ΔG @ COMPASS:
PROSPECTS for the 2002 RUN

Yann Bedfer
Saclay

On behalf of the COMPASS collaboration

Bielefeld, Bochum, Bonn (ISKP), Bonn (PI), Burdwan and Calcutta, CERN, Dubna (LPP and LNP), Erlangen, Freiburg, Heidelberg, Helsinki, Mainz, Moscow (INR), Moscow (LPI), Moscow (State University), München (LMU), München (Technical University), Nagoya, Protvino, Saclay, Tel Aviv, Torino (University and INFN), Trieste (University and INFN), Warsaw (SINS), Warsaw (TU)

More than 200 physicists from 26 Institutes

ΔG

○ Polarised DIS @ SMC, SLAC, HERMES $\qquad \Gamma_1 = \int g_1(x, Q^2) dx$
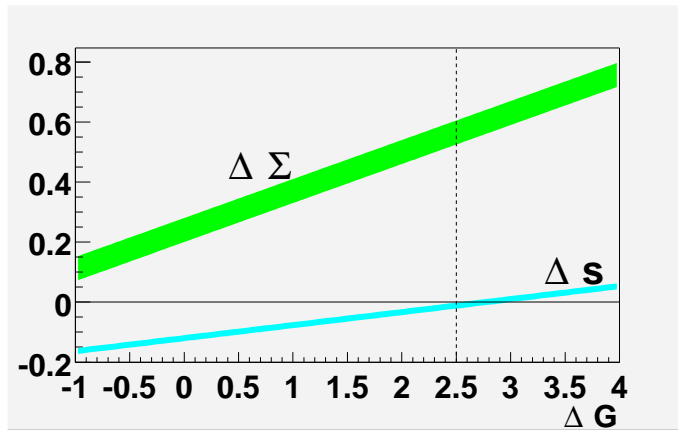
$\Rightarrow$ QPM analysis:

Fraction of Spin carried by Quarks $\ll$ Quark Model expectations.

$\Delta\Sigma = 0.27 \pm 0.04 \qquad \Delta s = -0.11 \pm 0.03 \qquad (@Q^2 = 3 GeV^2)$

○ Axial Anomaly of QCD introduces Gluon contributions to Polarised DIS

$\Rightarrow$ Contribution to $\Gamma_1 \ldots$
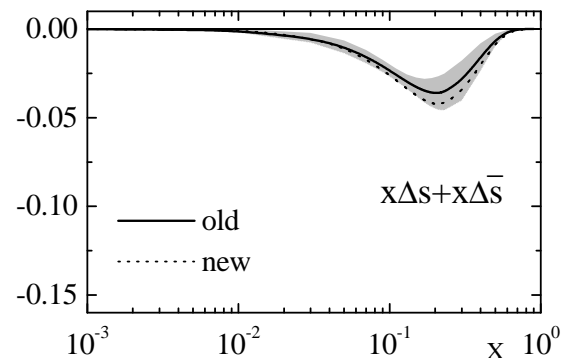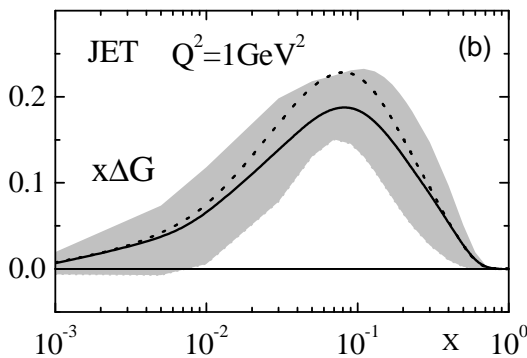

QCD improved QPM:

$\Delta\Sigma \rightarrow$
$\Delta\Sigma_{CI} - 3\alpha_s(Q^2)/2\pi \, \Delta G(Q^2)$
$\Delta s \rightarrow$
$\Delta s_{CI} - \alpha_s(Q^2)/2\pi \, \Delta G(Q^2)$

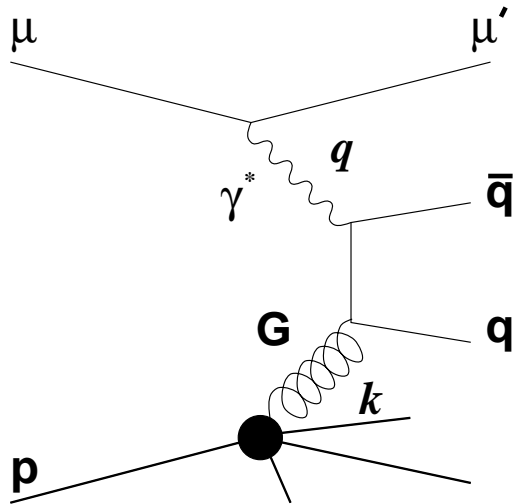$\Rightarrow$ ...or induced sea quark polarisation.

○ NLO QCD Fit: $\Delta G, \Delta s, \Delta\bar{s}$ hardly constrained.

Leader, Sidorov, Stamenov hep-ph/0111267

$\Rightarrow$ Independent Determination of ΔG Needed (to better than $\pm.5$).

MEASUREMENT of ΔG: PGF

○ Open Charm

$$\gamma^* N \longrightarrow c\bar{c} \ X$$
$$D^0 \longrightarrow K \ \pi$$
$$D^* \longrightarrow D^0 \ \pi_s \longrightarrow K \ \pi \ \pi_s$$
$$\mathrm{BR}(D \to K\pi) \simeq 4\%$$

○ High p_T Hadron Pairs

Competing processes:
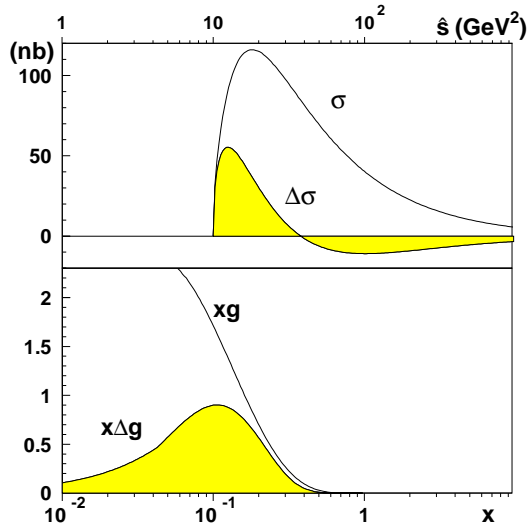· Leading order $\gamma q \to q$
· QCD Compton $\gamma q \to qg$

Opposite charge:	$h^+ h^-$
Back to Back:	$\Delta\phi = 180° \pm 30°$
Transverse Momentum	$p_T > 1 GeV/c$
Flavour	$K^+ K^-$

PROPOSAL EXPECTATIONS

$\sigma/\Delta\sigma_{\gamma g \to c\bar{c}} @ \nu = 50 \ GeV$

Parameterization
of $G/\Delta G(x_g = \hat{s}/2M\nu)$

Optimum photon energies $35 \ GeV \ < \ \nu \ < \ 85 \ GeV$
$+$ Large Depolarisation factor $D = A_{\mu N \to c\bar{c}} \ / \ A_{\gamma^* N \to c\bar{c}}$
$\Rightarrow$ Beam Energy $= 100$ GeV

$\Rightarrow \sigma_{\mu N \to c\bar{c}} \ (\ 25 < \nu < 85 \ GeV \ ) \ = \ 2 \ nb \qquad \sigma^{\gamma} \ = \ 500 \ nb$

$\Rightarrow$ High Rate $\qquad\qquad \Rightarrow \quad 10^4$ Trigger/s 300 TByte/year
Particle identification $\quad \Rightarrow \quad$ RICH
Large dynamical Range $\quad \Rightarrow \quad$ Two-Stage Spectrometer

$\circ$ Monte Carlo Analysis:
$\cdot \ D^0$ Transverse momentum: $p_T < 1 \ GeV \Rightarrow$ Smaller $\hat{s} \Rightarrow$ Higher a_{LL}
$\cdot$ Decay angle in the D^0 frame: $|\cos\theta^*| < .5 \Rightarrow$ Higher S/B

$\Rightarrow \boldsymbol{\delta(\Delta G/G) \ = \ 0.11} \qquad$ in 1.5×150 days $(\boldsymbol{2.9 fb^{-1}})$
$\boldsymbol{0.08 \ < \ x_g \ < \ 0.35}$

FULL PHYSICS PROGRAM

○ **ΔG**

+ Inclusive DIS including large Q^2 data.
+ Semi-inclusive DIS:
    Flavour Decomposition of Longitudinal Spin Distribution.
+ Transverse Spin Distribution.
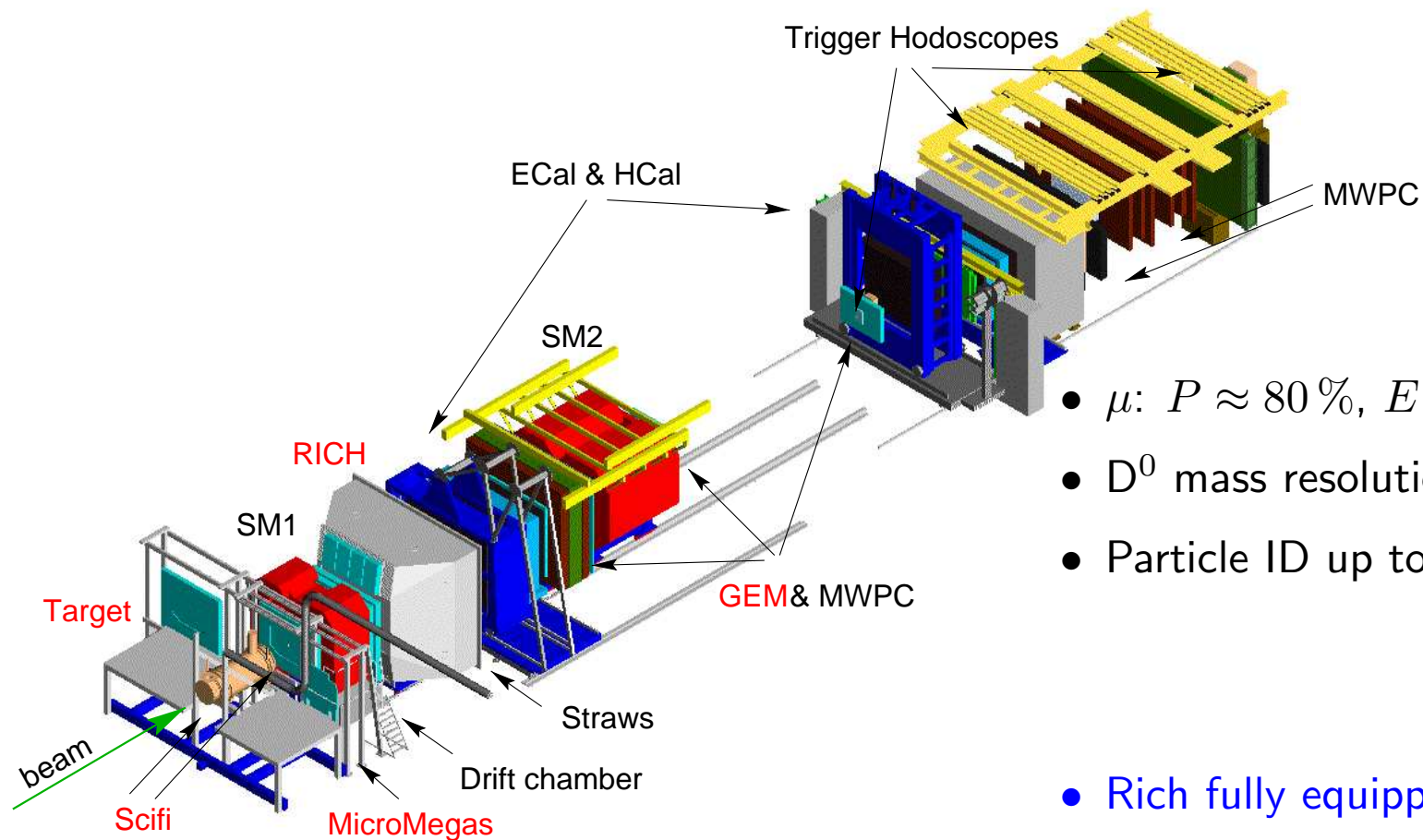+ Λ $\bar{\Lambda}$ Polarisation.

○ Physics with hadron beams.

http://wwwcompass.cern.ch/compass/proposal

• 1997 Approved by CERN.

• 2001 Commissioning Run.

• 2002 First Data Taking.

The COMPASS Spectrometer in 2002

- μ: $P \approx 80\,\%$, $E = 160\,\text{GeV}$
- D^0 mass resolution $15\,\text{MeV}$
- Particle ID up to $60\,\text{GeV/c}$

- Rich fully equipped
- Full ΔG trigger available
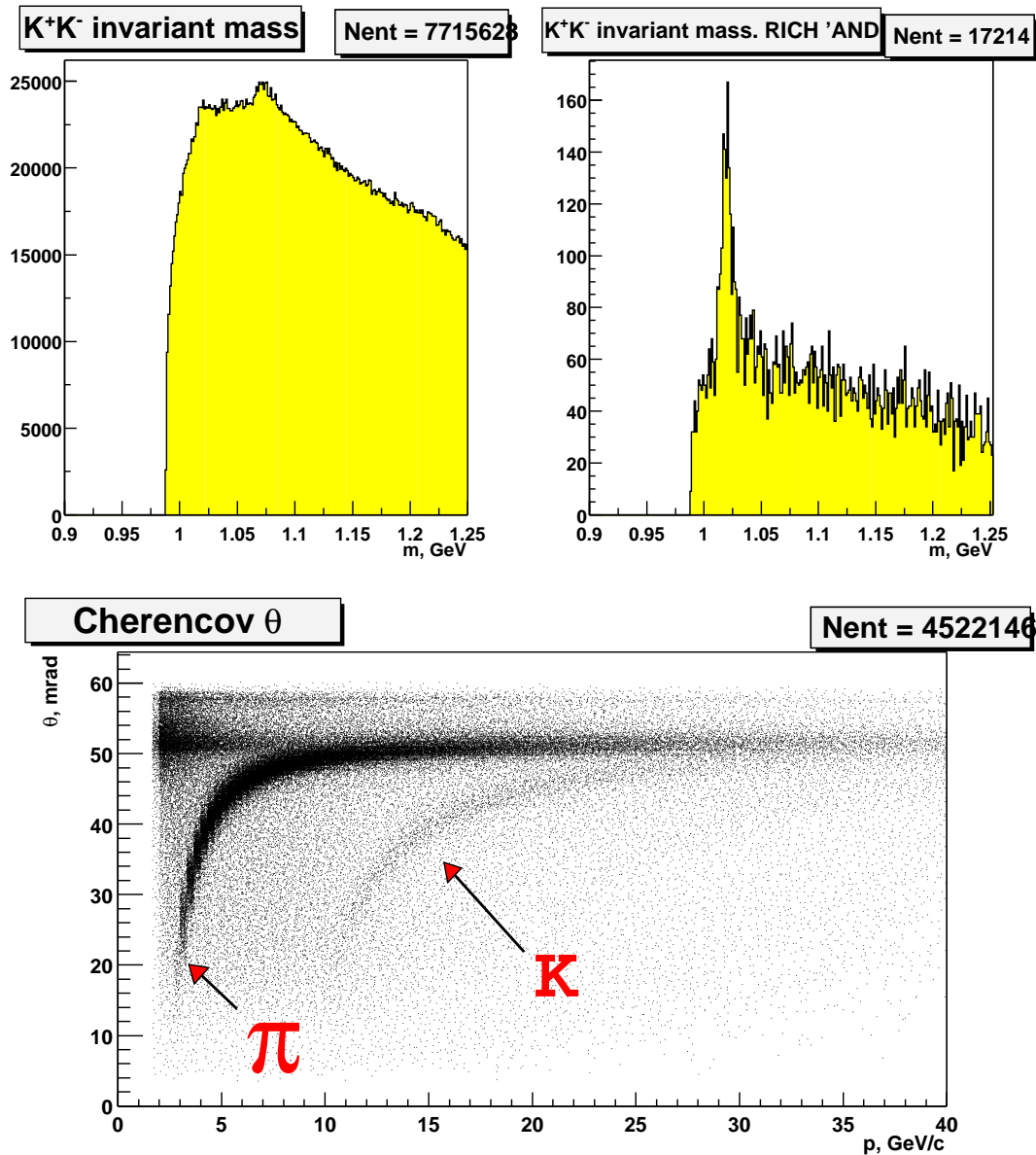
The Polarized ^{6}LiD Target

- Preliminary polarisation values: $P_{\mathsf{max}} = 55\,\%$.

- Spin relaxation times:

  - Longitudinal spin (2.5 T field): too long to be measured
  - Transverse spin (0.5 T field): 2000 hours
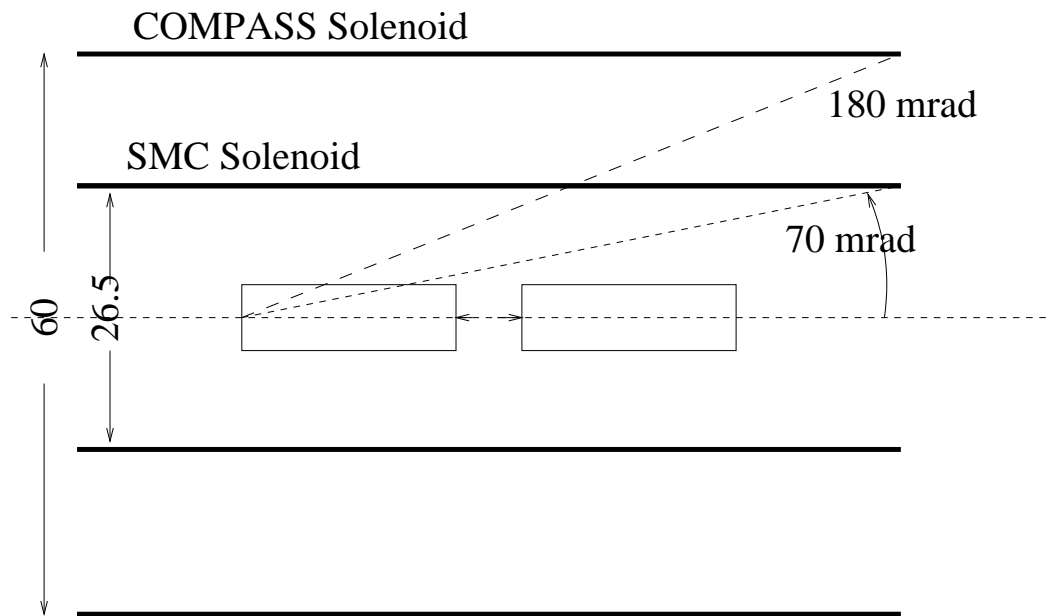 $\Rightarrow$ transversity, g_2.

PARTICLE ID with RICH

○ Not yet corrected for:
  · Misalignment of Mirrors and Photon Detectors.
  · Fluctuation in the refractive Index.
  · Background in Photon Detectors.

⇒ Preliminary

REDUCED ACCEPTANCE

COMPASS Solenoid

180 mrad

SMC Solenoid

70 mrad

60

26.5

REDUCED DATA TAKING TIME

110 days in 2002 instead of 150.

RESOLUTION on $\Delta G/G$ in 2002 vs. PROPOSAL EXPECTATIONS

○ **Event by event weighting**

$\Delta G/G = (1/P_T P_\mu f)(\Sigma_i^{\uparrow\downarrow} w_i - \Sigma_i^{\uparrow\uparrow} w_i)/(\Sigma_i^{\uparrow\downarrow} w_i^2 + \Sigma_i^{\uparrow\uparrow} w_i^2)$.

$w = <a_{LL}>/(1 + B/S)$

○ **Reduced Acceptance**

| | OIS ($\sim 250 \ mrd$) | $\longrightarrow$ | SMC ($\sim 100 \ mrd$) |

$\Rightarrow$ Energy   100 GeV $\longrightarrow$ 160 GeV

- $\delta M(D^0) \quad \delta M(D^* - D^0)$ ↘
- $<a_{LL}^2>$ ↘
- $\sigma c\bar{c}$ ↗
- Affects preferentially low a_{LL} data.

○ **Reduced Data Taking Time**

1.5 × 150 days $\longrightarrow$ 80 days

	D^0	D^*
Proposal	0.35	0.29
Updated Full Setup	0.24	0.23
2002 (Reduced Setup)	0.27	0.26

Statistical resolution on $\Delta G/G$ for **80 days** of data taking

with 25% efficiency:

$\delta(\Delta G/G) = 0.18$ **$0.05 \ < \ x_g \ < \ 0.22$**

J.-M. Le Goff, http://wwwcompass.cern.ch/compass/notes,
note 2002-02.