SIDIS Λ production with e1f data

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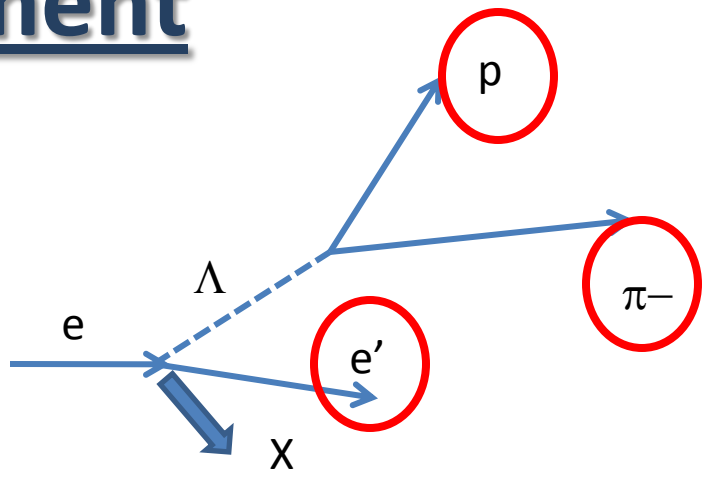
INFN – Laboratori Nazionali di Frascati

Roma – 11 giugno 2010

The measurement

Semi-inclusive Λ production

e p → e' Λ X

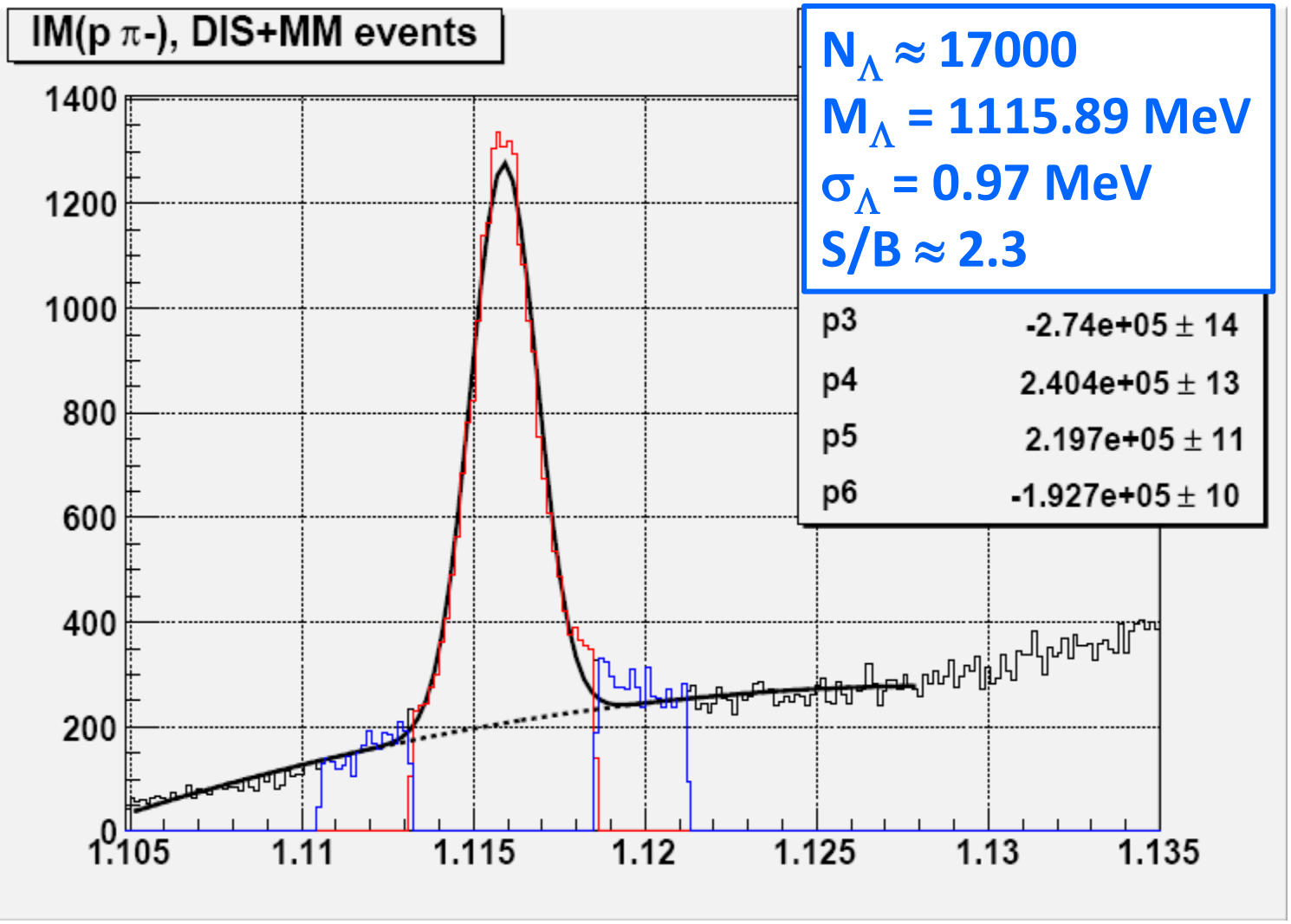


Analysis procedure

1. **Electron ID (DC+CC+EC)**
2. **Proton and pion ID (DC+TOF)**
3. **Λ in the IM(p π-)**
4. **Λ (longitudinal) polarization from Beam Spin Asymmetry**

DIS cuts:	**$Q^2 > 1$ GeV^2**
	$W^2 > 4$ GeV^2
	$y < 0.85$

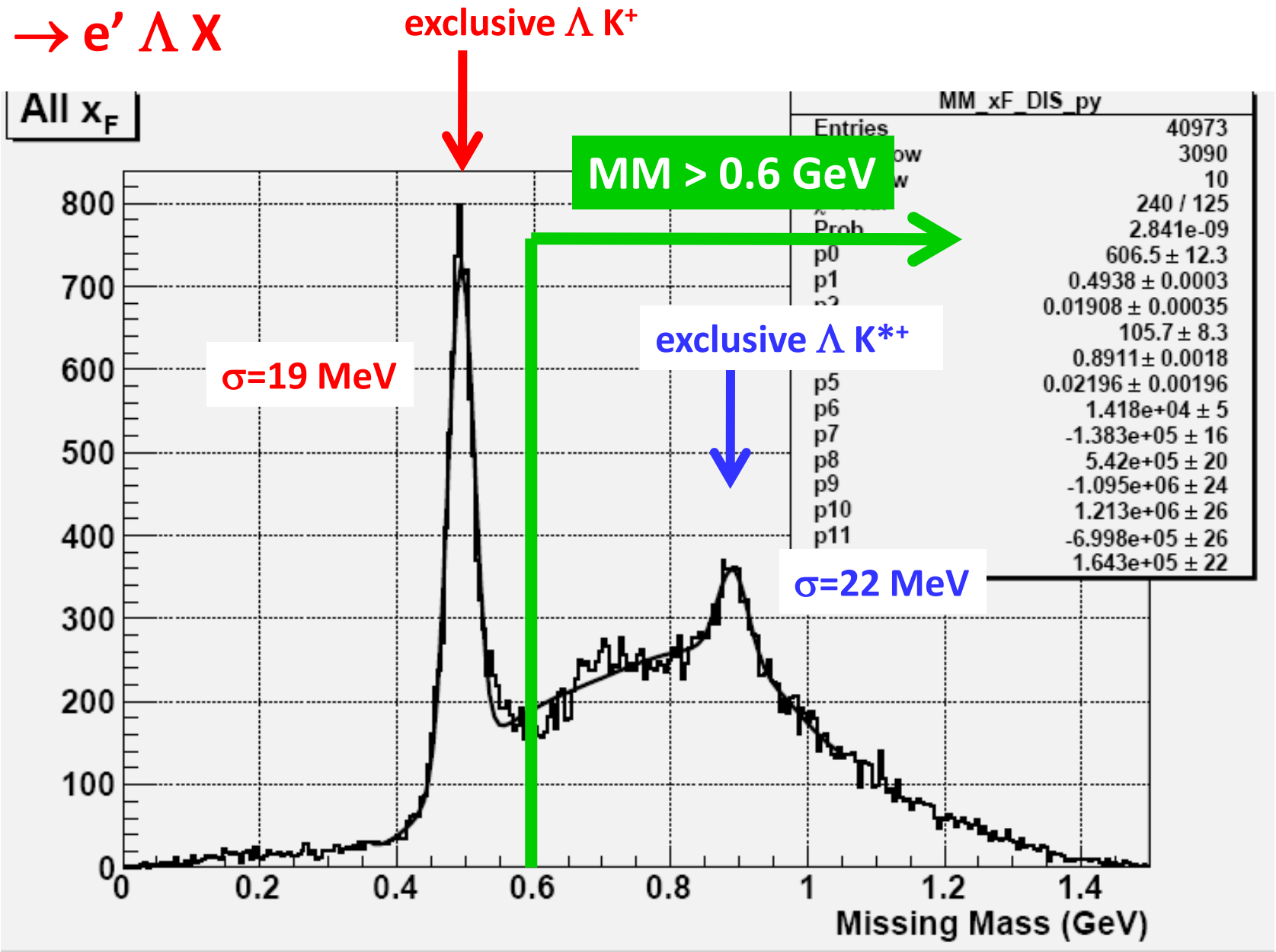
Λ detection



Gauss + P3 fit used as a template for next bin-by-bin yield extraction

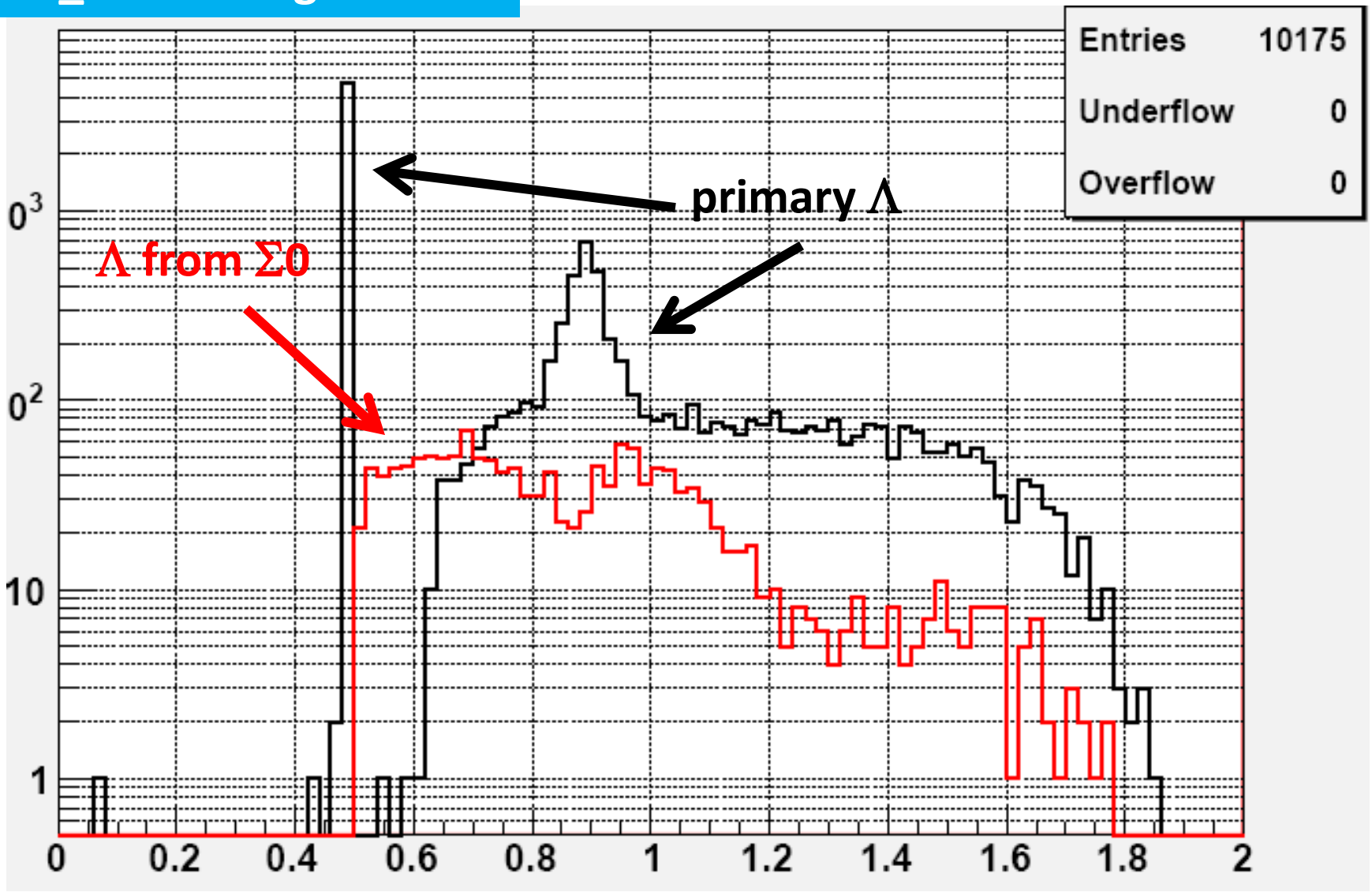
Missing Mass

$e\,p \rightarrow e'\,\Lambda\,X$

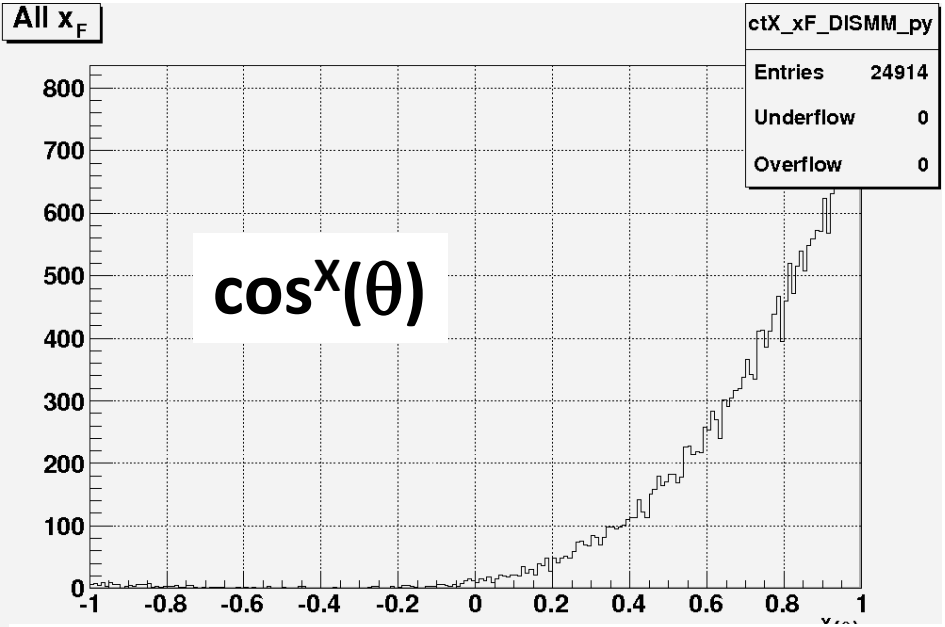


Missing Mass – Monte Carlo

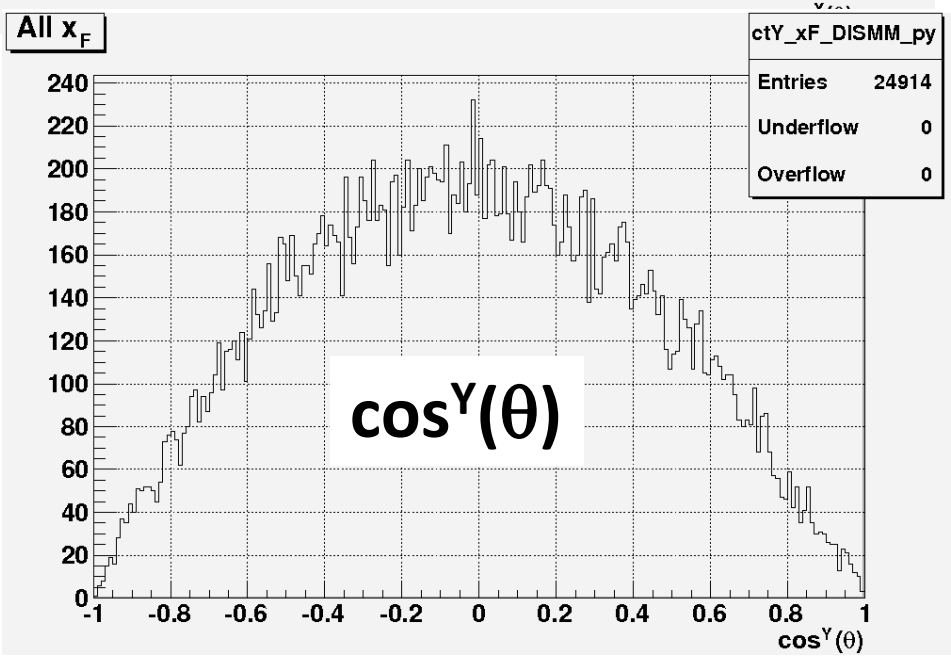
CLAS_DIS event generator

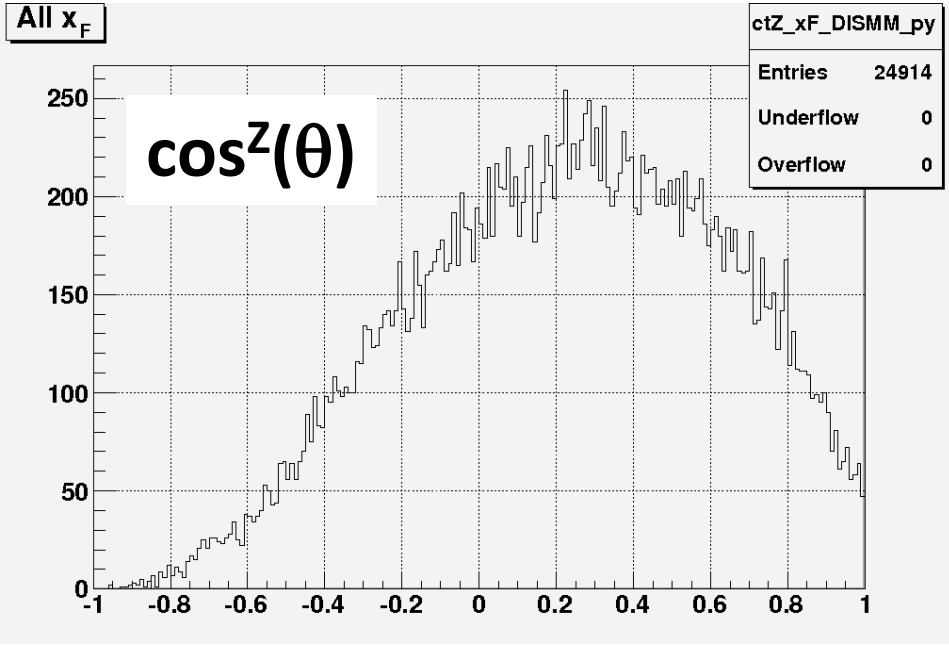


cos(θ) distributions



z along the γ*
y normal
x sideways

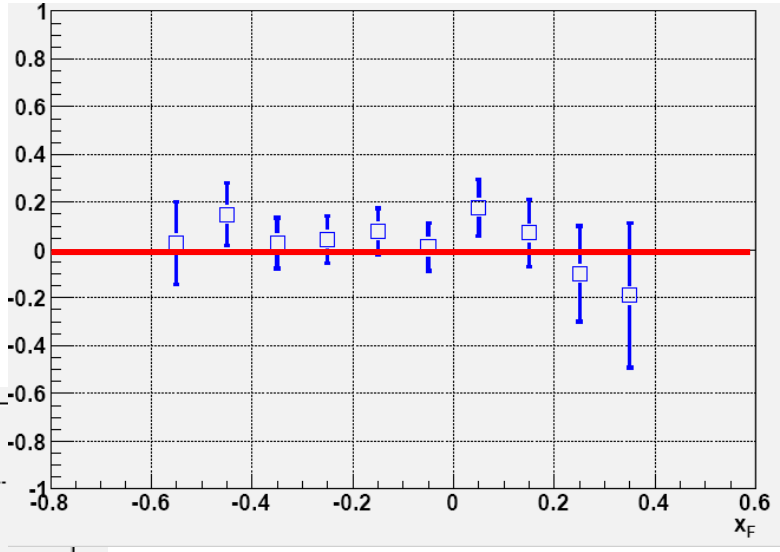




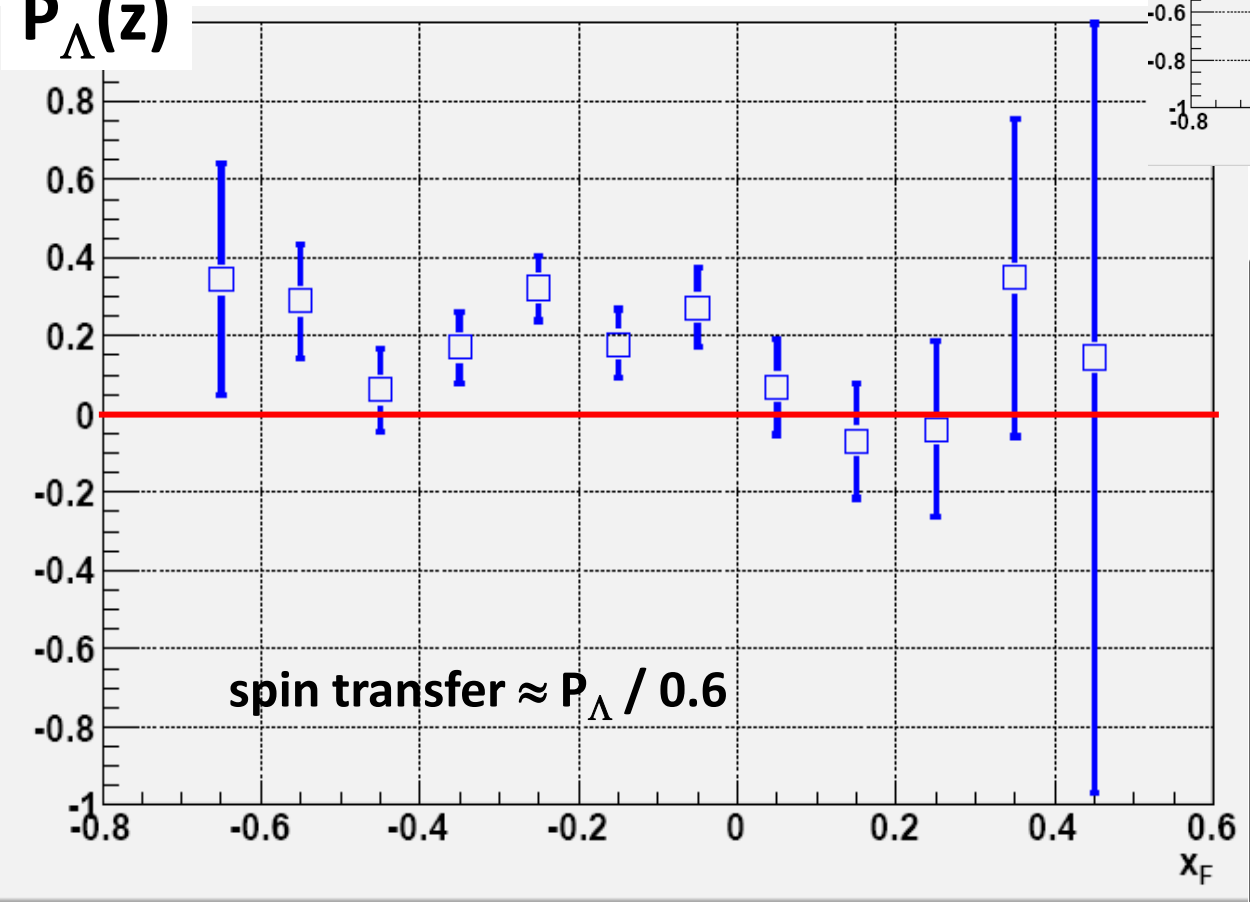
Longitudinal polarization vs x_F

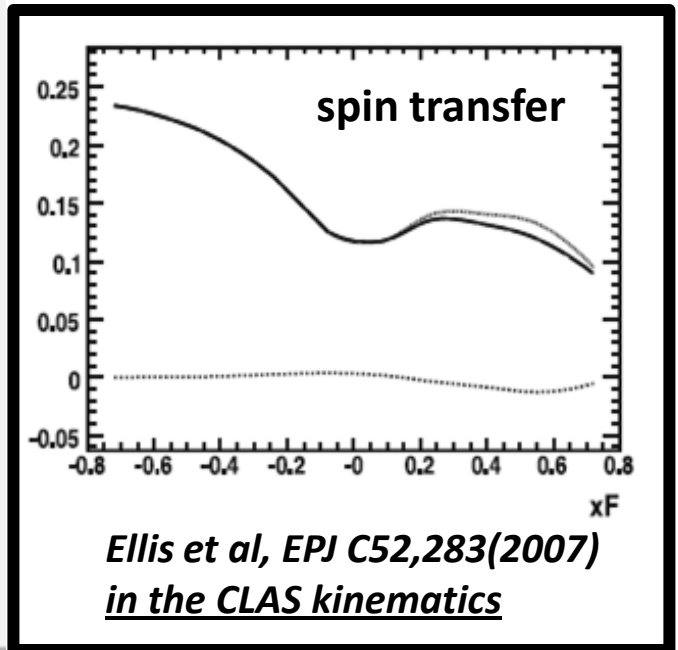
$$P_\Lambda = D(y) P_B D_{LL}^\Lambda$$

$P_B\, D(y) \approx 0.6$



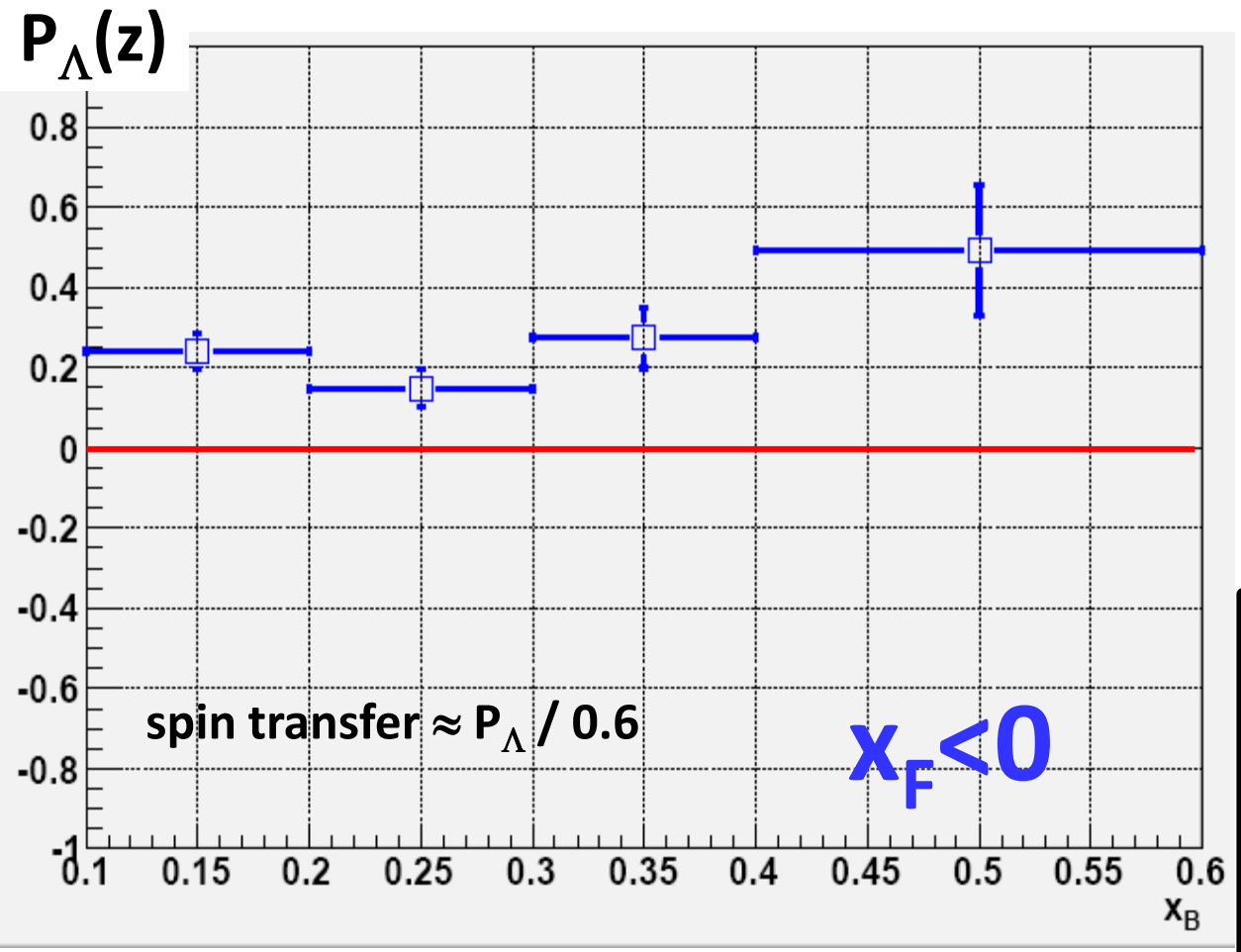
$P_\Lambda(z)$





Ellis et al, EPJ C52,283(2007)
in the CLAS kinematics

Longitudinal polarization vs x_B



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

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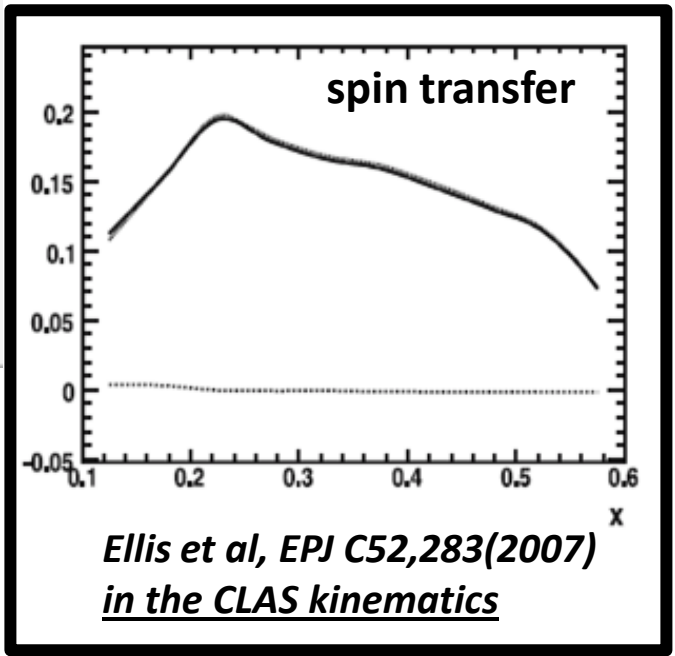

Ellis et al, EPJ C52,283(2007)
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Longitudinal polarization vs MM

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

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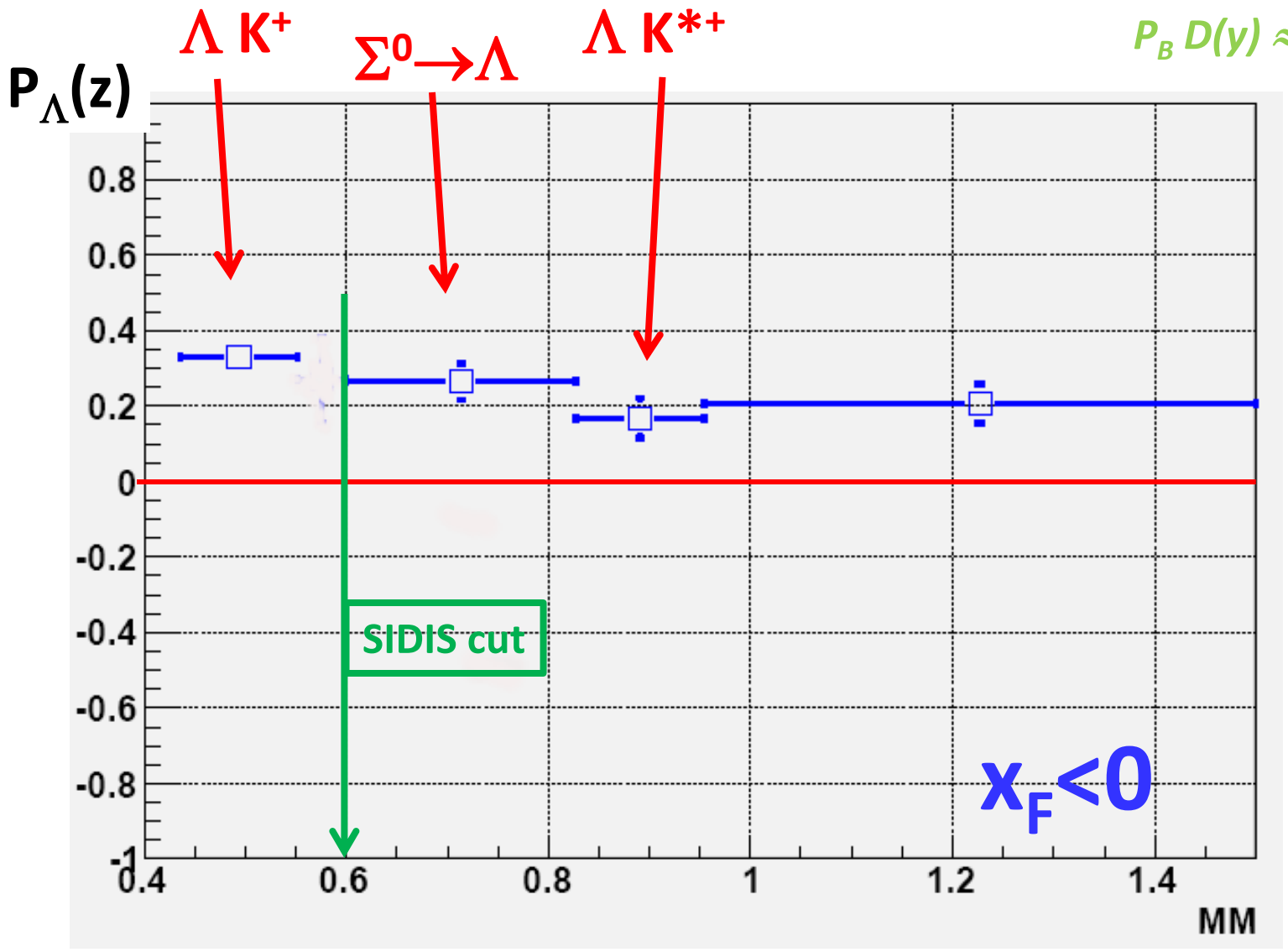
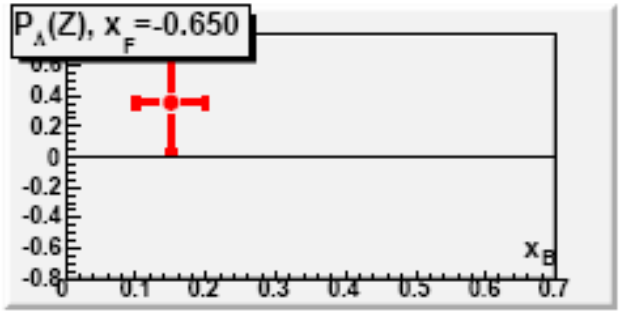
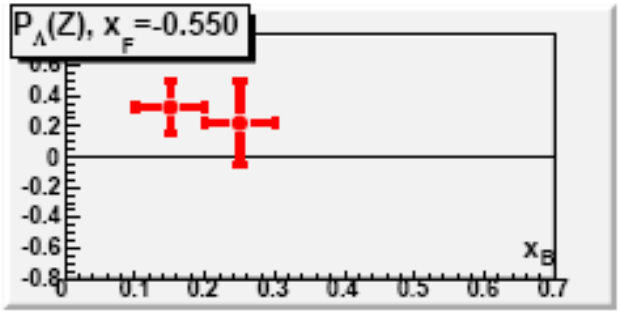
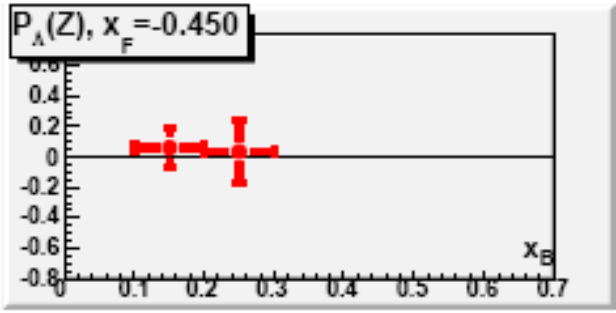
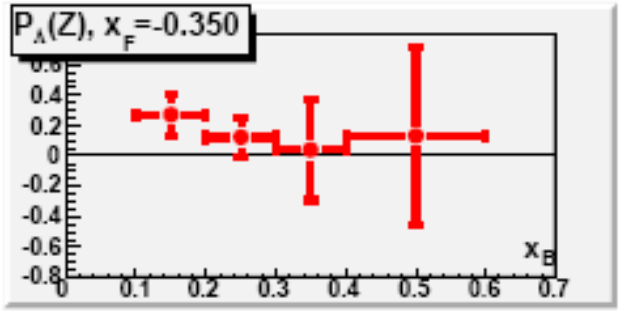


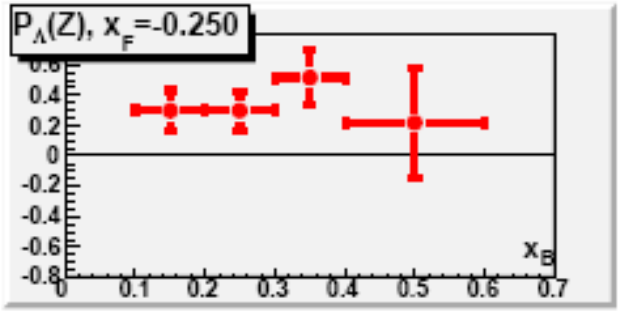
Long. polarization vs x_B, fixed x_F

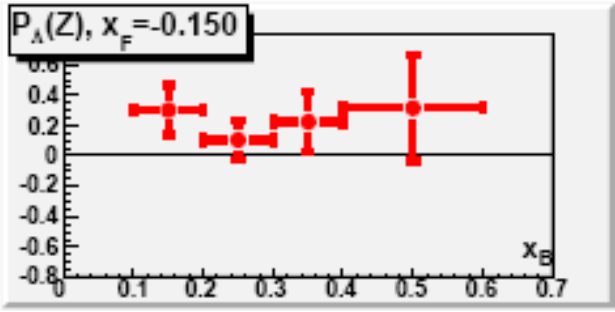


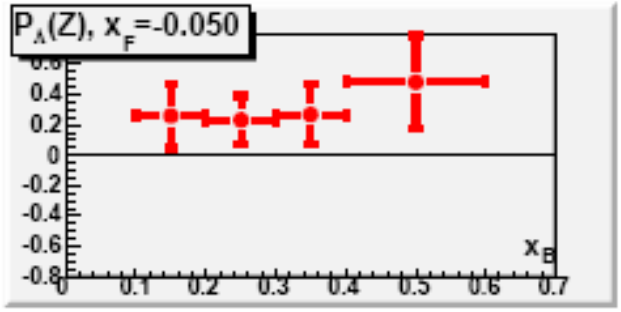


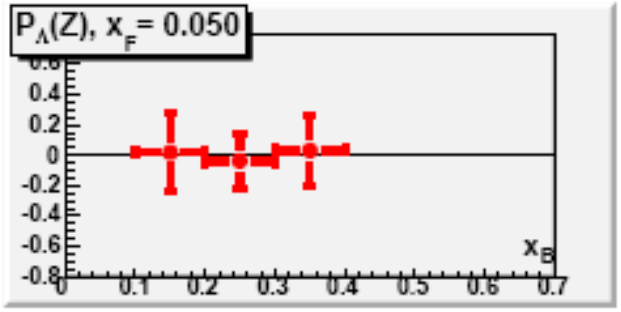


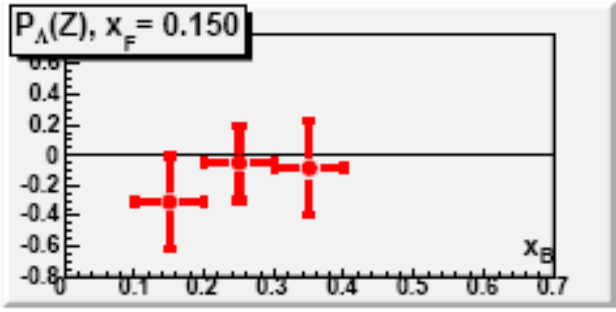


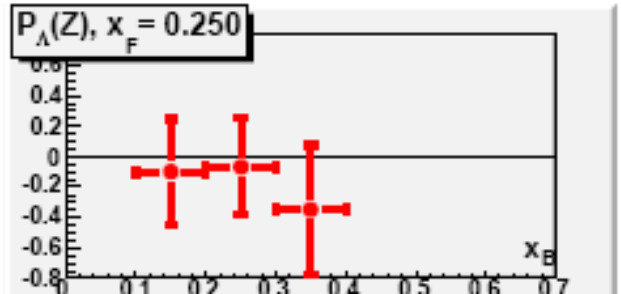


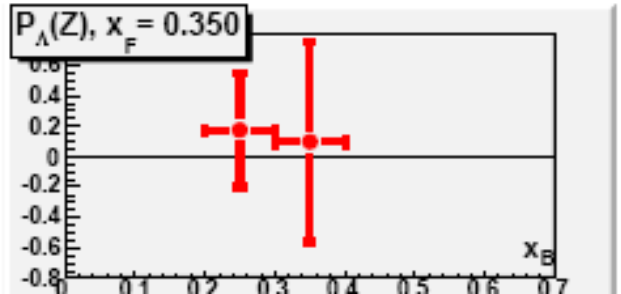


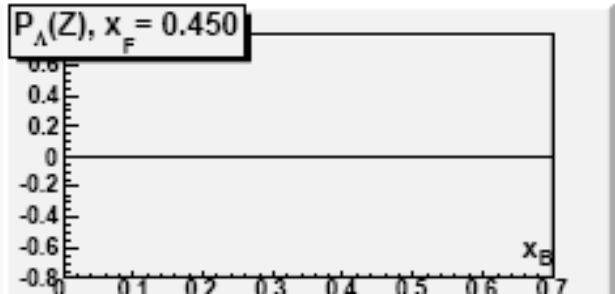












Outlook

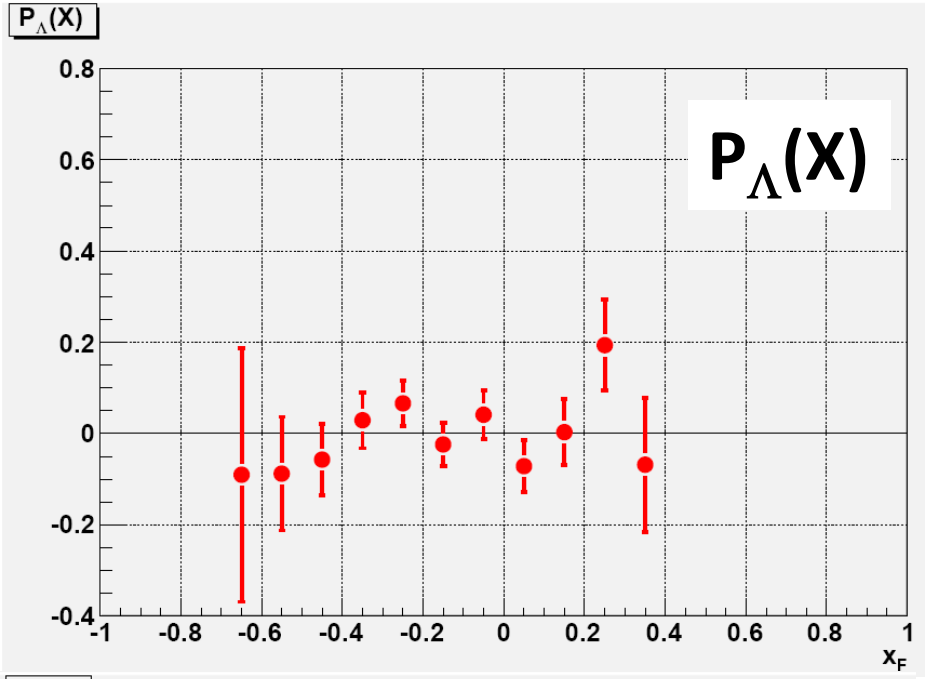
Monte Carlo

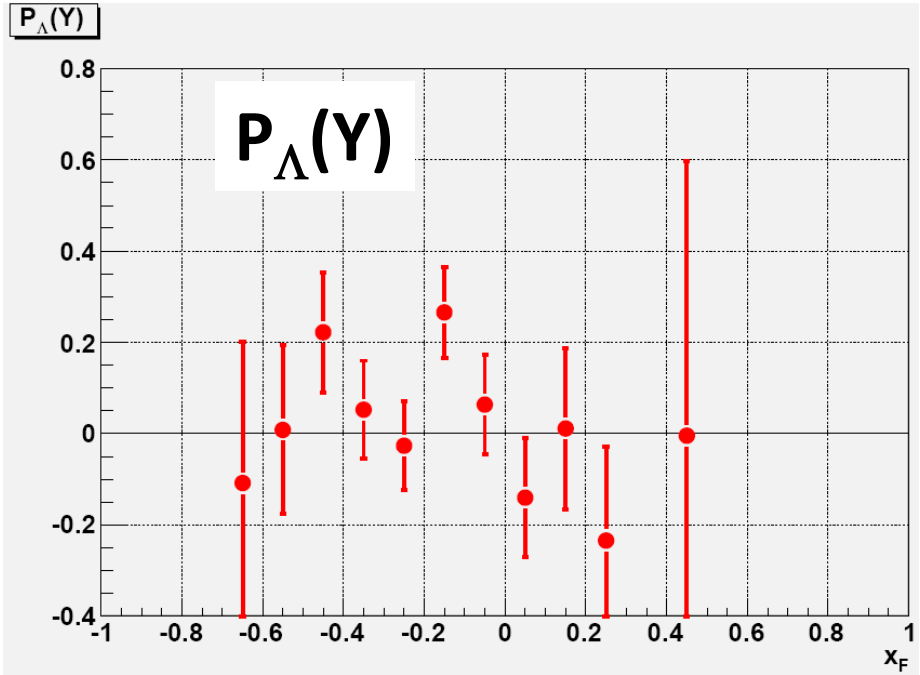
- event generator, CLAS detector simulation programs are ok
- smearing factors to be adjusted
- massive simulated data production is starting (acceptance ~ 1%)

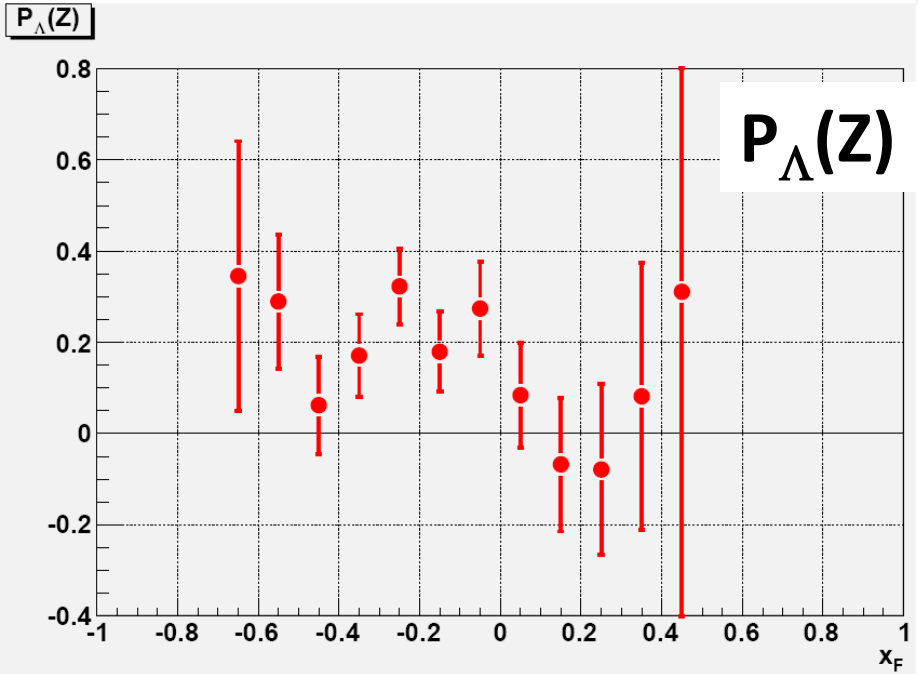
Signal extraction

- unbinned vs binned fits
- multidimensional fits

Polarization vs xF







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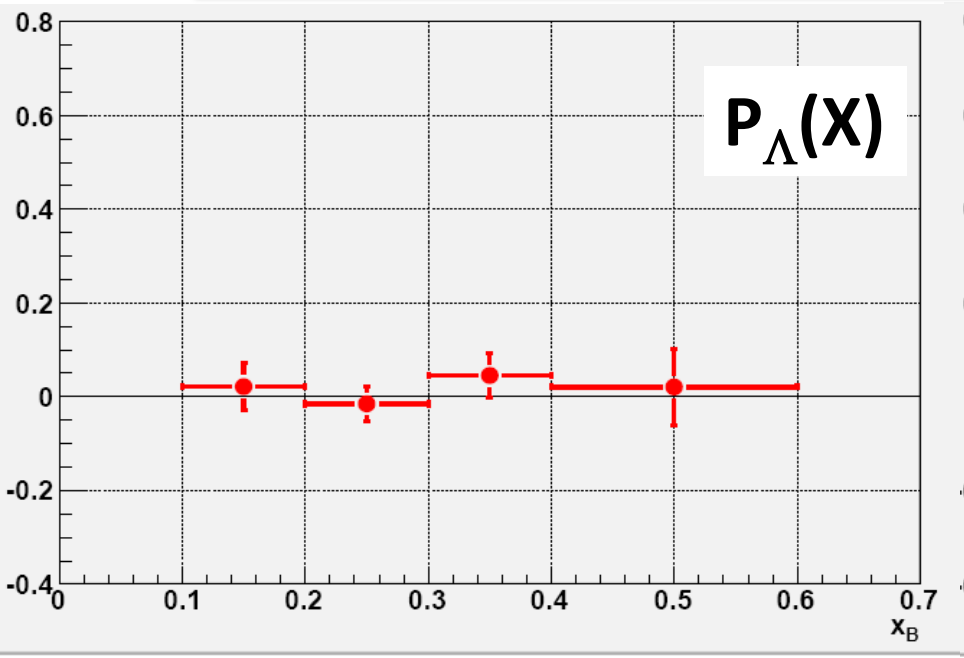
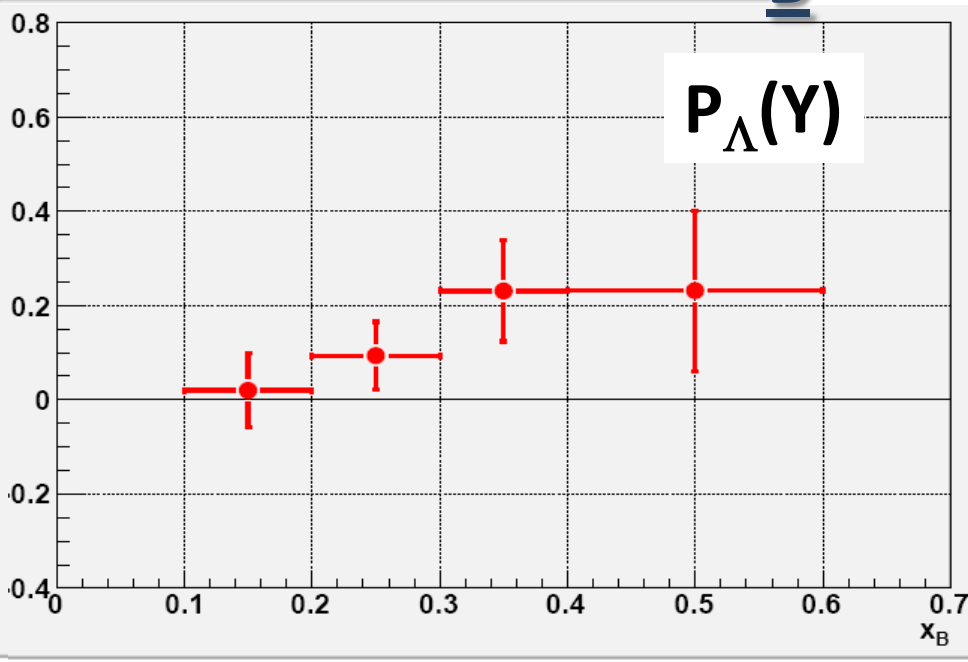
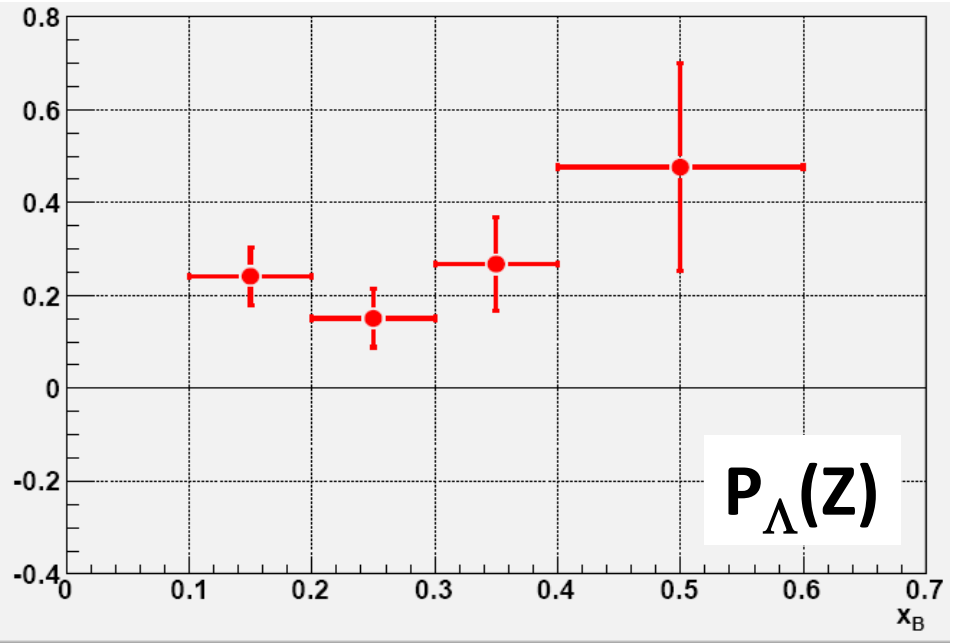
$P_B\, D(y) \approx 0.6$

Longitudinal Λ polarization vs x_B





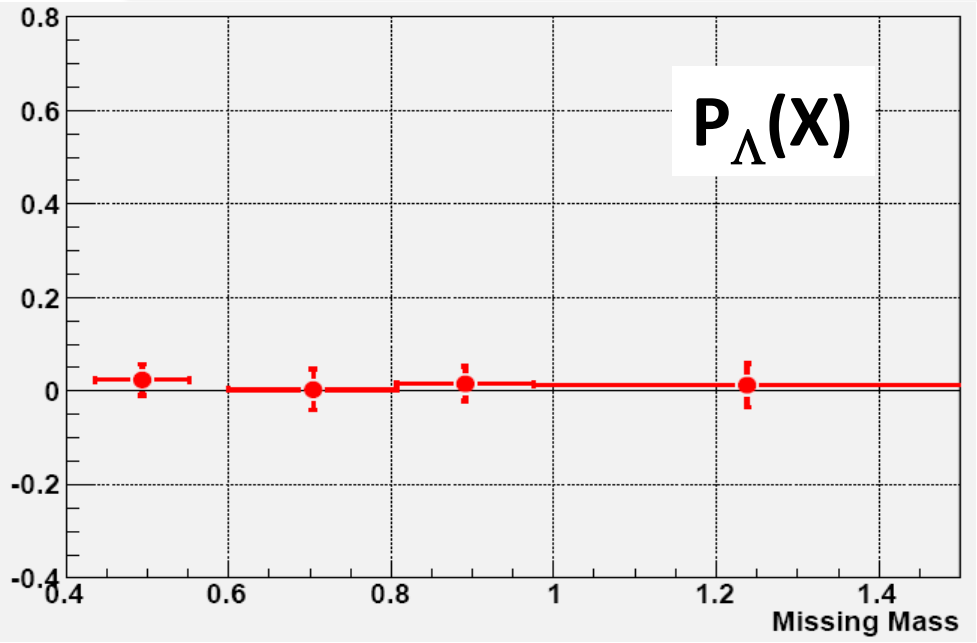


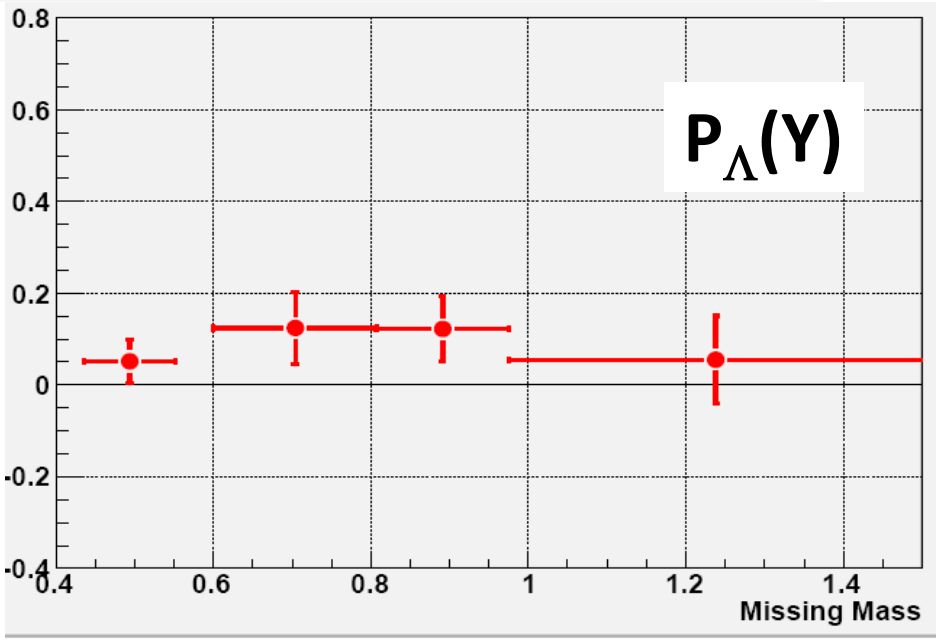
$x_F<0$

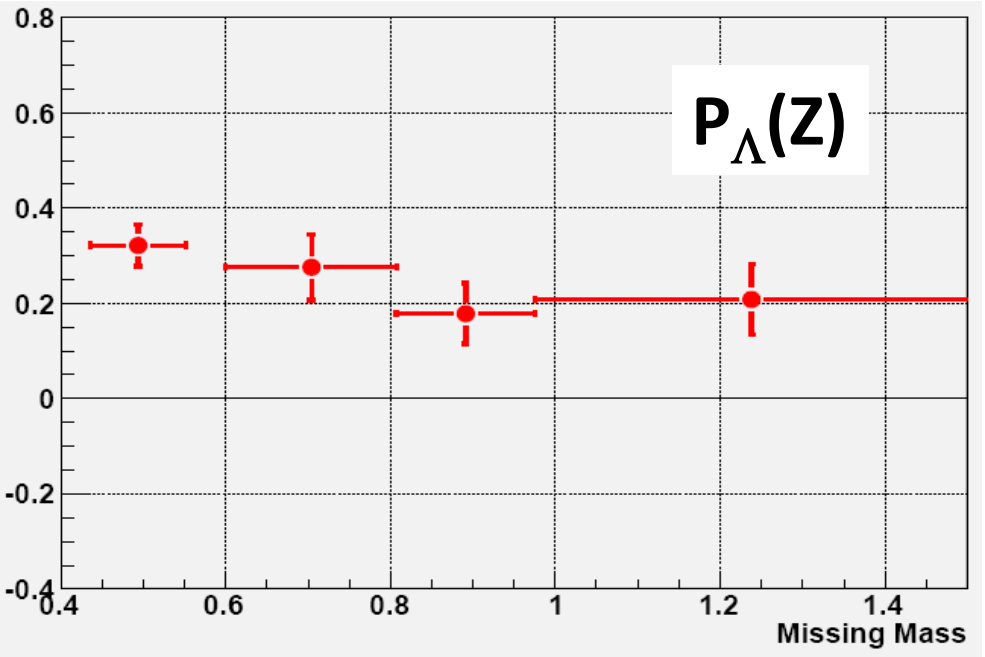
$$P_\Lambda = D(y) P_B D_{LL}^\Lambda$$

$P_B\, D(y) \approx 0.6$

Longitudinal Λ polarization vs MM





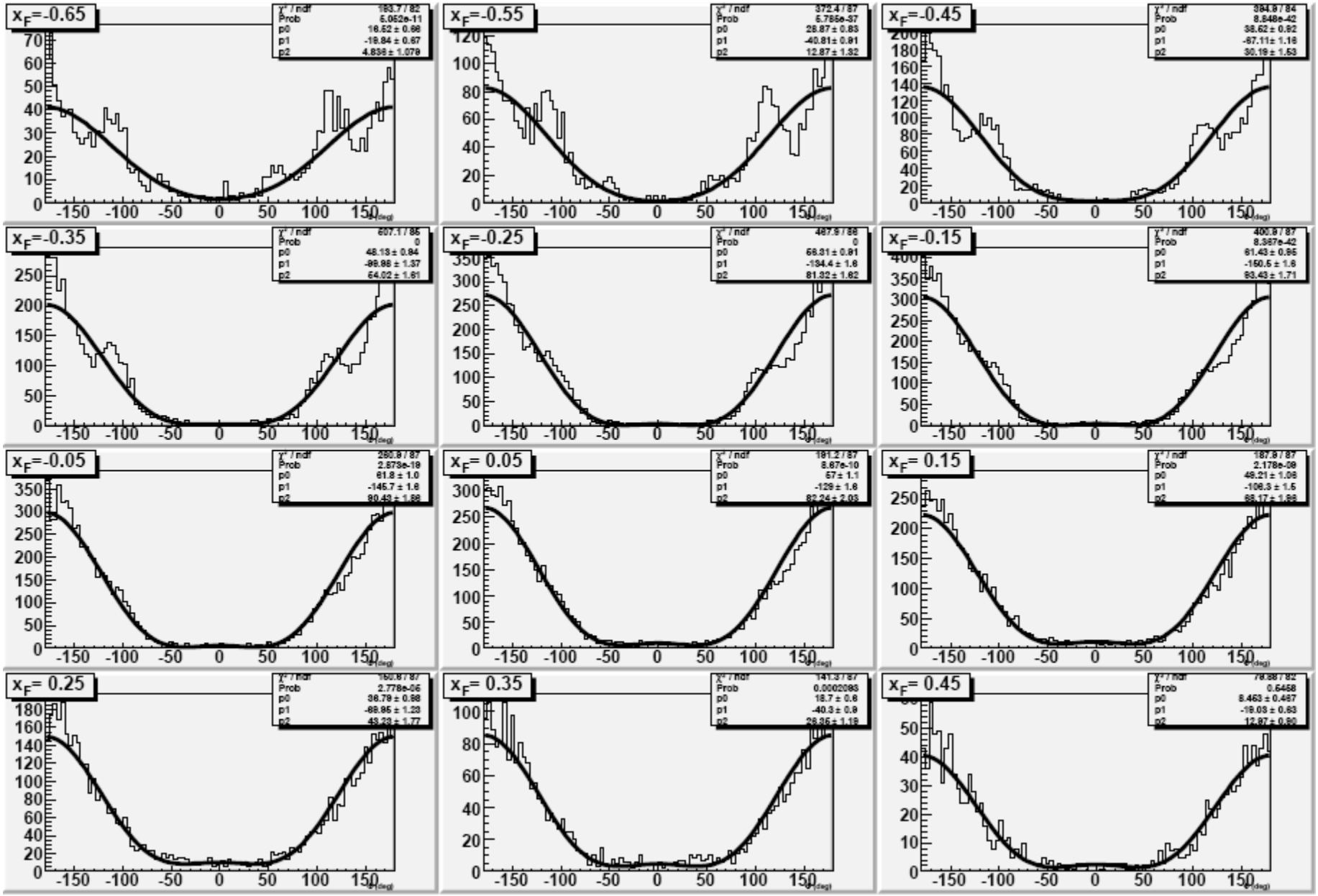


$$P_\Lambda = D(y) P_B D^\Lambda_{LL}$$

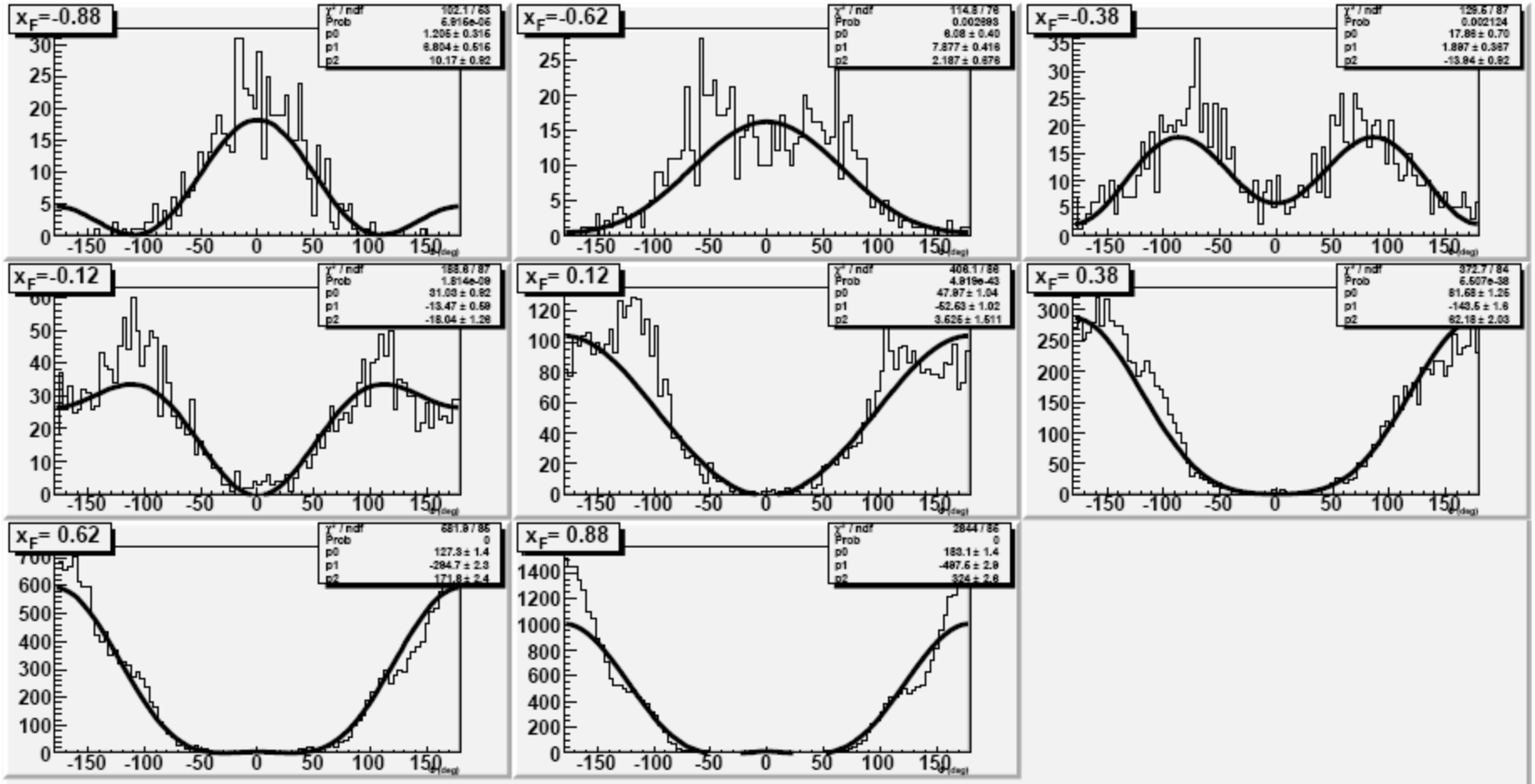
$P_B\, D(y) \approx 0.6$

$x_F < 0$

Experimental ϕ-dependencies vs xF

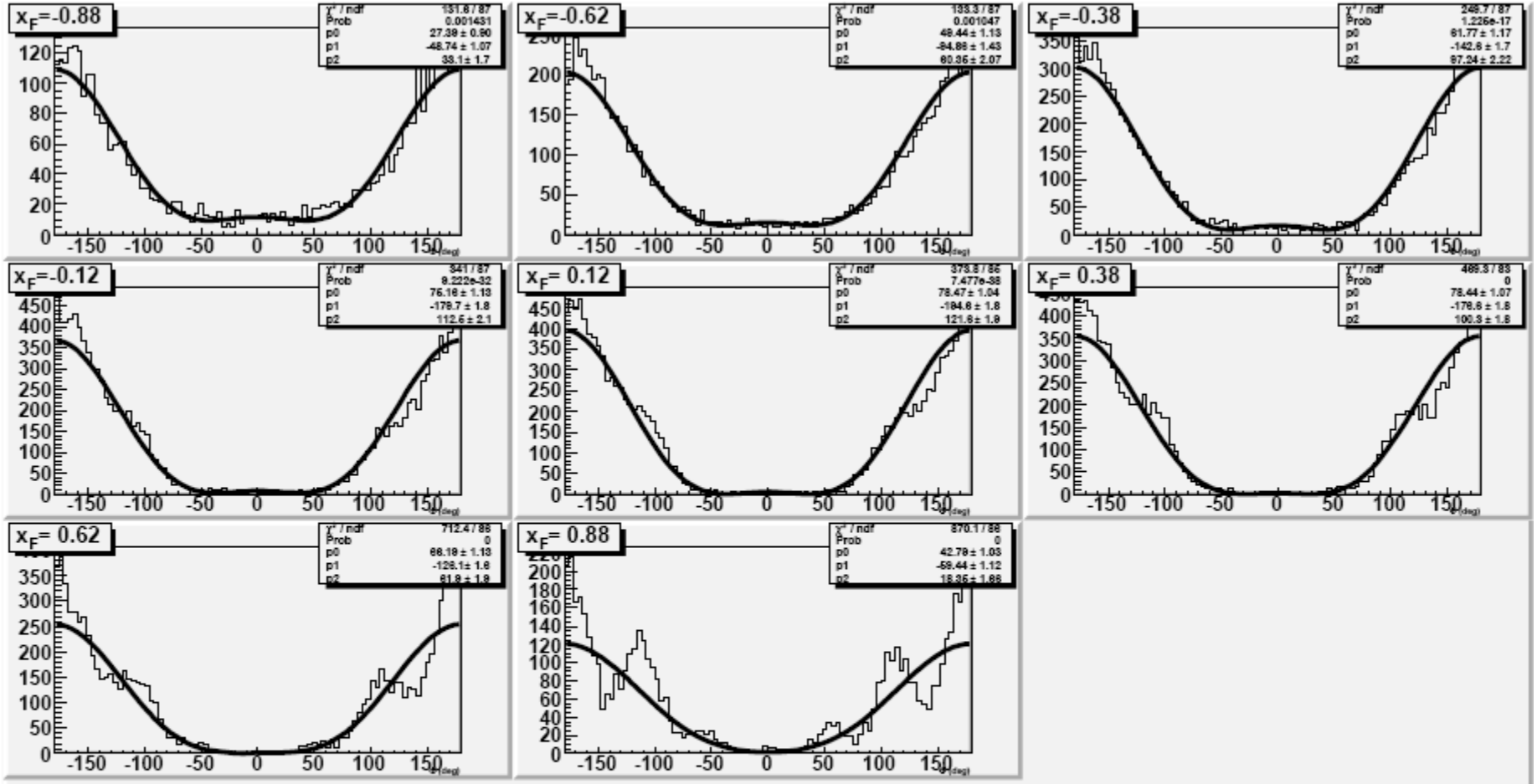


Experimental ϕ-dependencies vs $\cos\theta^x$



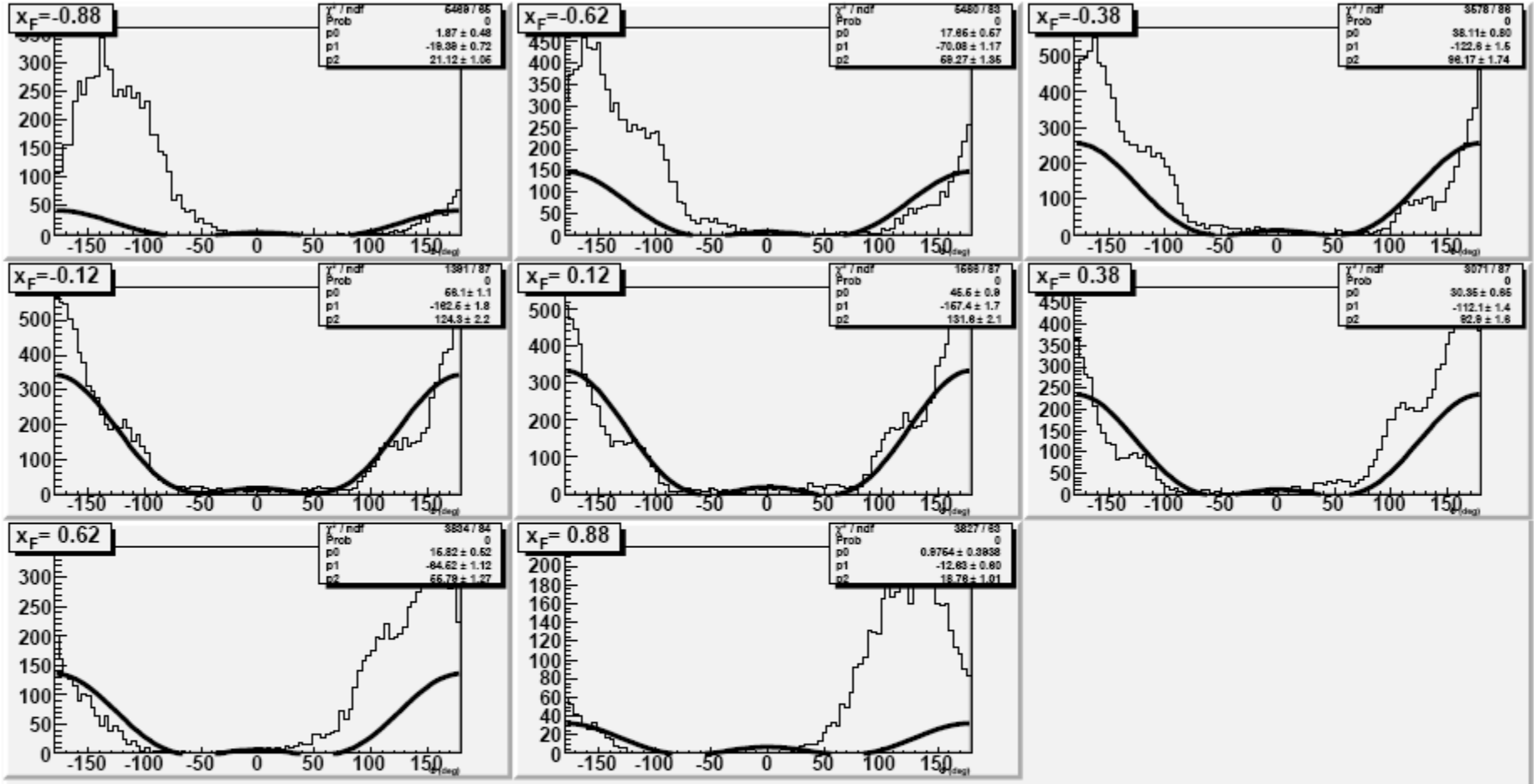
Symmetric in ϕ but many cos(ϕ) harmonics

Experimental ϕ-dependencies vs cosθ^z



Symmetric in ϕ but many cos(ϕ) harmonics

Experimental ϕ-dependencies vs $\cos\theta^{\gamma}$



Highly non symmetric in ϕ

Measured polarization - 1

For acceptance corrected events, only ϕ-independent terms survive

SINGLE BEAM SPIN ASYMMETRY

$$A_{LT'} \propto \sin\phi \to 0$$

INDUCED POLARIZATION

$$P_\Lambda^I(x,y,z) \propto \begin{cases} \sin\phi, \sin 2\phi \\ 1, \cos\phi, \cos 2\phi \\ \sin\phi, \sin 2\phi \end{cases} \to \begin{cases} 0 \\ \neq 0 \\ 0 \end{cases}$$

TRANSFERRED POLARIZATION

$$P_\Lambda^T(x,y,z) \propto \begin{cases} 1, \cos\phi \\ \sin\phi \\ 1, \cos\phi \end{cases} \to \begin{cases} \neq 0 \\ 0 \\ \neq 0 \end{cases}$$

$$A(\cos\vartheta_p^{x,z}) = P_B \alpha \int d\phi \; P_\Lambda^{T,(x,z)}(\phi) \cos\vartheta_p^{x,z} = \alpha P_B P_\Lambda^{T,(x,z)} \cos\vartheta_p^{x,z}$$

$$A(\cos\vartheta_p^{y}) = 0$$

Measured polarization - 2

Let assume $\varepsilon \propto 1 + \cos\phi + \cos^2\phi + \ldots \Rightarrow$ only even powers of $\cos\phi$ survive

SINGLE BEAM SPIN ASYMMETRY $A_{LT'} \propto \sin\phi \to 0$

INDUCED POLARIZATION

$$P_\Lambda^I(x,y,z) \propto \begin{cases} \sin\phi, \sin 2\phi \\ 1, \cos\phi, \cos 2\phi \\ \sin\phi, \sin 2\phi \end{cases} \to \begin{cases} 0 \\ 3 \text{ terms} \neq 0 \\ 0 \end{cases}$$

TRANSFERRED POLARIZATION

$$P_\Lambda^T(x,y,z) \propto \begin{cases} 1, \cos\phi \\ \sin\phi \\ 1, \cos\phi \end{cases} \to \begin{cases} 2 \text{ terms} \neq 0 \\ 0 \\ 2 \text{ terms} \neq 0 \end{cases}$$

$$A\left(\cos\vartheta_p^{x,z}\right) = P_B \frac{\alpha \int d\phi\, \varepsilon(\phi) P_\Lambda^{T,(x,z)}(\phi)}{\int d\phi\, \varepsilon(\phi)} \cos\vartheta_p^{x,z} = \alpha P_B \left\langle P_\Lambda^{T,(x,z)} \right\rangle_\varepsilon \cos\vartheta_p^{x,z}$$

$$A\left(\cos\vartheta_p^{y}\right) = 0$$

more difficult extraction of structure functions

Exclusive Λ K*

Yield from fit of MM (e Λ X)

S/B ≈ 0.2-0.3