



Λ und $\bar{\Lambda}$ longitudinal polarization in the COMPASS Experiment

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- Introduction
- Physical motivation
- The COMPASS spectrometer
- Reconstruction of Λ , $\bar{\Lambda}$, K^0
- Results of Λ , $\bar{\Lambda}$ polarization and spin transfer
- Summary and outlook

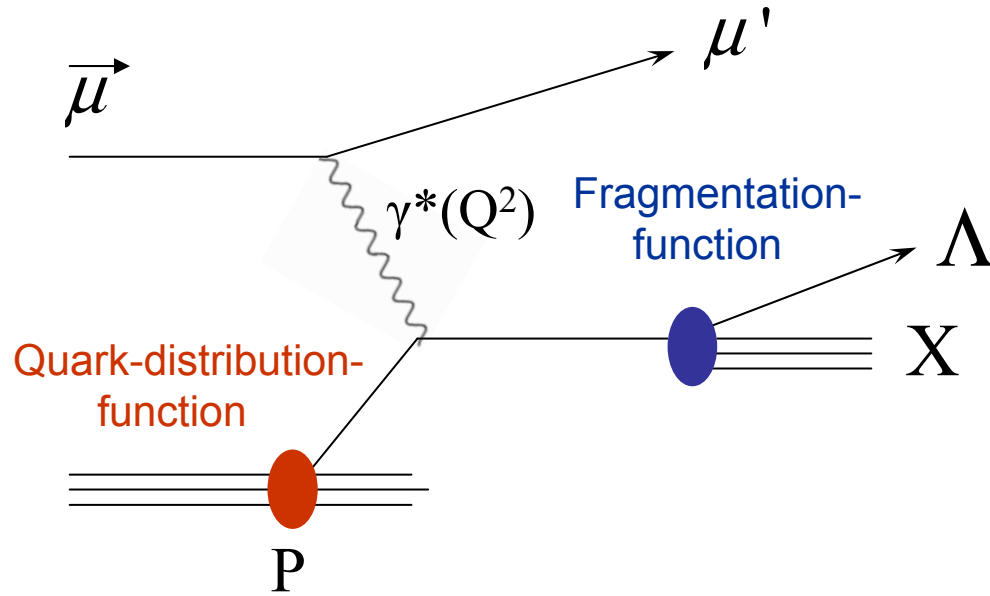


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bmb+f - Förderschwerpunkt
COMPASS
Großgeräte der physikalischen
Grundlagenforschung

Introduction



Inclusive variables

$$Q^2 = -q^2 \quad x_{Bj} = \frac{Q^2}{2M\nu}$$

$$y = \frac{E - E'}{E} \quad W^2 = M^2 + 2yEM - Q^2$$

Semi-inclusive variables

$$x_F = \frac{2P_{\parallel}^*}{W} \quad z = \frac{E_h}{\nu}$$

Longitudinal Λ polarization :

$$P_{\Lambda} = P_B D(y) \frac{\sum_q e_q^2 q(x) \Delta D_q^{\Lambda}(z)}{\sum_q e_q^2 q(x) D_q^{\Lambda}(z)}$$

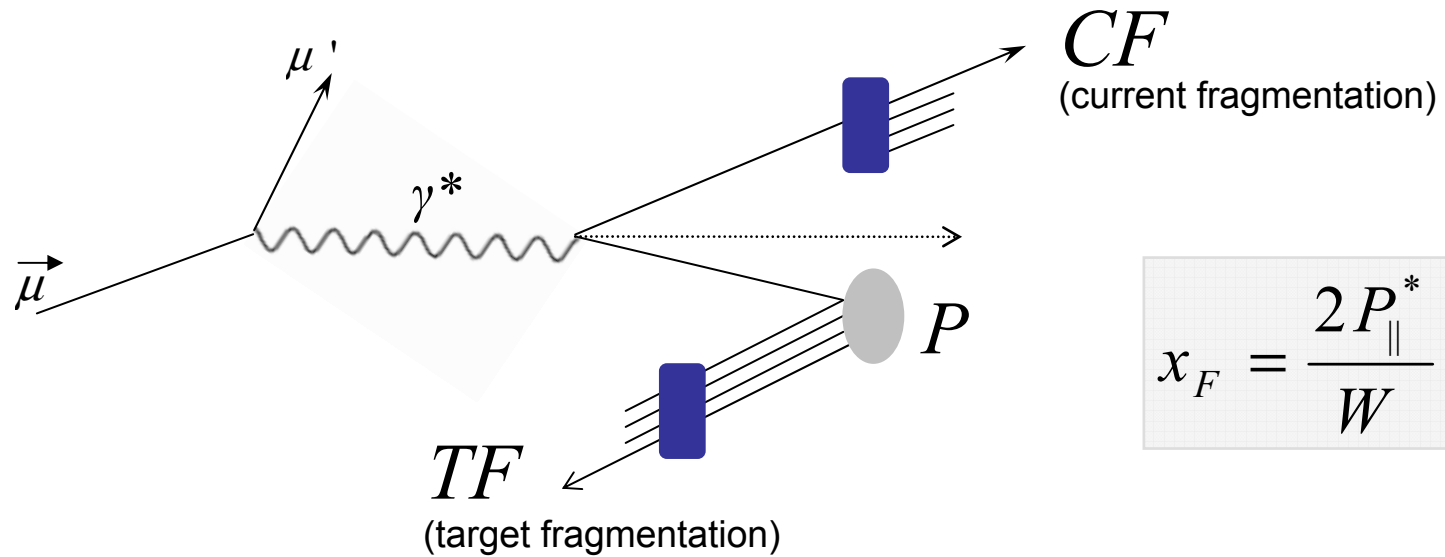
$q(x)$ = unpolarized quark distribution function
 $\Delta D_q(z)$ = polarized fragmentation function
 $D_q(z)$ = unpolarized fragmentation function

Spin transfer :

$$C_{LL}^{\Lambda} = \frac{P_{\Lambda}}{P_B D(y)}$$

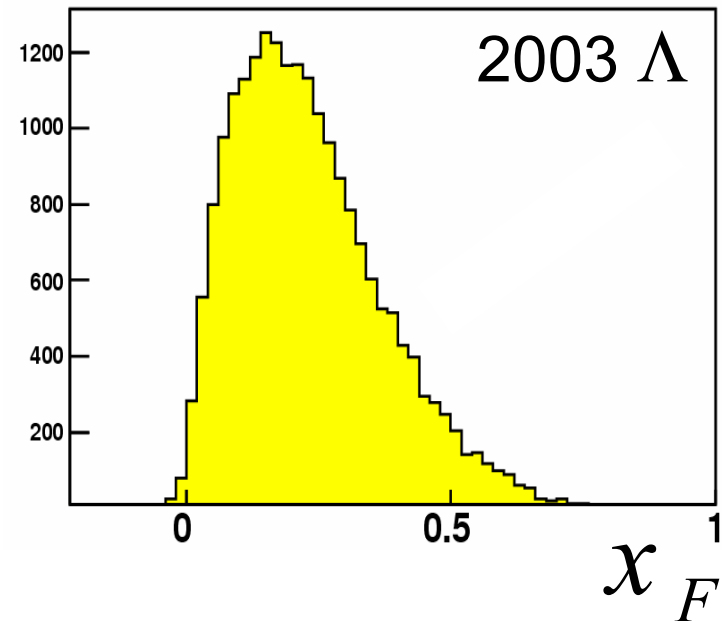
P_B = Beam polarization
 $D(y) = \frac{1 - (1 - y)^2}{1 + (1 - y)^2}$
 Depolarization factor

Motivation



$x_F > 0$ (current fragmentation)

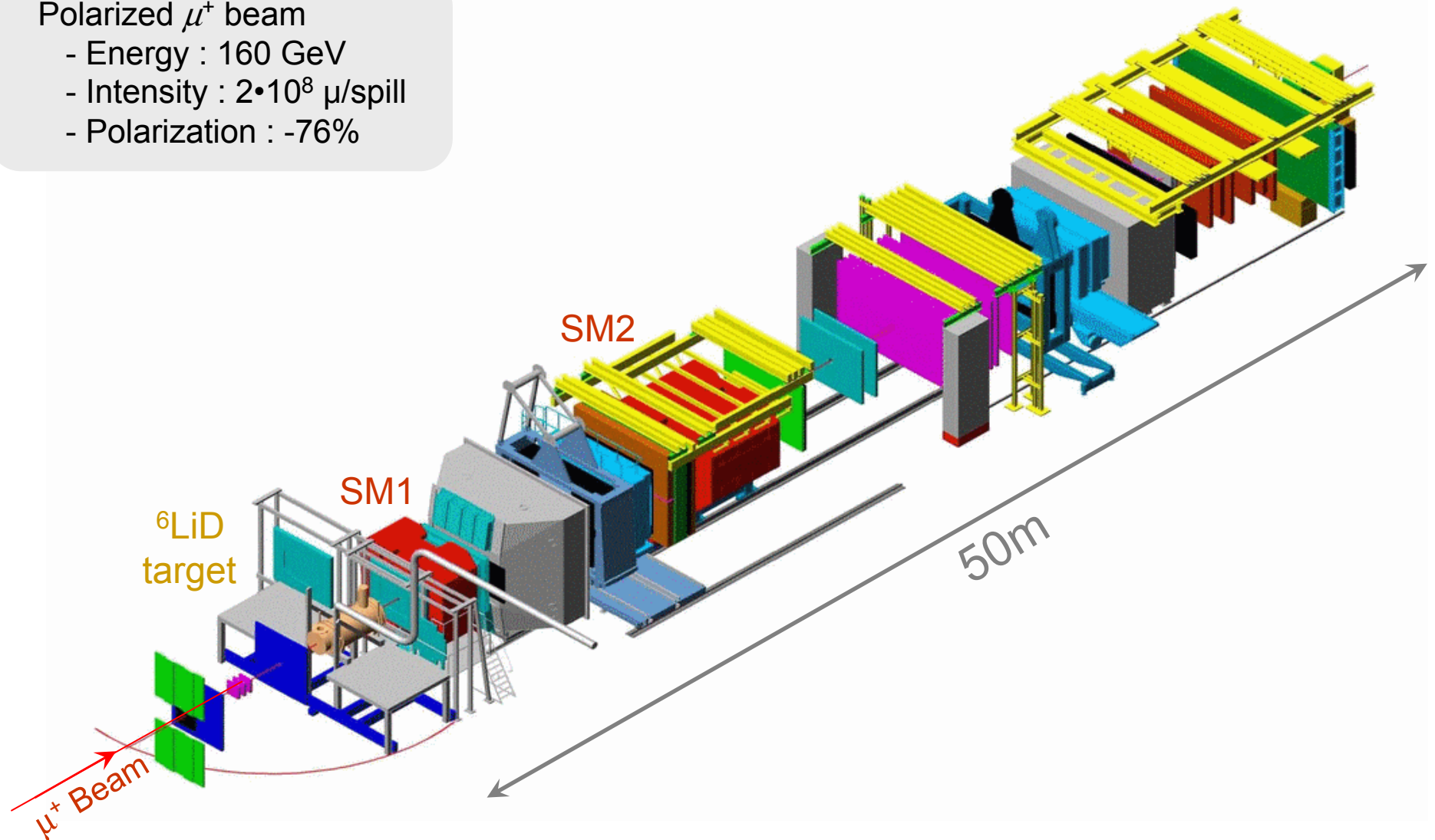
- Study of the quark to baryon fragmentation processes $q \rightarrow \Lambda$ (spin transfer mechanism)
- Test of the polarized fragmentation function
- What is the spin structure of Λ hyperon?



The COMPASS spectrometer

Polarized μ^+ beam

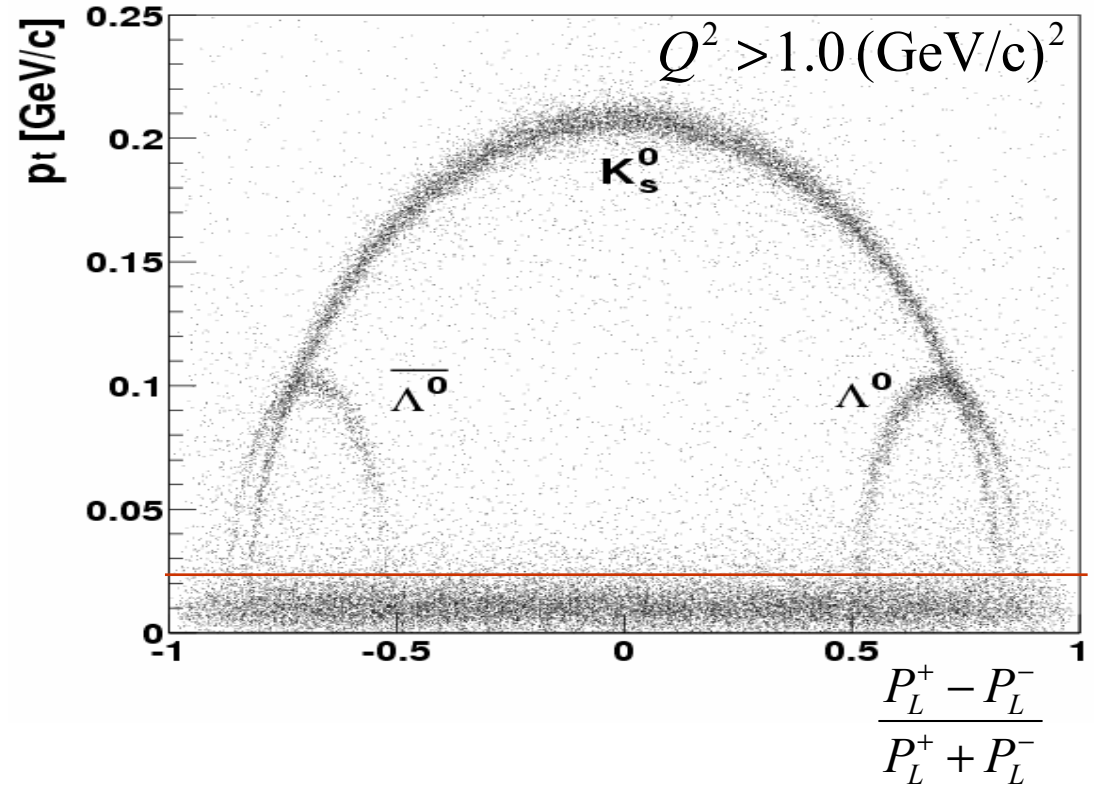
- Energy : 160 GeV
- Intensity : $2 \cdot 10^8$ μ /spill
- Polarization : -76%



Identification of $\Lambda \rightarrow p\pi^-$, $\bar{\Lambda} \rightarrow \bar{p}\pi^+$, $K^0 \rightarrow \pi^+\pi^-$

Selection cuts

- The position of V^0 vertex must be downstream of primary vertex
- $P_T > 23$ MeV/c to exclude e^+e^- pair-production
- $P > 1$ GeV/c for the reconstructed tracks of protons and pions in decay process
- $P_V^0 > 10$ GeV/c (just for 2003 data)
- $Q^2 > 1$ (GeV/c)², $0.2 < y < 0.8$ (2002)
 $0.2 < y < 0.9$ (2003)



statistics

	Λ	$\bar{\Lambda}$
COMPASS 2002	~ 8000	~ 5000
COMPASS 2003	~ 35000	~ 20800

Determination of polarization

- $\Lambda, \bar{\Lambda}$ - weak decay process

$$\frac{1}{N_{tot}} \frac{dN}{d \cos \theta_x} = (1 \pm \alpha P_\Lambda \cos \theta_x) A(\cos \theta_x)$$

$\alpha = \pm 0.642 \pm 0.013$ asymmetry parameter

θ_x = Angle between positive particle and γ^* direction

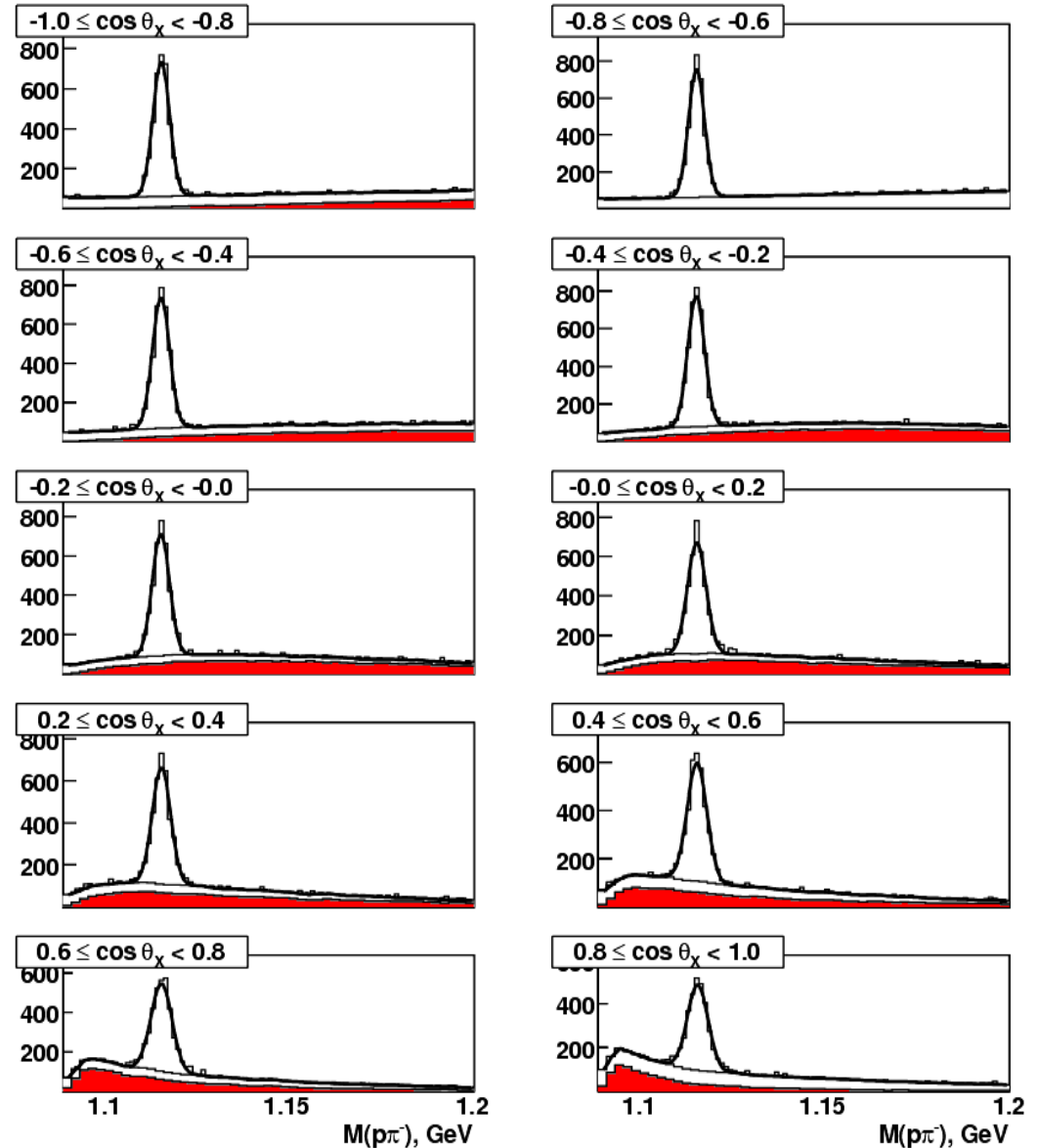
A = Detector acceptance function

- Fitting the reconstructed invariant mass provides ΔN_Λ for each $\cos \theta$

- Data are fitted with Kaon Background from MC simulation

$$\text{Gauss} + c_0 K_{BG} + c_1 + c_2 M(p\pi^-)$$

COMPASS 2003 preliminary



Corrected angular distributions

- Acceptance correction from unpolarized MC simulation(LEPTO)

$$A(\cos \theta_x) = \frac{N_{accepted}}{N_{generated}}$$

- Angular distribution after the correction for acceptance

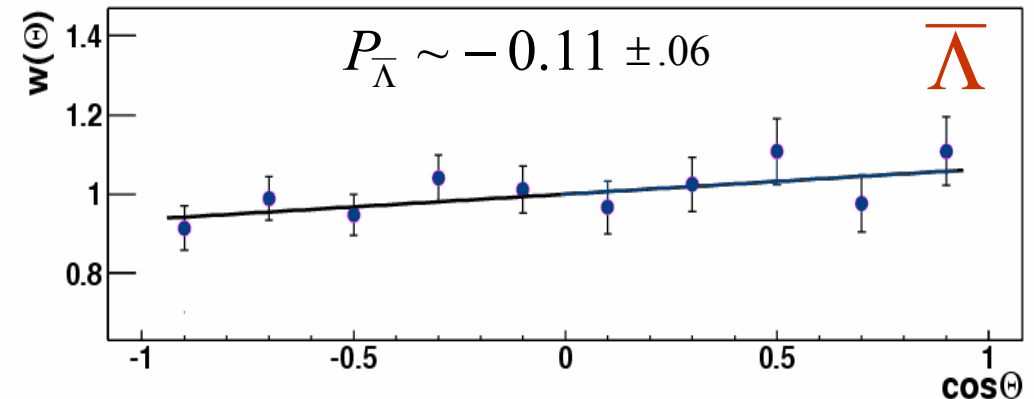
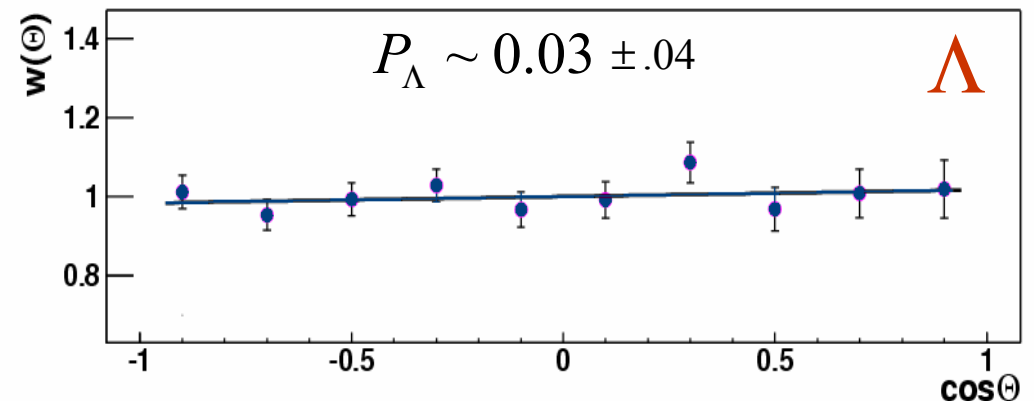
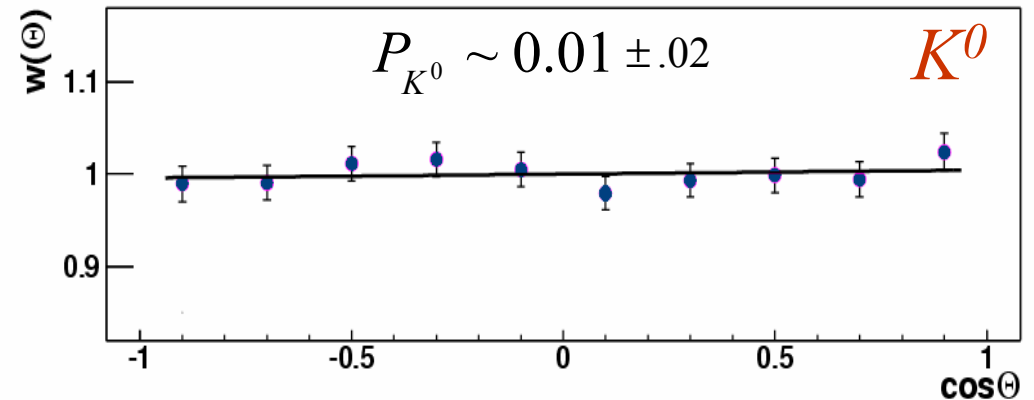
$$w(\theta_x) = 1 \pm \alpha P_\Lambda \cos \theta_x$$

$$\alpha_{K^0} = 0$$

$$\alpha_\Lambda = +0.642$$

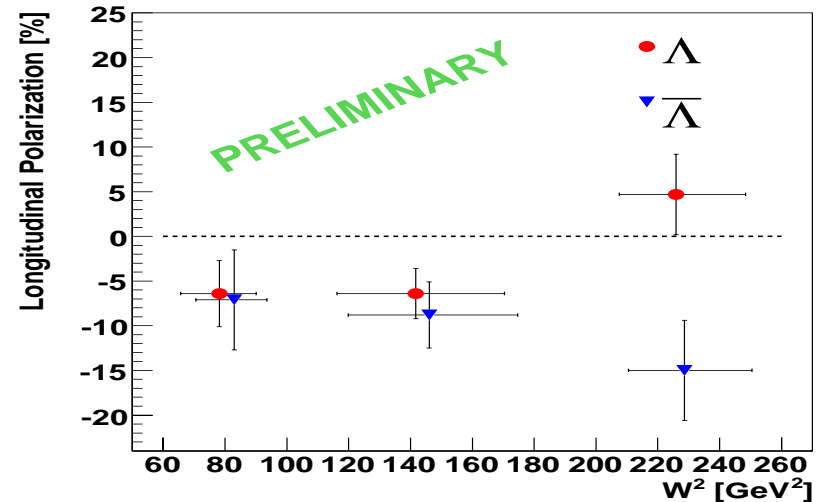
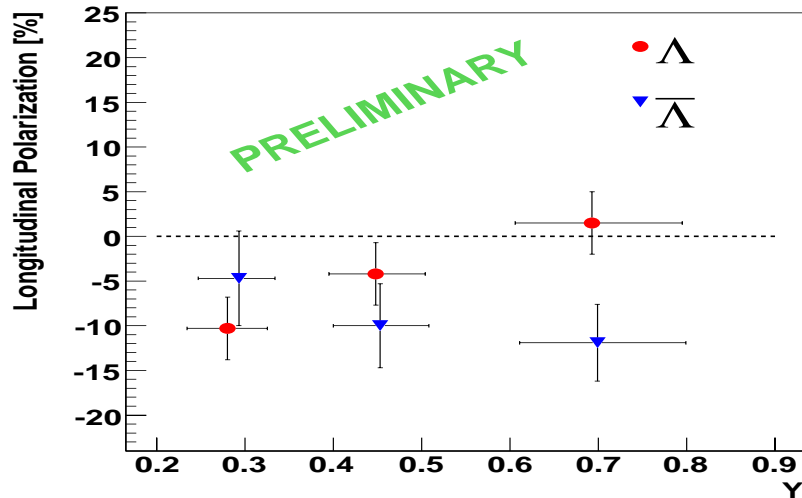
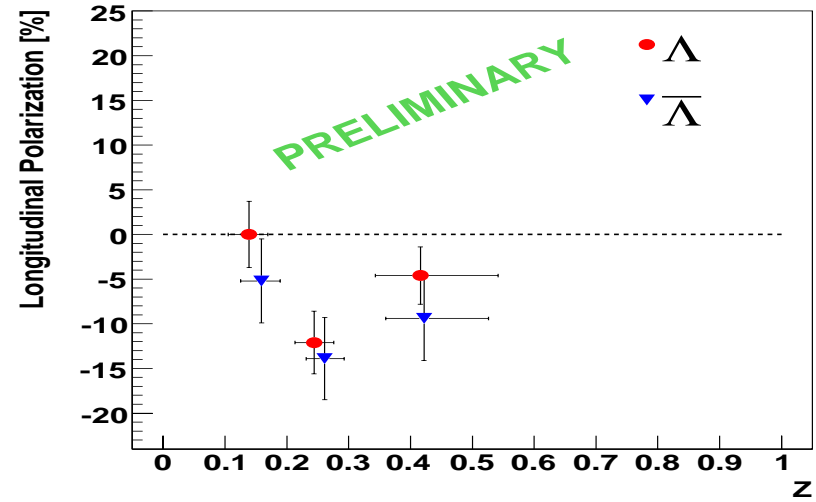
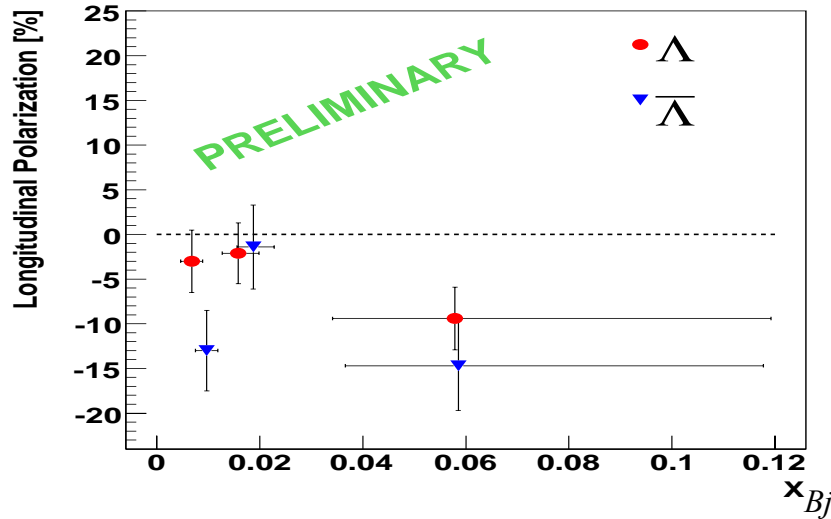
$$\alpha_{\bar{\Lambda}} = -0.642$$

2002 data



Results of 2003

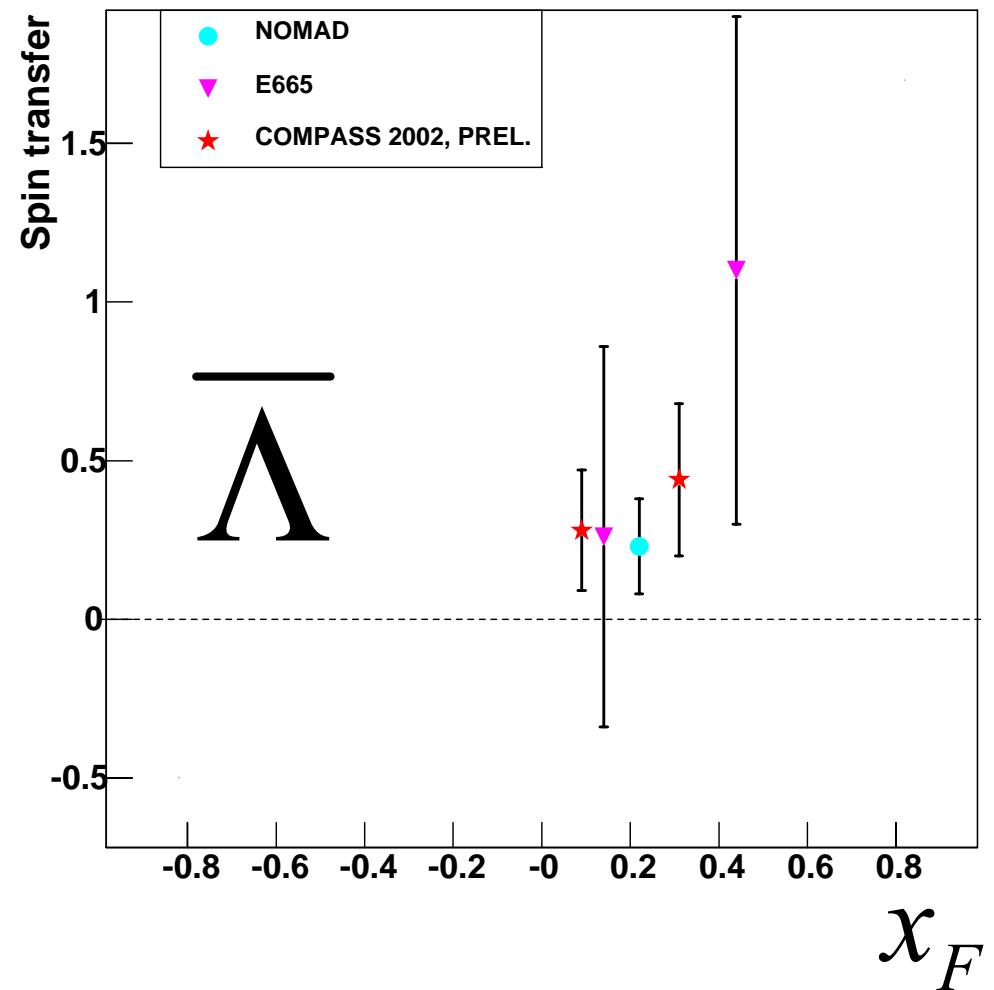
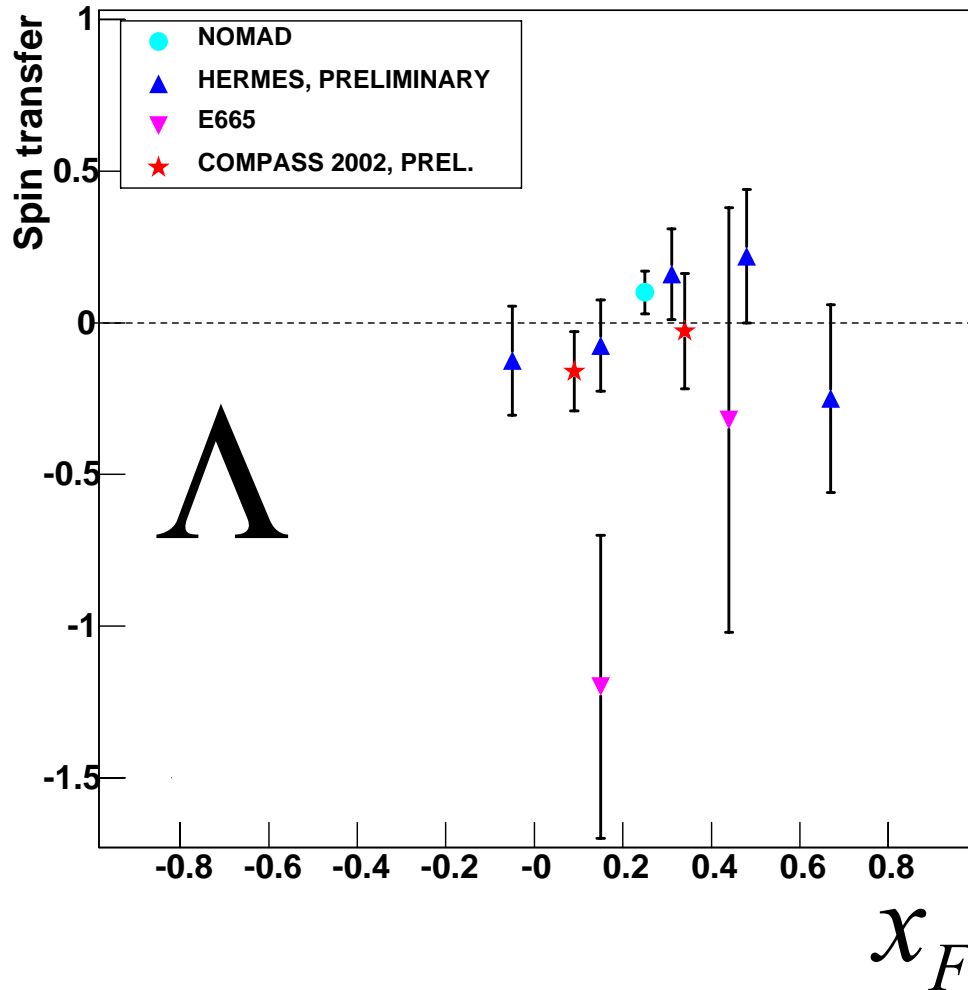
Polarization :
$$P_{\Lambda} = P_B D(y) \frac{\sum_q e_q^2 q(x) \Delta D_q^{\Lambda}(z)}{\sum_q e_q^2 q(x) D_q^{\Lambda}(z)}$$



Systematic errors < 5%

Results of 2002

Spin transfer :
$$C_{LL}^{\Lambda} = \frac{P_{\Lambda}}{P_B \cdot D(y)}$$



Summary & outlook

- Determination of the Λ and $\bar{\Lambda}$ polarization and spin transfer have been shown in DIS region at COMPASS
 - similar longitudinal polarization and spin transfer of Λ , $\bar{\Lambda}$
 - slightly dependence on y and W^2
- Collected data sample in 2004 will significantly increase the statistics by factor 2

	Λ	$\bar{\Lambda}$
COMPASS (2002)	~ 8000	~ 5000
COMPASS (2003)	~ 35000	~ 20800
COMPASS (2004)	~ 86000	~ 52000

- Analysis of 2002-2004 nearly finalized
- Continue data taking in 2006

