Spin Physics with COMPASS

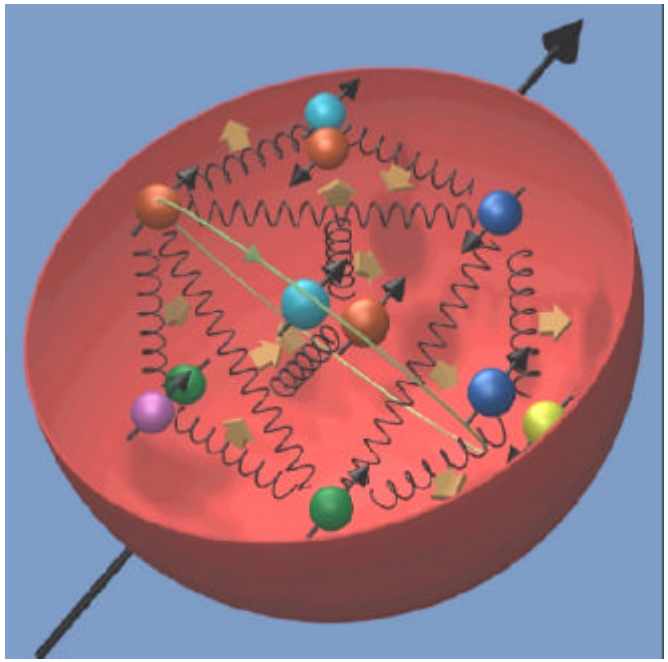
Eric Weise
Universität Freiburg
on behalf of the
COMPASS Collaboration

1. The Nucleon Spin
2. The COMPASS Experiment
3. First Results from 2002 Year‘s Run

17th Conference on Few-Body Problems in Physics,
May 5, 2003 - Durham, North Carolina, USA

bmb+f - Förderschwerpunkt
COMPASS
Großgeräte der physikalischen Grundlagenforschung

The Nucleon Spin



$$S_z = \frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_q + L_g$$

$$\Delta\Sigma = \Delta u + \Delta\bar{u} + \Delta d + \Delta\bar{d} + \Delta s + \Delta\bar{s}$$

- expectation from SU(3) (Ellis/Jaffe 1974), baryon decay (assumption $\Delta s = 0$): $\Delta\Sigma \approx 0.6$

- but DIS experiments (EMC/SMC, SLAC, HERMES): $\Delta\Sigma \approx 0.3$ (HERMES, Phys. Lett. B **442** (1998) 484)

Where is the rest ?
Gluon polarisation ?

→ **Measurement of $\Delta G/G$!**
(by COMPASS)

COMPASS

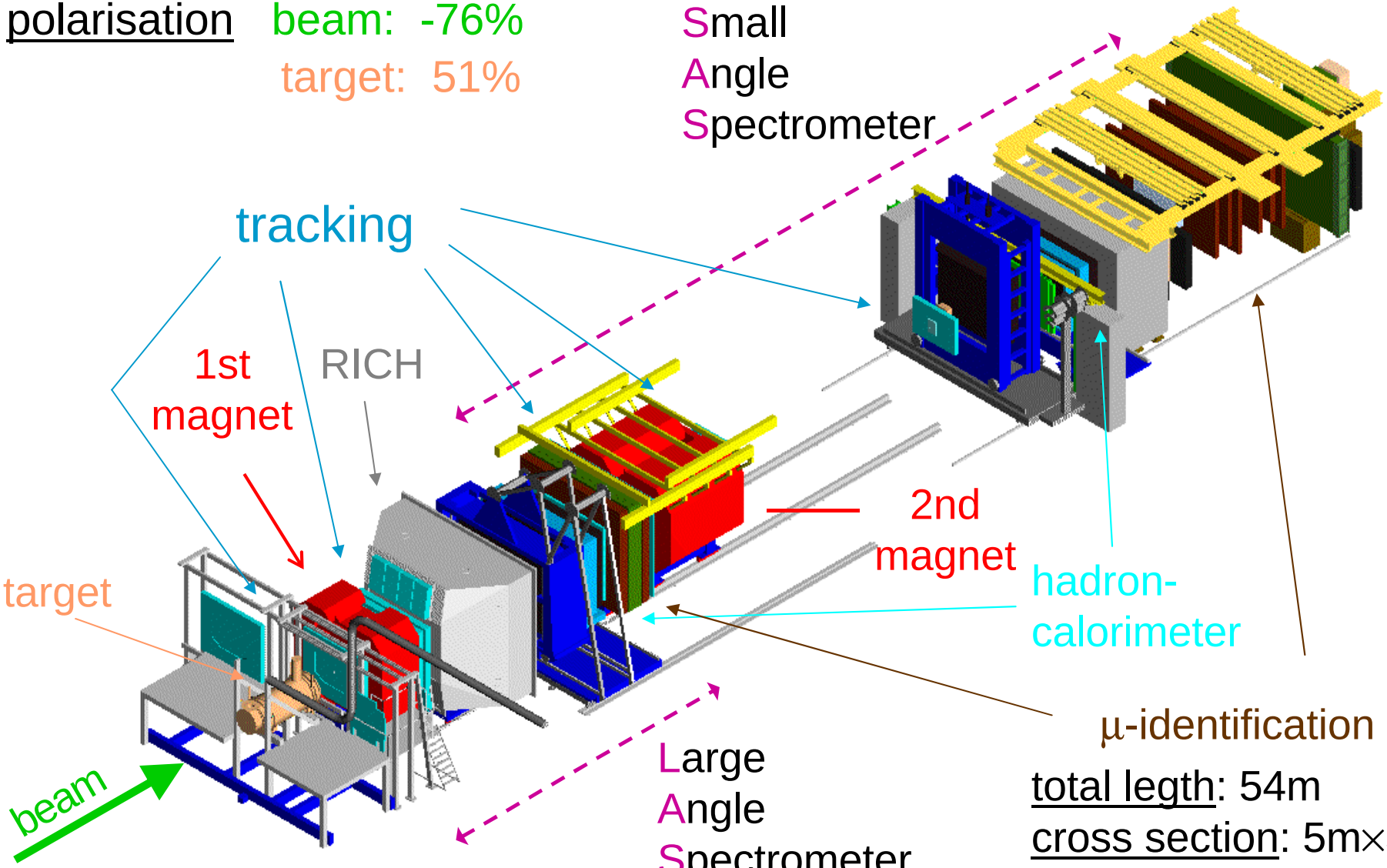
(SPS @ CERN, Geneva, Switzerland)

beam: 2.8×10^{8} μ^{+}/spill
(currently) 160 GeV/c

target: ^{6}LiD

luminosity: $\sim5\times10^{32}\,cm^{-2}s^{-1}$

polarisation beam: -76%
target: 51%



total legth: 54m
cross section: 5m×5m

Acceptance of COMPASS

run 2002:

in total 260 TByte of data

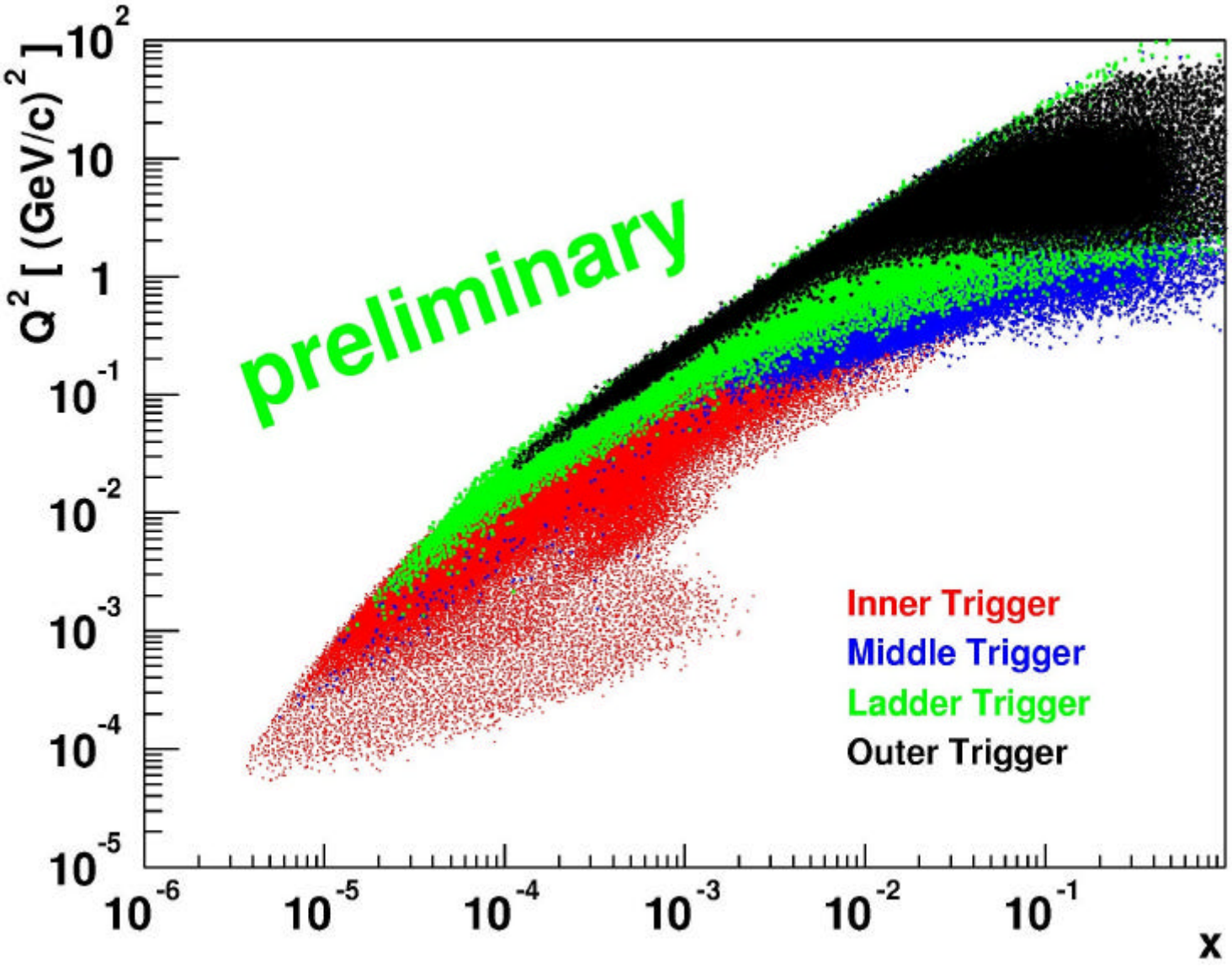
3800×10^6 trigger

570×10^6 recontructable events with μ/μ´

29×10^6 inclusive events with $Q^2 > 1\,(GeV/c)^2$

access to

- ***small x_{Bj}***
- ***very small Q^2***



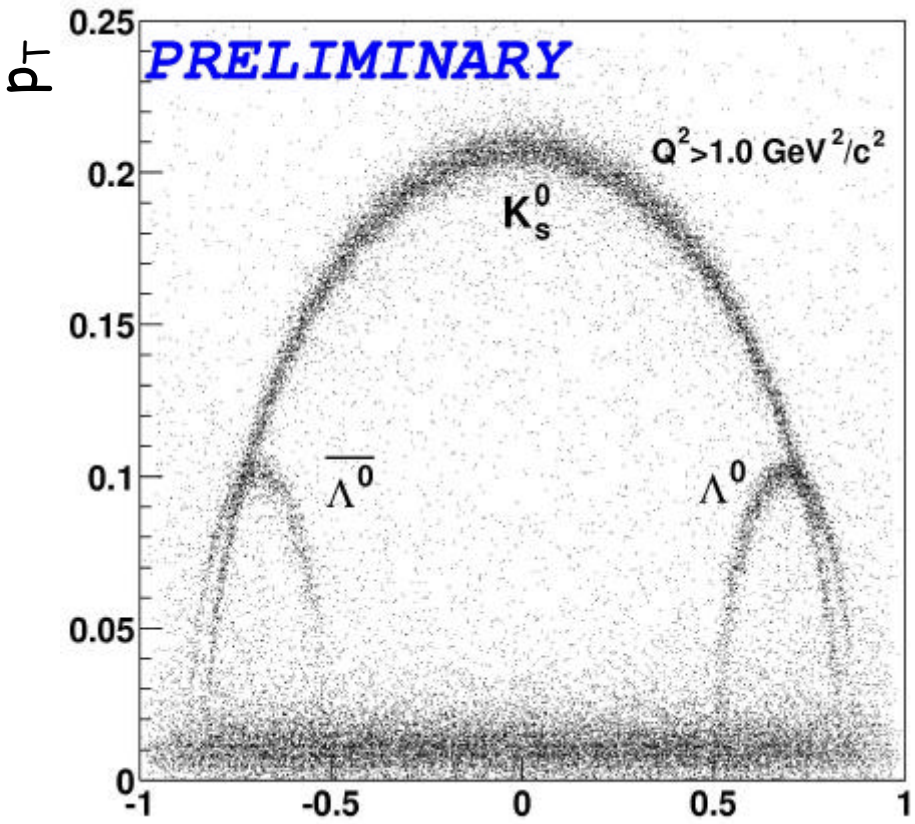
Preliminary Results & Error Estimates

nucleon spin structure

- reconstruction of Λ and $\overline{\Lambda}$
- diffractive vector-meson production
- flavour separation $\Delta q, \Delta\overline{q}$
- gluon polarisation $\Delta G/G$
- transversity
- spin dependent fragmentation ΔD^{Λ}_{q}

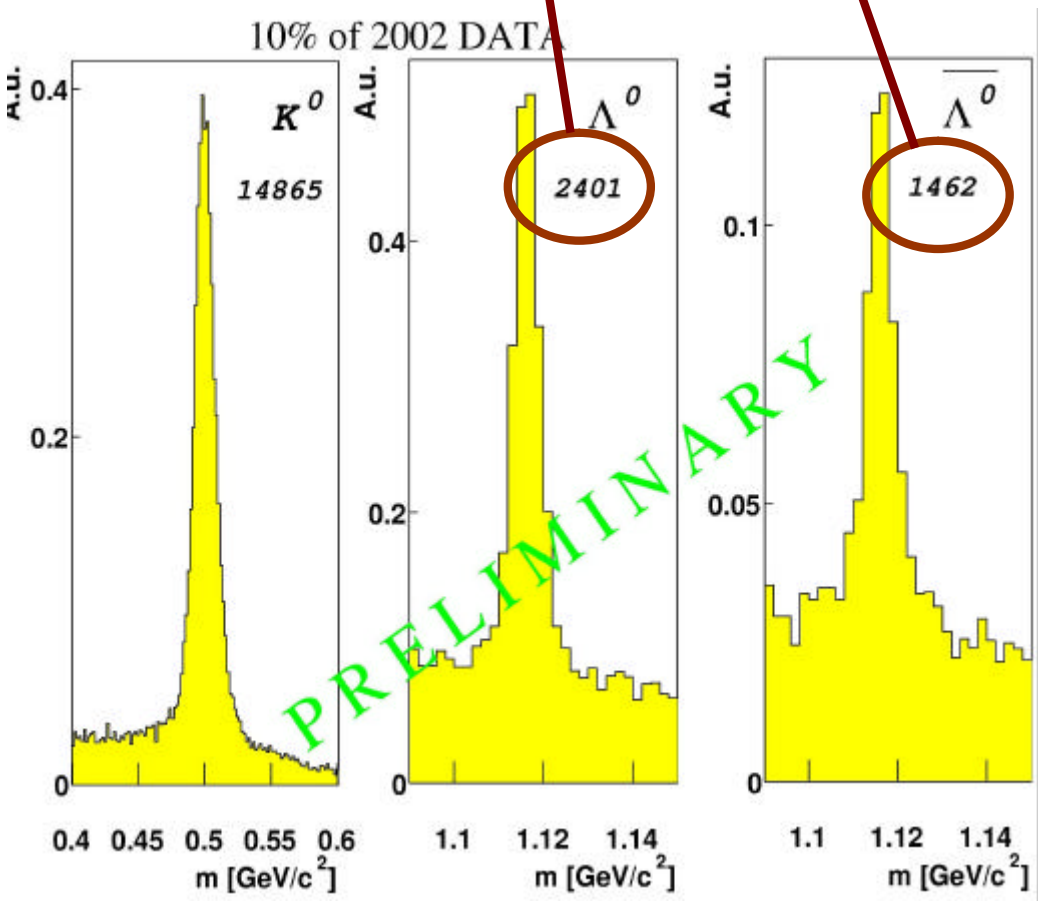
preliminary results & error estimates

Reconstruction of Λ and $\overline{\Lambda}$

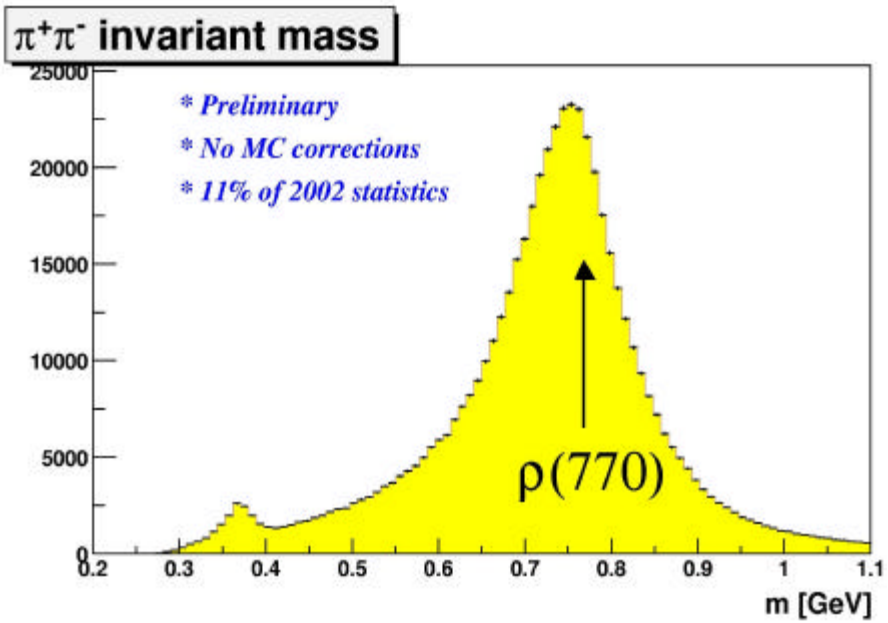


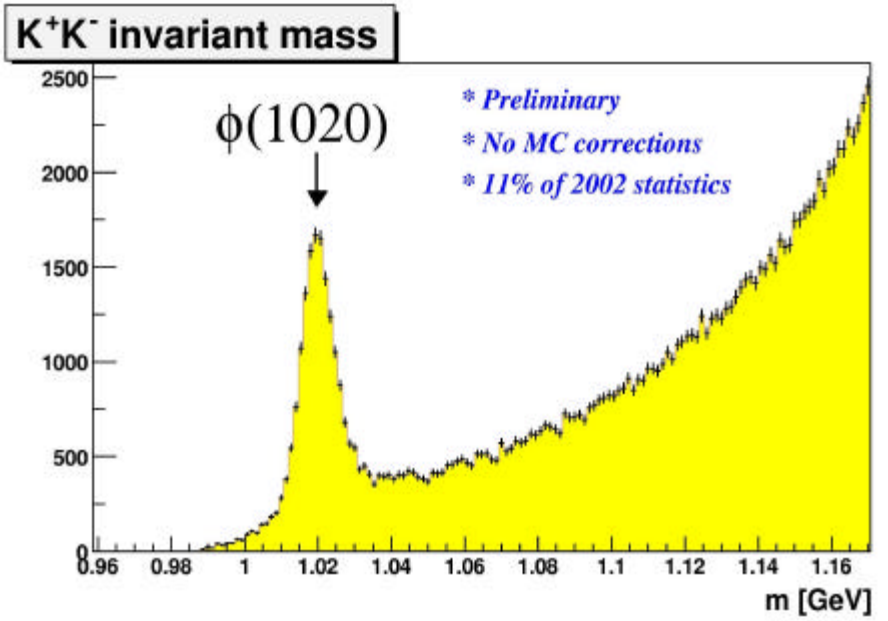
$$\frac{p_L^+ - p_L^-}{p_L^+ + p_L^-}$$

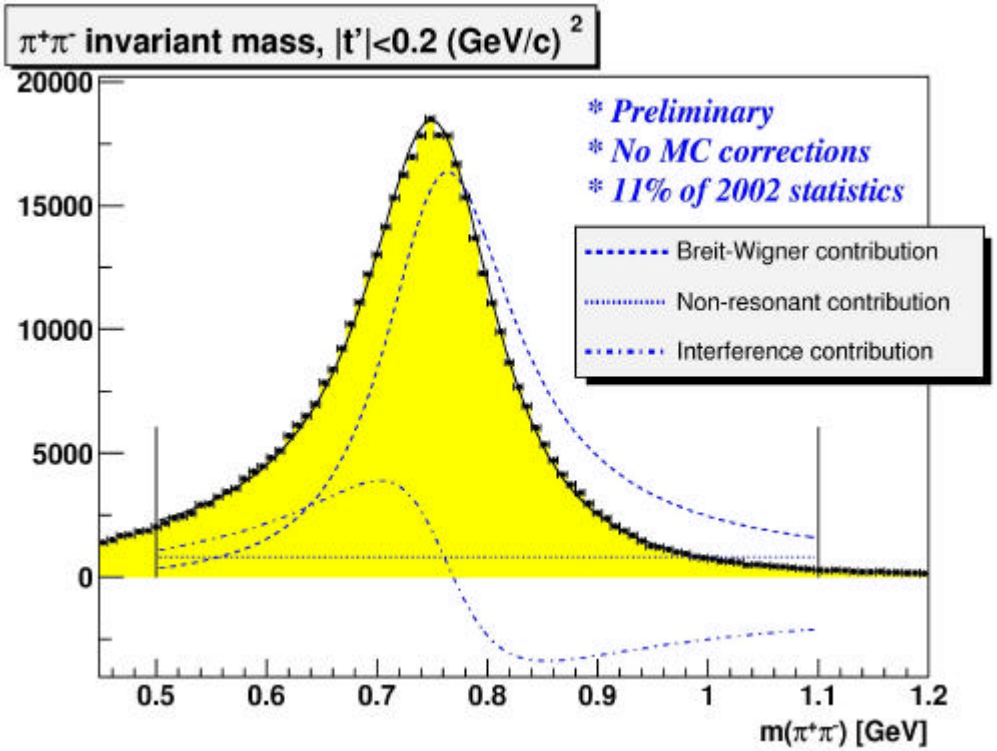
$N(\Lambda) \sim 2 * N(\overline{\Lambda})$



Diffractive Vector-Meson Production

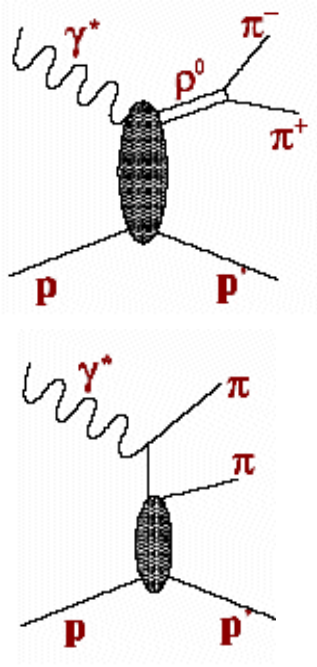




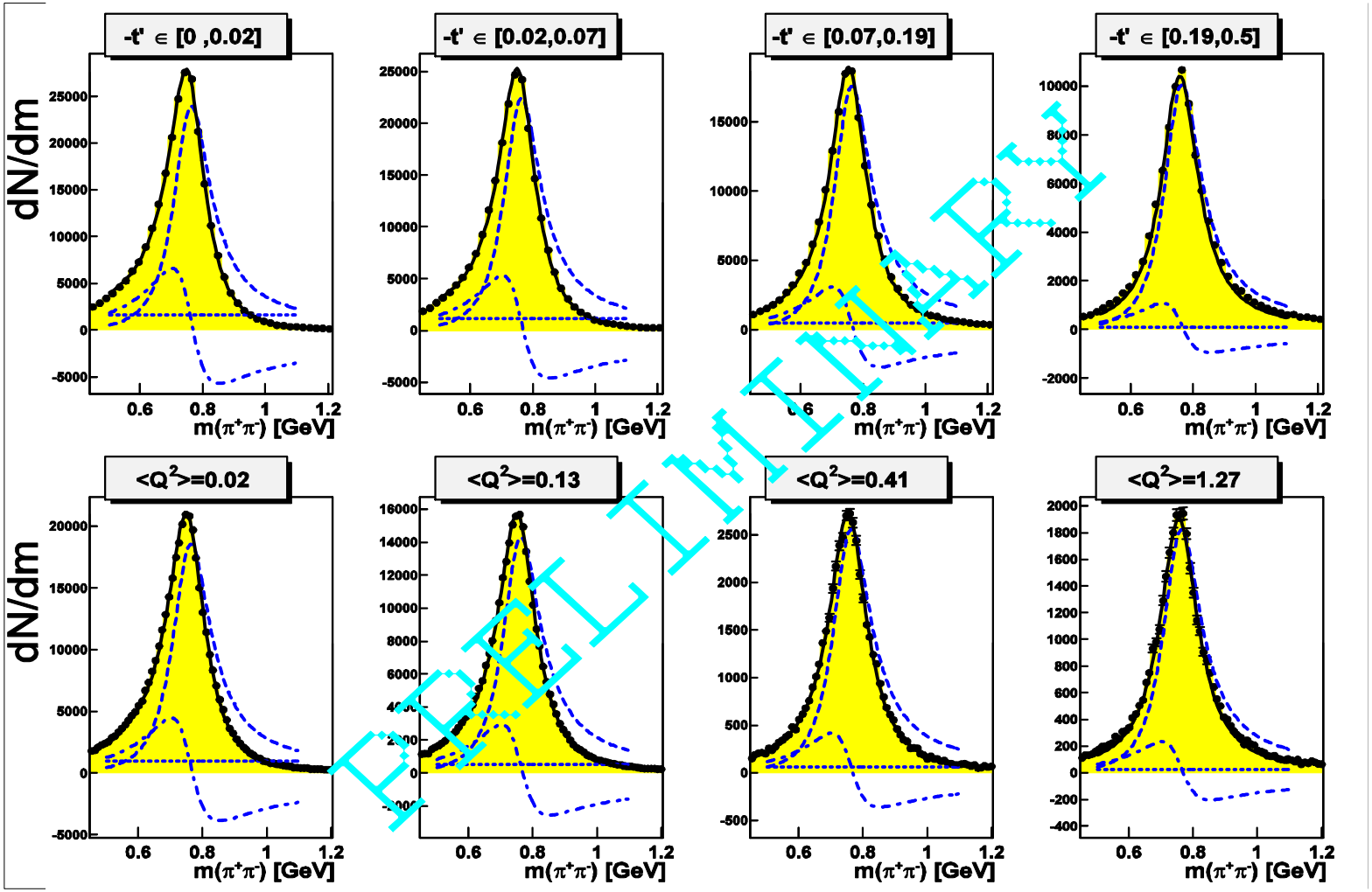


displacement of the -mass caused by interference of resonant production with background

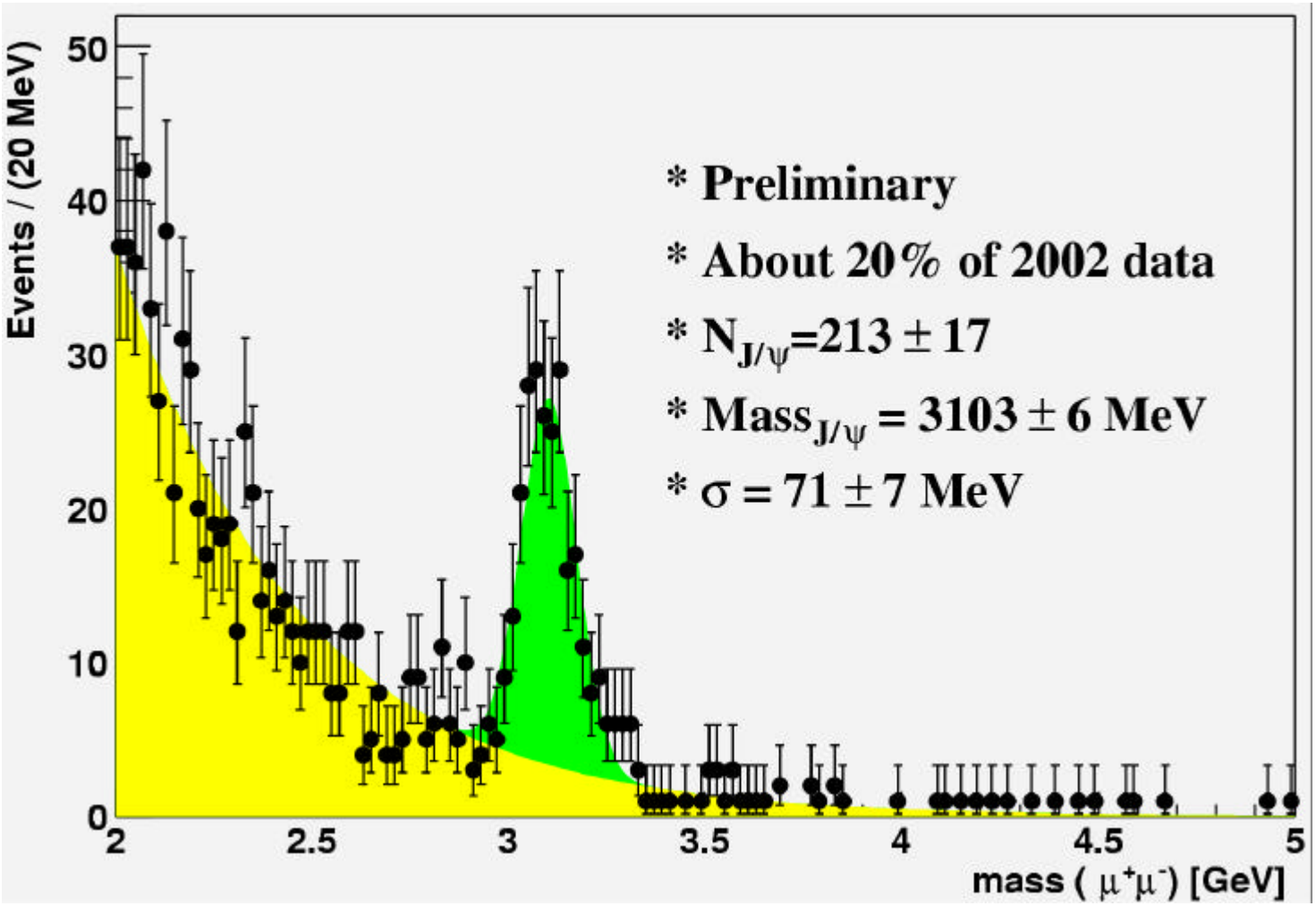
Interference of ?^{0} and pp



- Söding parametrization
- No acceptance correction



… and Charmed Mesons



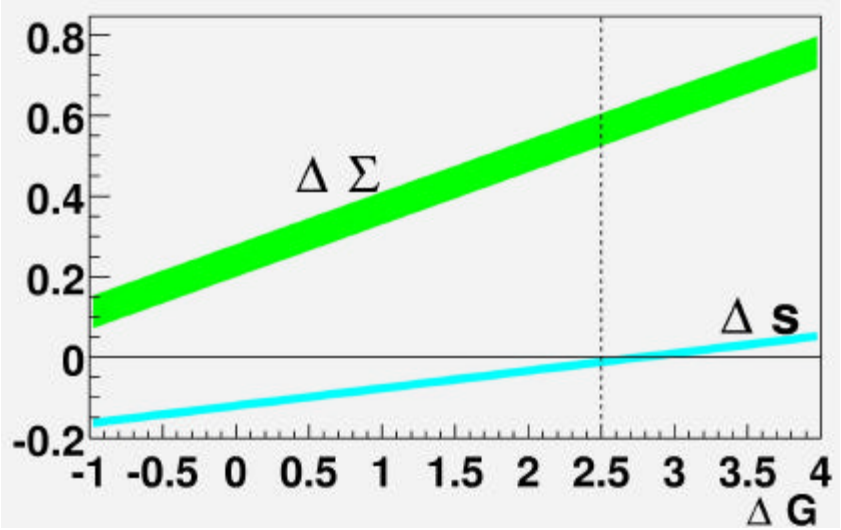
Flavour Separation

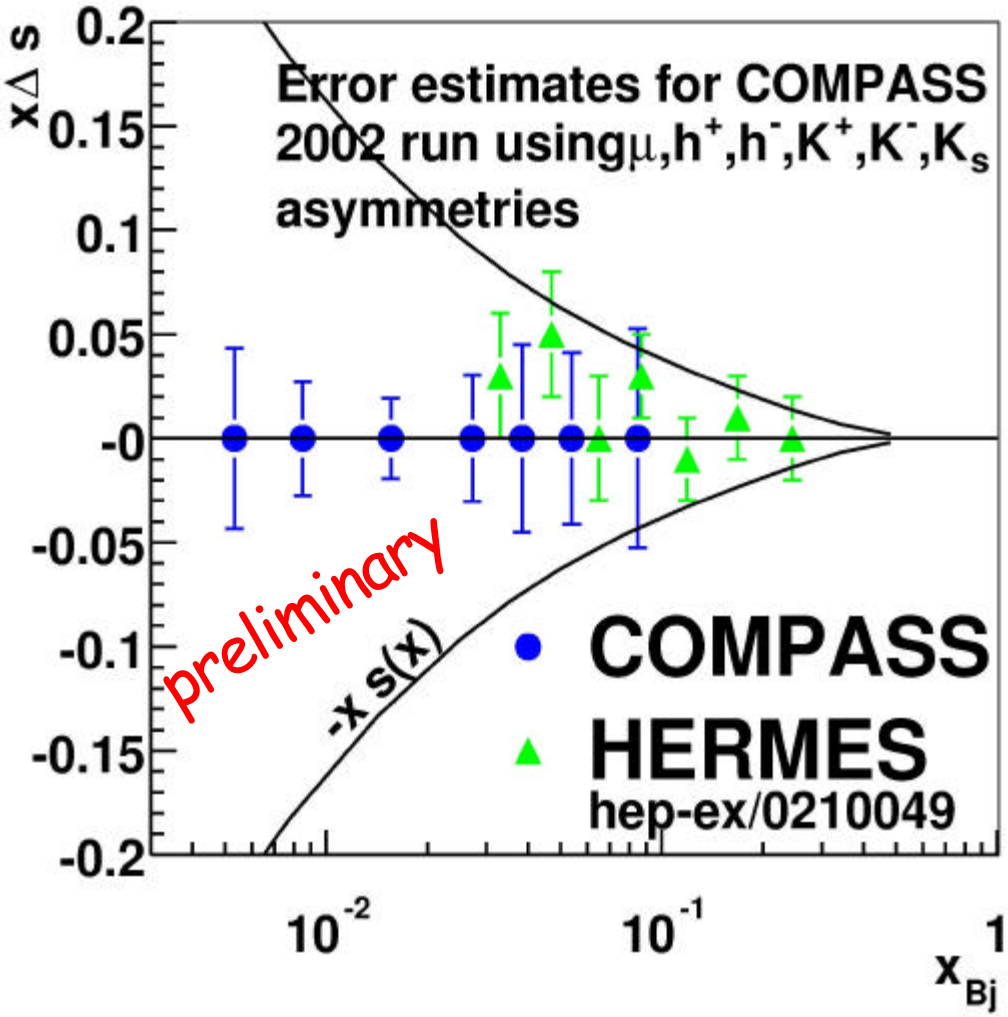
of special interest: Δs !

$$\Delta\Sigma = \Delta u + \Delta\bar{u} + \Delta d + \Delta\bar{d} + \Delta s + \Delta\bar{s}$$

interpretation of $\Delta G/G$-measurement complicated due to axial anomaly

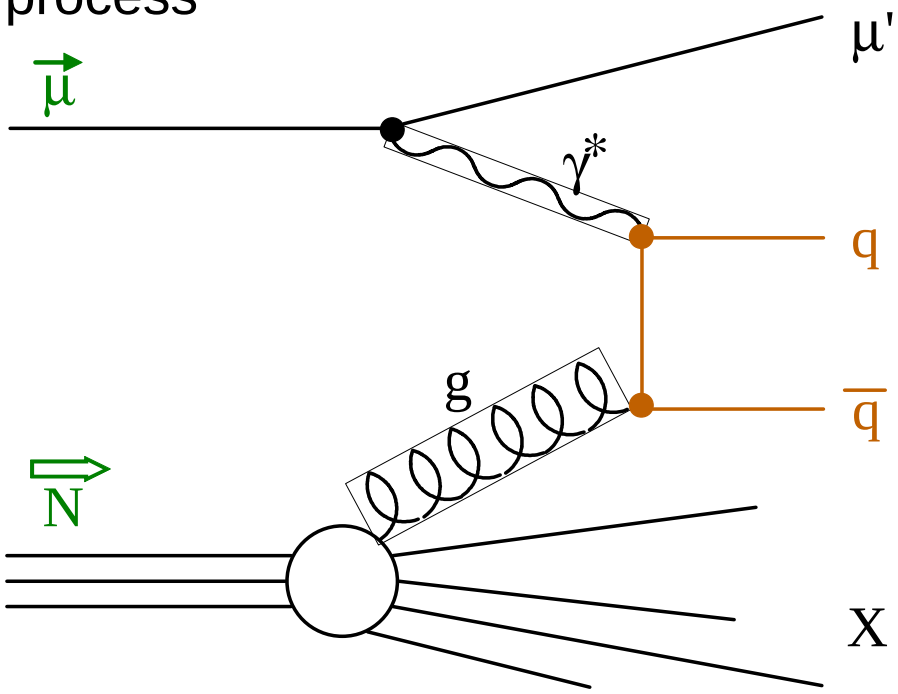
measurement $\rightarrow \Delta s - \frac{\alpha_s}{2\pi}\Delta\Sigma$

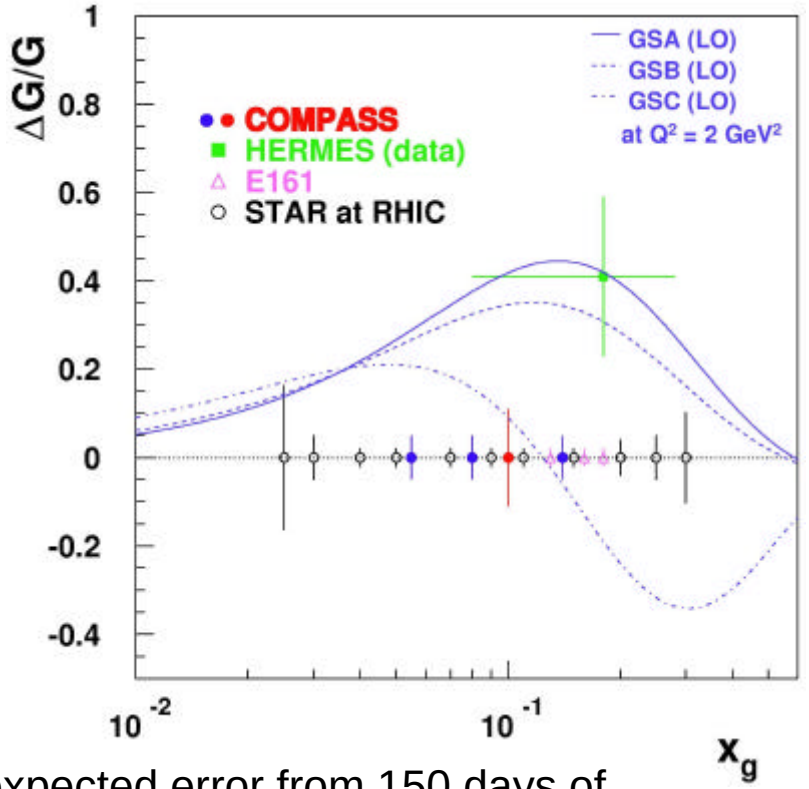




Measurement of ΔG/G

- using polarized beam and target
- measuring cross-section asymmetries
- selecting the photon-gluon fusion process



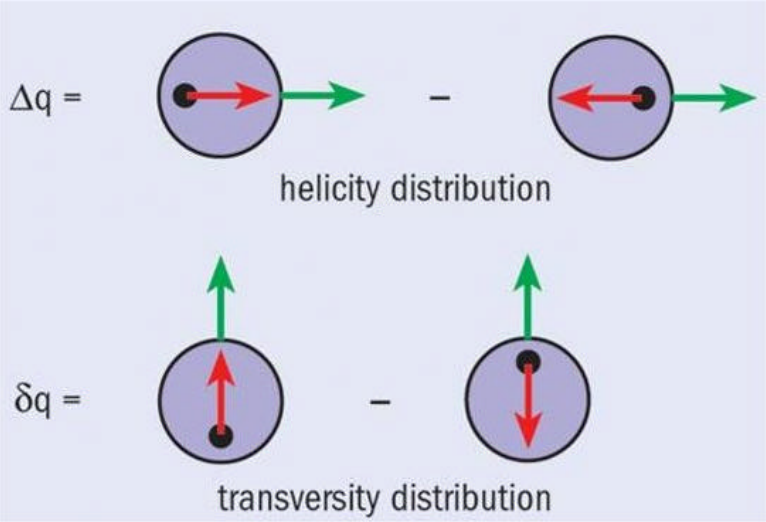


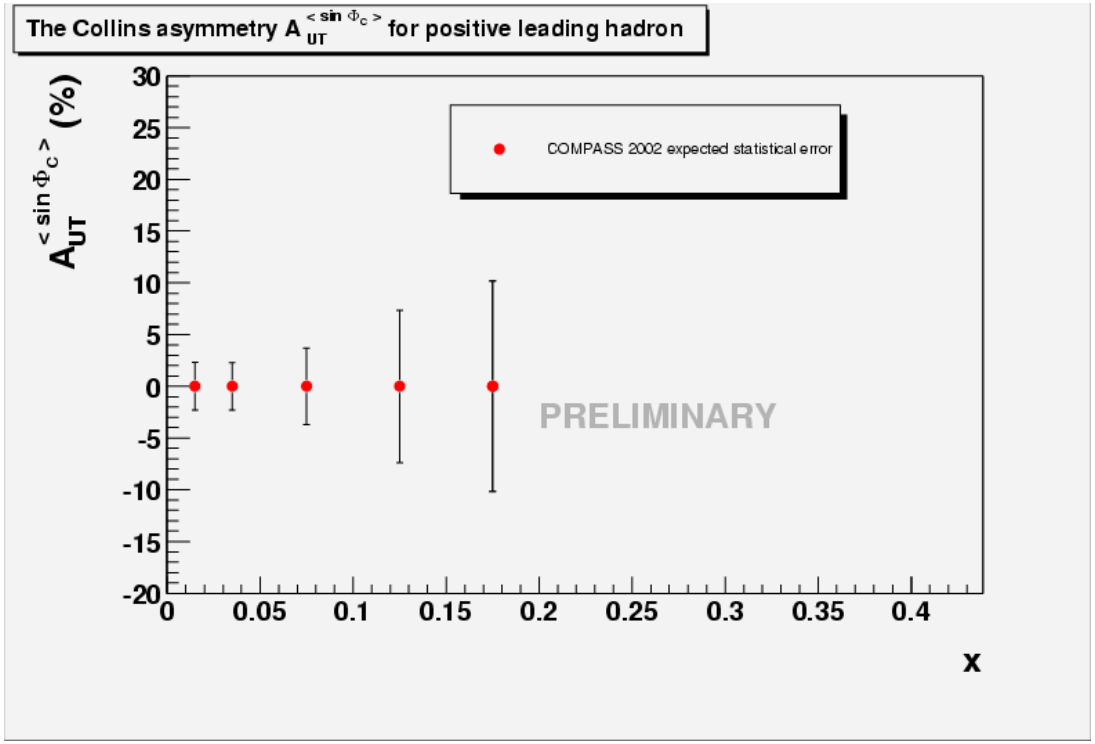
(expected error from 150 days of data taking, 25% efficiency SPS&COMPASS)

1. open-charm production
   - $c, \bar{c}$
   - $D^0 \rightarrow K^- + \pi^+$

2. high-p_T hadron
   - light quarks
   - pair of hadrons with high transverse momentum

Transversity





run 2002:

~ 10^7 DIS events with transversal polarised ^{6}LiD-target

Outlook: COMPASS Physics Program

2003 & 2004 nucleon spin structure (μ-beam)

- collect more statistics

break in **2005** upgrade of COMPASS

starting **2006** in addition nucleon spectroscopy (π-,K- and p-beam)

- Primakoff-reactions: polarisibility of π, K
- generalised parton distributions
- glue-balls and hybrid-mesons
- charmed mesons and baryons:
  - semi-leptonic decays
  - double-charmed baryons