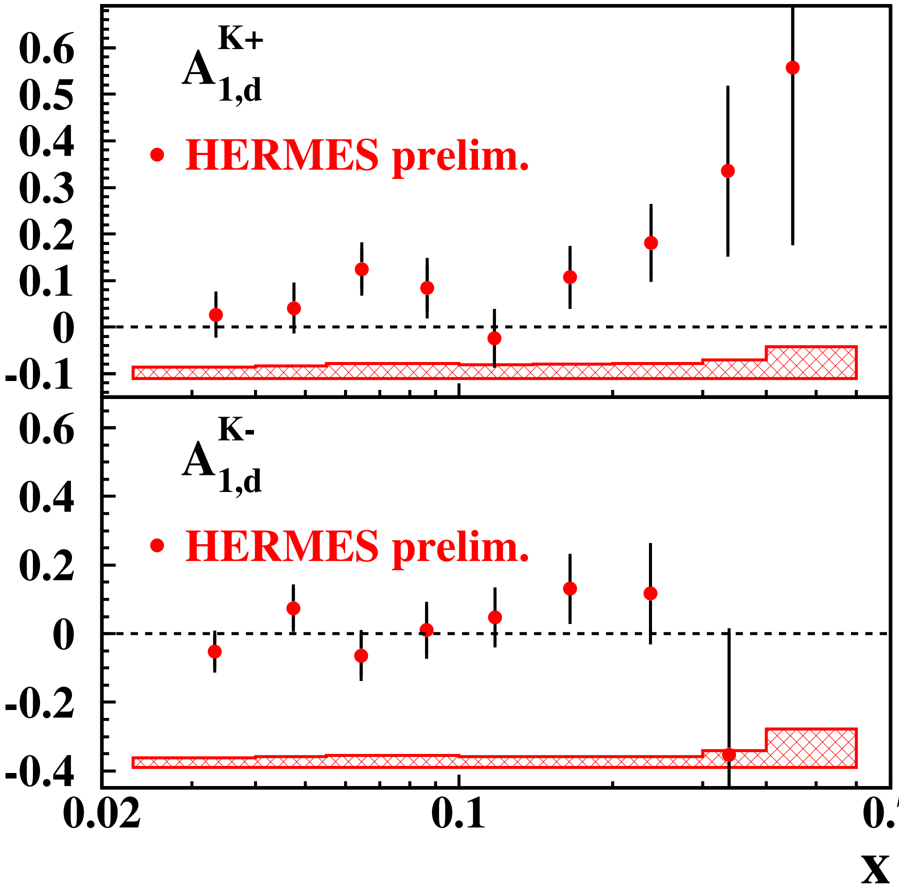
Using only h^+, h^- gives little sensitivity to strange sea

Since 1998: RICH detector installed
$\Rightarrow$ full hadron separation π, K, p
Data taken with long. pol. D-target

e.g. $P_s^{K^-}$ gives much increased sensitivity to Δs

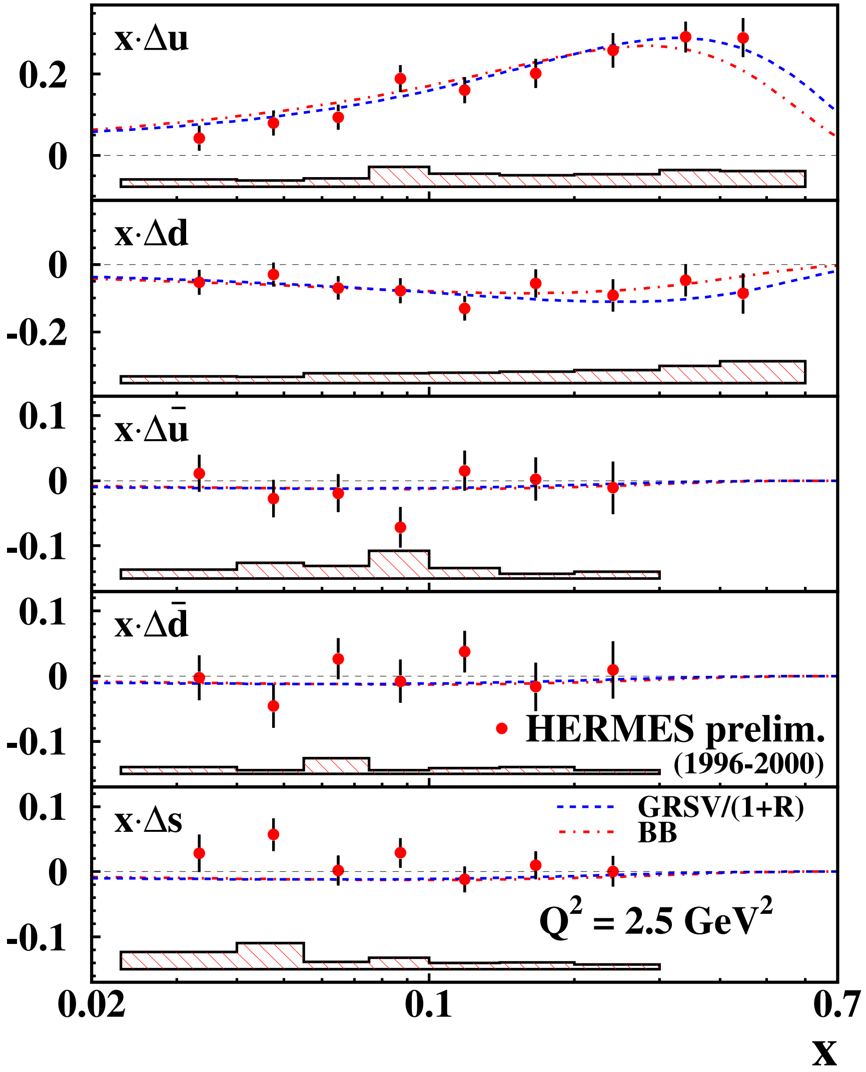
Input Asymmetries





First measurement of π and K asymmetries

Δq: Polarized Quark Distributions

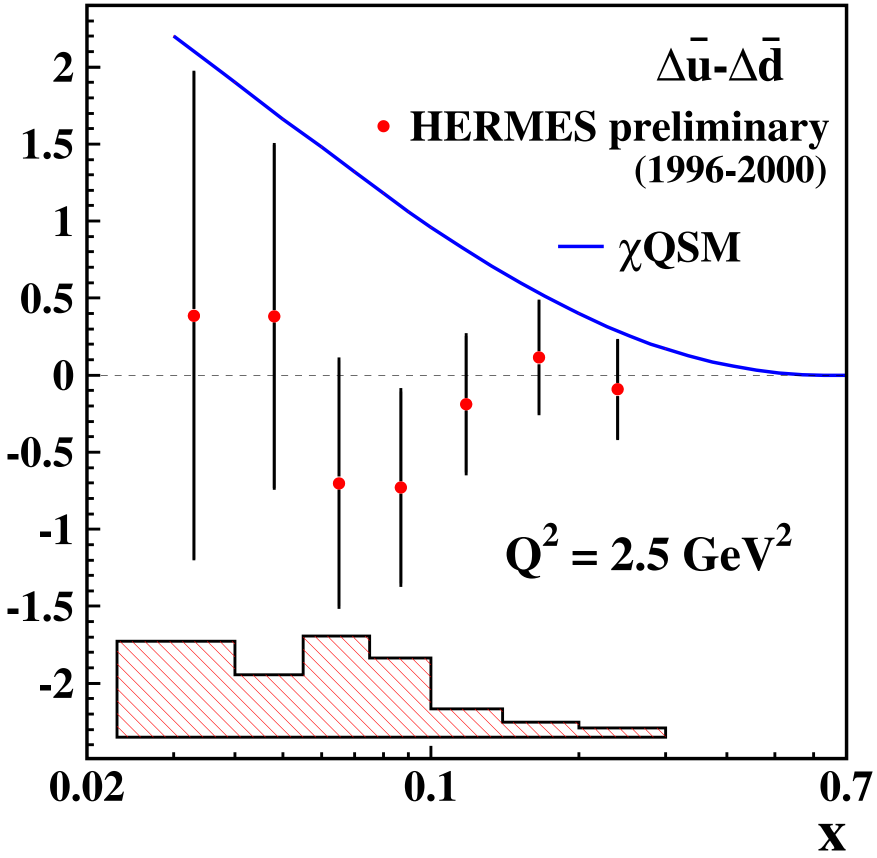


Results show

- u-quark positively polarized
- d-quark negatively polarized
- light sea quark polarization small
- s-quark polarization somewhat positive

First separation of the quark sea

(A)symmetry of the Light Quark Sea

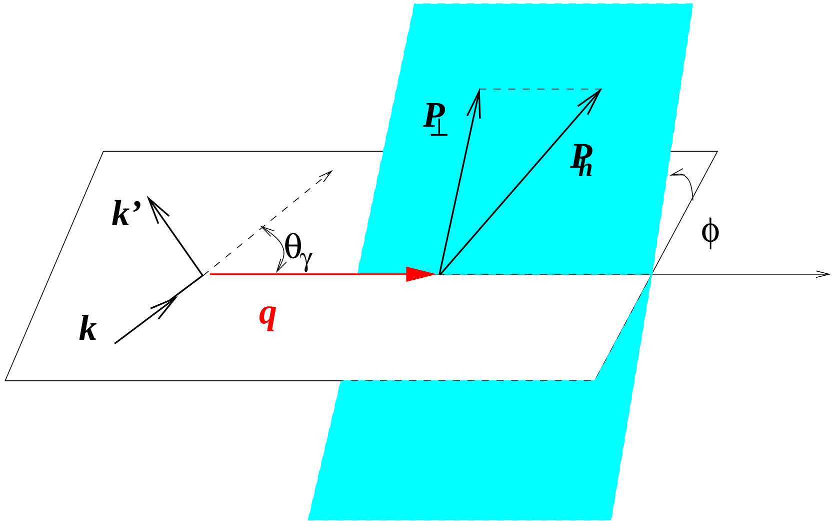


☛ Comparison to chiral quark soliton model calculations

Single Spin Azimuthal Asymmetries

With unpolarized beam, longitudinally polarized target:

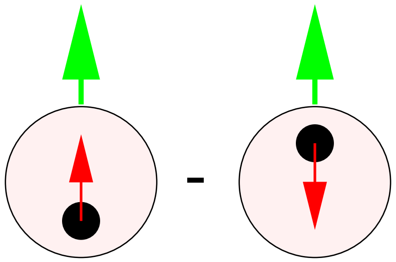
$$
\begin{aligned}
A_{UL}^{\sin\phi} \quad \propto \quad & S_L\left(x h_L z H_1^{\perp(1)} - h_{1L}^{\perp(1)} \tilde{H}\right) \\
& + S_T\left(h_1 z H_1^{\perp(1)}\right)
\end{aligned}
$$



- Sensitive to transversity distribution

$h_1(x) = \delta q(x)$

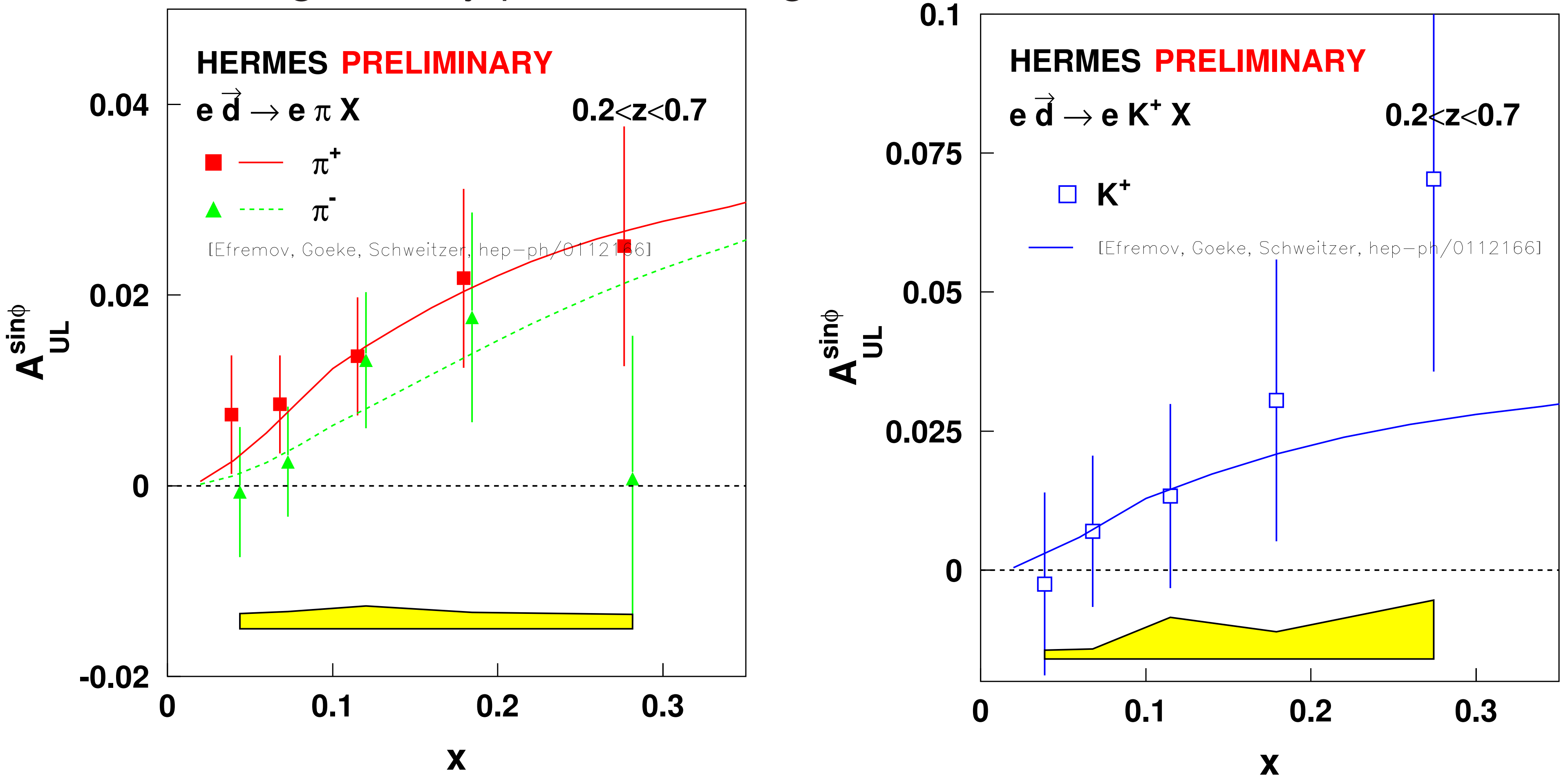
h_1 =



- Collins fragmentation function $H_1^\perp(z)$

New Results from 1998-2000 Data

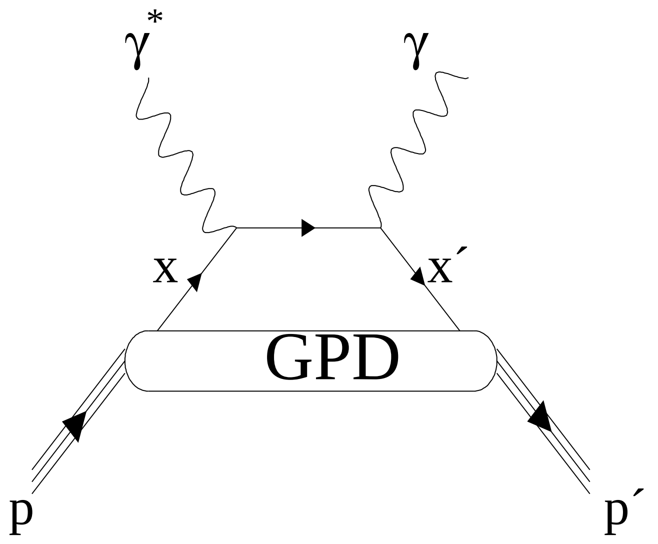
1998-2000: longitudinally polarized D-target

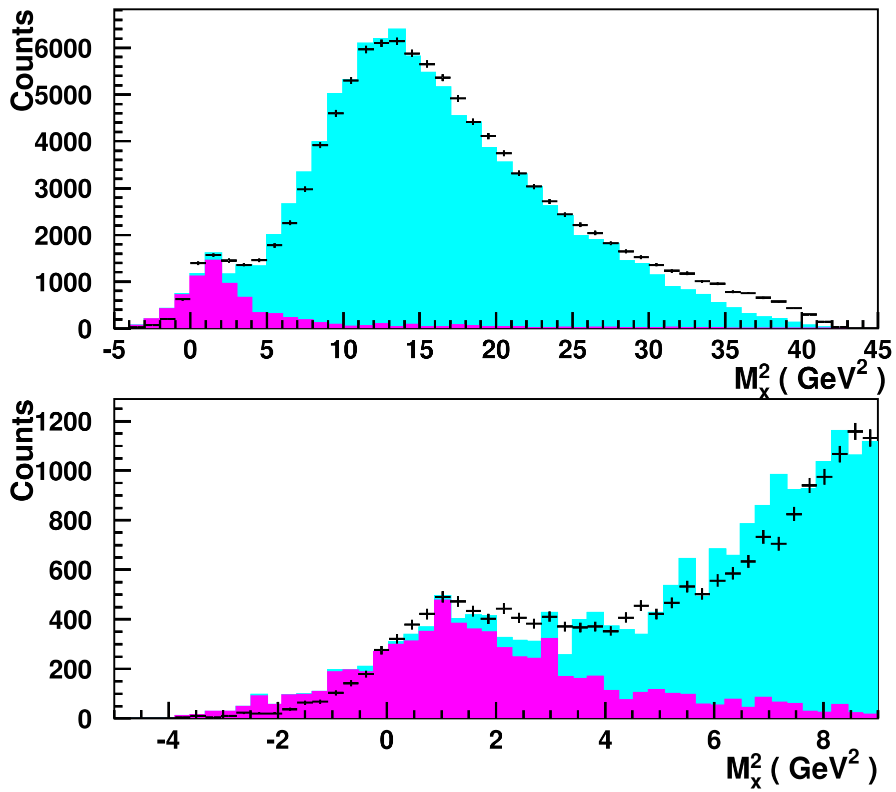


Deeply Virtual Compton Scattering

- Cleanest example of exclusive reaction
- Can be described in terms of

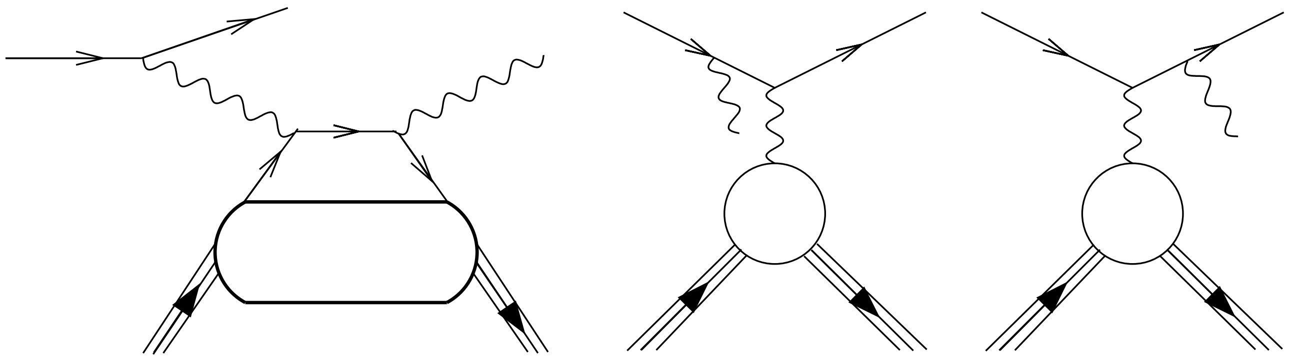
Generalized Parton Distributions





Asymmetries associated with DVCS

☛ Interference of Bethe-Heitler and DVCS amplitudes

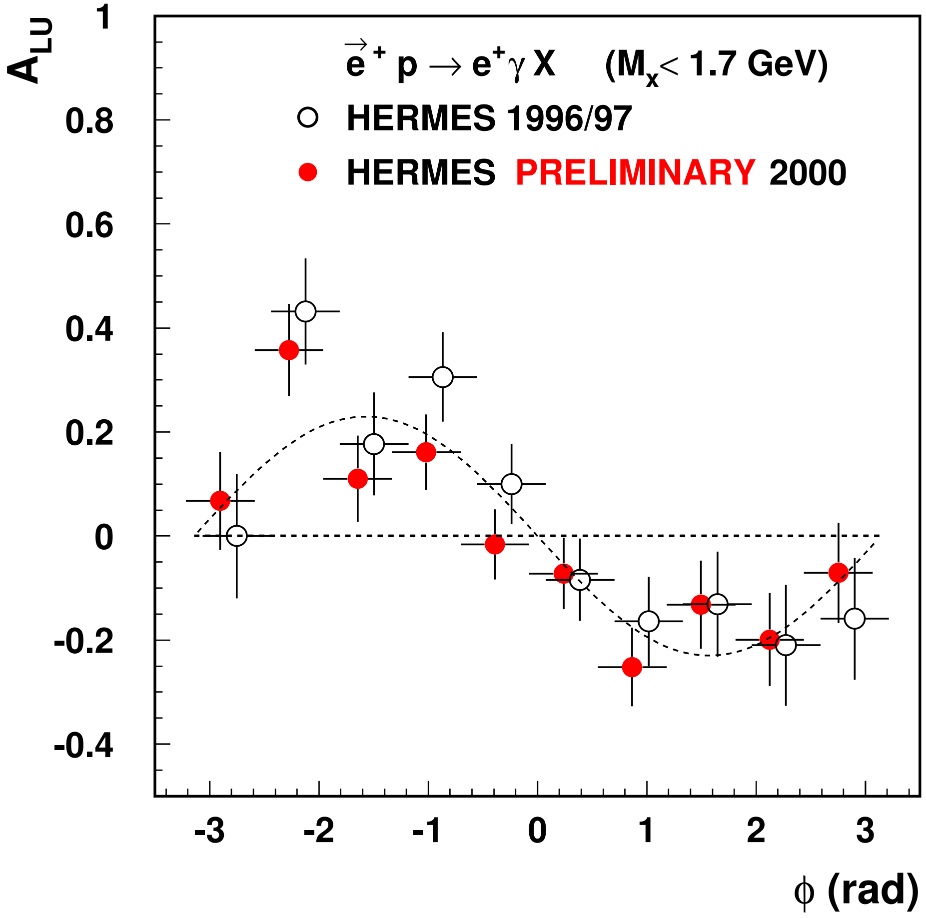


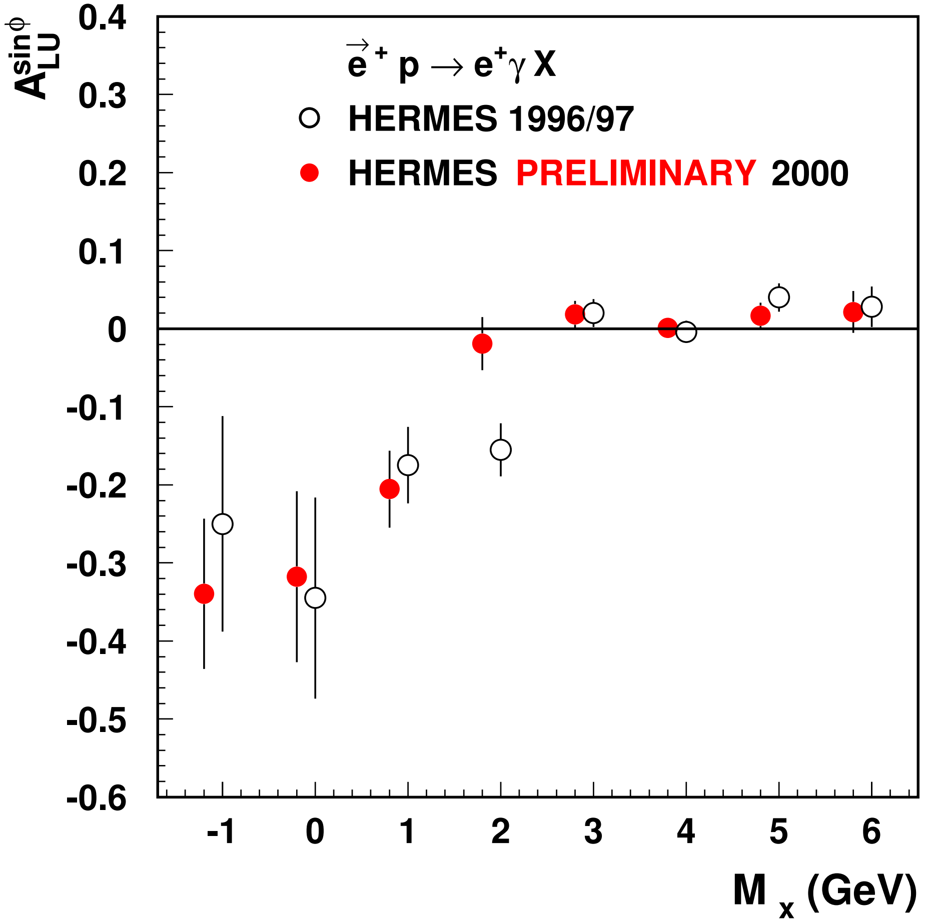
(a) (b)

Imaginary part of interference
Beam spin asymmetry
Polarized beam, unpolarized target
$\propto \sin\phi$

Real part of interference
Beam charge asymmetry
e^+ vs. e^-
$\propto \cos\phi$

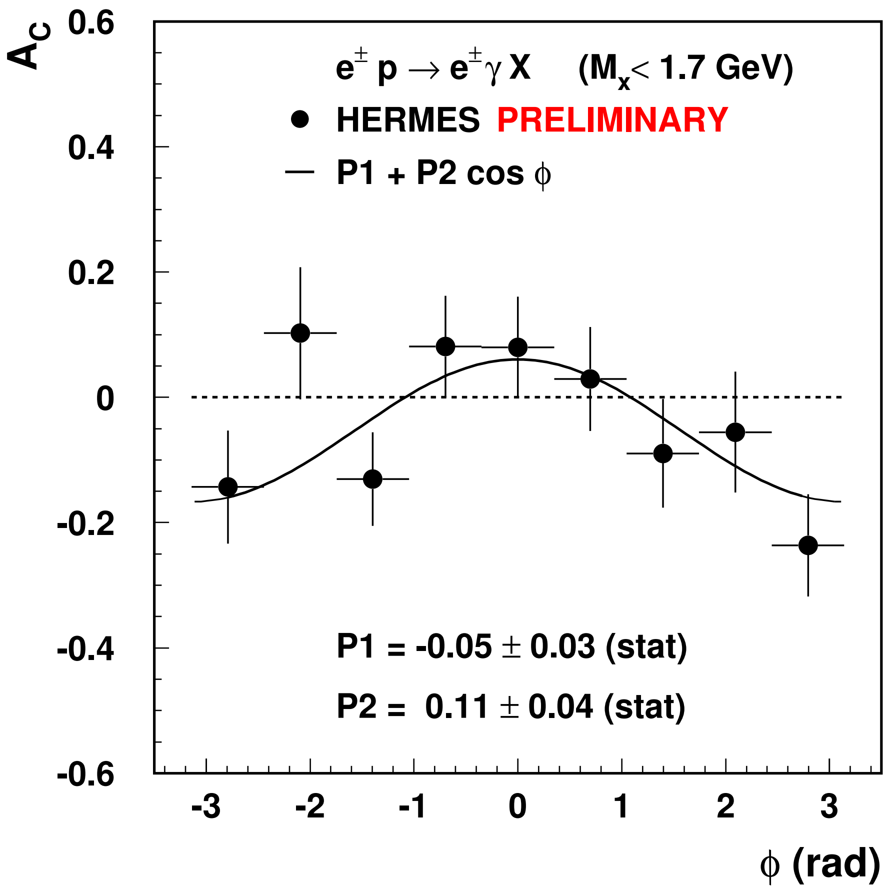
DVCS: Beam Spin Asymmetry

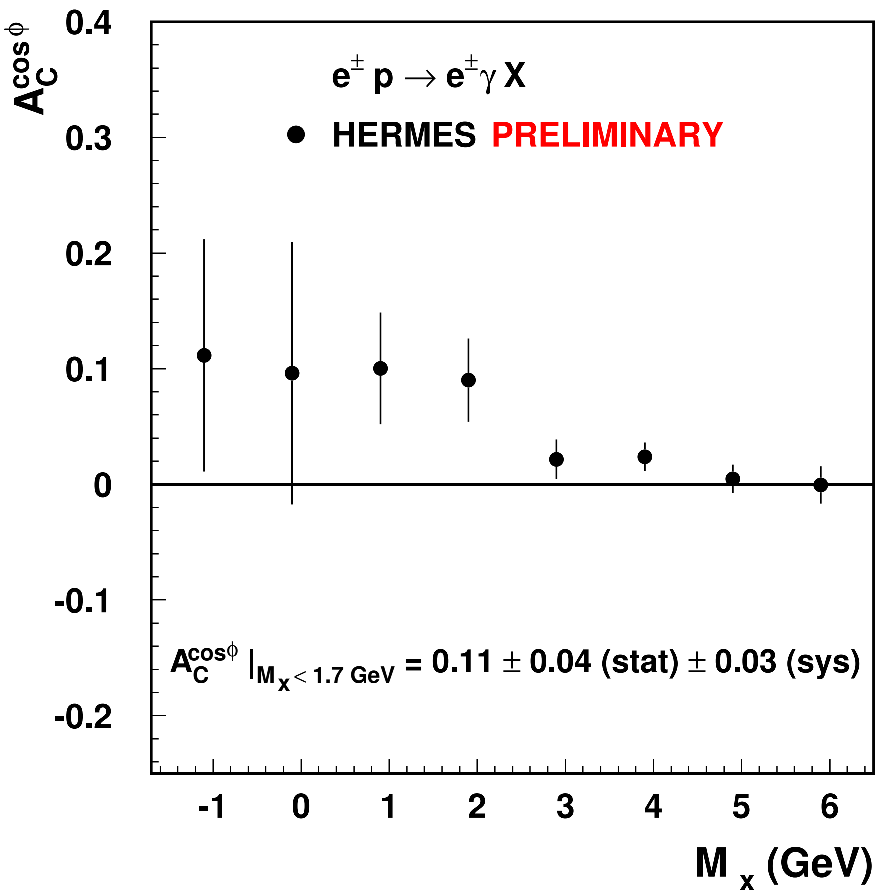




DVCS: Beam Charge Asymmetry

Unique possibility at HERA





Plans for HERMES Run II

Year	Target	P_t	Beam	Physics
2002	H	Transverse	e^+, (e^-)	δu
2003	H	Transverse	e^-	δu
2004	H	Transverse	e	δu
2004	H	Longitudinal	e	Δq
2005*	H	Unpol.	e^-	Exclusive reactions (Recoil det.)
2006	H	Unpol.	e^+	Exclusive reactions (Recoil det.)

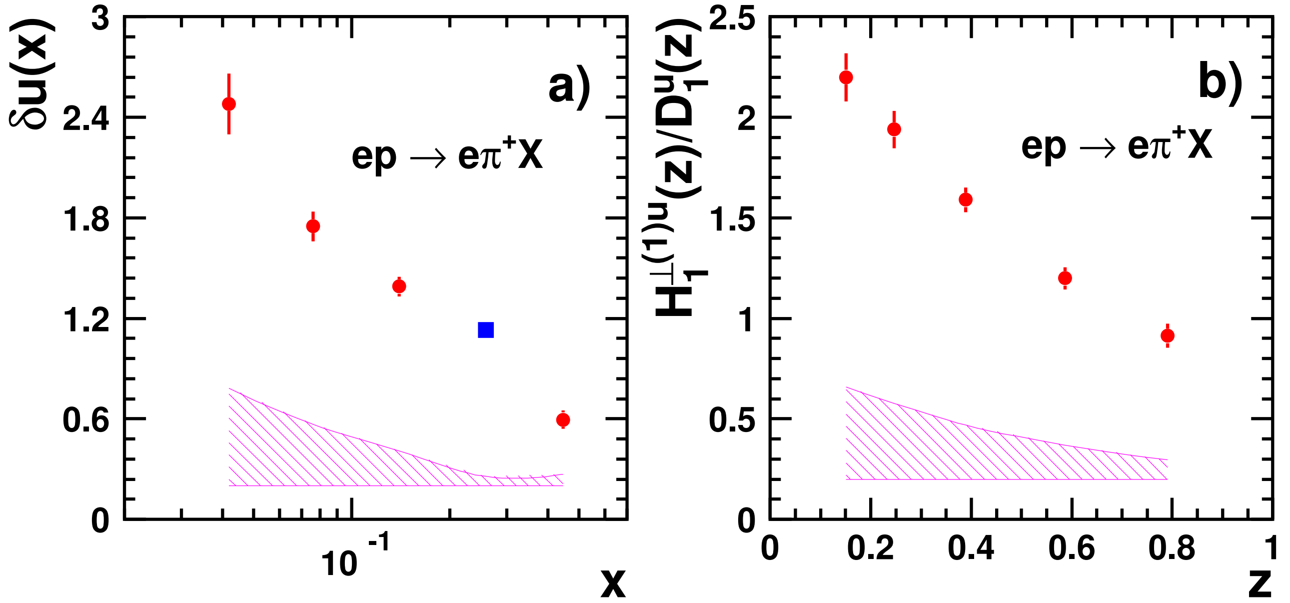
* Need 3-4 month shutdown to install Recoil Detector

Always require polarized beam, with beam helicity balanced data sets

Plans for 2002-2004

Transversity: Use transversely polarized H-target

Projected accuracy on transversity $h_1^u(x) = \delta u(x)$ and Collins function $H_1(z)$



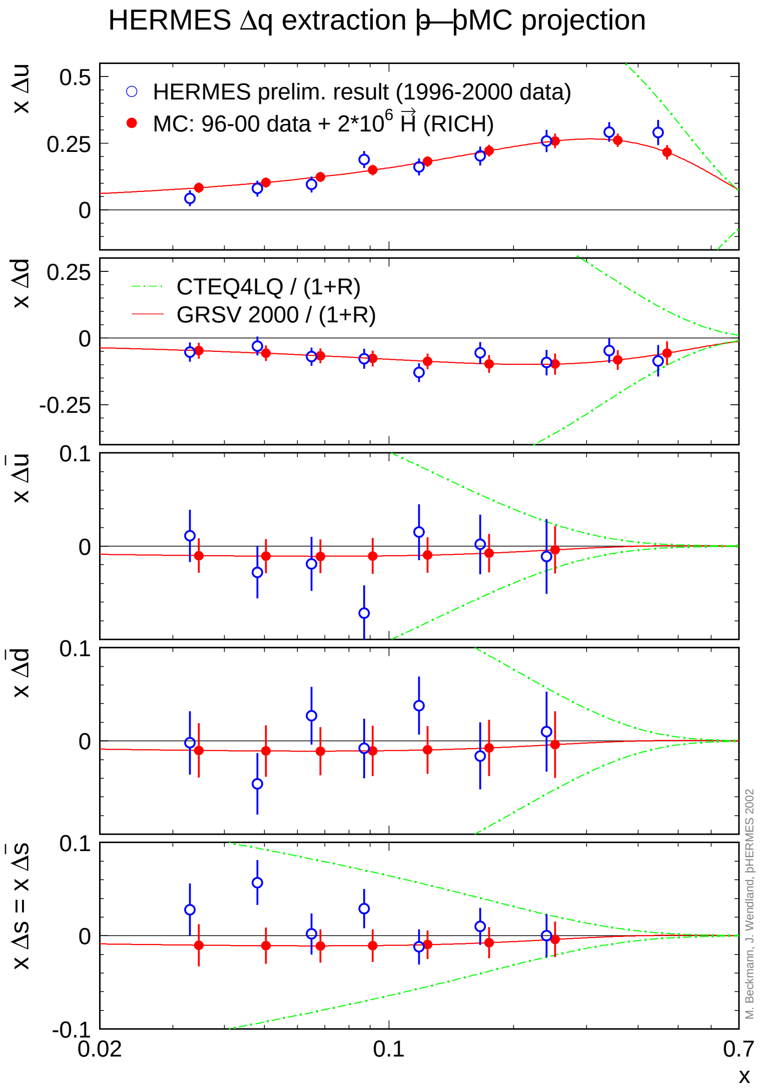
Based on 7.0 Mio DIS events: Year 2000 running conditions ∝ 4 Mio DIS

Plans for 2004

- RICH was installed in 1998
- Since 1998: longitudinally polarized D-target
- Extra 2.0 Mio DIS on longitudinally polarized H-target

- Increase accuracy of Δq measurement

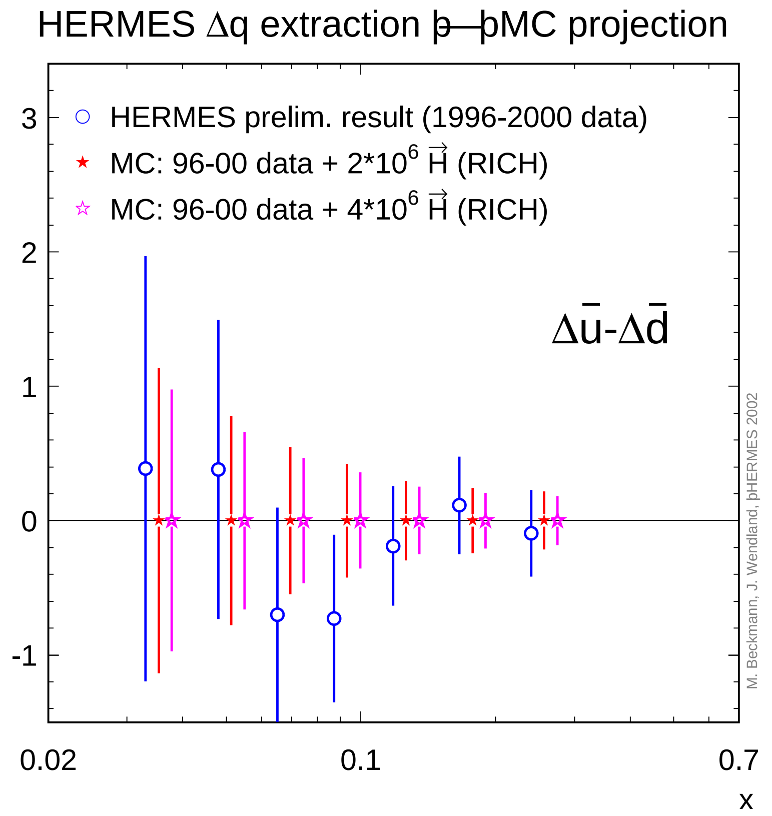
- If time allows after h_1 measurement
- Transverse $\rightarrow$ Longitudinal: $\approx$ 2 weeks



Plans for 2004

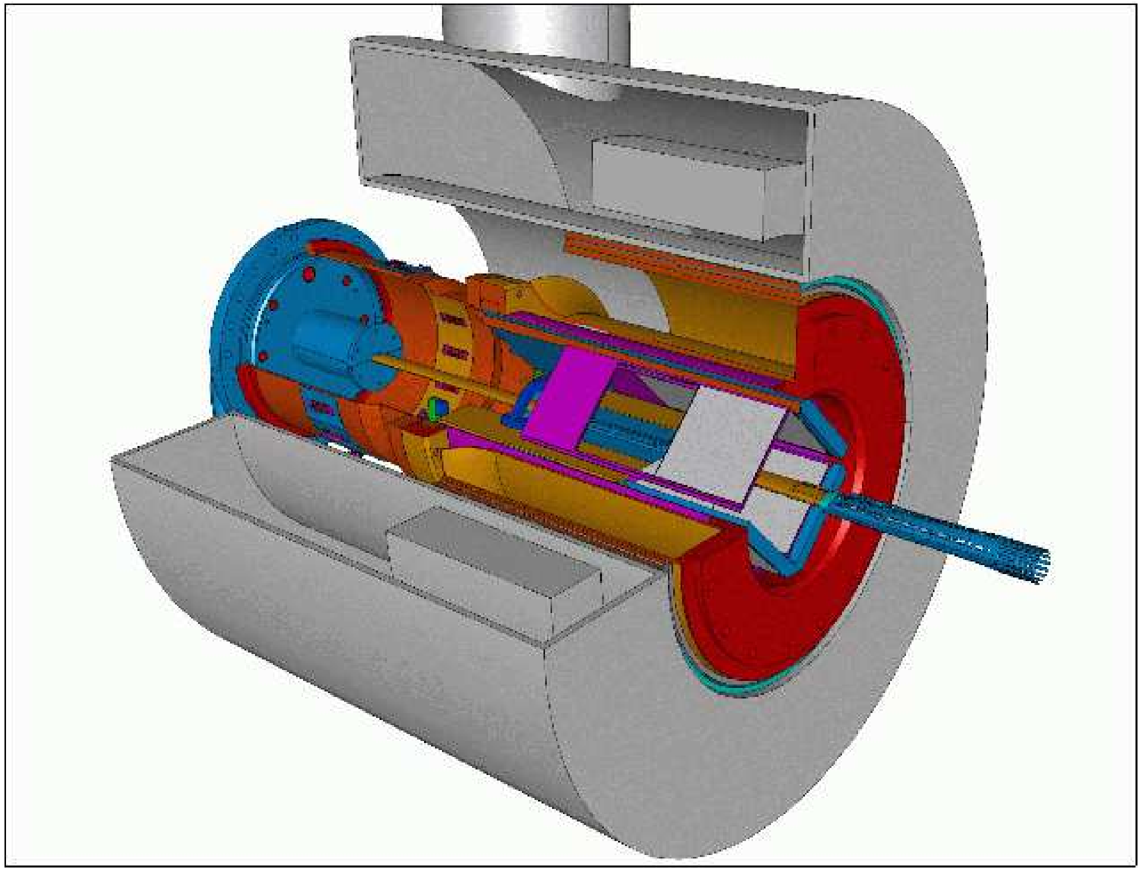
☛ Extra data on longitudinally polarized H-target

⋗ Better determination of polarized quark sea asymmetry



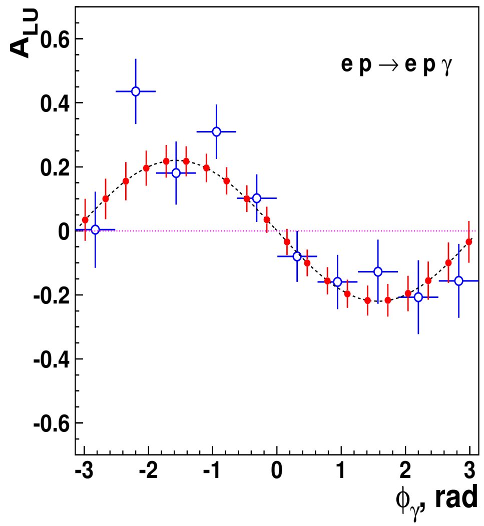
Plans for 2005-2006

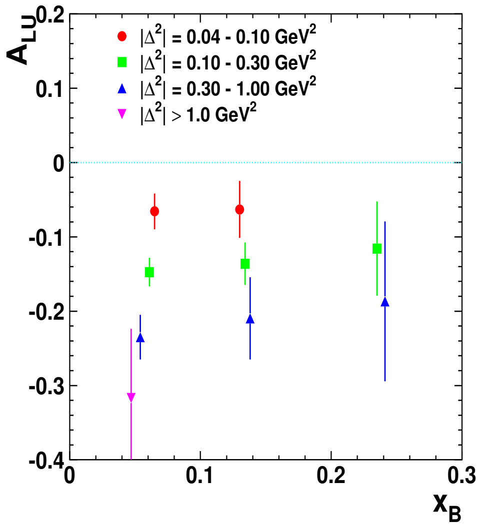
Exclusive reactions: Use Recoil Detector to increase exclusivity of sample

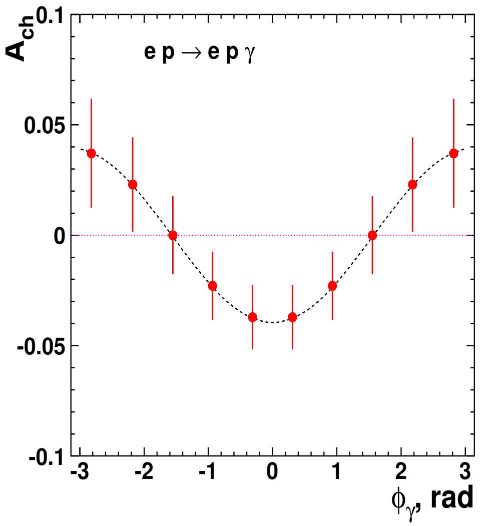


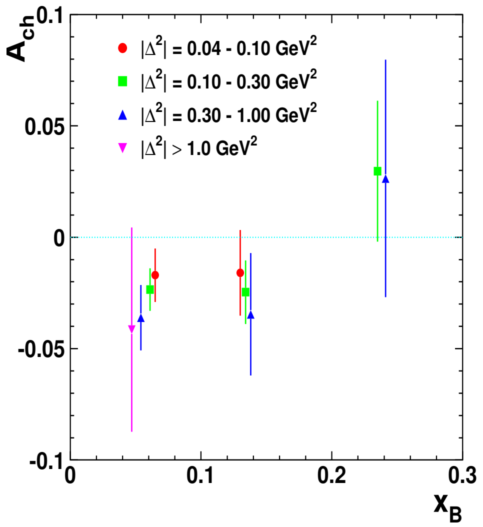
Plans for 2005-2006

Beam Spin Asymmetry









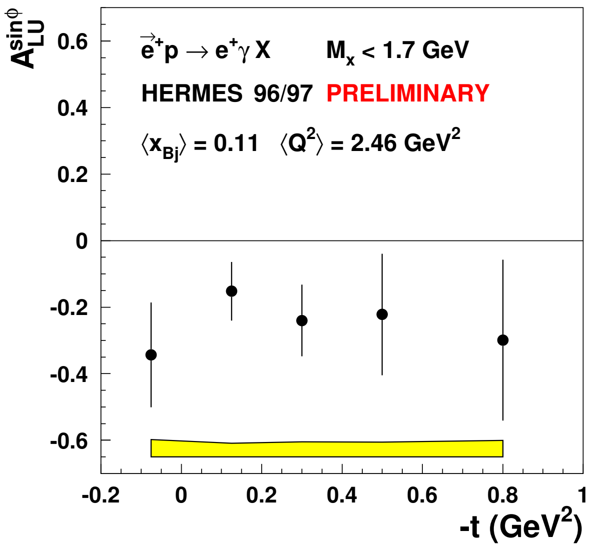
Beam Charge Asymmetry

Plans for 2005-2006

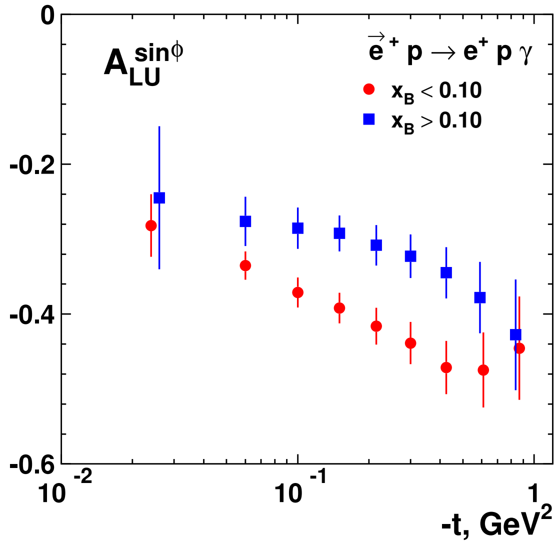
Main impact of Recoil Detector:

- Detect recoil proton
- Improve exclusivity
  - Background from Δ-excitation
- Improve resolution in t
  - Presently $\Delta t \approx .17$ GeV^2

Present data ($\Delta t \approx 0.17$ GeV^2)

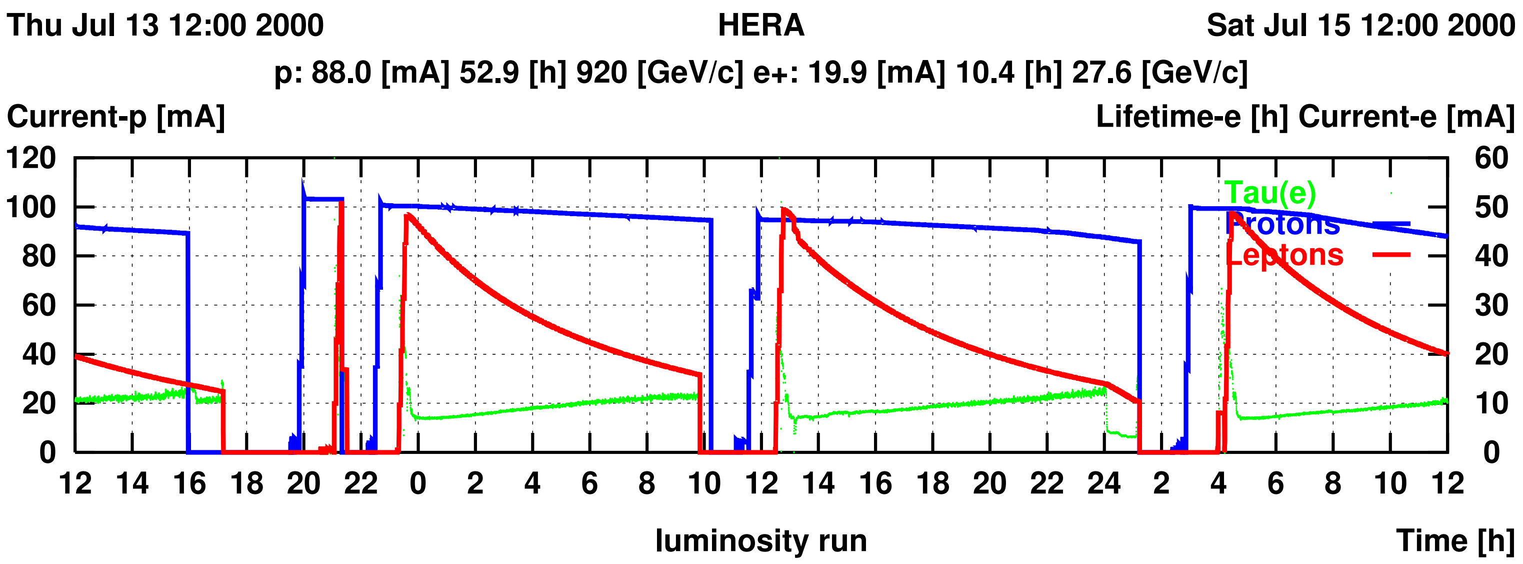


With recoil detector ($\Delta t/t \approx 0.2$)



Plans for Run II

Also continue "end-of-fill" running



- Λ-physics
- fragmentation functions
- $\cdots$