Measurement of Transverse Λ Polarisation at COMPASS

Jan Friedrich

on behalf of the *COMPASS* collaboration

bmb+f - Förderschwerpunkt COMPASS Großgeräte der physikalischen Grundlagenforschung

spin 16th international spin physics symposium

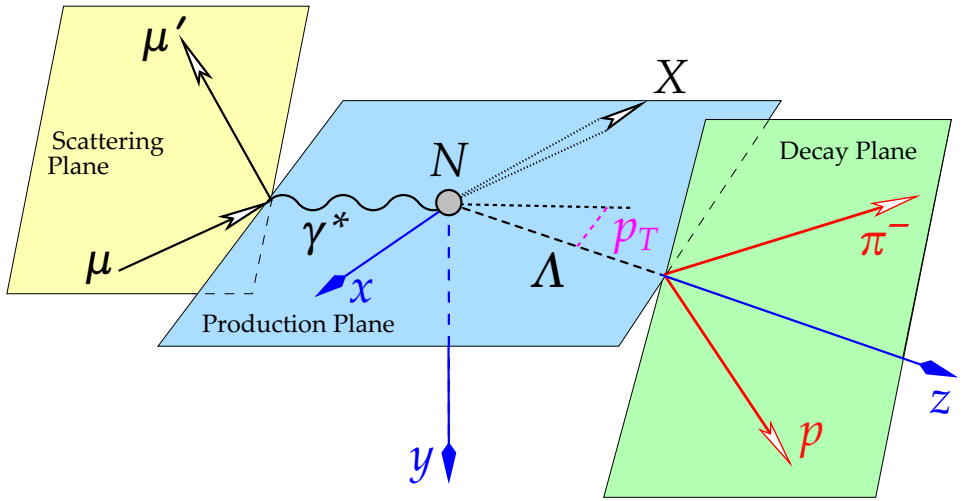
Overview

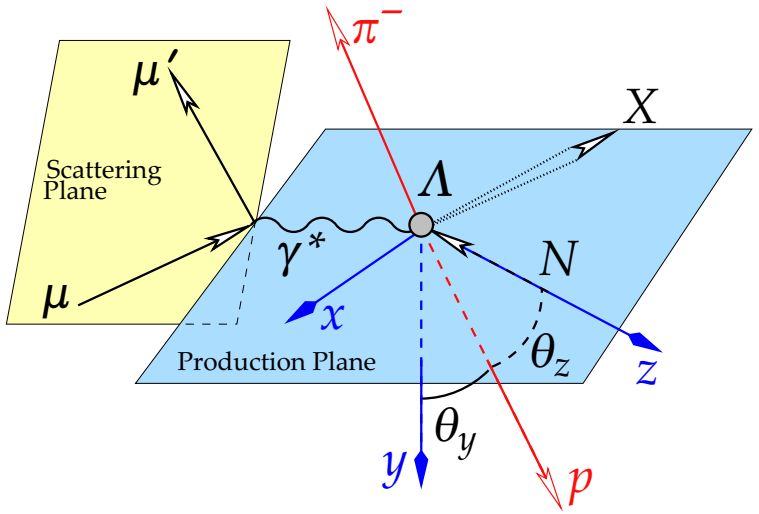
- The COMPASS Experiment
  $\rightarrow$ previous talks by A. Ferrero, V. Alexakhin
- Λ Polarization in μN-Scattering
  - Kinematics
  - Aim of Measurement
  - Polarisation Extraction Method
- Results of Analysis of the 2002 Data
- Conclusion and Outlook

Kinematics for $\mu N \to \mu' \Lambda + X$

Laboratory

$\vec{y} = \vec{\gamma^*} \times \vec{\Lambda}$



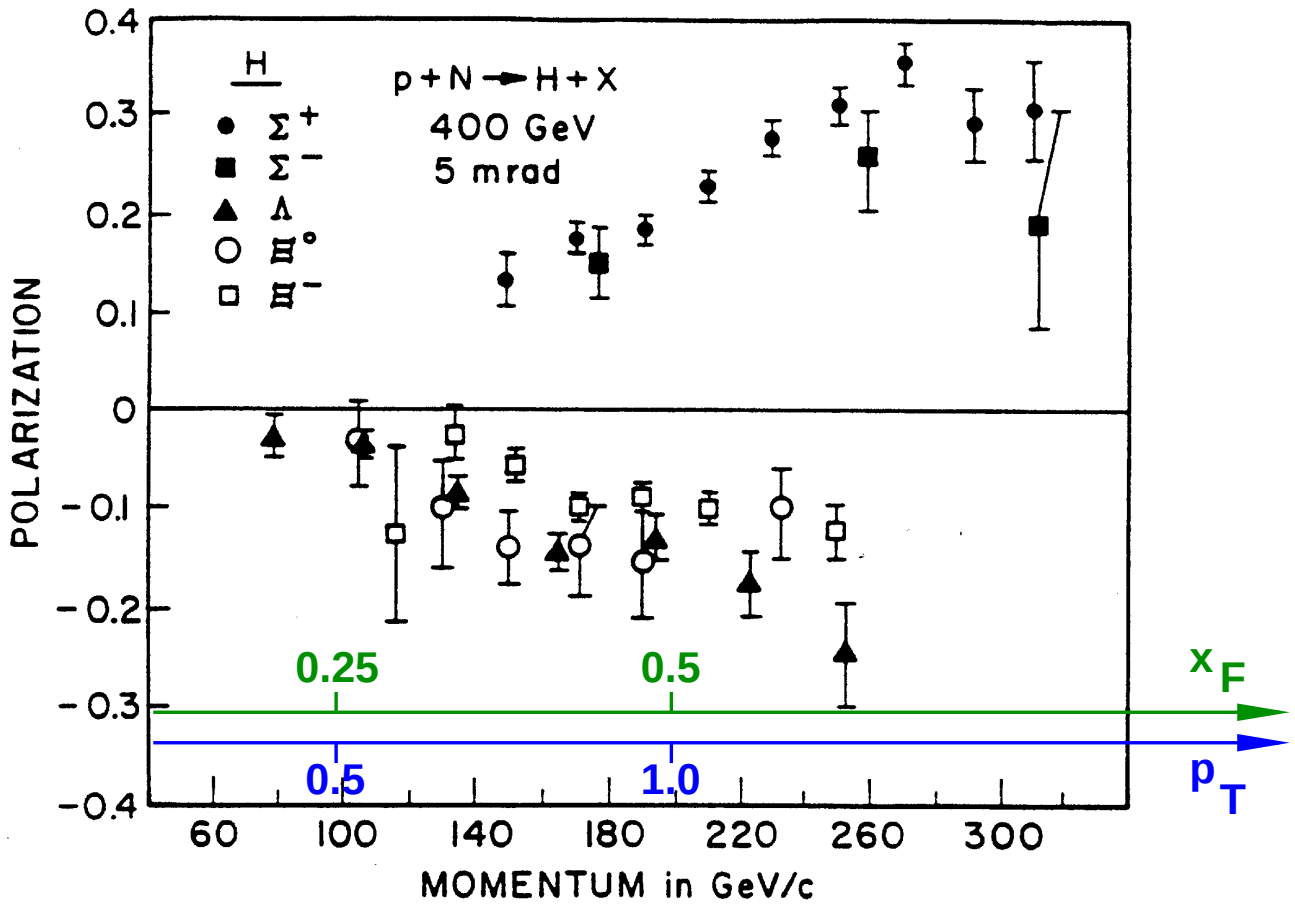


Λ rest system

Experiments on Λ Polarisation

- longitudinal: spin transfer, double spin asymmetry
  fragmentation/distribution functions q, Δq, D, ΔD
- transverse
  - polarised target: transversity h_1
  - Spontaneous polarisation in unpolarised collisions
    (known in Hadroproduction, seen also in Neutrino- and Electroproduction)
    polarising fragmentation functions

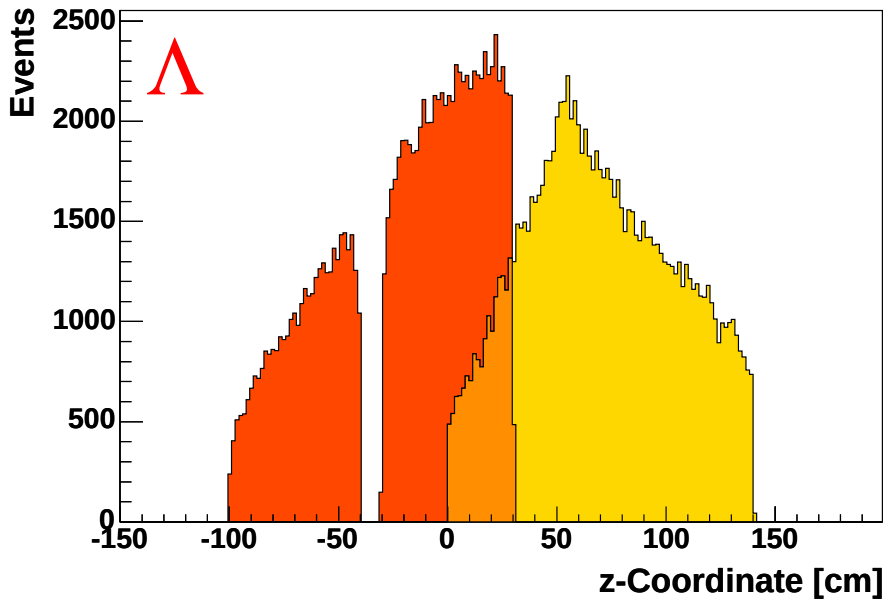
Polarisation in Hadroproduction



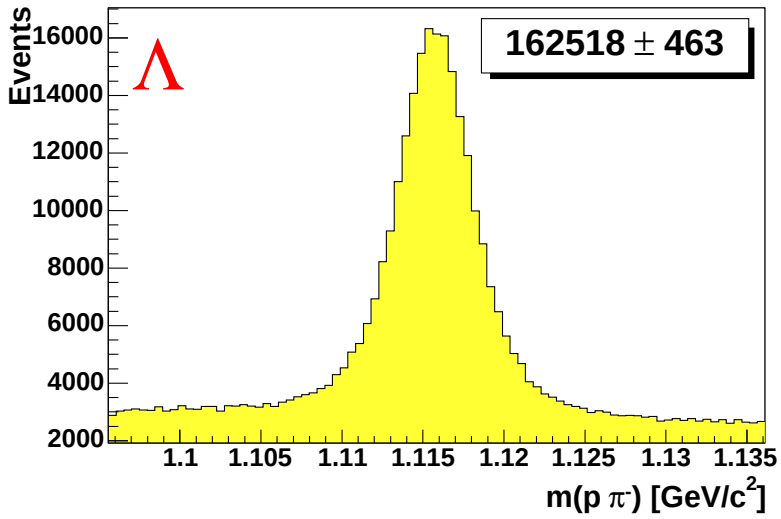
Data (mainly) from FermiLab since 1975

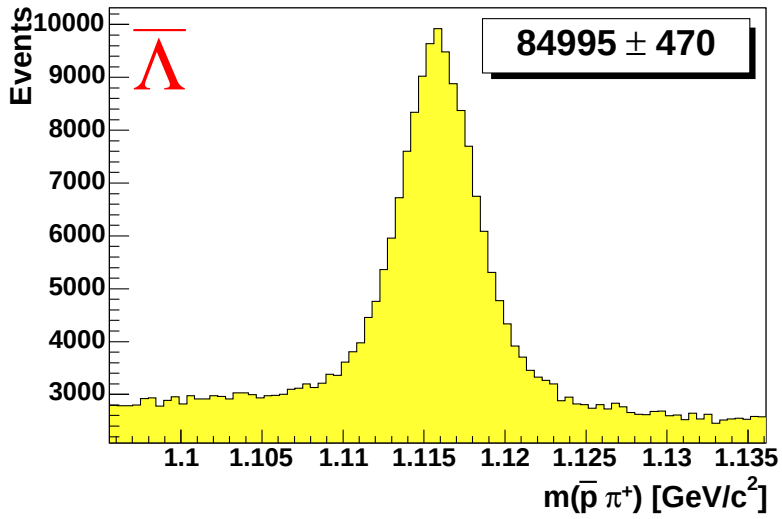
Event Selection

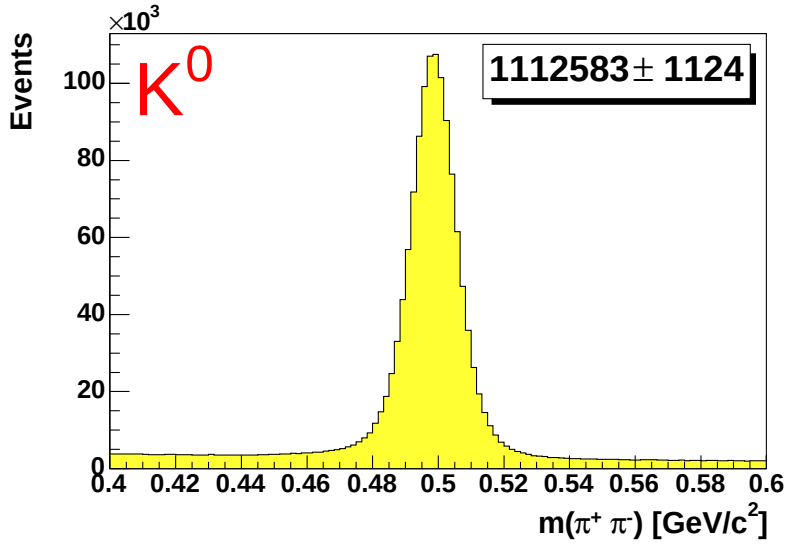
- All 2002 data, longitudinal target polarisation, no Q^2 cut
- Primary interaction point μ, μ'
- Decay vertex $\Lambda^0 \rightarrow p\pi^-$
- Λ flight path > 20 cm
- Collinearity (prompt production)
  $\angle(\vec{p}_{V^0}, \vec{\delta}_{PD})$ < 15 mrad
- $p_T > 100$ MeV/c (definition of $\vec{y}$)
- Rejection of e^+e^--pairs: $-0.70 < \cos\theta_z < 0.80$



$\Lambda, \bar{\Lambda}, K_s$ Samples







Extraction Method for Polarisation

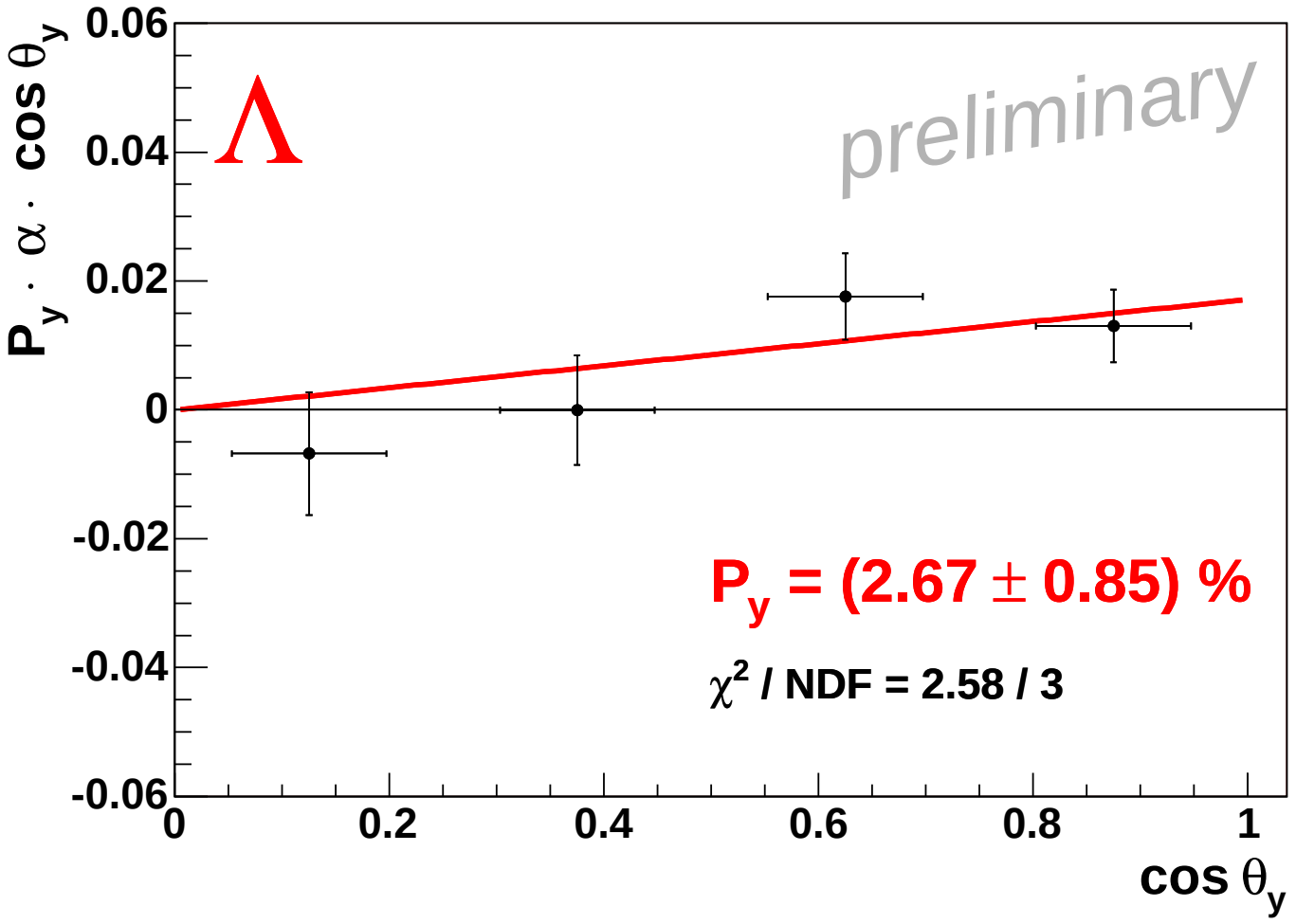
- detector effects may fake polarization
- 2 subsamples: Λ momentum Up- and Down-going:

$$(U,D)_{\pm} = \frac{\mathrm{d}N_{U,D}}{\mathrm{d}\cos\theta} = A_{U,D}(\cos\theta)(1 \pm \alpha\, P_y\, \cos\theta)$$

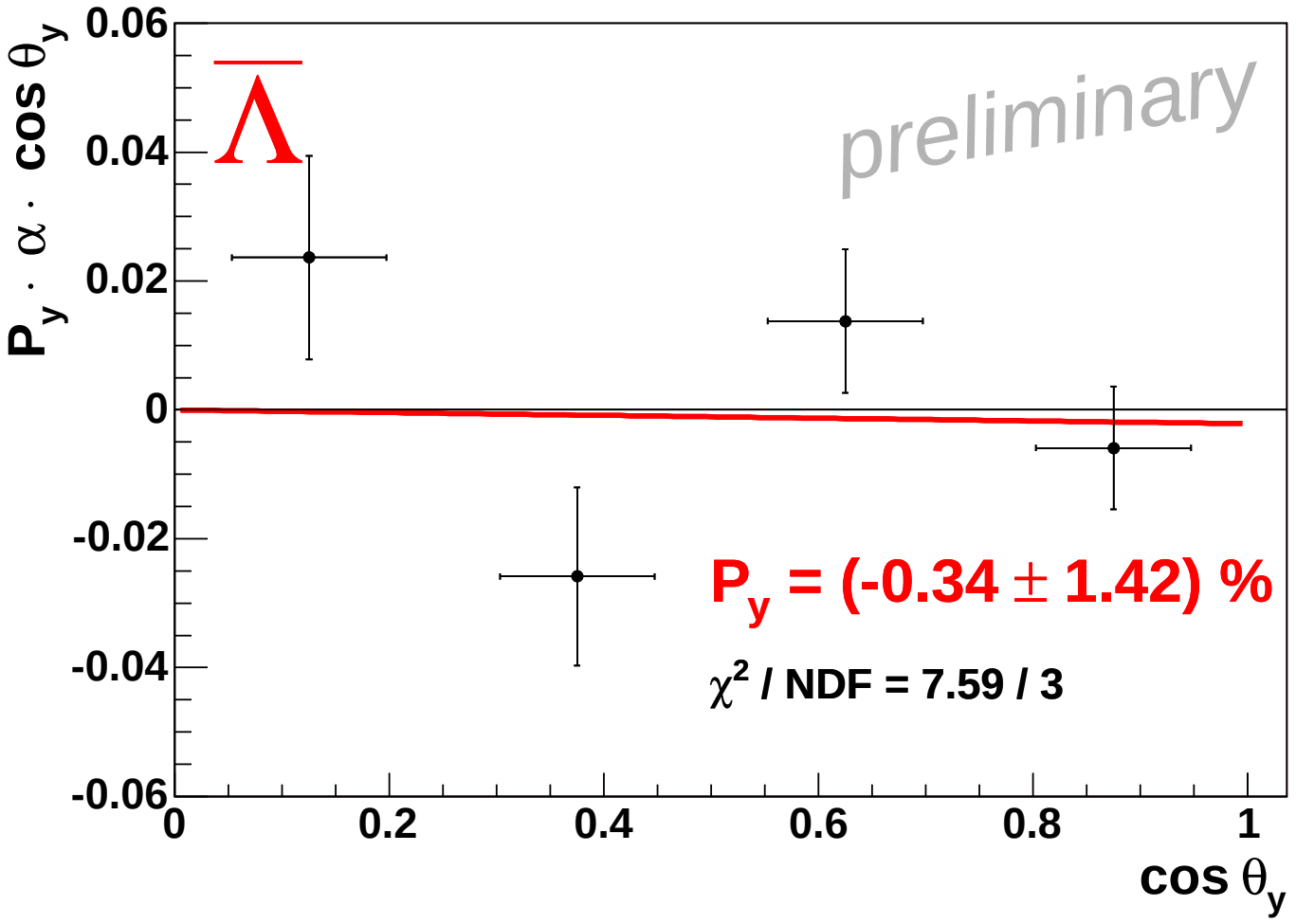
- where $A_U(+\cos\theta) = A_D(-\cos\theta)$ (midplane symmetry)

$$\begin{aligned} \rightarrow R &= \frac{\sqrt{U_+ D_+} - \sqrt{U_- D_-}}{\sqrt{U_+ D_+} + \sqrt{U_- D_-}} \\ &= \alpha\, P_y\, \cos\theta \quad \text{(acceptance-corrected)} \end{aligned}$$

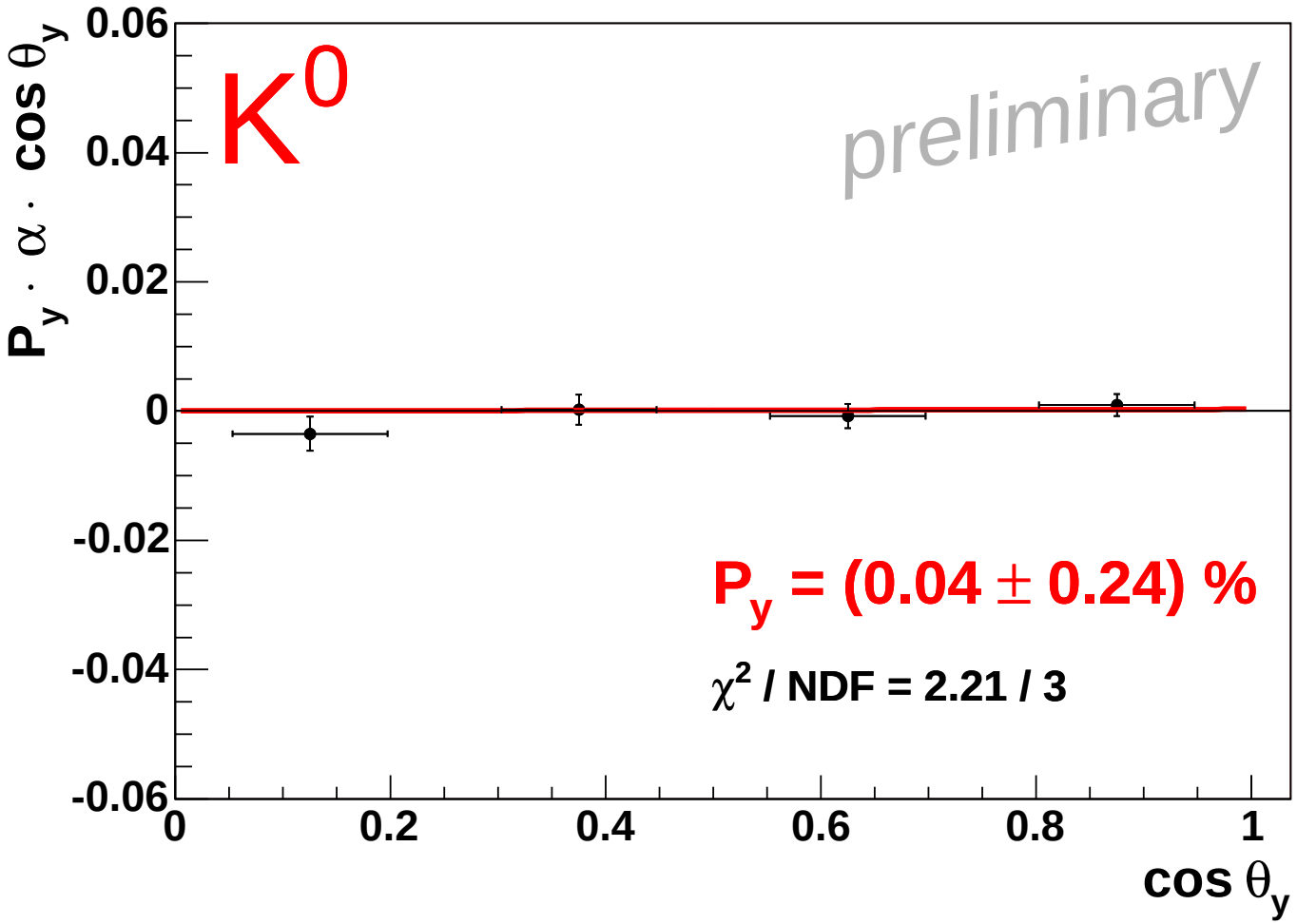
Result on Λ Polarisation



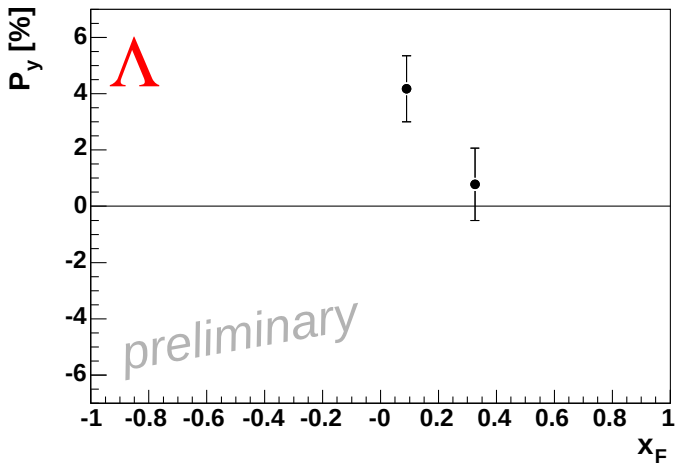
Result on $\bar{\Lambda}$ Polarisation

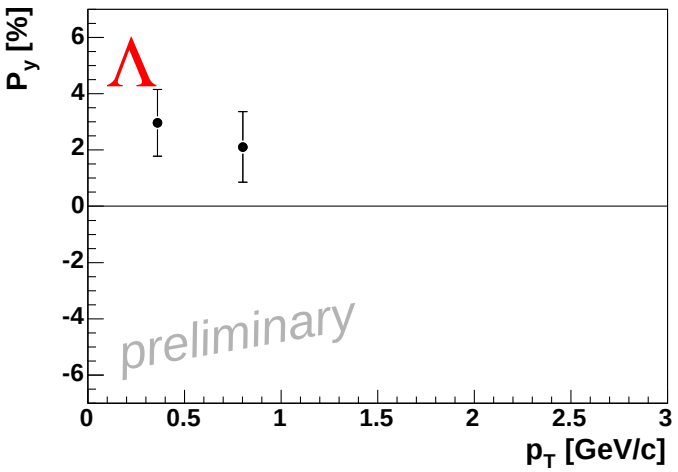


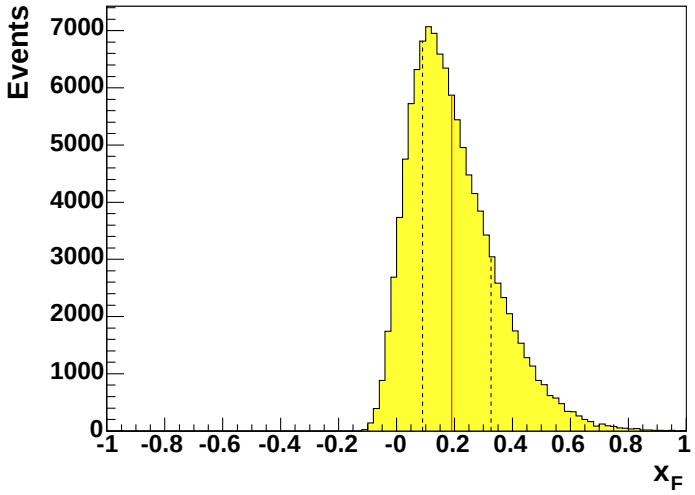
Cross check with K^0_s

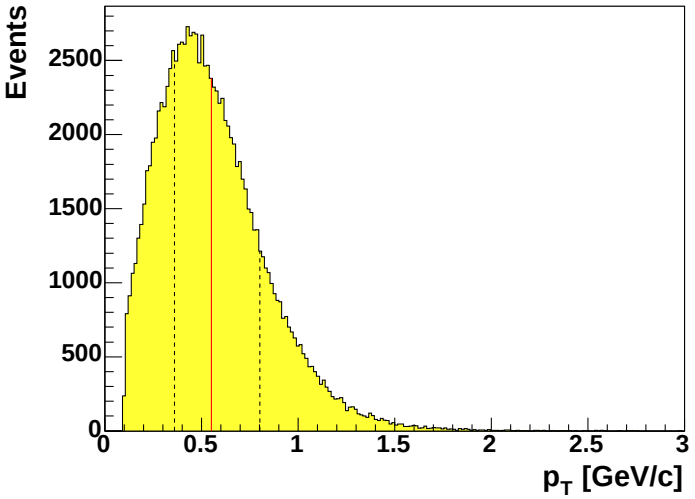


Dependence on x_F and p_T for Λ

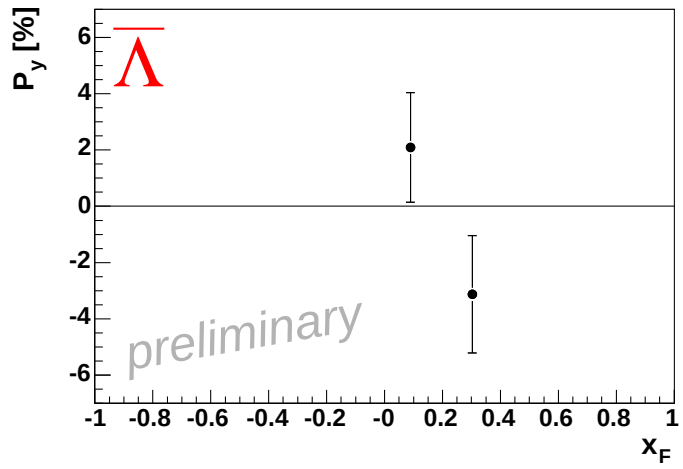


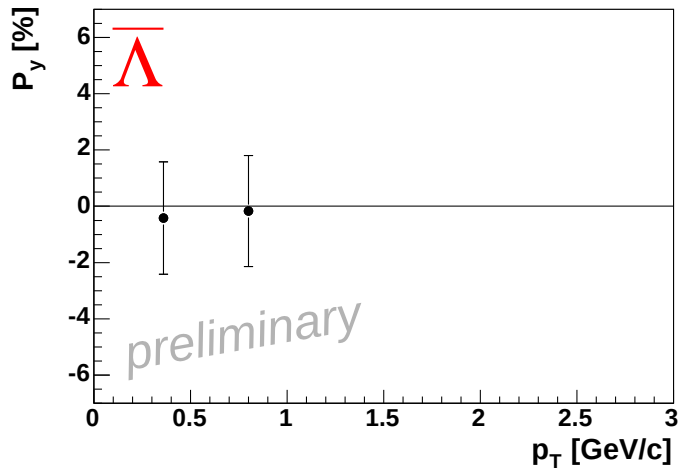


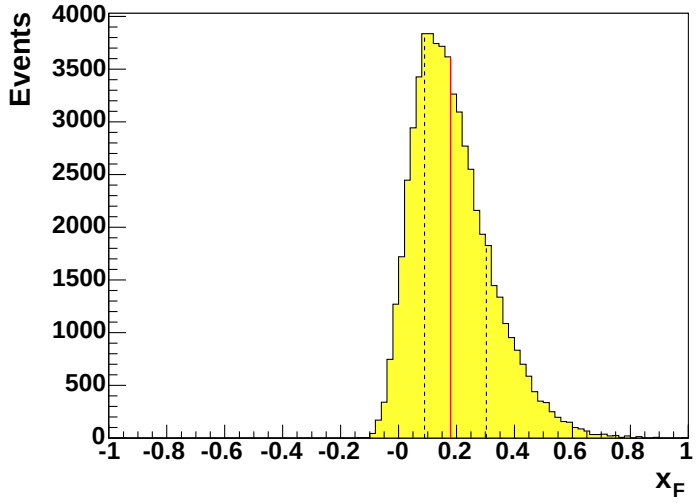


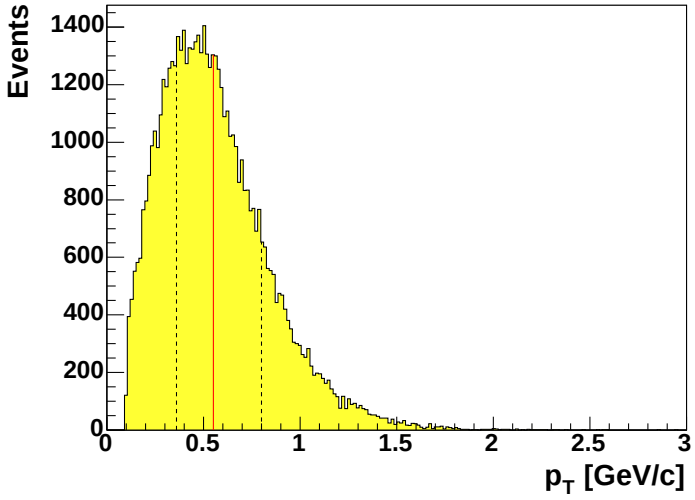


Dependence on x_F and p_T for $\bar{\Lambda}$

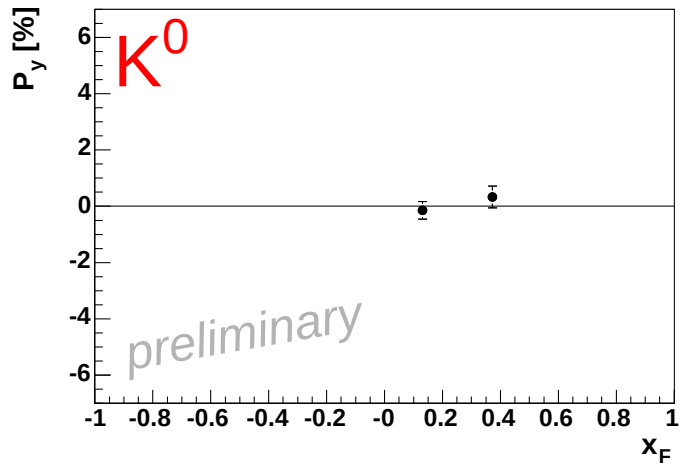


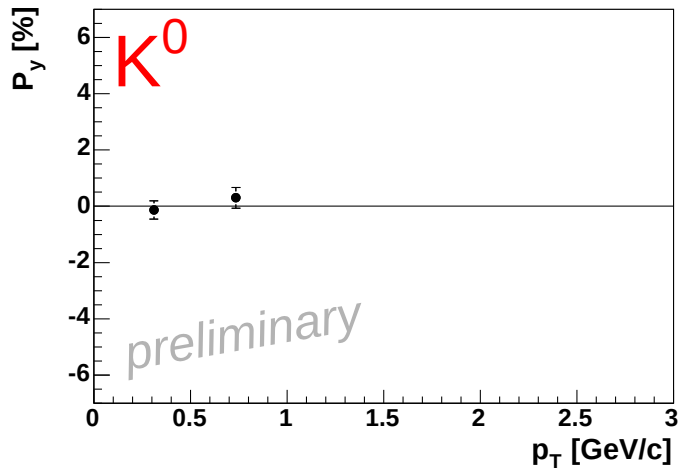


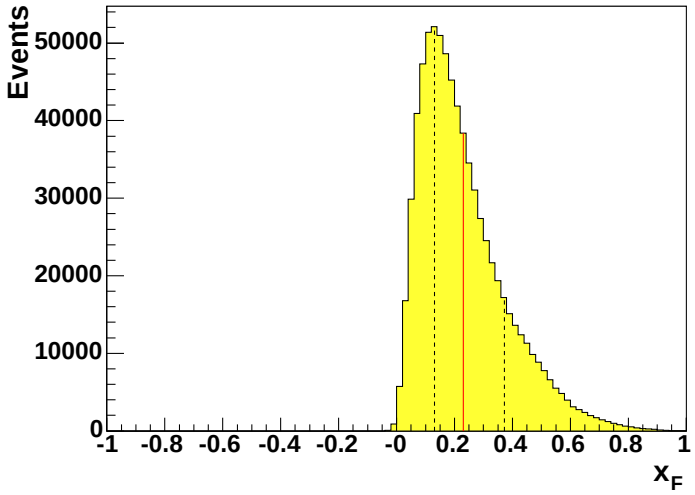


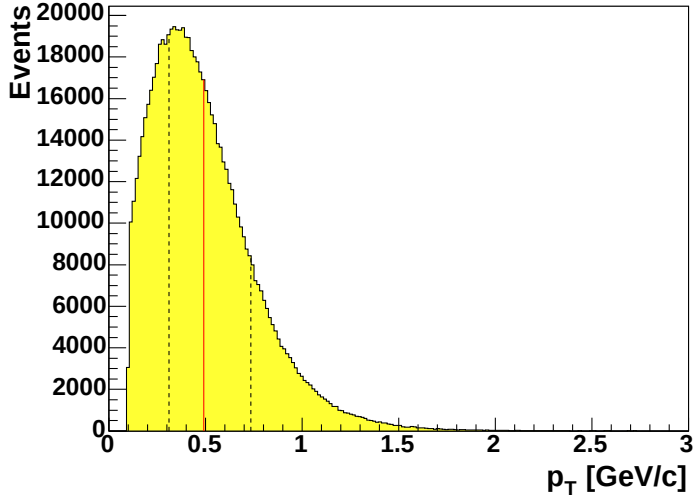


Cross check with K^0_s









Discussion

	COMPASS 2002	HERMES 1996-2000
P^{Λ}	0.027 $\pm 0.008_{\text{stat}} \pm 0.011_{\text{sys}}$	0.055 $\pm 0.006_{\text{stat}} \pm 0.016_{\text{sys}}$
$P^{\bar{\Lambda}}$	-0.003 $\pm 0.014_{\text{stat}} \pm 0.018_{\text{sys}}$	-0.043 $\pm 0.013_{\text{stat}} \pm 0.012_{\text{sys}}$

Dynamical model (from hadron phenomenology):

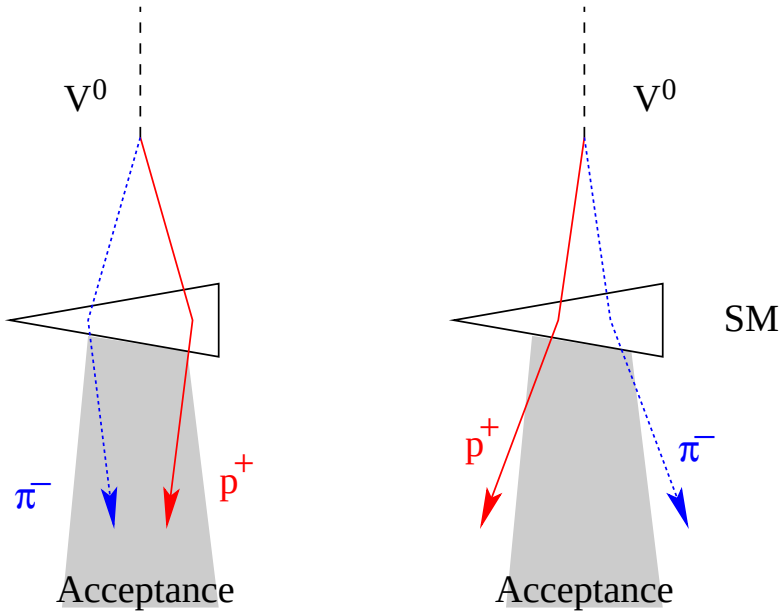
- $\vec{L} \cdot \vec{S}$-coupling during acceleration process $s \to \Lambda$ (Thomas-Precession) [DeGrand, Miettinen 1981]
- cascading completely ignored

Conclusion and Outlook

- From COMPASS 2002 data: First analysis of spontaneous transverse Λ^0 polarisation in μN-scattering (quasi-real photoproduction)
- Positive Polarisation $2.67 \pm 0.8 \pm 1.1\%$ for Λ (same sign seen by HERMES), $\bar{\Lambda}$ polarisation consistent with 0
- Promising perspective for 2003/2004 data (statistics increase factor ~ 8, trigger enhanced for high Q^2), more refinement in kinematical range will be possible
- Ξ polarisation analysis planned

Acceptance Correction

Effect of magnetic dipole field (top view):



- bending in magnet
  $\rightarrow$ left-right asymmetry
- midplane (Up-Down) symmetry
- Division into 2 subsamples
  $\rightarrow A_U(+\cos\theta) = A_D(-\cos\theta)$