New Measurements of $\frac{\Delta G}{G}$ at COMPASS

Susanne Koblitz,
Universität Mainz

on behalf of the COMPASS Collaboration

Outline

- Spin Structure & Measurement
- COMPASS Experiment
- $\frac{\Delta G}{G}$ in Open Charm
- $\frac{\Delta G}{G}$ from High p_T Hadron Pairs
- Conclusion

Spin Structure of the Nucleon

Nucleon:

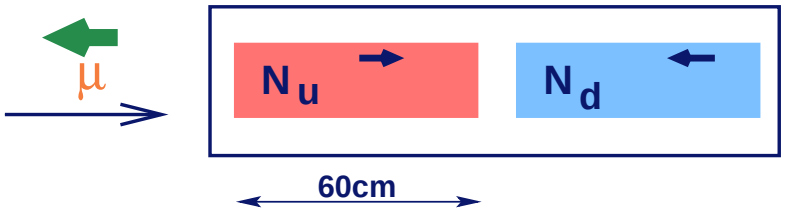
- composition: quarks, gluons
  - spin: $\frac{1}{2}$ $\rightarrow$ spin composition?

$$< \mathbf{S_z^N} > = \mathbf{\frac{1}{2}} = \frac{1}{2}\Delta\Sigma + \Delta G + < L_Z >$$

- quark contribution:
  - naive parton model (+rel.corr.): $\Delta\Sigma = 0.6$
  - experiments at CERN, SLAC, DESY: $\Delta\Sigma \approx 0.3$
- **How about the gluon contribution?**

Measurement of Spin Contributions

- DIS: polarised leptons on polarised target
- GOAL: measure $A_{||} = \frac{\sigma^{\uparrow\Downarrow} - \sigma^{\uparrow\Uparrow}}{\sigma^{\uparrow\Downarrow} + \sigma^{\uparrow\Uparrow}}$
- use counting rates: $A_{exp} = \frac{N_u - N_d}{N_u + N_d}$



- experimental asymmetry: $A_{exp} = p_\mu \, p_t \, f \, A_{||}$

  (f:dilution factor, $p_{\mu,t}$: beam,target polarisation)
- Target: 2 cells (60 cm), ^{6}LiD, >50% polarised

COMPASS Detector

2 stage spectrometer:

large angle: SM1 $\approx$ 1 Tm

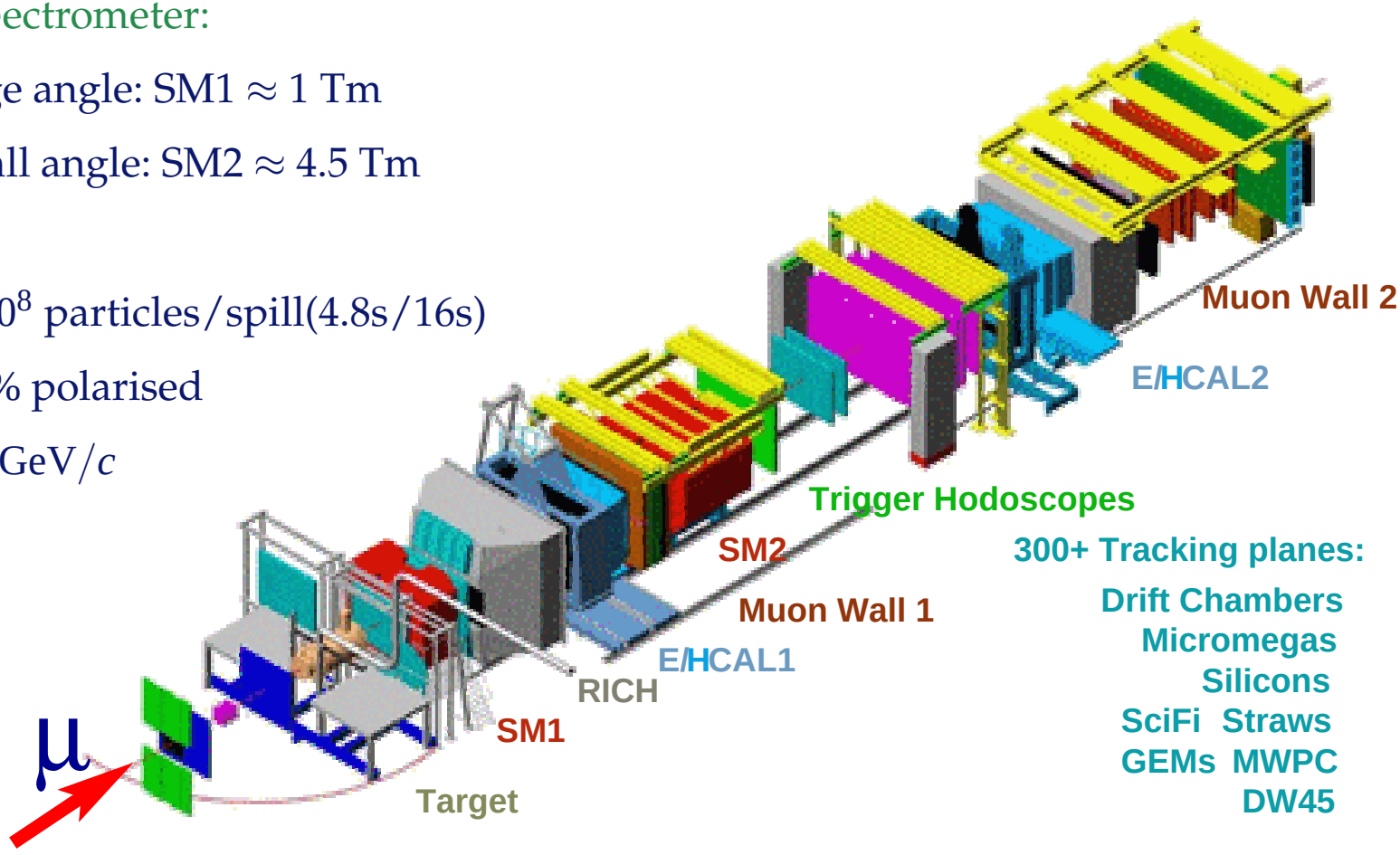
small angle: SM2 $\approx$ 4.5 Tm

μ beam:

$2 \cdot 10^8$ particles/spill(4.8s/16s)

-76% polarised

160 GeV/c

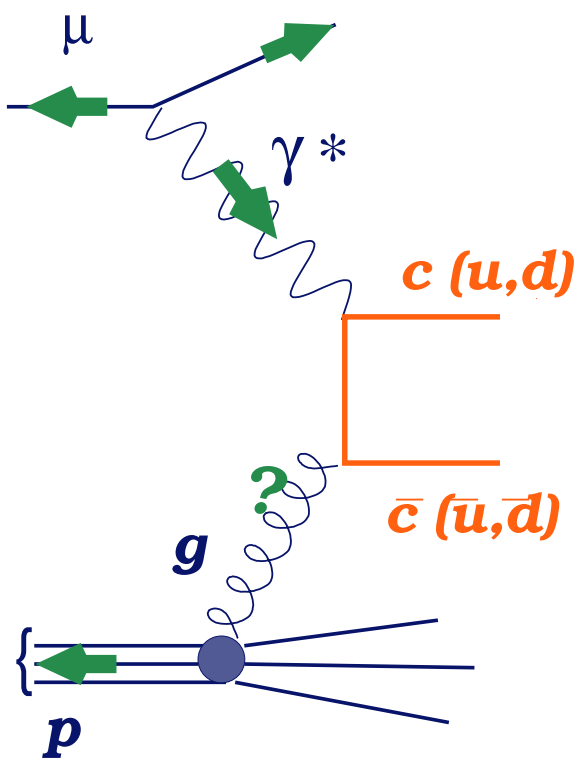


300+ Tracking planes:

Drift Chambers
Micromegas
Silicons
SciFi Straws
GEMs MWPC
DW45

ΔG in COMPASS

GLUON in DIS: LO process: photon-gluon fusion



PGF Tags:

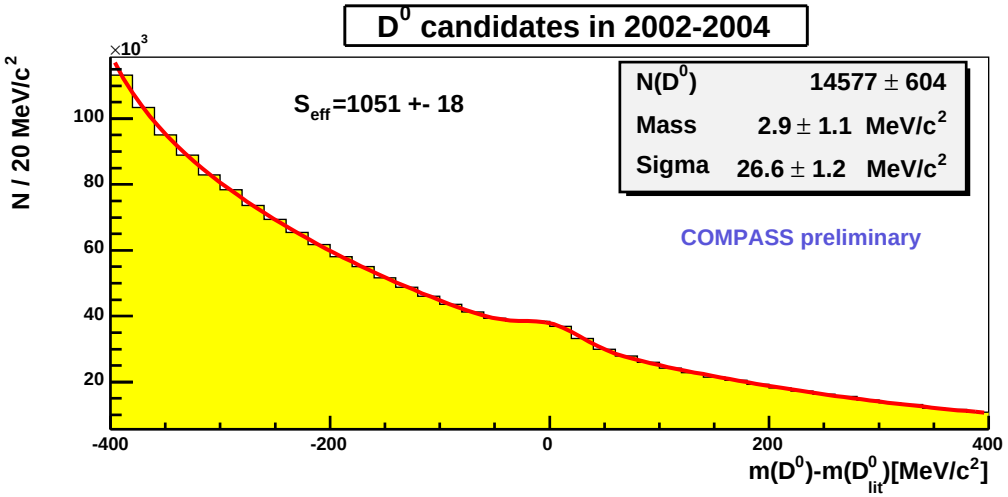
- open charm
  - no physical background
  - hard scale: $\hat{s} = 4m_c^2$

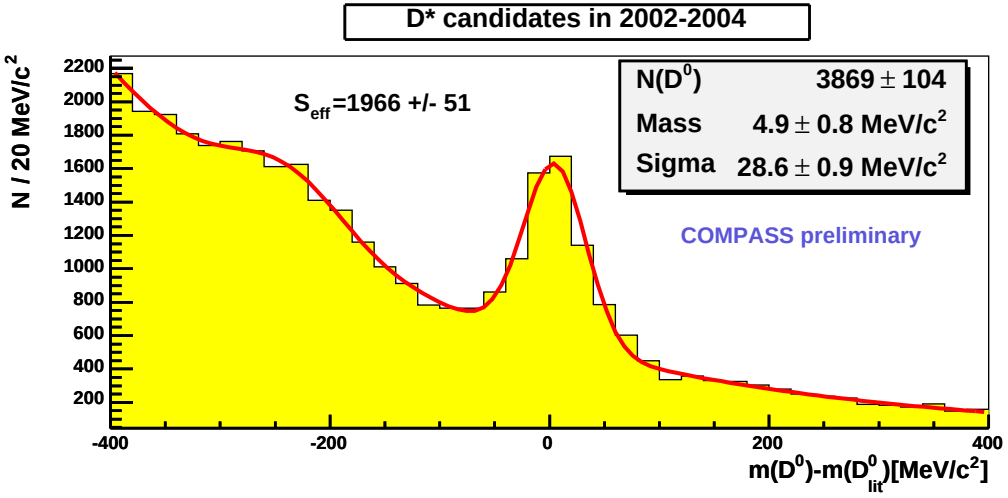
  BUT low statistics
- high p_T hadron pairs
  - light quarks from PGF
  - scale: $\sum p_T^2$
  - large statistics

  BUT competing processes

D Meson Reconstruction

- open charm tag: **reconstructed D-mesons**

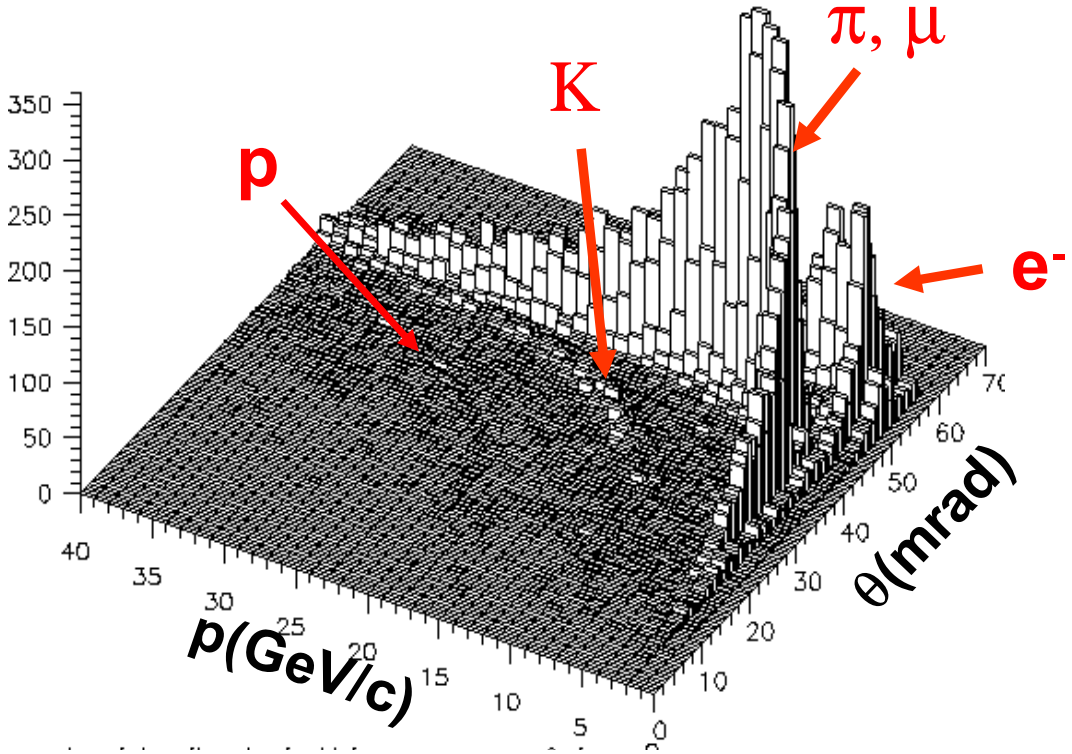


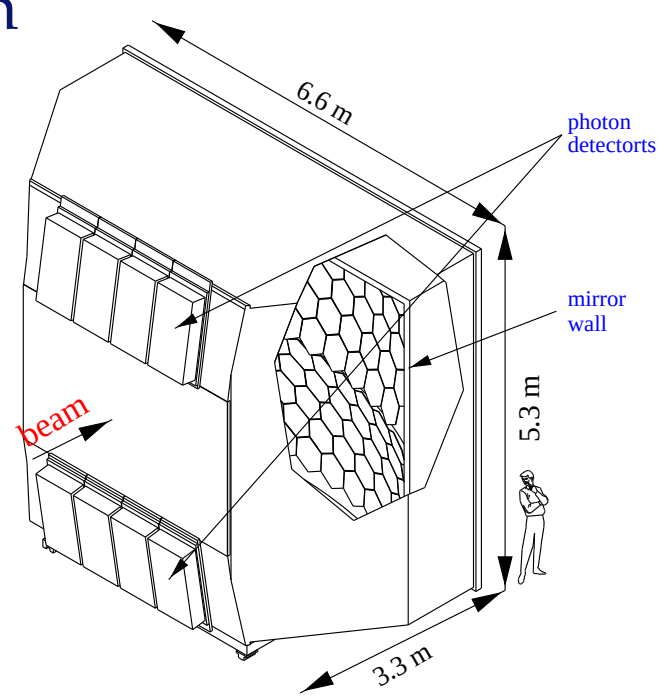


- thick target: no decay vertex
- track based reconstruction
- two channels:
  - $D^0 \rightarrow (K\pi)$, **no $D^\star$ tag**
  - $D^\star \rightarrow (K\pi)\pi_{slow}$
- selection criteria:
  - D^0 kinematics: z_{D^0}, $cos\theta^\star$
  - π_{slow} for $D^\star$ tag: δm
  - PID (next slide)

PID with the RICH

- RICH: K/π separation up to 50 GeV/c
- for D-mesons: **kaon** identification

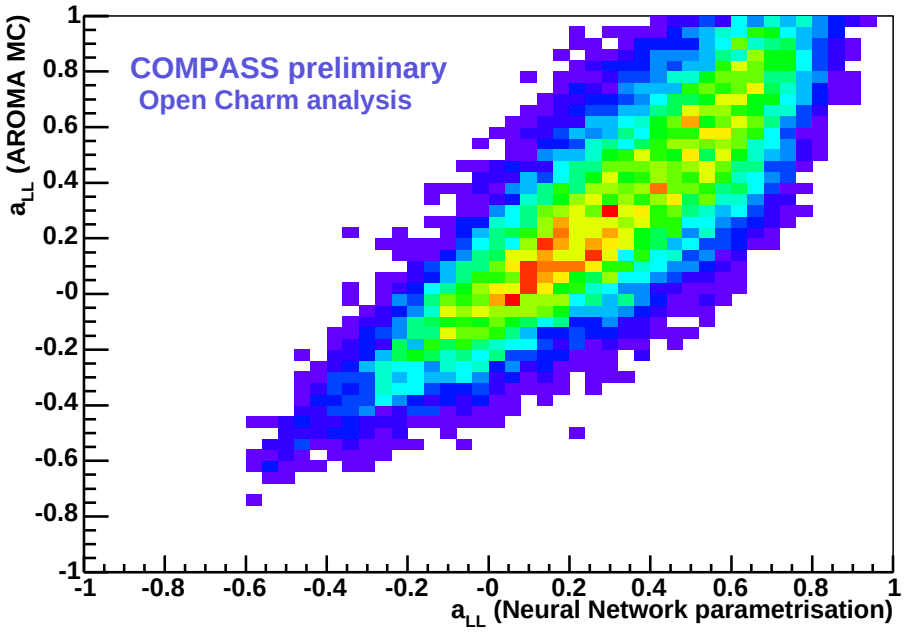




Analysing Power

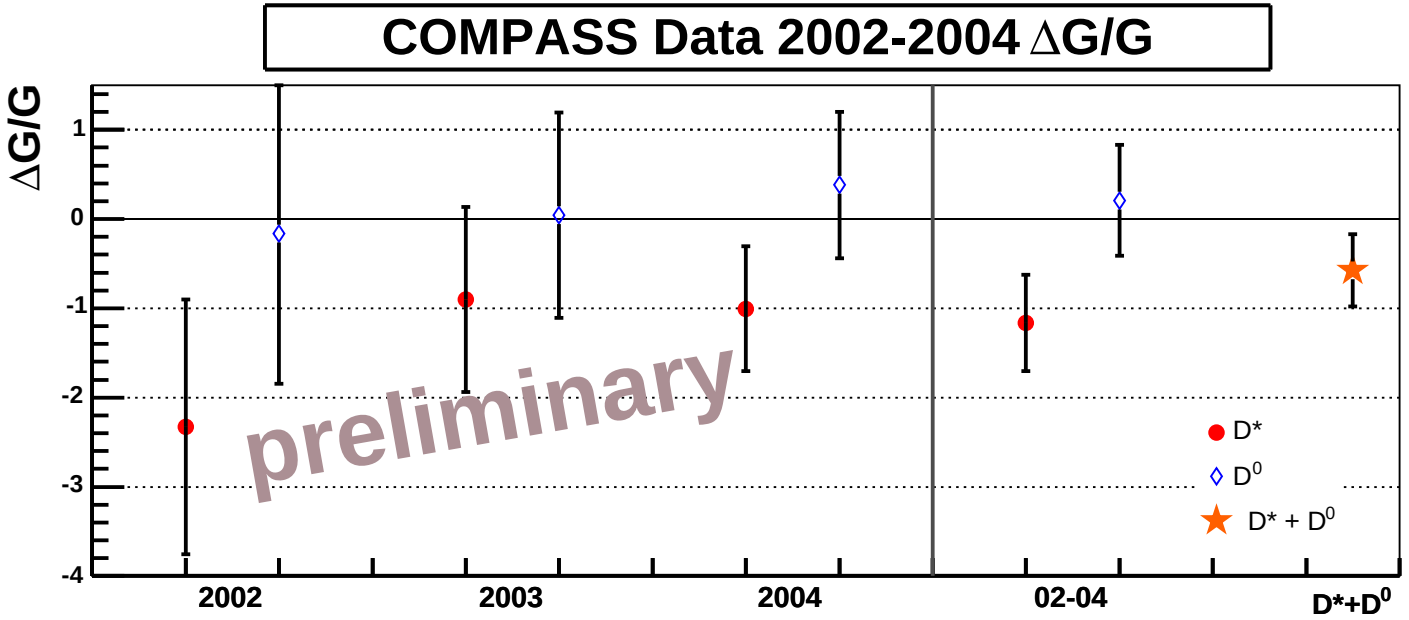
PGF events: $\frac{A_{||}}{D} = \frac{\int d\hat{s}\,\Delta\sigma^{PGF}(\hat{s})\,\Delta G(x_g,\hat{s})}{\int d\hat{s}\,\sigma^{PGF}(\hat{s})\,G(x_g,\hat{s})} \approx < a_{LL} > \frac{\Delta G}{G}$

D: Depolarisation factor



- needs MC information
- good description of data
- NN trained with AROMA
- improved correlation

$\frac{\Delta G}{G}$ from Open Charm (preliminary)

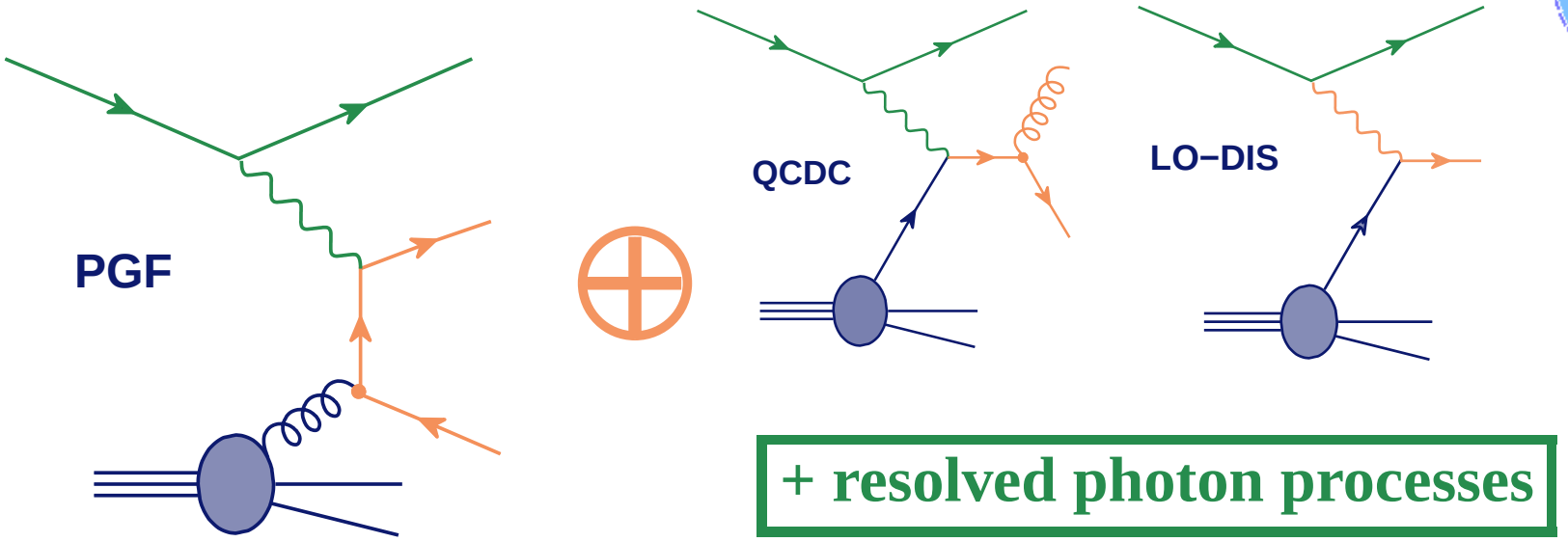


- optimise statistics: event weighting
- calculate $\frac{\Delta G}{G}$ for each year/channel

$$\frac{\Delta G}{G} = -0.57 \pm 0.41 \pm \text{syst.(under study)}$$

$$\mu^2 \sim 13\,(\text{GeV}/c)^2\,,\; x_G \sim 0.15$$

High p_T : Measurement Principle



+ resolved photon processes

- more physics background: Monte Carlo for event fractions and $< a_{LL} >$
- 2 separate analysis:

  $Q^2 > 1\,\mathrm{GeV}^2$: no resolved photons, low statistics, scale: Q^2, LEPTO-MC

  $Q^2 < 1\,\mathrm{GeV}^2$: large statistics, scale: $\sum p_T^2$, PYTHIA-MC

- event selection:
  - high p_T : $p_{T,1}, p_{T,2} > 0.7\,\mathrm{GeV}/c$ and $p_{T,1}^2 + p_{T,2}^2 > 2.5\ (\mathrm{GeV}/c)^2$
  - current fragmentation: $x_F > 0.1$ and $z > 0.1$
  - event kinematics: $0.1 < y < 0.9$ and $x < 0.05$ ($\leftarrow$ background asymmetry)

High p_T : Preliminary Results

high Q^2:(2002+2003 DATA)

$$\frac{\Delta G}{G} = 0.06 \pm 0.31\,(\text{stat}) \pm 0.06\,(\text{syst})$$

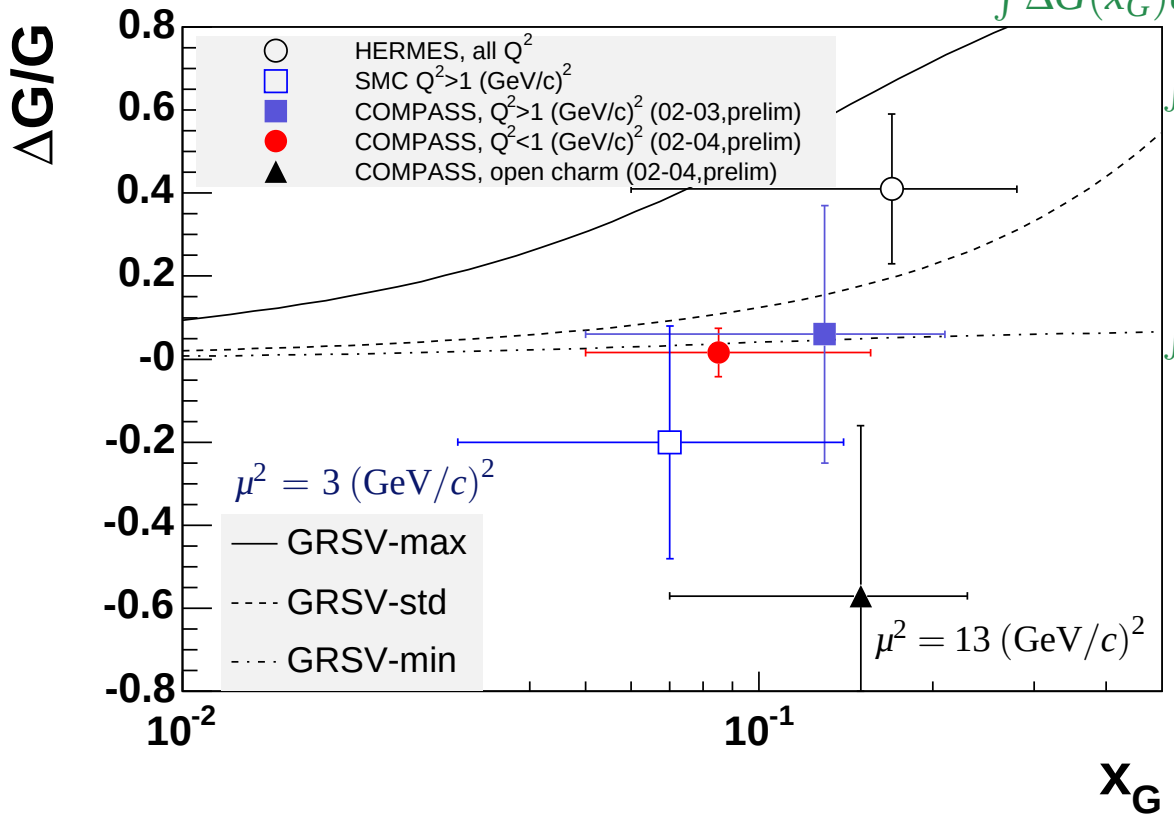
$x_G \sim 0.13$ and $\mu^2 = 3\,(\text{GeV}/c)^2$

low Q^2: 2002+2003+2004 DATA

$$\frac{\Delta G}{G} = 0.016 \pm 0.058\,(\text{stat}) \pm 0.055\,(\text{syst})$$

$x_G \sim 0.085$ and $\mu^2 = 3\,(\text{GeV}/c)^2$

Conclusion



$\int \Delta G(x_G) dx_G = 2.5$

$\int \Delta G(x_G) dx_G = 0.6$

$\int \Delta G(x_G) dx_G = 0.2$

$\int \Delta G dx_G > 1$ **disfavoured**

$\frac{\Delta G}{G}(x_G \sim 0.1)$ **small**

- addition of 2004: significant improvement in statistics
- ongoing work: systematic studies, new methods, NLO...
- about to start 2006 run ☺