COMPASS INCLUSIVE ASYMMETRIES

Marcin Stolarski

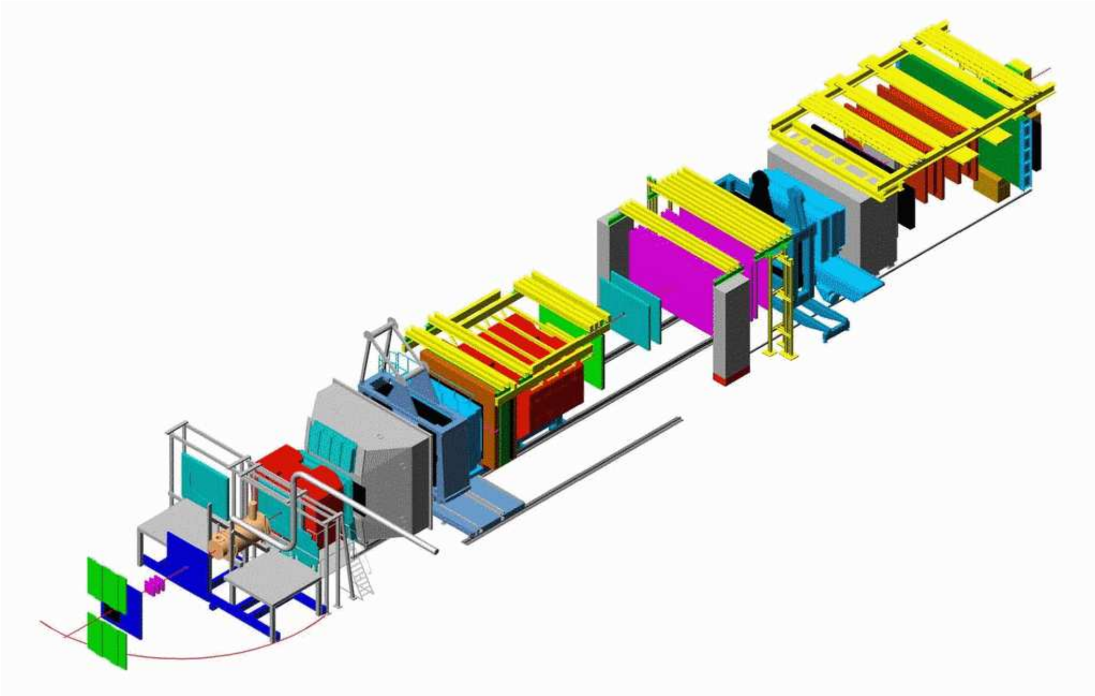
Warsaw University

on behalf of the COMPASS collaboration

22 IV 2006

- COMPASS
- results for A_1^d and g_1^d for $Q^2 > 1$ GeV^2 and QCD analysis
- results for A_1^d and g_1^d for $Q^2 < 1$ GeV^2

COMPASS

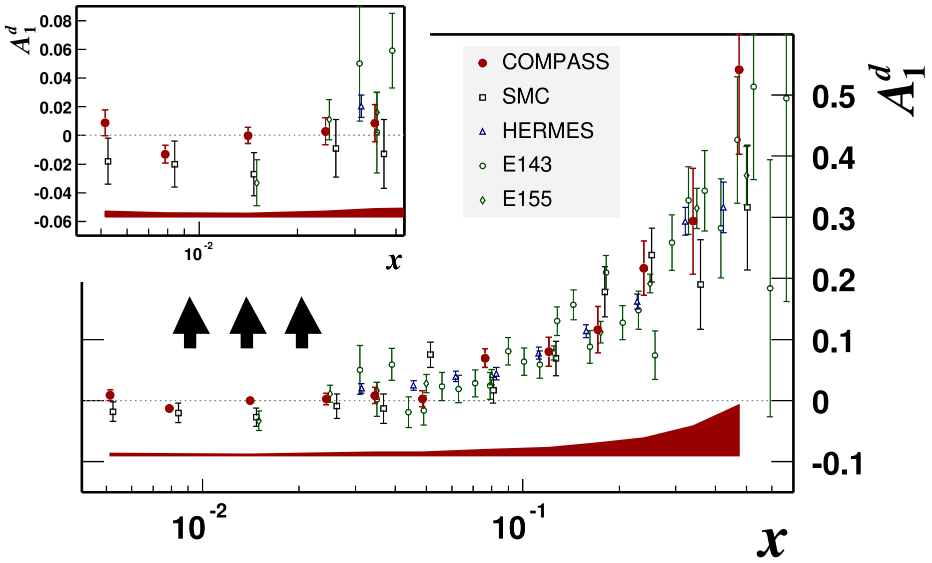


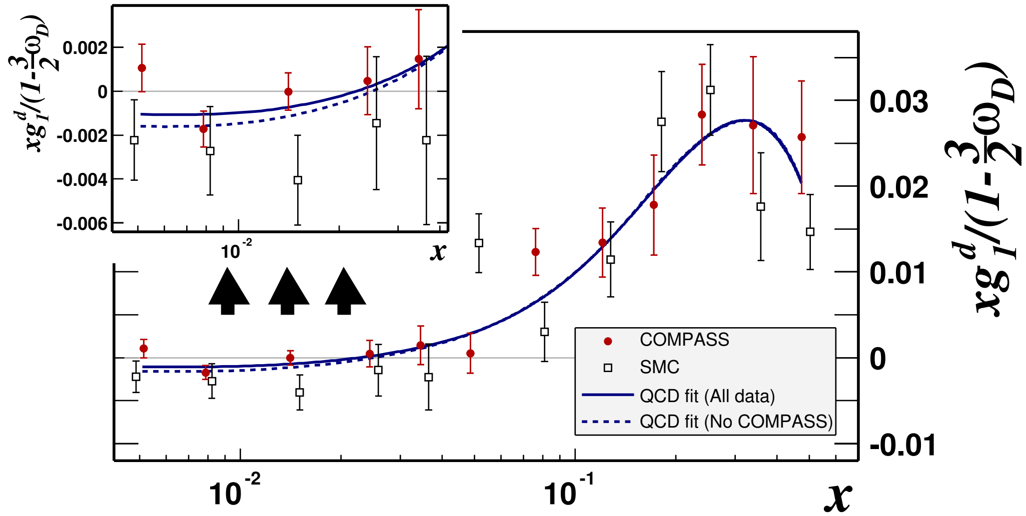
- POLARIZED TARGET
  - ^{6}LiD target
  - 2 cells (60 cm long each)
  - ± 50% polarization
  - polarization reversal every 8h
- POLARIZED BEAM
  - muons at 160 GeV
  - polarization –76 %
- FEATURES
  - acceptance: 70 mrad
  - track reconstruction: $p > 0.5$ GeV
  - identification: π, K, p (RICH) above 2, 9, 18 GeV respectively

- COLLABORATION
  - about 240 physicists
  - 31 institutes
- DETECTOR
  - 60 m length
  - 2 (3) magnets
  - about 350 detector planes

A_1^d AND g_1^d ANALYSIS FOR $Q^2 > 1$ GeV^2

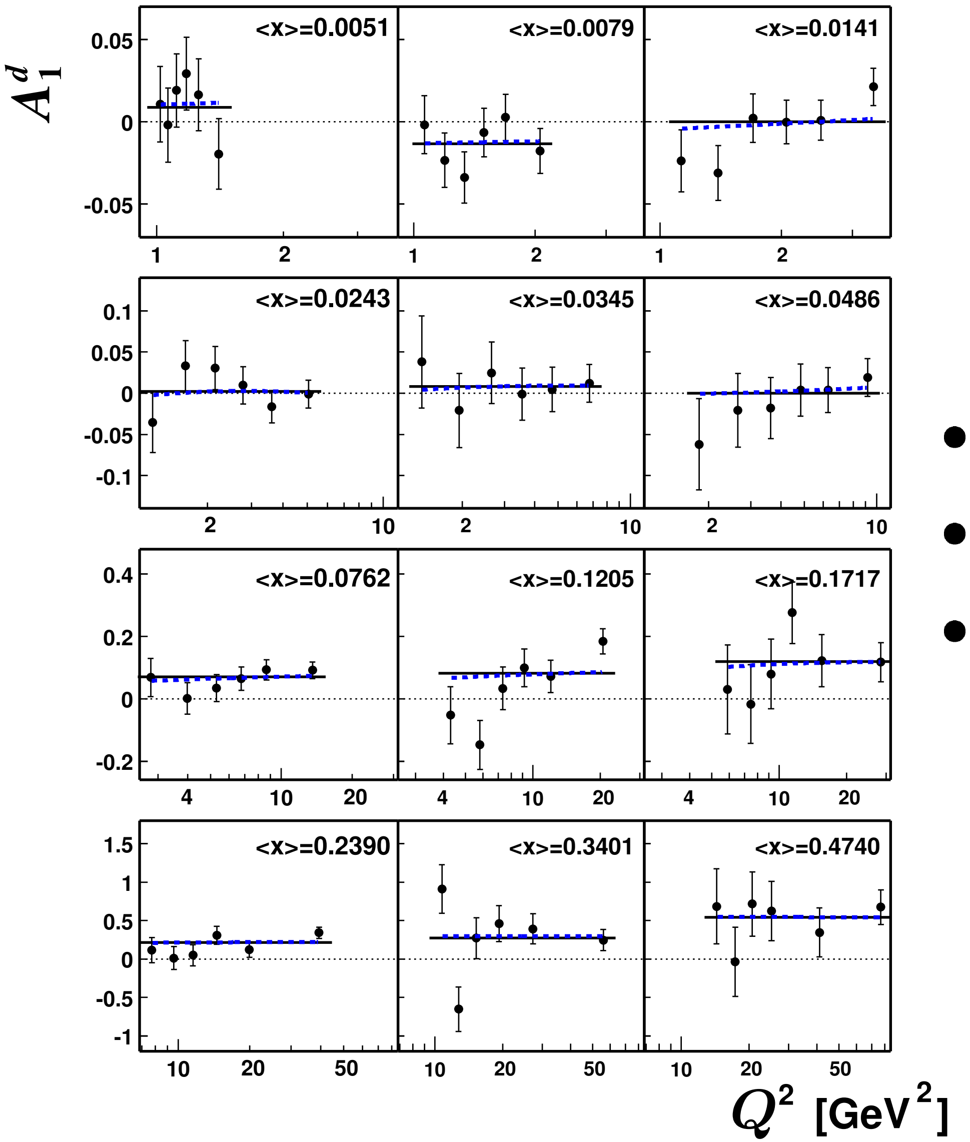
COMPASS A_1^d AND g_1^d; 2002-03 DATA





- results from 2002-03 published: E. S. Ageev *et al.*, *Phys. Lett.* B612 (2005) 154
- results from 2004 run expected soon!
- statistics in 2004 as large as 2002+2003

COMPASS QCD ANALYSIS



- $\Delta\Sigma = 0.25 \pm 0.02$ (stat.); $Q^2 = 3$ GeV^2
- $\Delta G = 0.4 \pm 0.2$ (stat.); $Q^2 = 3$ GeV^2
- without COMPASS:
  $\Delta\Sigma = 0.22 \pm 0.03$ (stat.); $Q^2 = 3$ GeV^2

A_1^d AND g_1^d ANALYSIS FOR $Q^2 < 1$ GeV^2

NEW!

MOTIVATION

- structure functions contain full information about the nucleon
- at small x and/or Q^2 the value of A_1^d is poorly known, it was measured only by the SMC
- knowledge of g_1 at low Q^2 is needed to test non-perturbative models, *e.g.* :
  - Regge models
  - (G)VMD
- rich physics at low x
  - BFKL (g_1 governed by $ln^2(1/x)$ in the low x region)
  - parton saturation
- unfortunately in COMPASS low x is correlated with low Q^2

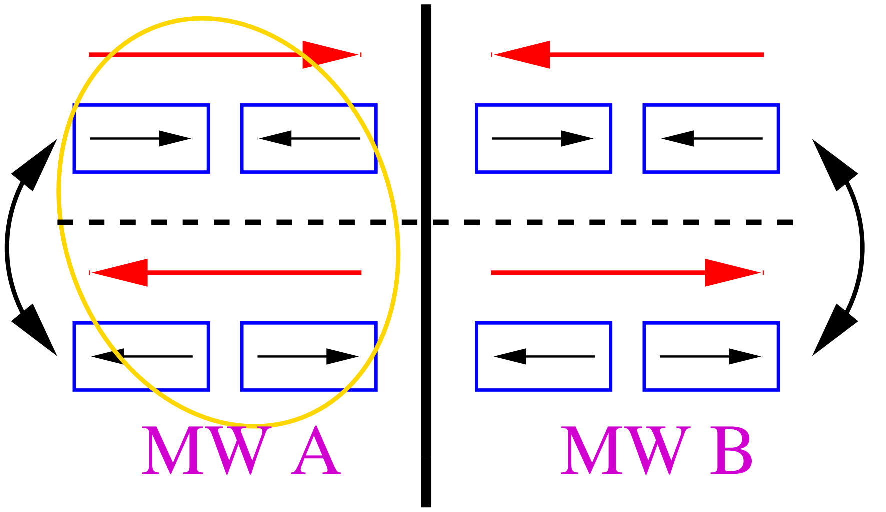
DATA SAMPLE AND CUTS

- $Q^2 < 1.0$ GeV^2
- $x > 4 \cdot 10^{-5}$
- $0.1 < y < 0.9$
- ....
- there is at least one additional track outgoing from the PV
- $\theta_{h-\gamma^*} > 0.005$; elastic μe scattering rejection ($x_{\mu e} \approx 0.0005$)

- final data sample: about 300 million events

METHOD

- $A_1^d = \frac{\sigma_0^T - \sigma_2^T}{2\sigma^T}$ $A_2^d = \frac{\sigma_0^{TL} + \sigma_1^{TL}}{2\sigma^T}$
- $g_1^d = \frac{F_2^d}{2x(1+R)} A_1^d$
- $A_{raw} \sim A_{||}$
- $A_{||} = D(A_1^d + \eta A_2^d)$
- $\eta A_2 \approx (\sqrt{Q^2}/\nu) A_2^d \approx 0$
- $N_i = a_i \phi_i n_i \bar{\sigma}(1 + P_t P_b f D A_1^d)$; $i = 1...4$
- ratio $\frac{N_1 N_4}{N_3 N_2} \sim a(A_1^d)^2 + b(A_1^d) + c$
- weighted method used
  - $w = f D P_b$
  - P_t is not in the weight since $\partial P_t / \partial t \neq 0$
  - $< w > P_t \approx 0.06$



SYSTEMATIC STUDIES

- extended systematic studies were performed
- final data sample and elastic scattering μe sample were used
- MC simulation used only occasionally

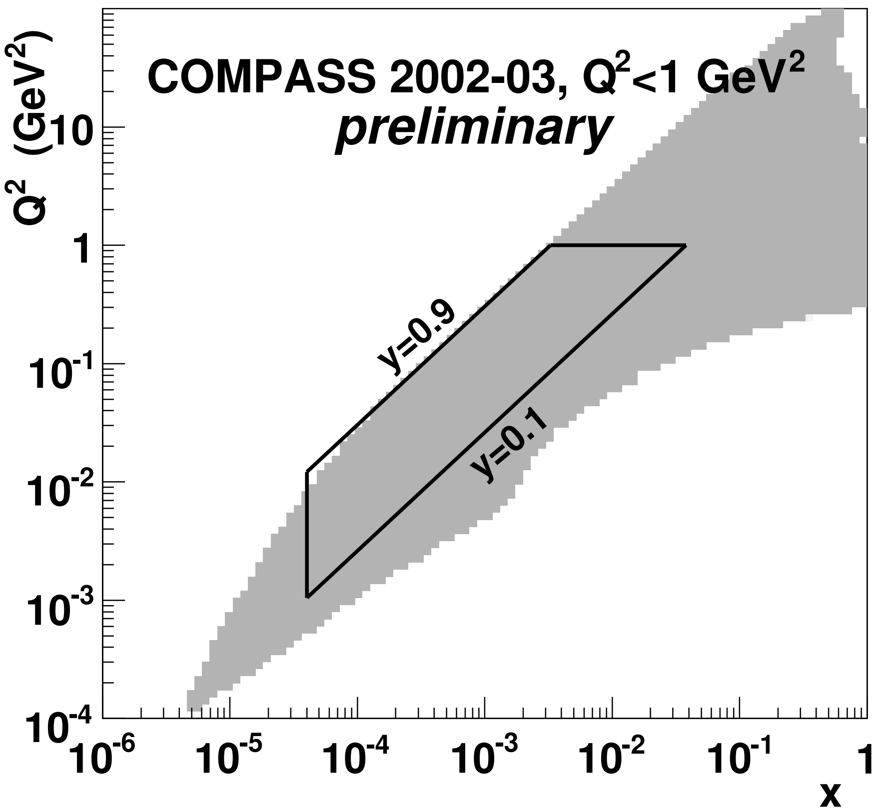
CONTRIBUTIONS TO THE TOTAL SYSTEMATIC ERROR

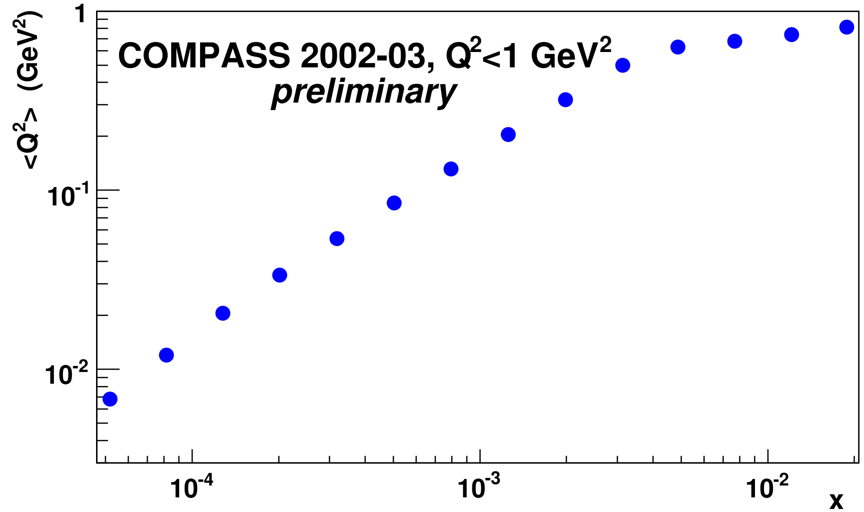
- δP_b, δP_t, δD, δf
- $\delta F2$ (for g_1^d)
- the false asymmetries (dominate, $A_{false} \sim \delta A^d_{1,Stat}$)
- vertex smearing
- electrons from photon conversion
- A_2^d contribution
- polarized radiative corrections

RESULTS

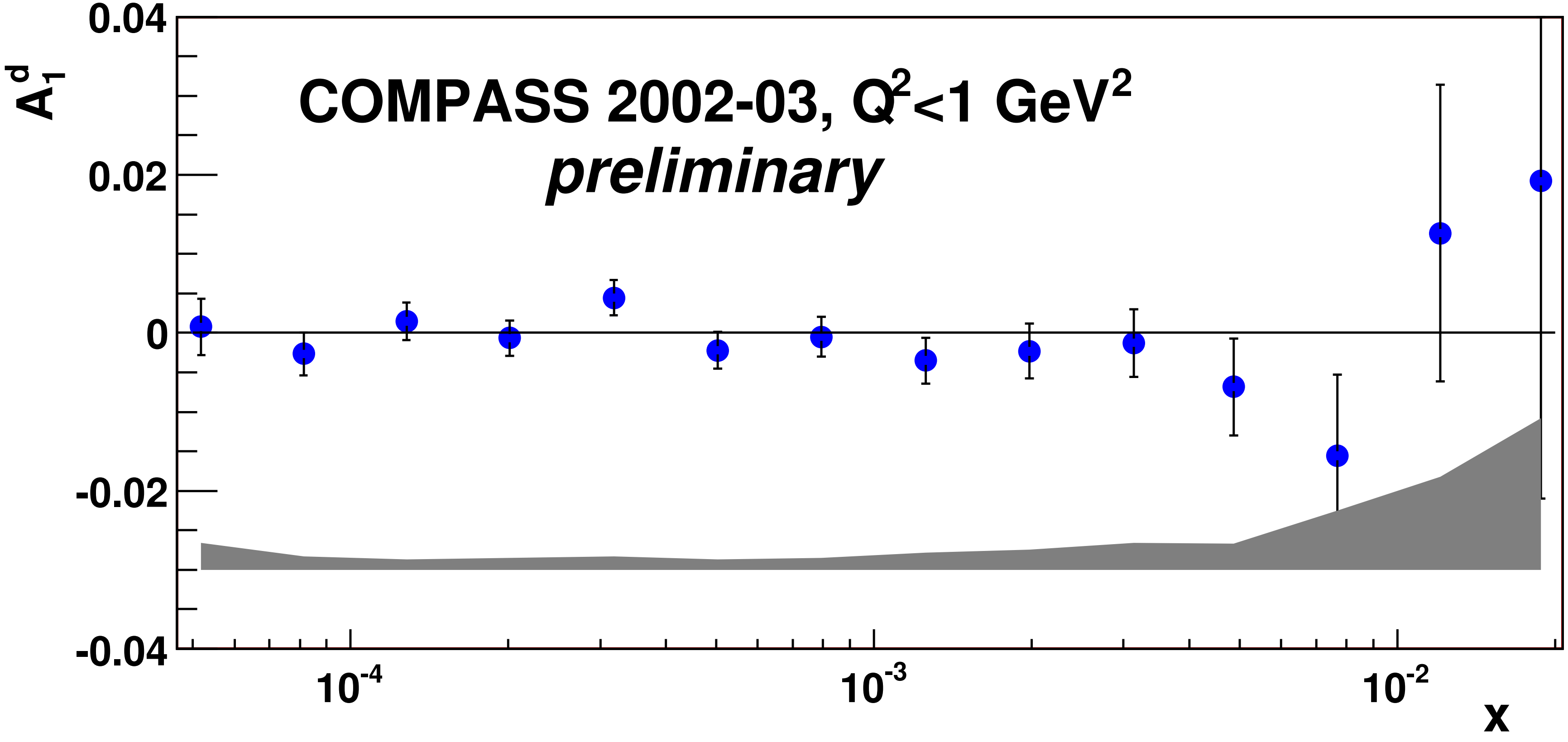
COMPASS ACCEPTANCE

COMPASS 2002+2003 acceptance and kinematic range for this analysis



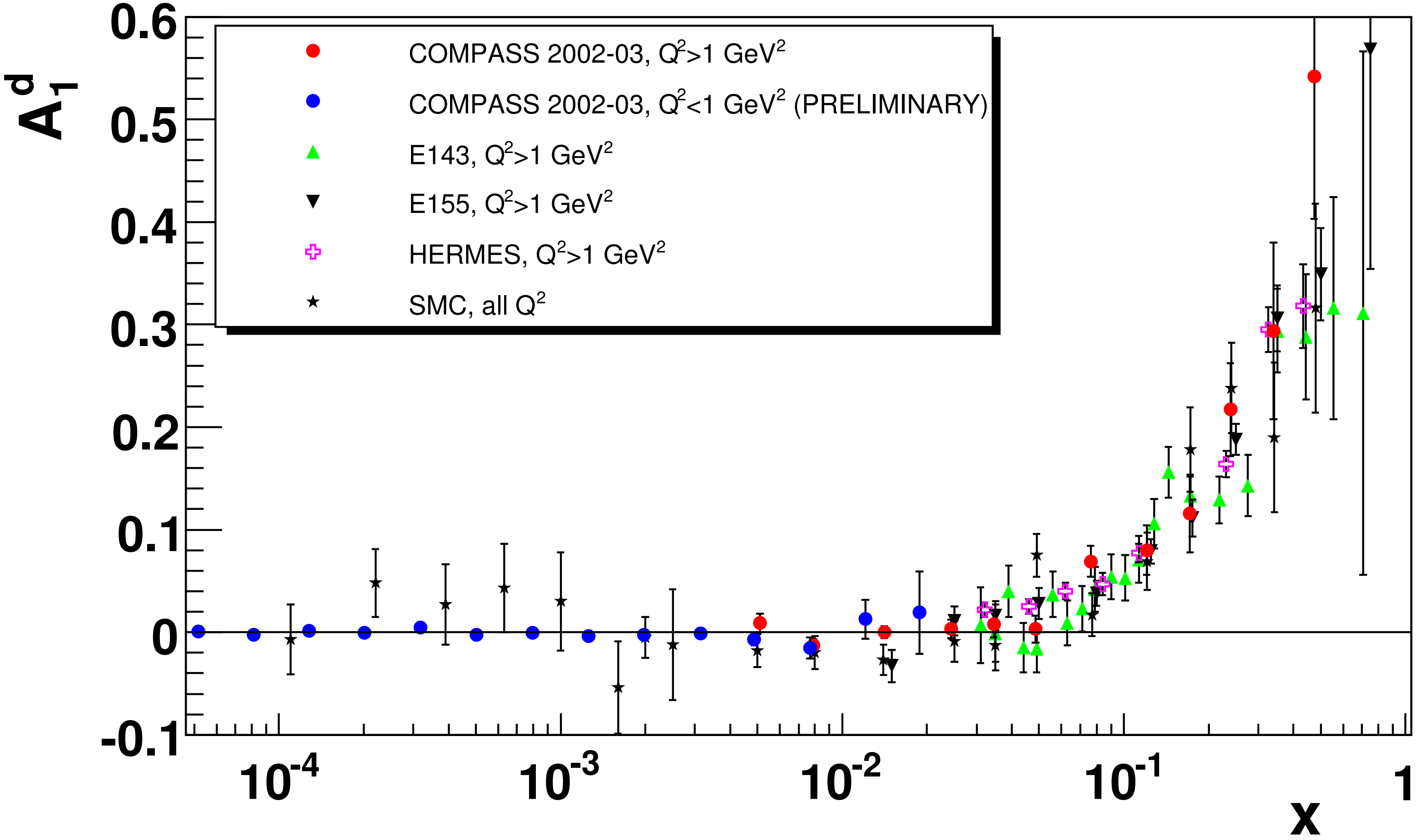


A_1^d



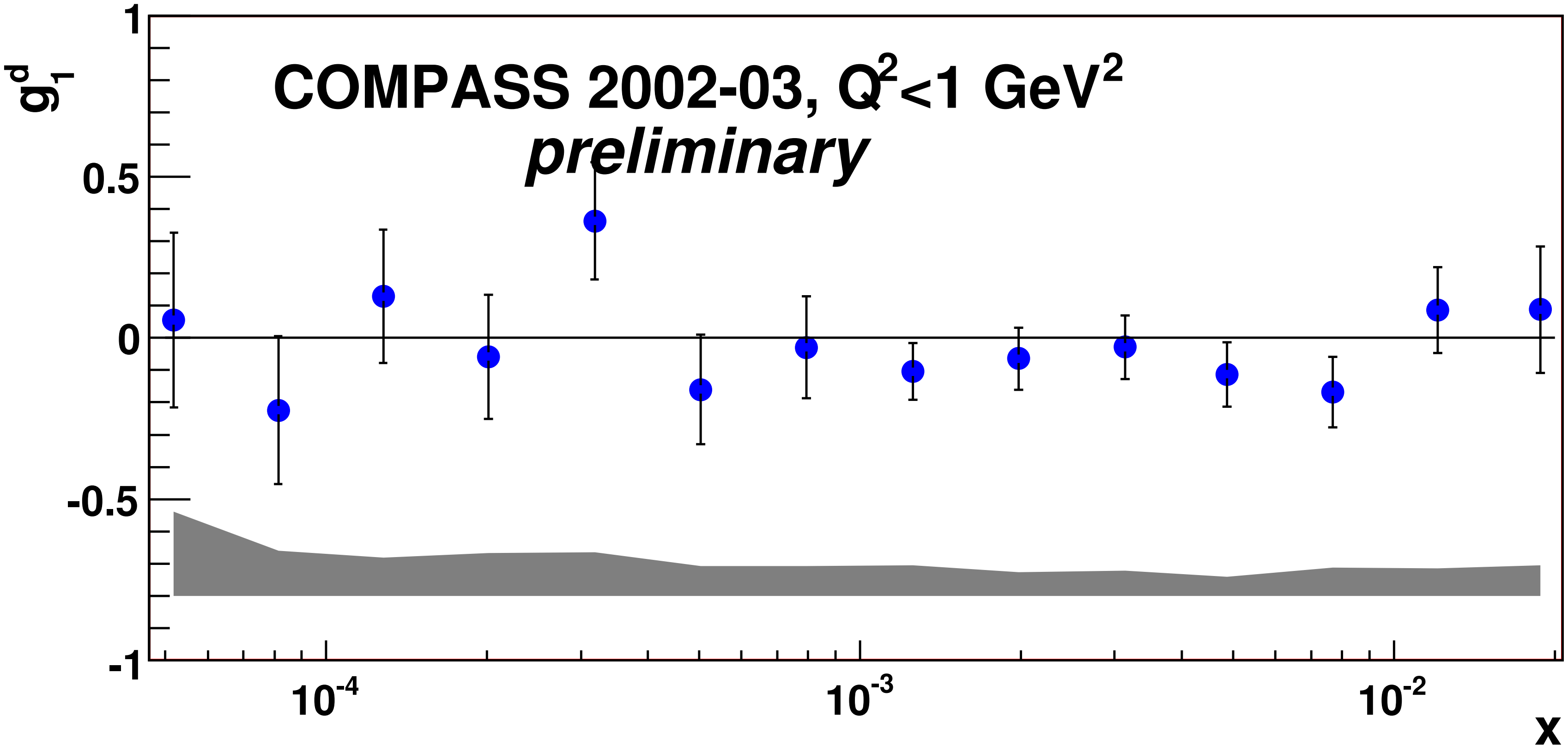
main contribution to systematic error comes from false asymmetries

A_1^d WORLD DATA



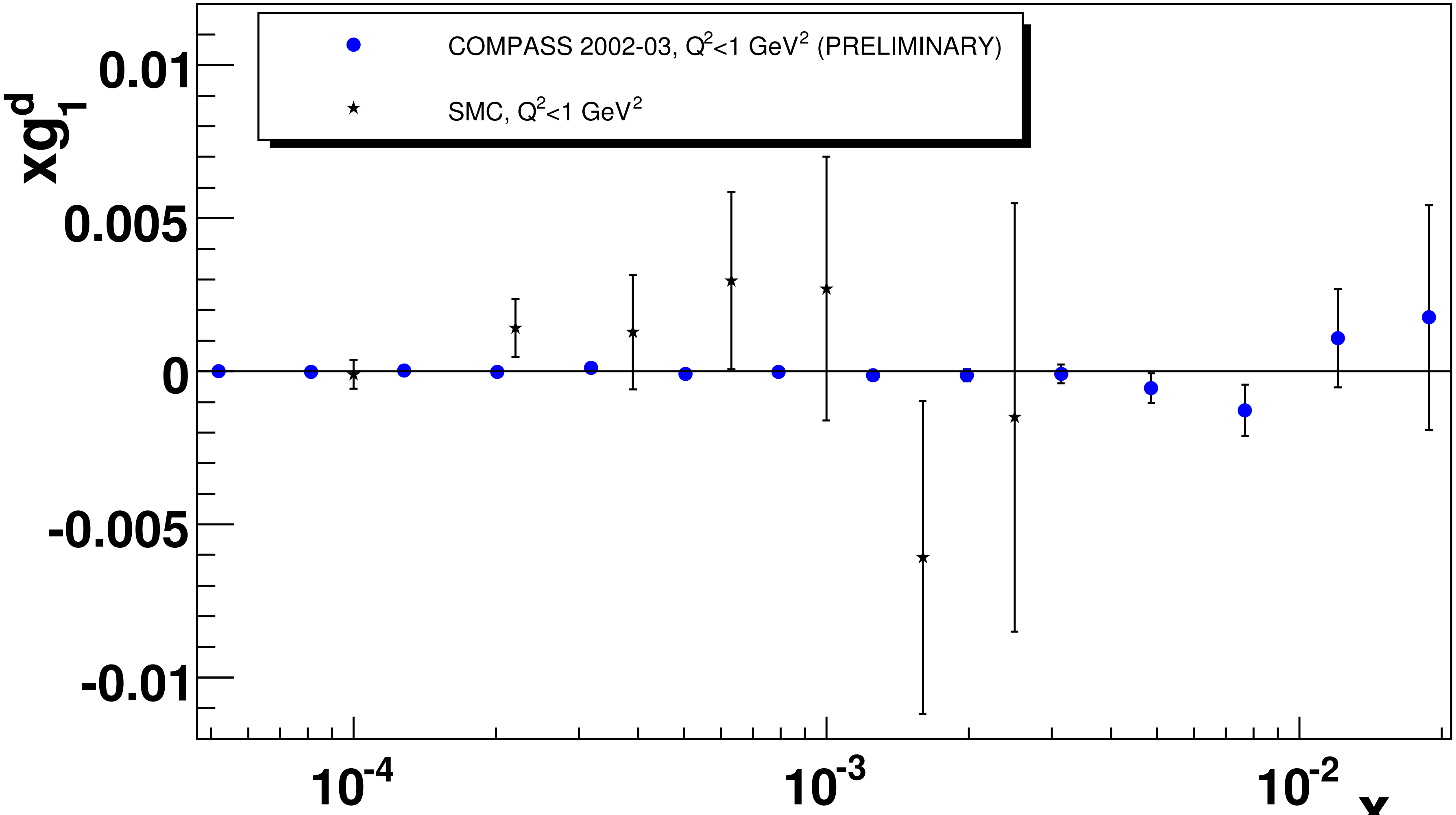
Compared to SMC, COMPASS has 10-20 times lower statistical errors in low x, Q^2 region.

g_1^d



NOTE: F_2 taken from the standard SMC parametrization (SMC fit + JKBB)

g_1^d WORLD DATA



SUMMARY

- new results for the A_1^d and g_1^d for $Q^2 < 1$ GeV^2 have been presented
  - A_1^d and g_1^d are compatible with zero in low x and low Q^2 range
  - statistical error of A_1^d and g_1^d are reduced 10-20 times compared to SMC at low x, Q^2
- new results of A_1^d and g_1^d for $Q^2 > 1$ GeV^2 are expected soon
- new results of QCD analysis are expected soon