Study of the left-right asymmetry A_{UT} of pions and kaons produced in photo-production on a transversly polarised target.

Laura Manfrè

Supervised by: Achim Hillenbrand
Charlotte Van Hulse

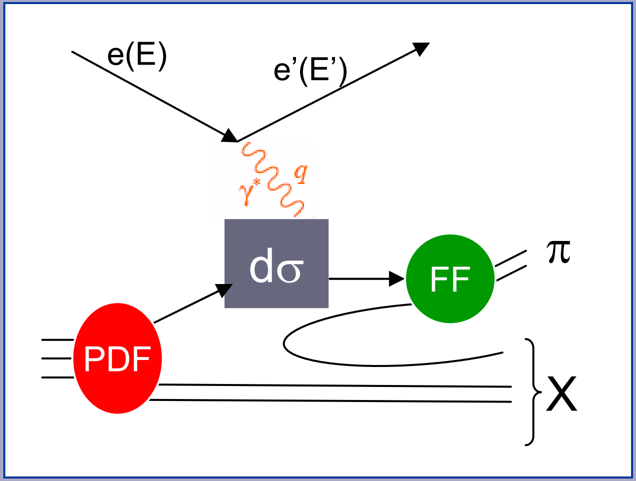
DESY Summer School Program 2007

Outline

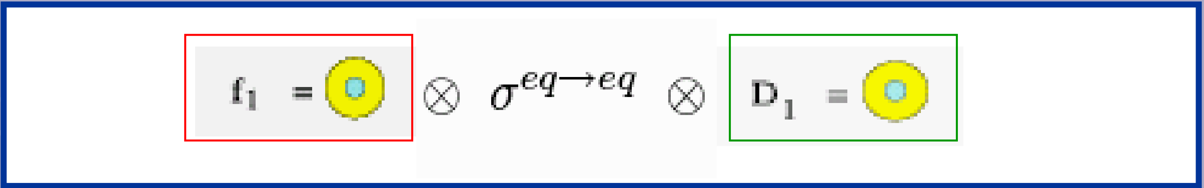
- The Semi Inclusive Deep Inelastic Scattering (SIDIS)
  - Cross section of SIDIS, a combination of Distribution Functions (DFs) and Fragmentation Functions (FFs)
- Studies of the Azimuthal Single Spin Asymmetries A_{UT}
  - Observation of huge amount of data at low Q^2: from the electroproduction to the photoproduction
- The measurement of the left-rigth A_{UT} Asymmetry
  - PID: separating leptons and hadrons
  - How we obtain the left-rigth A_{UT} measurement
  - Results
- Conclusions

Semi-Inclusive DIS

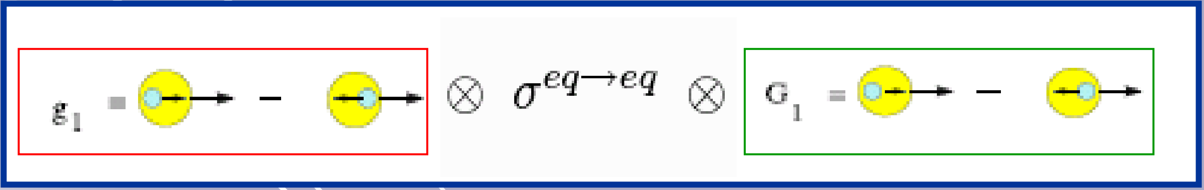
$$Q^2 = -q^2 = 4\ EE'\ \sin^2(\theta/2)$$



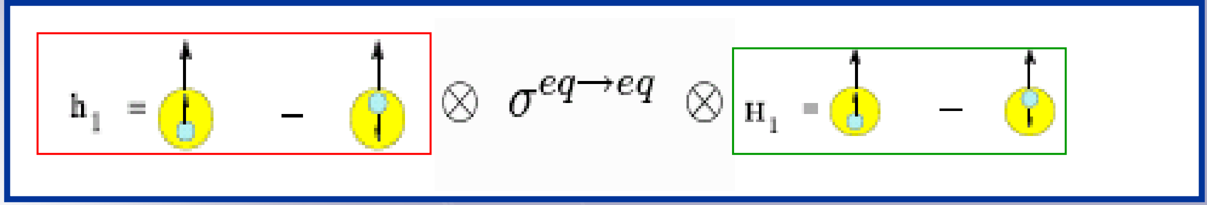
$$\sigma^{ep\to ehX} \sim \text{PDF} \otimes \sigma^{eq\to eq} \otimes \text{FF}$$



Unpolarized case



Polarized case LONGITUDINALLY



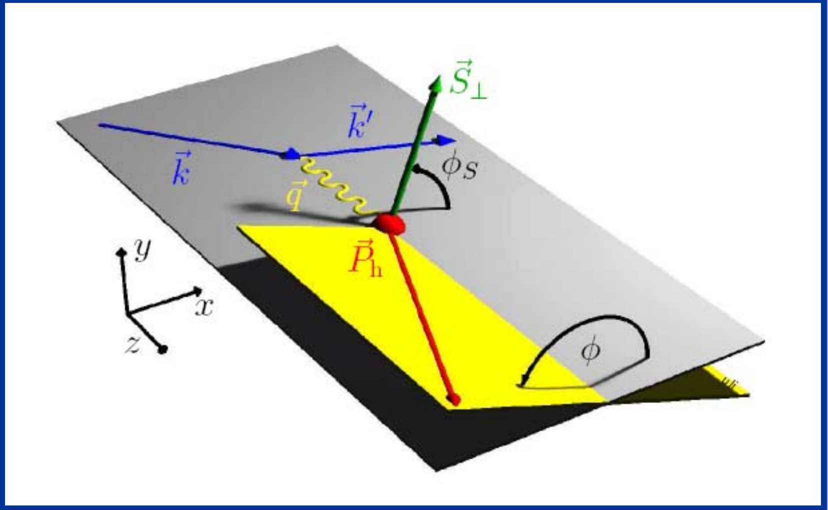
Polarized case LONGITUDINALLY

hermes

Study of Single Spin Asymmetry of the SIDIS cross-section ($Q^2>1$)

$$A_{UT}(\phi, \phi_S) = \frac{1}{\langle |S_\perp| \rangle} \frac{N_h^{\uparrow}(\phi, \phi_S) - N_h^{\downarrow}(\phi, \phi_S)}{N_h^{\uparrow}(\phi, \phi_S) + N_h^{\downarrow}(\phi, \phi_S)}$$

Measurement of cross-section asymmetries depending on the azimuthal angles ϕ and ϕ_s



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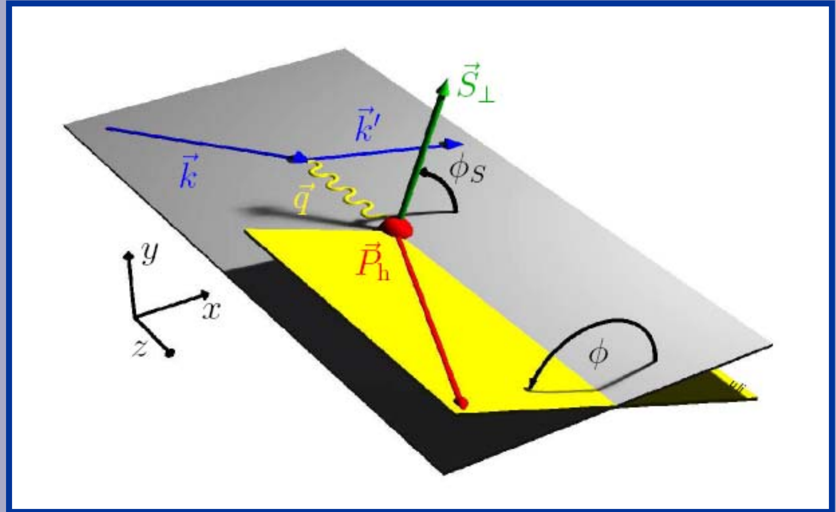

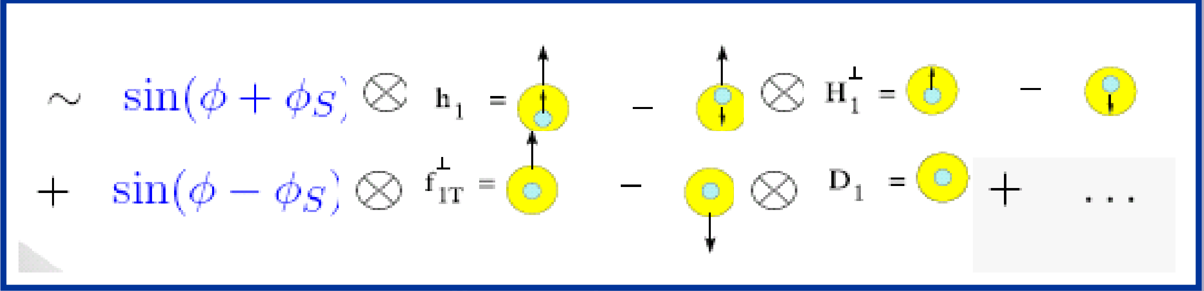

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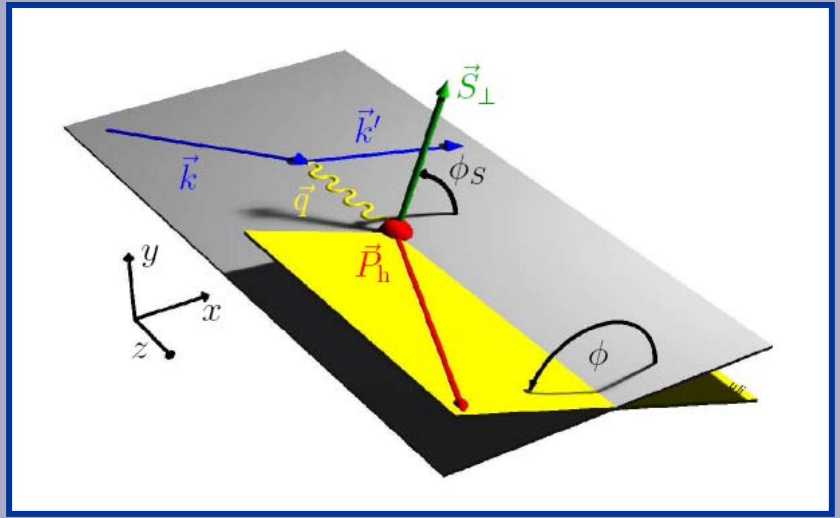
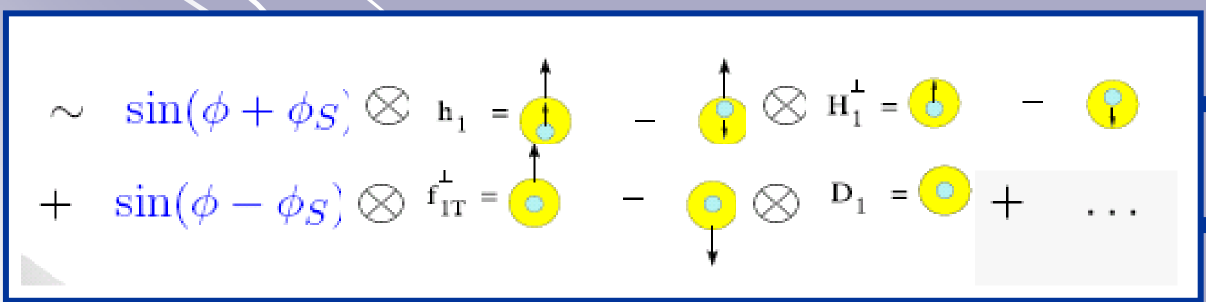




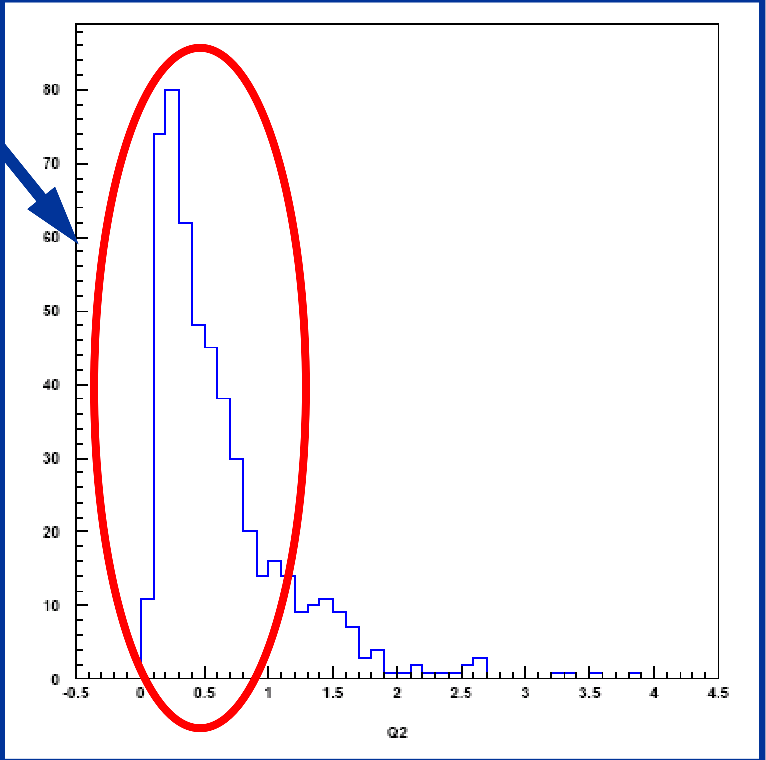
Collins Moment

Sivers Moment

Huge amount of data at low Q^2

$Q^2 > 1$ → electroproduction → HERMES measurement

$Q^2 \sim 0$ → photoproduction → $\gamma^* \sim$ vector-meson



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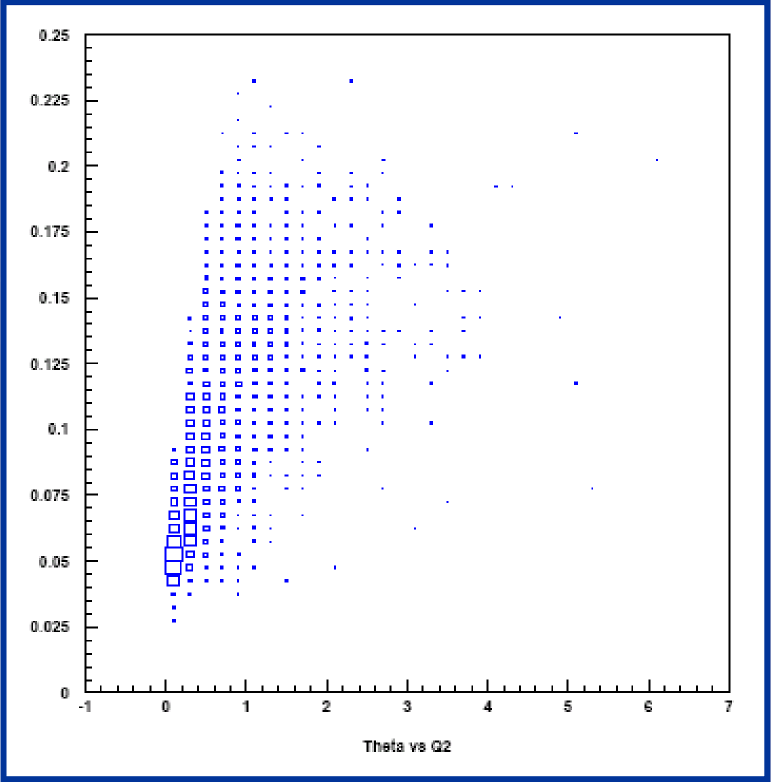
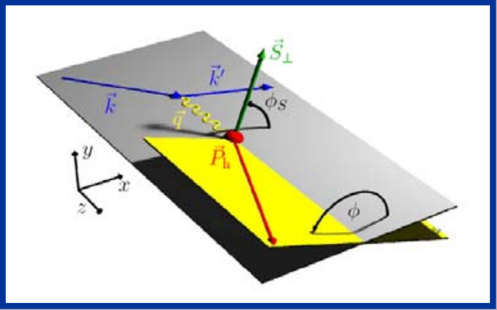
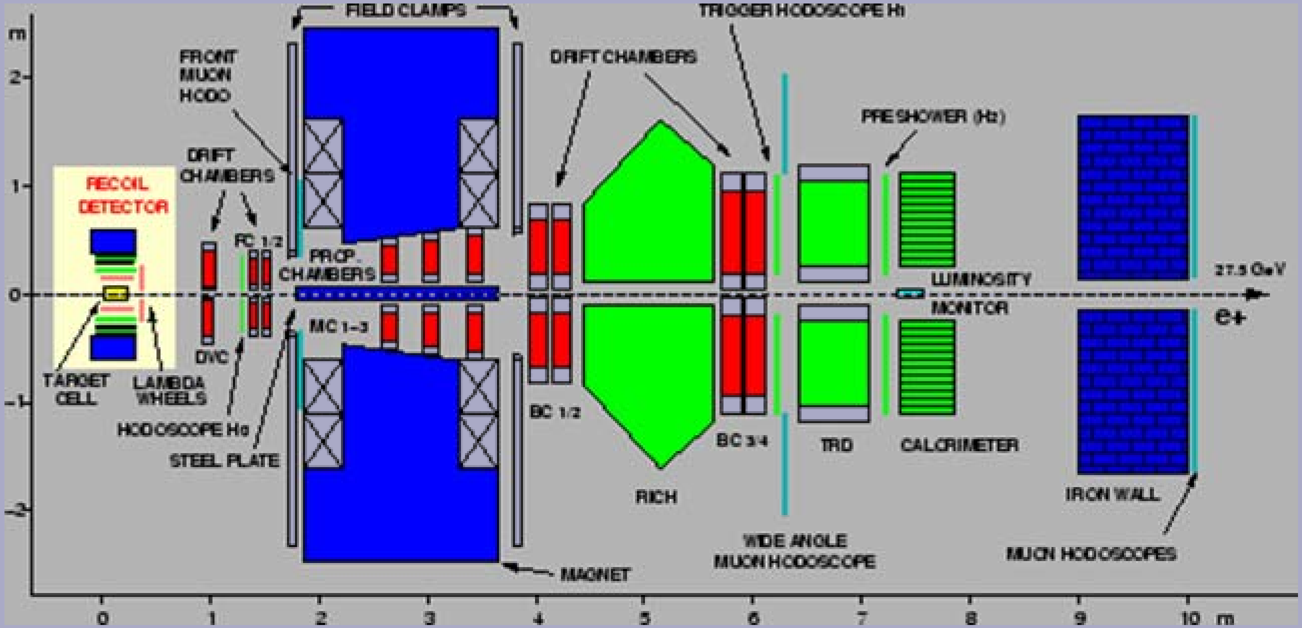




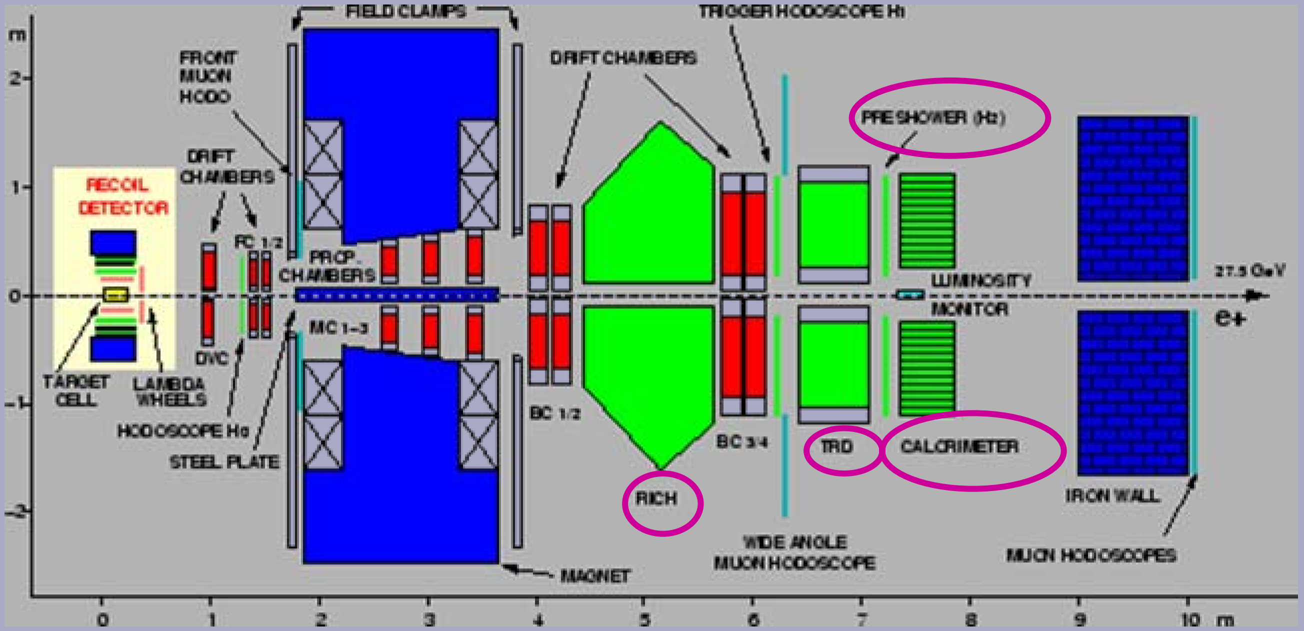
- angle of scattered lepton small: we <u>don't look at the scattered lepton</u>
- no lepton scattering plane

$(\phi - \phi s)$ still exist

hermes



- Angular acceptance:
  - 40 mrad $< |\theta_y| <$ 140 mrad
  - $|\theta_x| <$ 170 mrad
- Resolution:
  - $\delta p \leq 2.6\%$
  - $\delta \leq 1$ mrad



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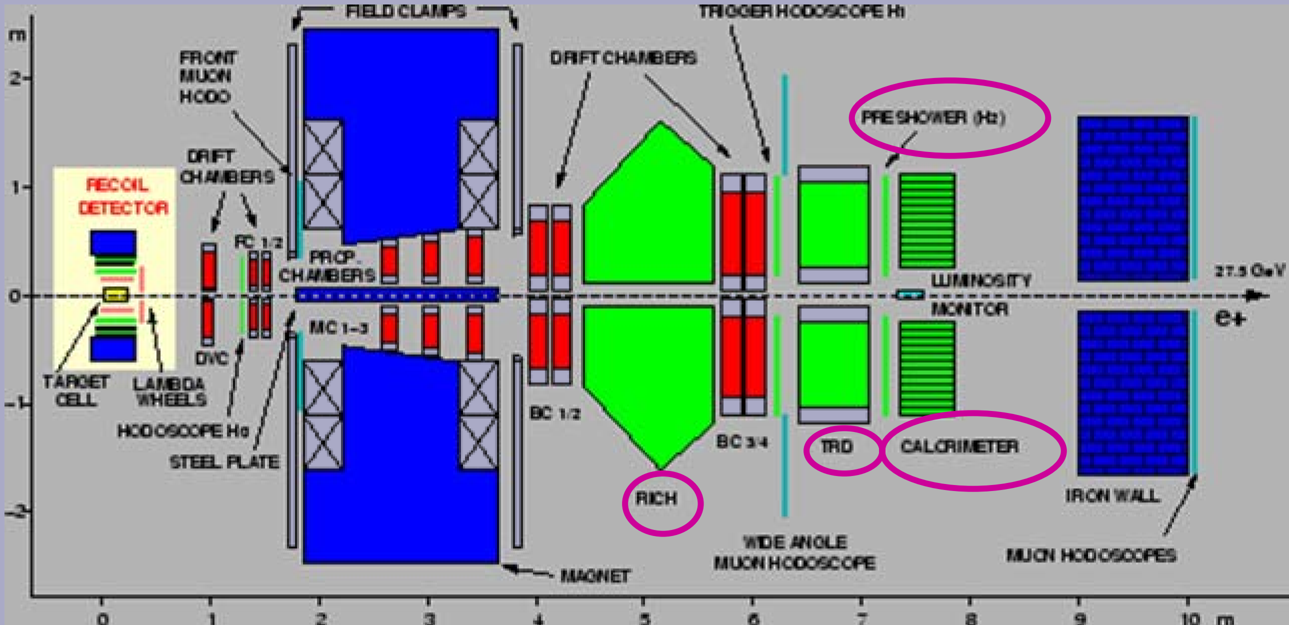
(h) ⟷ (l)

PID3+PID5



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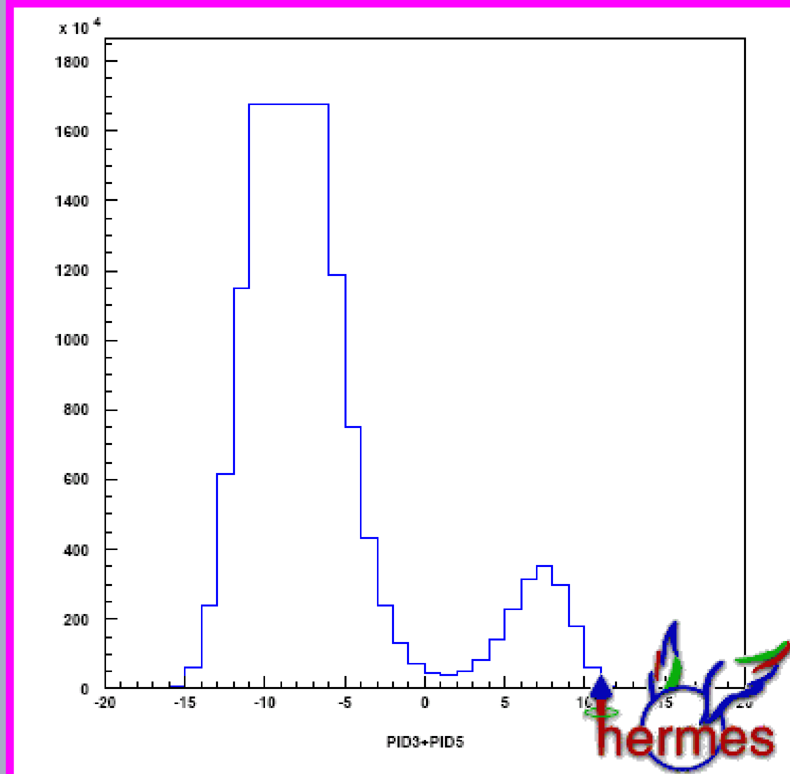

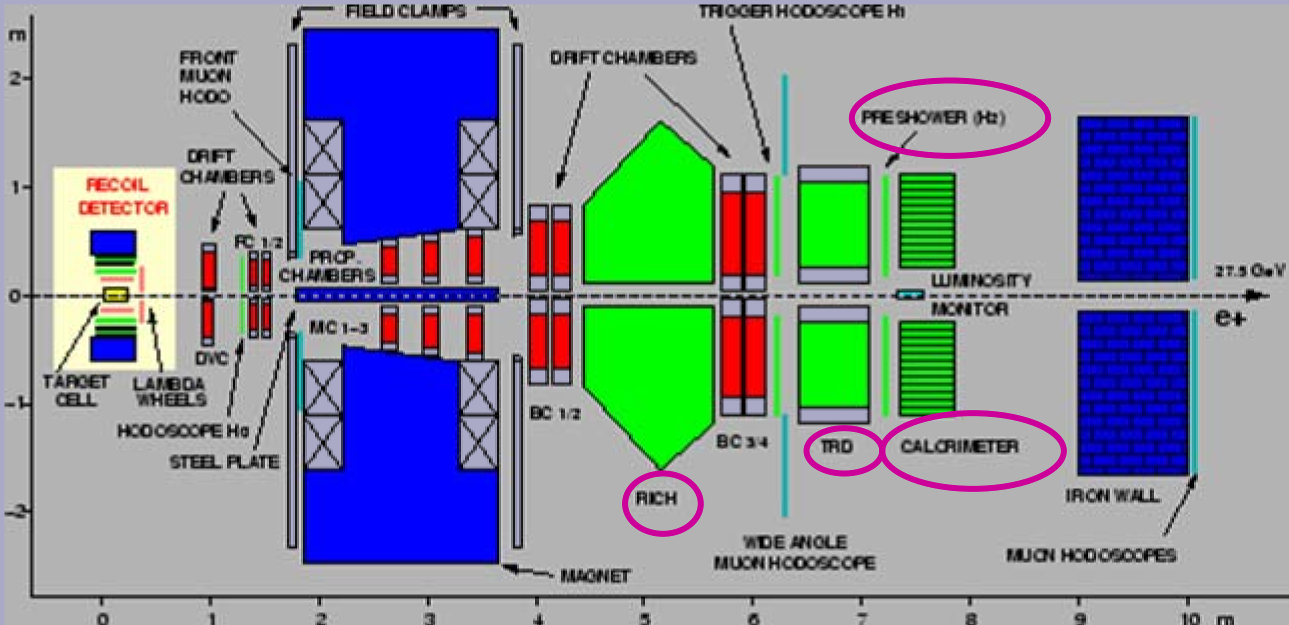

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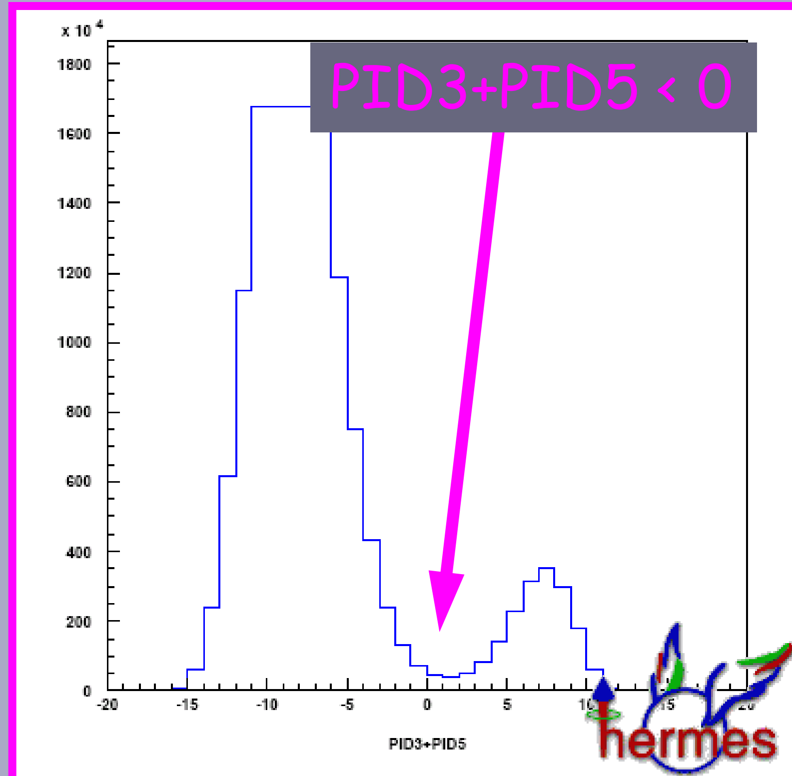

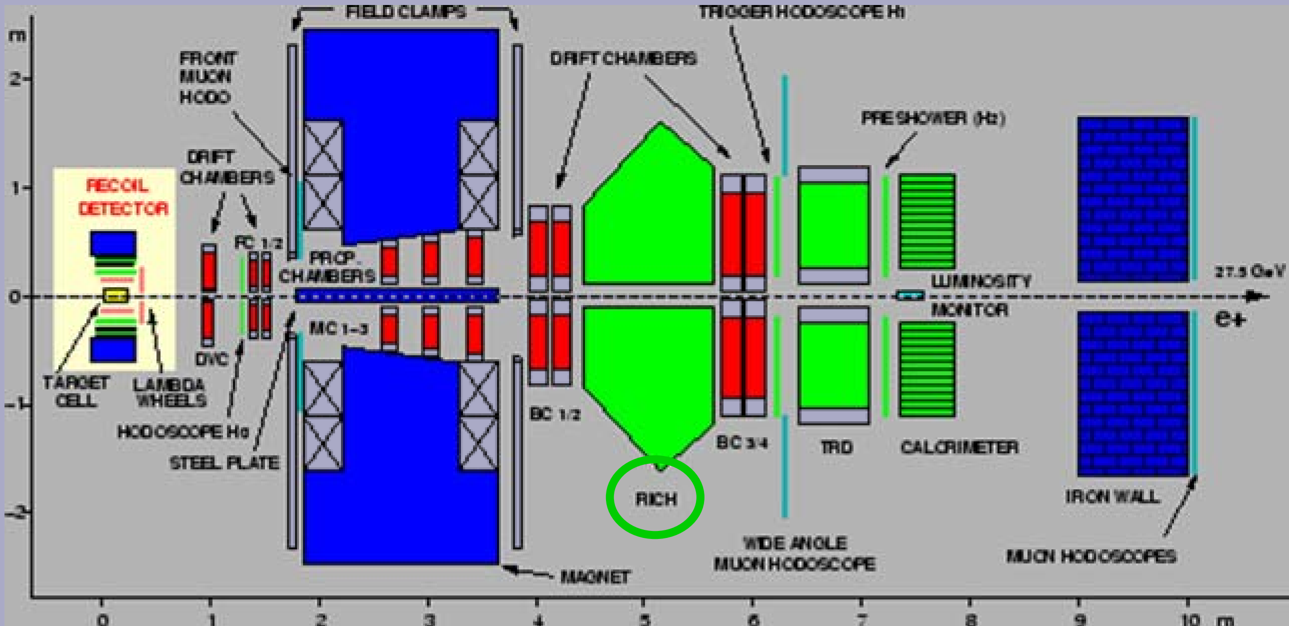

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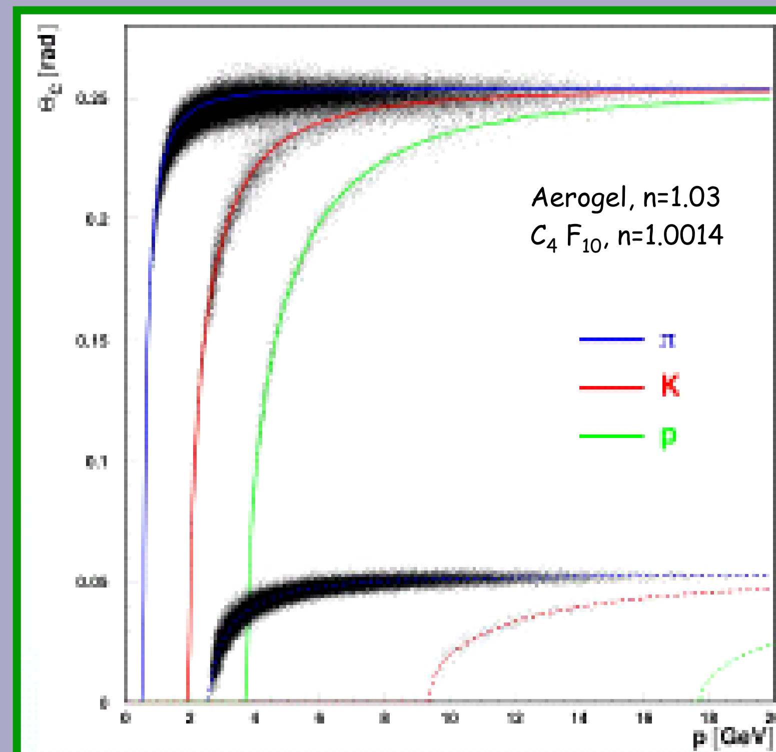
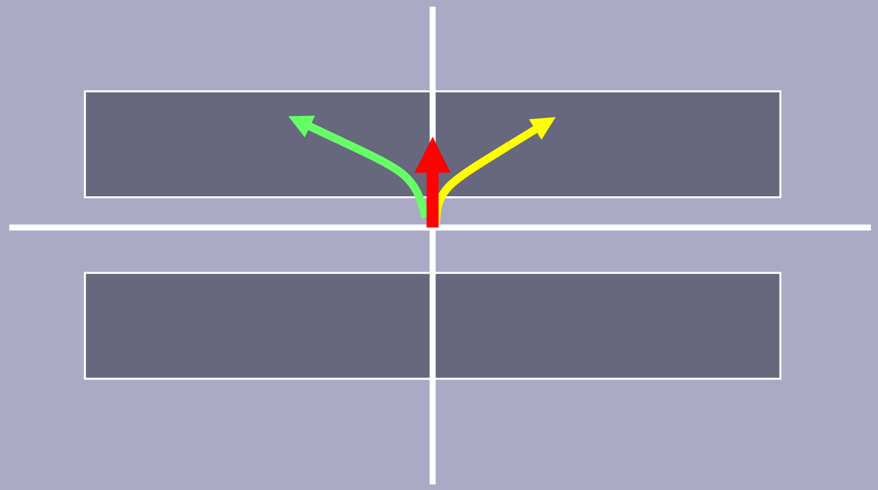
(π) (K) (p) → RICH DETECTOR

leptons-hadrons >98% π~98%, K~88%, p~85%



$$A_{UT} = \frac{1}{|S_{\perp}|}\,\frac{N_R - N_L}{N_R + N_L}$$



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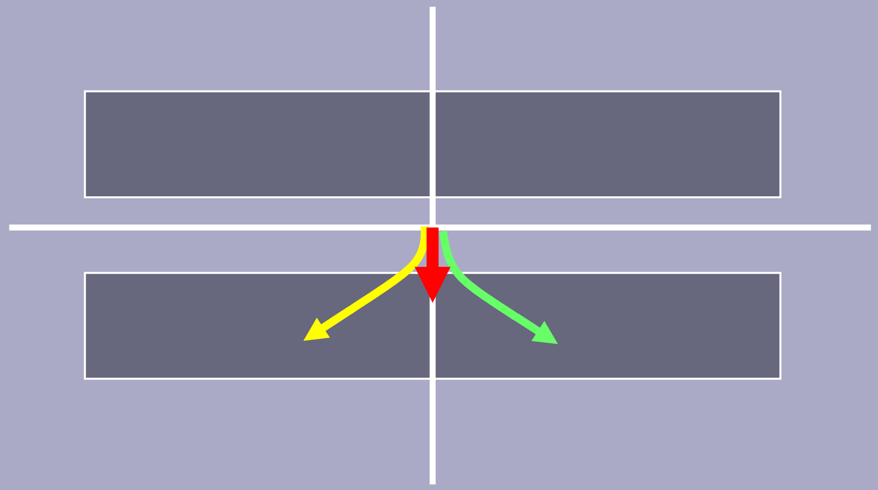

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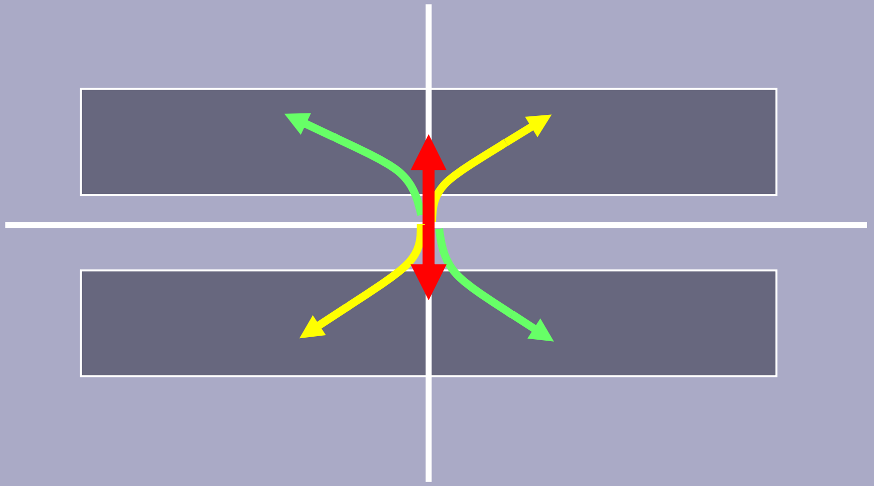

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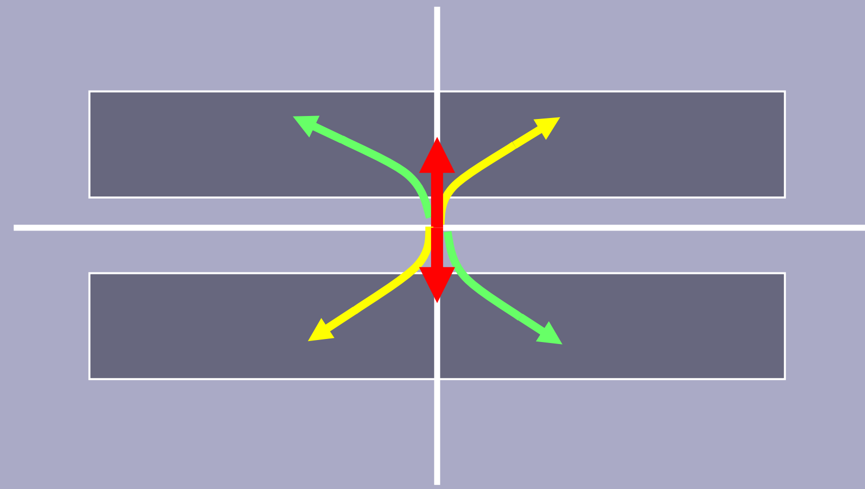

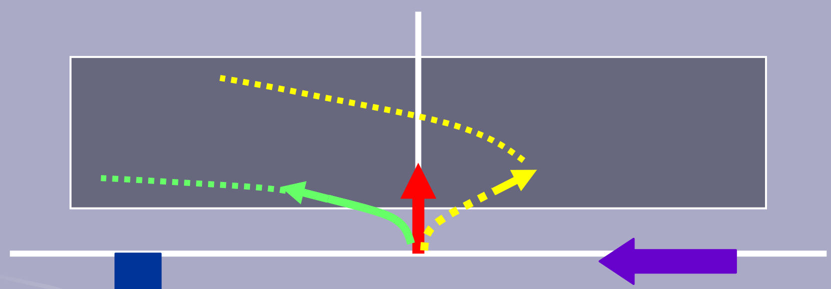

low momentum….particle more bended = high probability to lose the particle out of the detector

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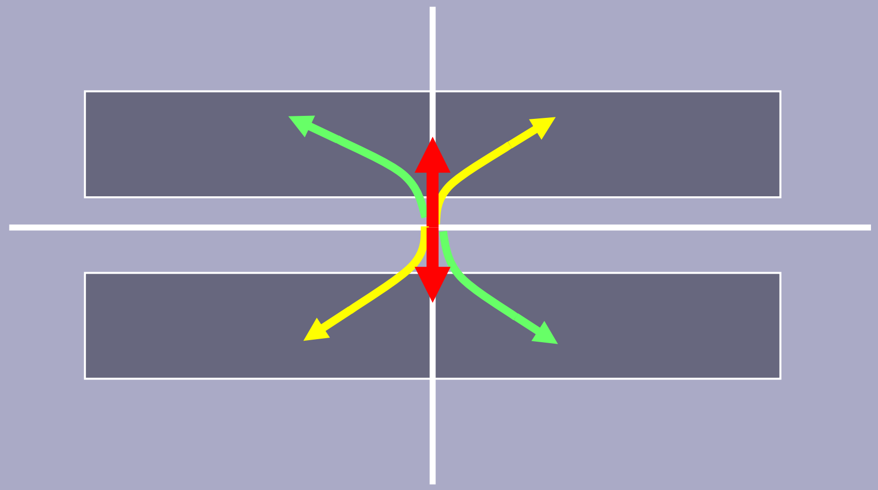

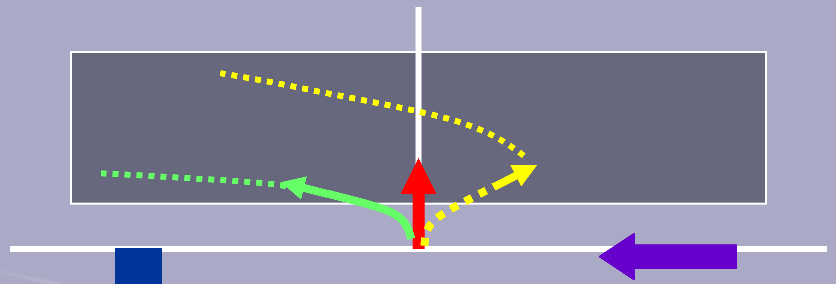

false Asymmetry

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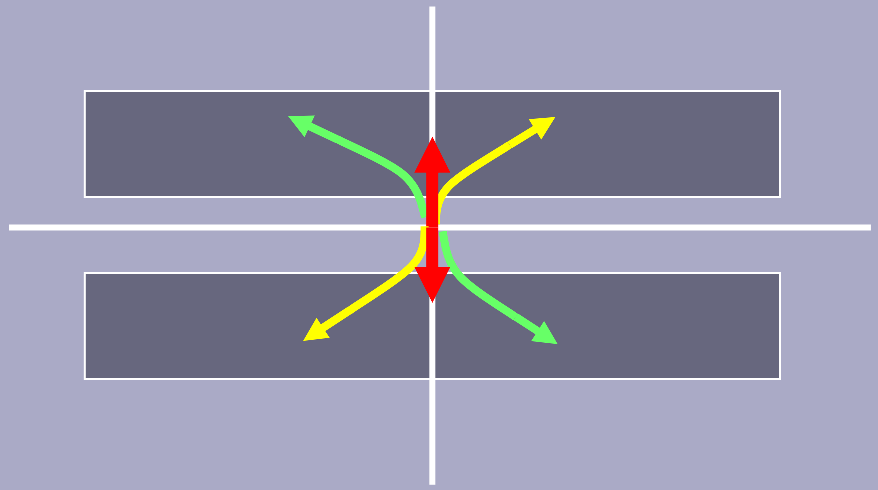

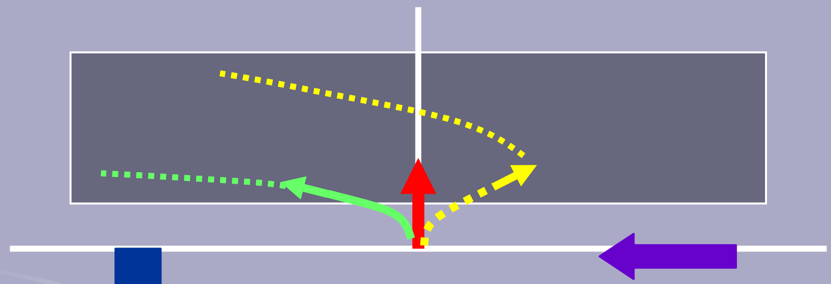

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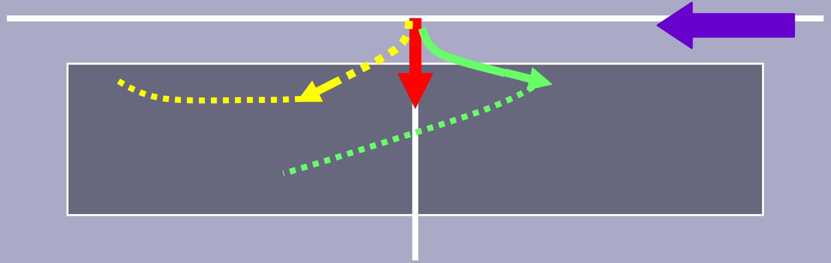

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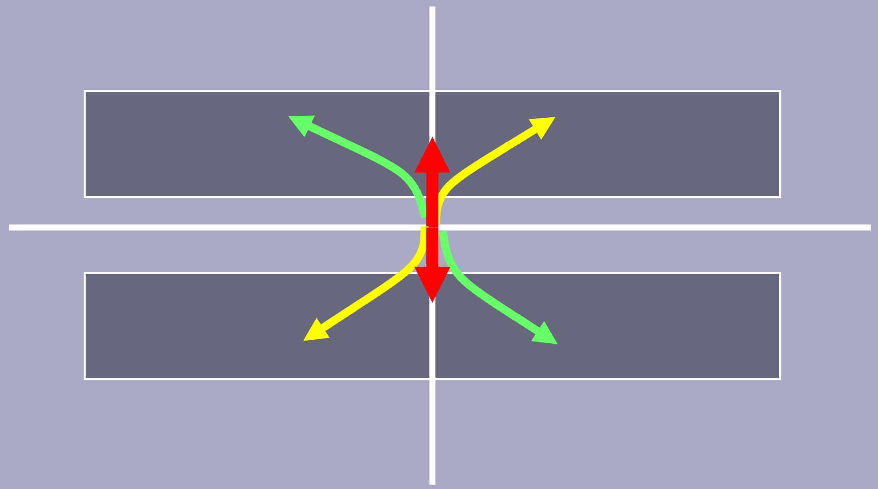

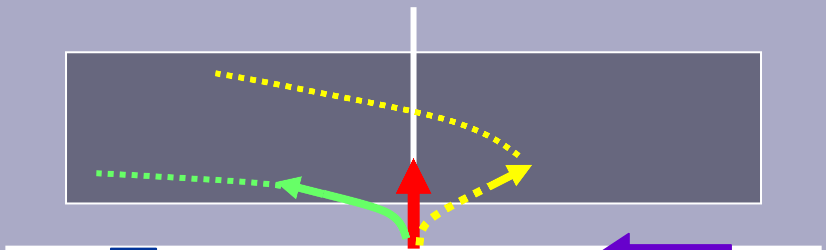

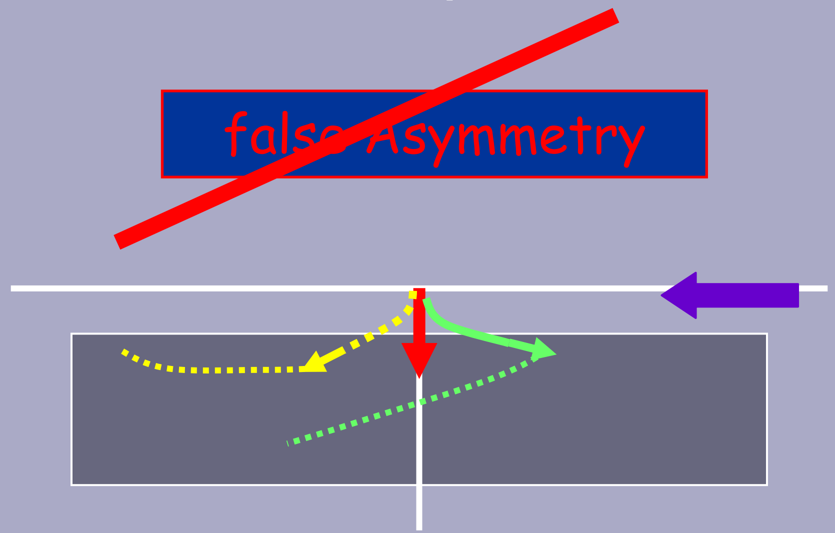

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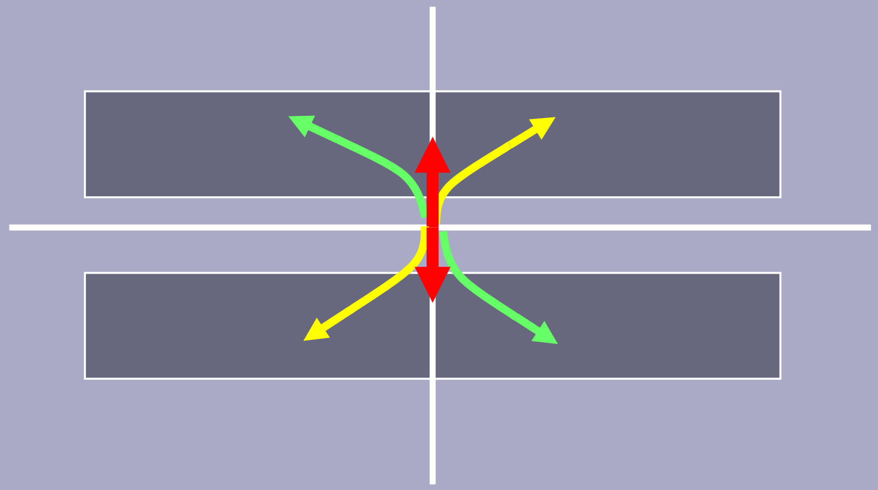

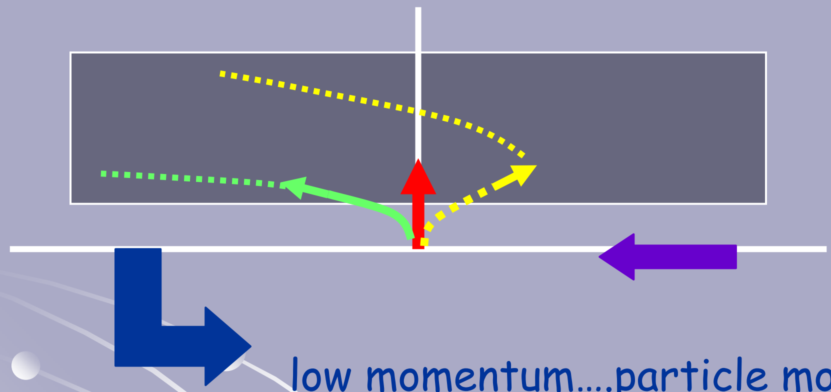

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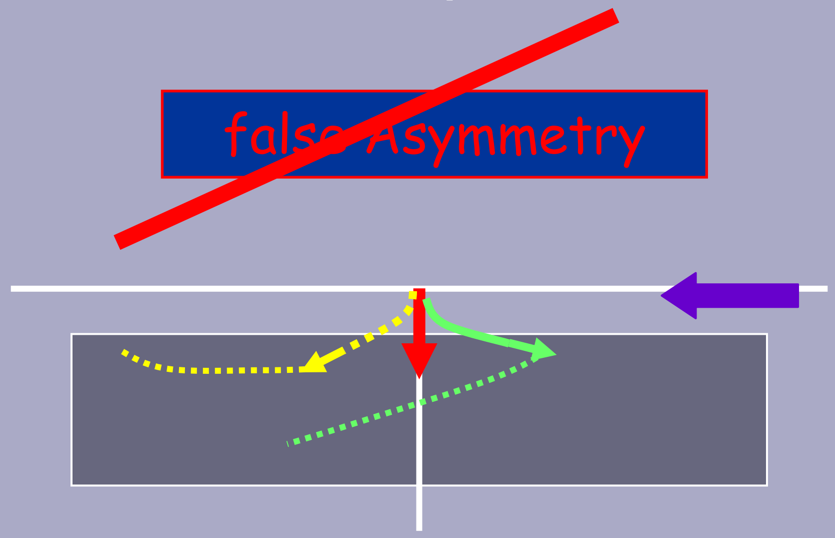
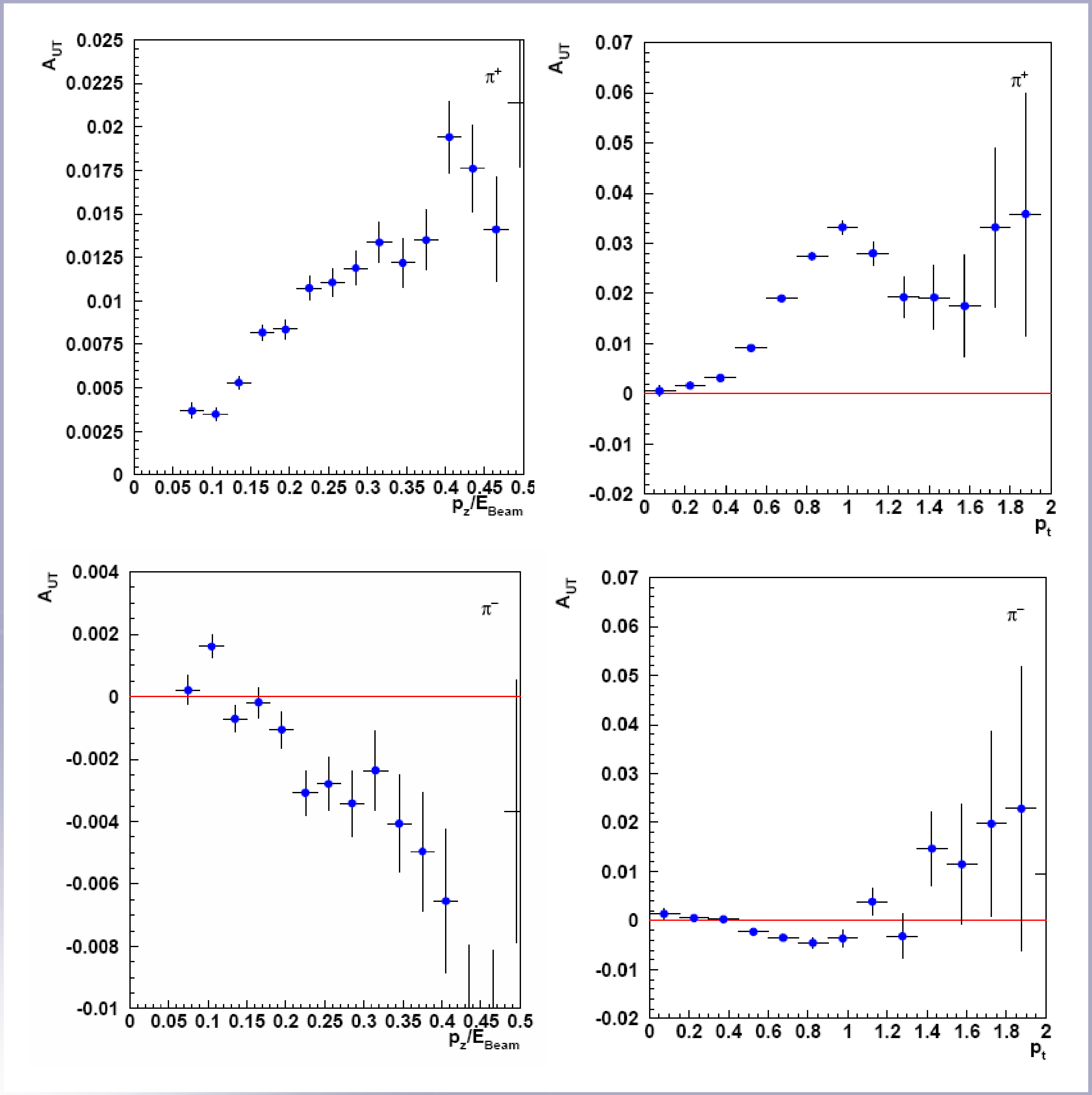


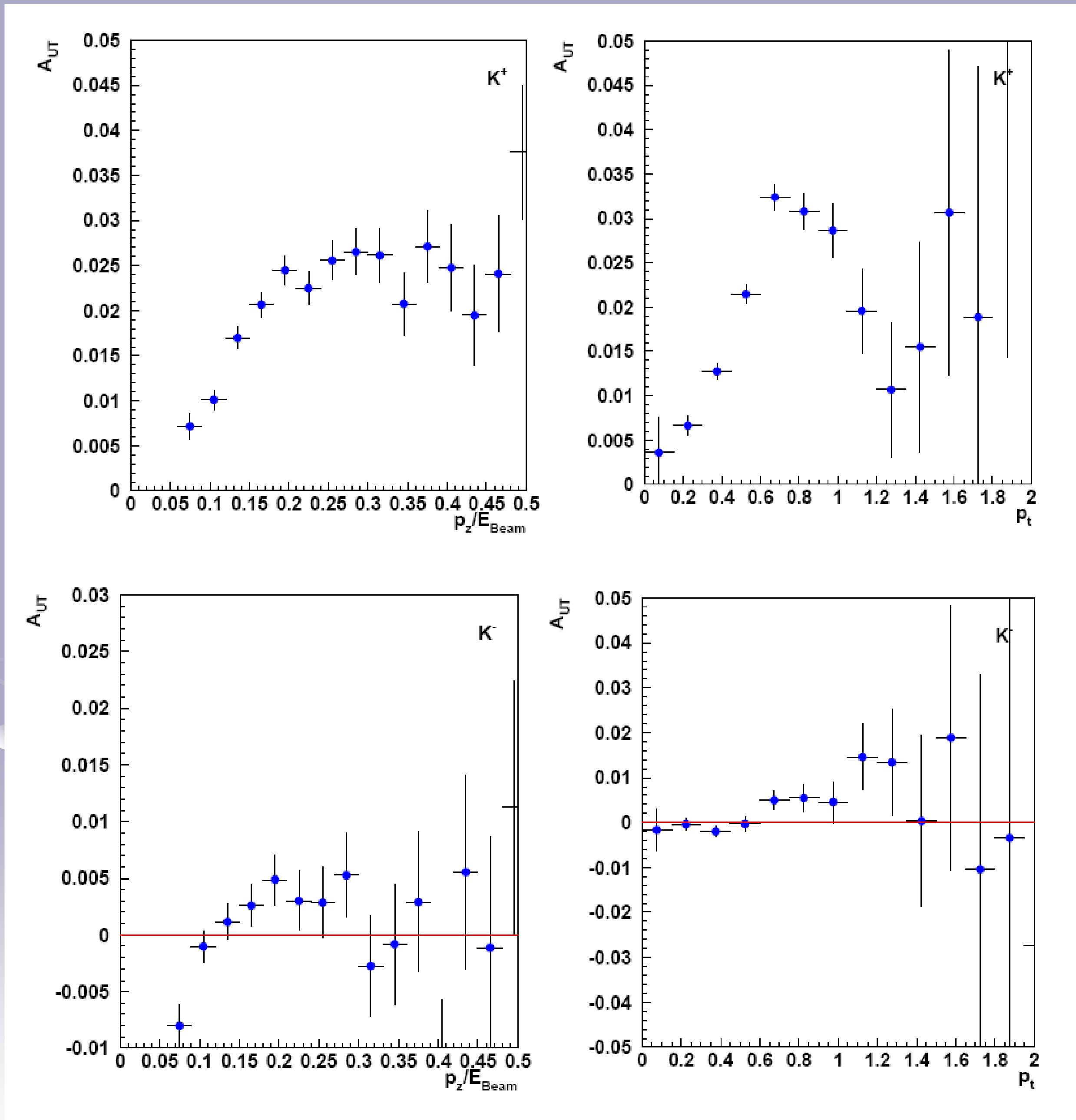
The percentage of the target polarization is 80 %

Results :



$A_{UT}(\pi^+)$: positive

$A_{UT}(\pi^-)$: slightly negative



$A_{UT}(K^+)$: positive

$A_{UT}(K^-)$: not very conclusive

$Q^2 \sim 0$

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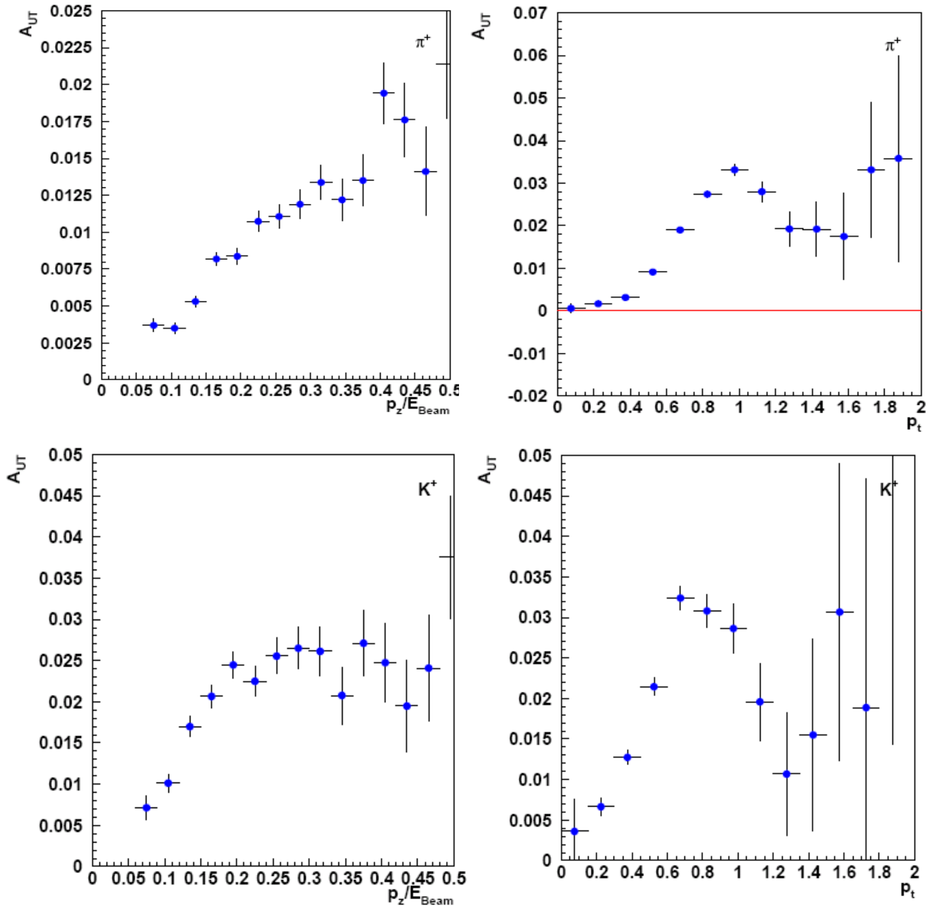
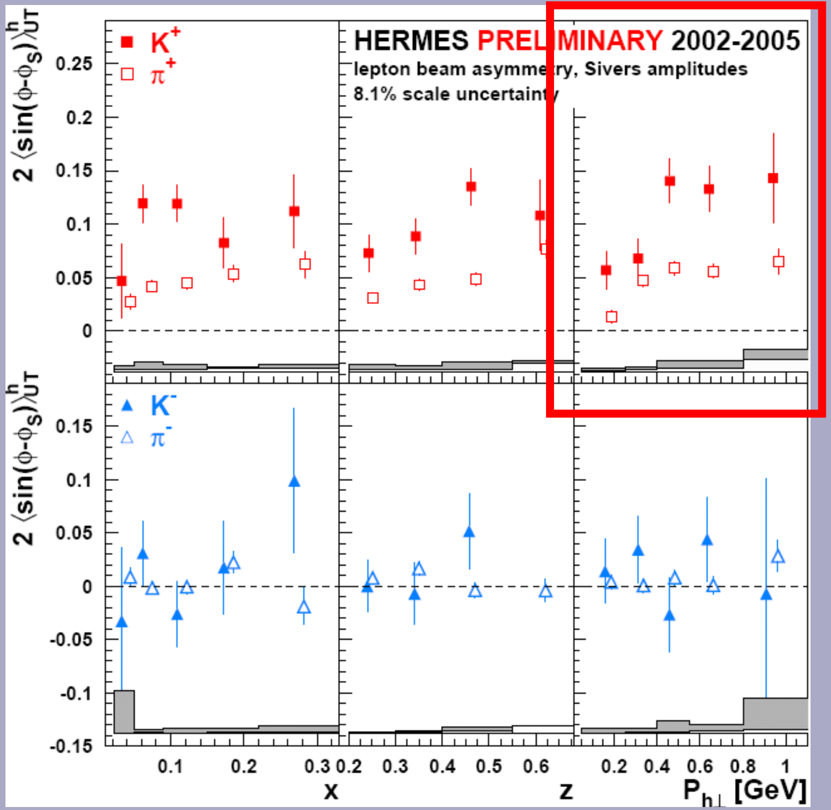


Results from this work



$Q^2 > 0$

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HERMES results

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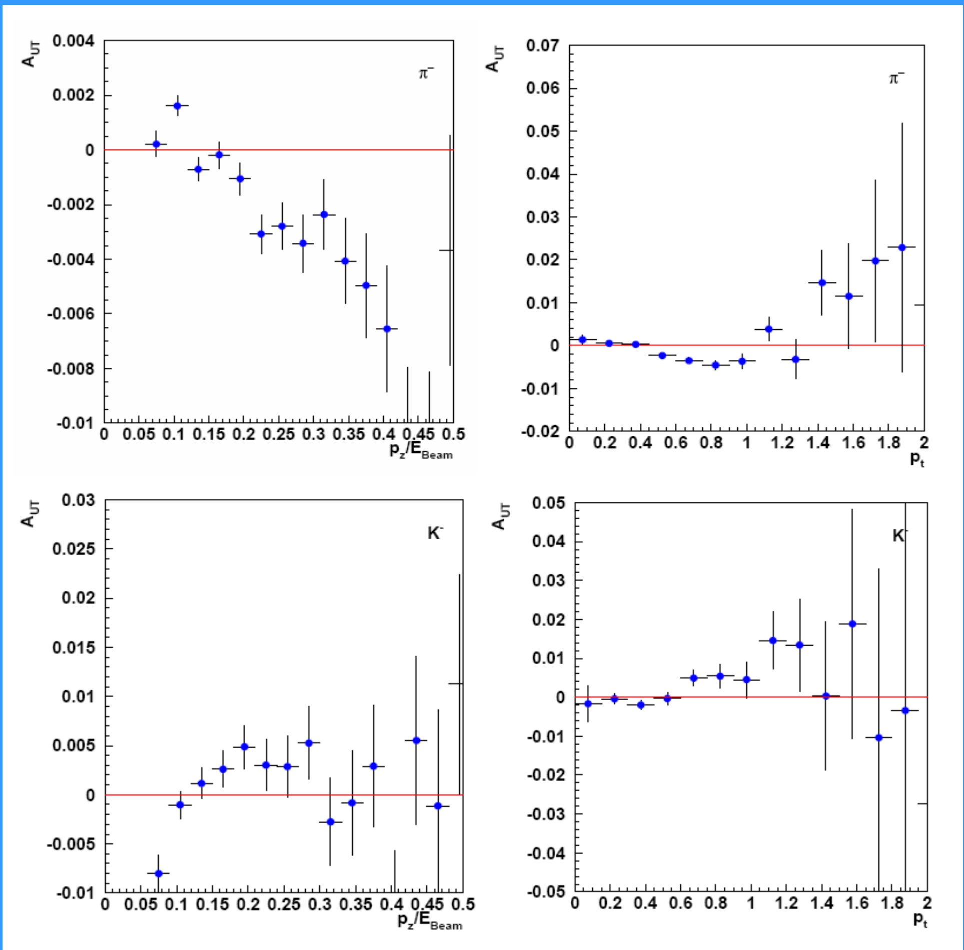

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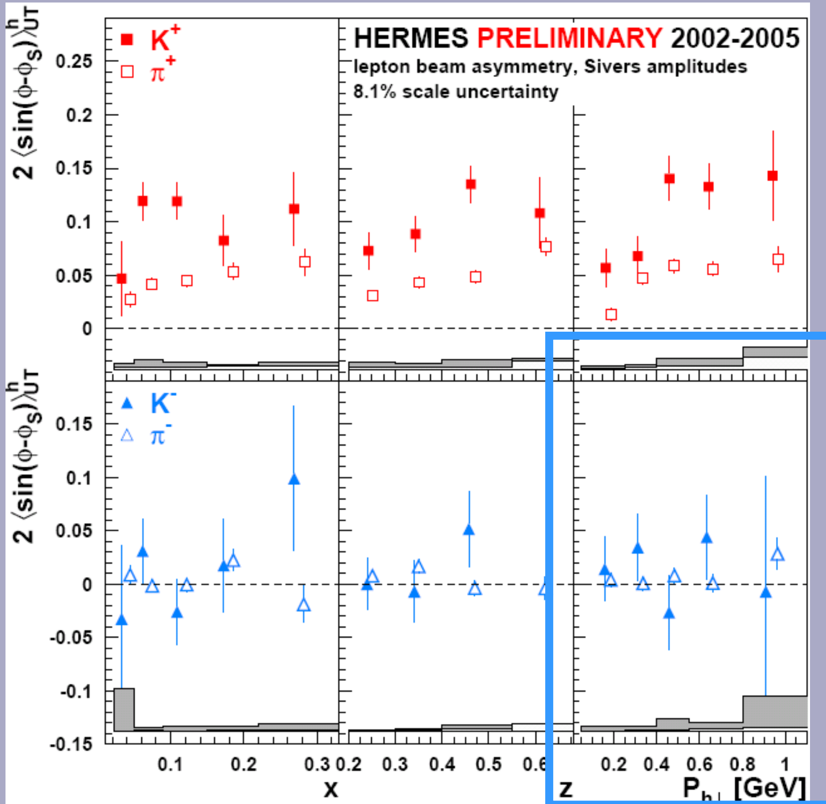

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HERMES results

Conclusion

- We measured the **A_{UT}** at **low Q^2** for π+, π- and for K+, k- vs P_z/E_{beam} and P_t

- The analysis of the A_{UT} function shown:
  - For **positive particle** a **positive Asymmetry** → results from this work are in the same trend with the HERMES results
  - For **negative particle** a **slightly negative Asymmetry** → different from the HERMES results (Asymmetry around zero)

hermes