Inclusive spin-dependend asymmetry A_1^d

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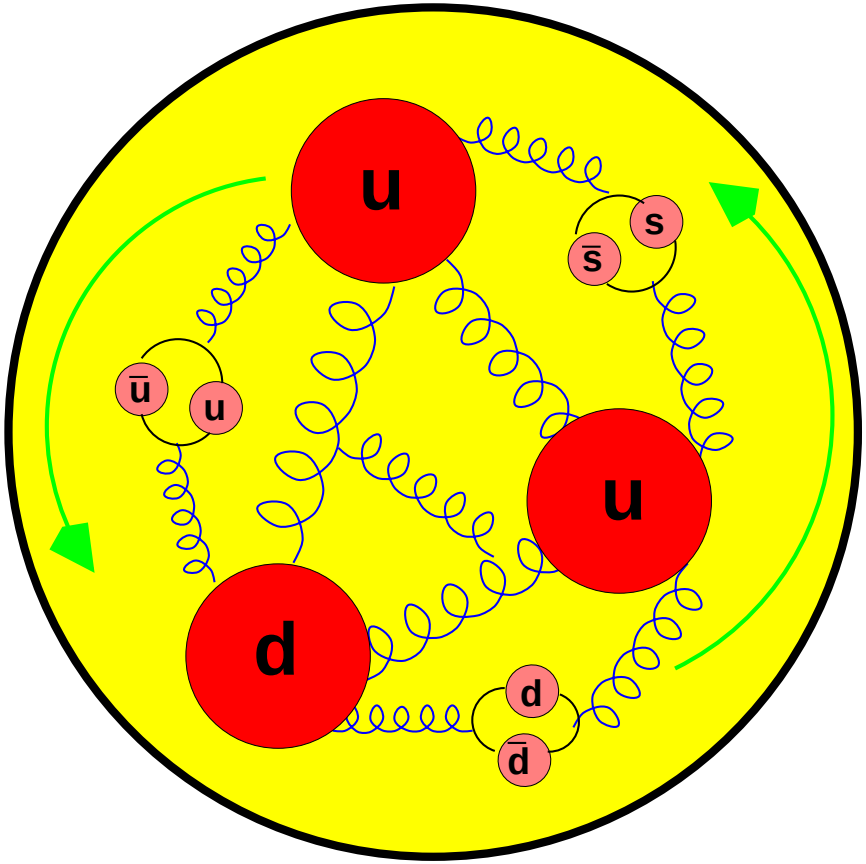
on behalf of the COMPASS Collaboration

Outline of the talk

- Introduction
- The COMPASS Experiment
- The Measurement of the Inclusive Asymmetry A_1^d
- The status of the Semi-Inclusive Asymmetry analysis
- Conclusion



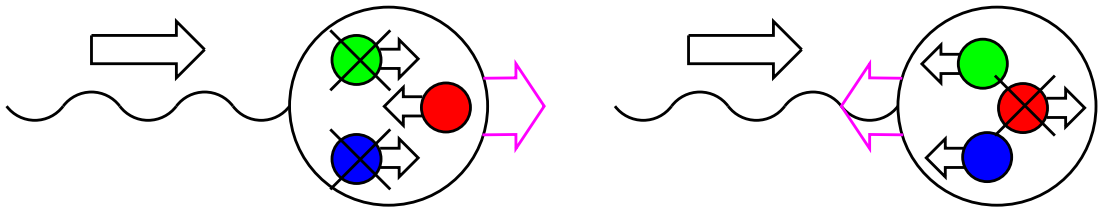
$$S_N = \frac{1}{2} = \frac{1}{2}\Delta\Sigma + \Delta G + L_q + L_g$$

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

$$\Delta q = q^{\uparrow\uparrow} - q^{\uparrow\downarrow} \qquad q = q^{\uparrow\uparrow} + q^{\uparrow\downarrow}$$

Polarised deep inelastic scattering

- **Photoabsorbtion:**



$$\sigma^{\uparrow\uparrow} = \sum_q e_q^2(q^{\uparrow\downarrow} + \bar{q}^{\uparrow\downarrow}) \qquad \sigma^{\uparrow\downarrow} = \sum_q e_q^2(q^{\uparrow\uparrow} + \bar{q}^{\uparrow\uparrow})$$

- **γ-nucleon asymmetry:**

$$A_1 = \frac{\sigma^{\uparrow\downarrow} - \sigma^{\uparrow\uparrow}}{\sigma^{\uparrow\downarrow} + \sigma^{\uparrow\uparrow}} = \frac{\sum_q e_q^2\left(q^{\uparrow\uparrow} - q^{\uparrow\downarrow} + \bar{q}^{\uparrow\uparrow} - \bar{q}^{\uparrow\downarrow}\right)}{\sum_q e_q^2(q^{\uparrow\uparrow} + q^{\uparrow\downarrow} + \bar{q}^{\uparrow\uparrow} + \bar{q}^{\uparrow\downarrow})} = \frac{\sum_q e_q^2(\Delta q + \Delta\bar{q})}{\sum_q e_q^2(q + \bar{q})}$$

Inclusive Asymmetry A_1

- **Inclusive DIS:**

- Detection of μ and μ'

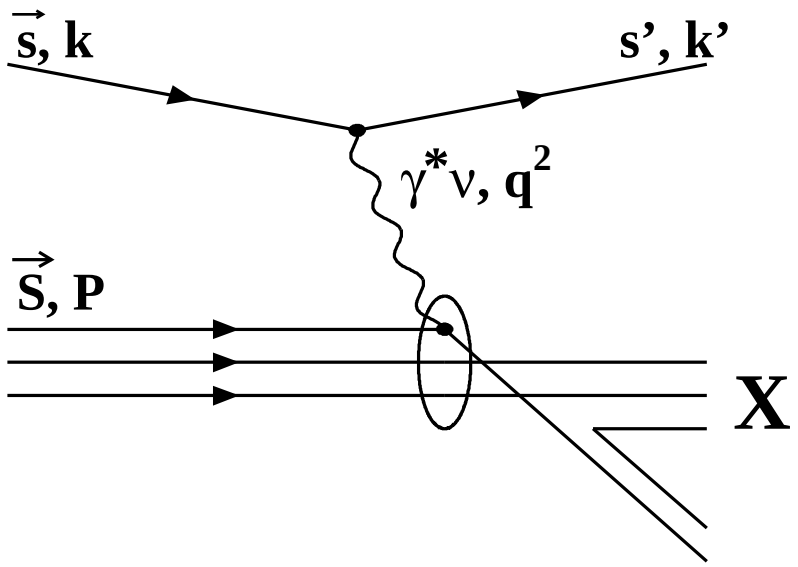
- Hadronic final state unobserved

- **μ - nucleon asymmetry:**

$$A_{\mu N} = \frac{1}{P_t f P_b} \left(\frac{N_{\uparrow\downarrow} - N_{\uparrow\uparrow}}{N_{\uparrow\downarrow} + N_{\uparrow\uparrow}} \right)$$

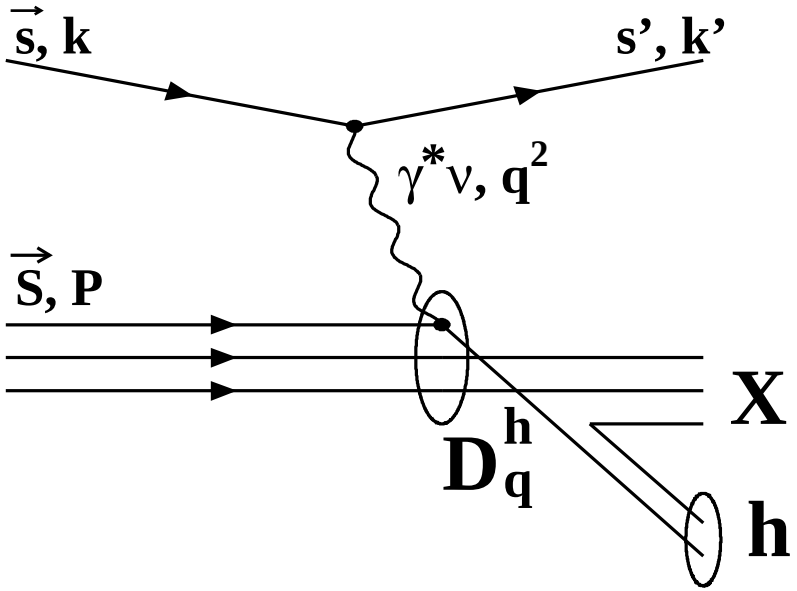
- **γ - nucleon asymmetry:**

$$A_1 = \frac{A_{\mu N}}{D} = \frac{\Sigma e_q^2 \left(\Delta q + \Delta \bar{q}\right)}{\Sigma e_q^2 \left(q + \bar{q}\right)}$$



- Δq and $\Delta \bar{q}$ can not be separated

Semi-Inclusive Asymmetries



- **Semi–inclusive Measurement:**
- Detection of μ and μ'
- Plus at least one hadron h
- Fragmentation independent of scattering
- Fragmentation function: $D_q^h(z)$ with $z = \frac{E_h}{\nu}$

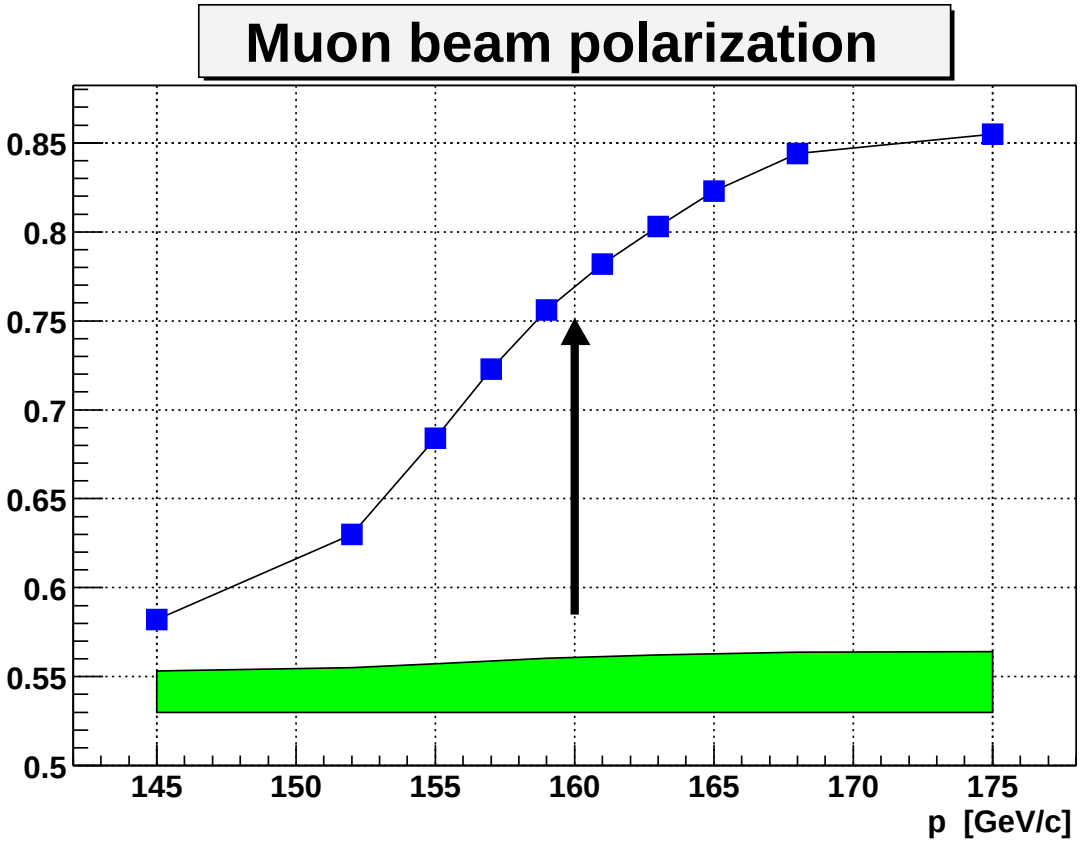
- **Asymmetries:**

$$A_1^h = \frac{1}{P_t f P_b D}\left(\frac{N^h_{\uparrow\downarrow} - N^h_{\uparrow\uparrow}}{N^h_{\uparrow\downarrow} + N^h_{\uparrow\uparrow}}\right) = \frac{\sum_q e_q^2\left(\Delta q(x)\int D_q^h(z)dz + \Delta\bar{q}(x)\int D_{\bar{q}}^h(z)dz\right)}{\sum_q e_q^2\left(q(x)\int D_q^h(z)dz + \bar{q}(x)\int D_{\bar{q}}^h(z)dz\right)}$$

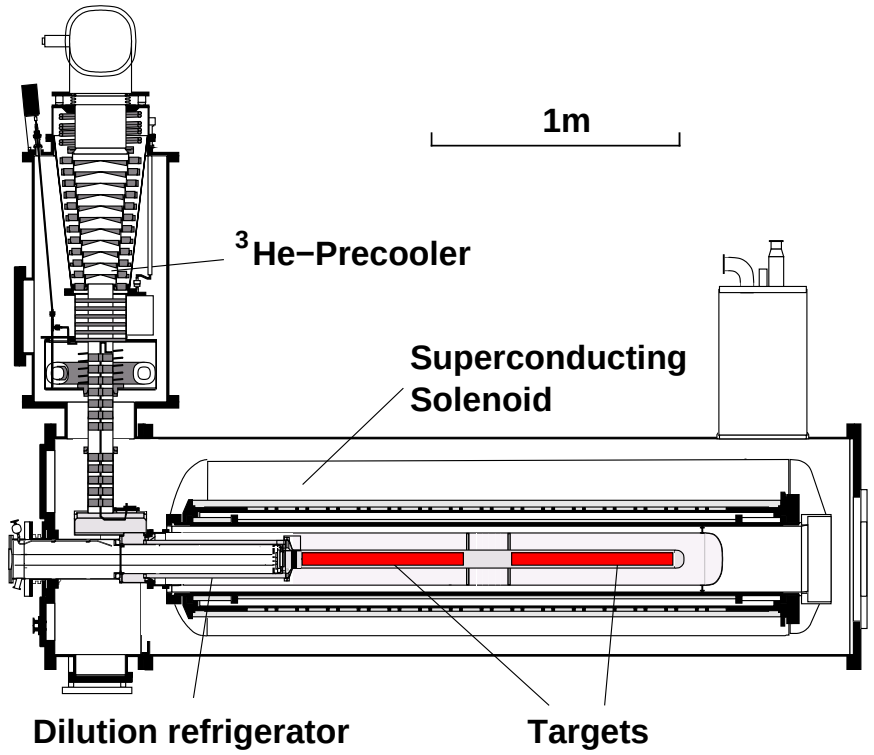
- since $D_q^h \neq D_{\bar{q}}^h$ quarks and anti-quarks can be separated
- Δu,$\Delta\bar{u}$, Δd, $\Delta\bar{d}$, Δs, $\Delta\bar{s}$ separation possible

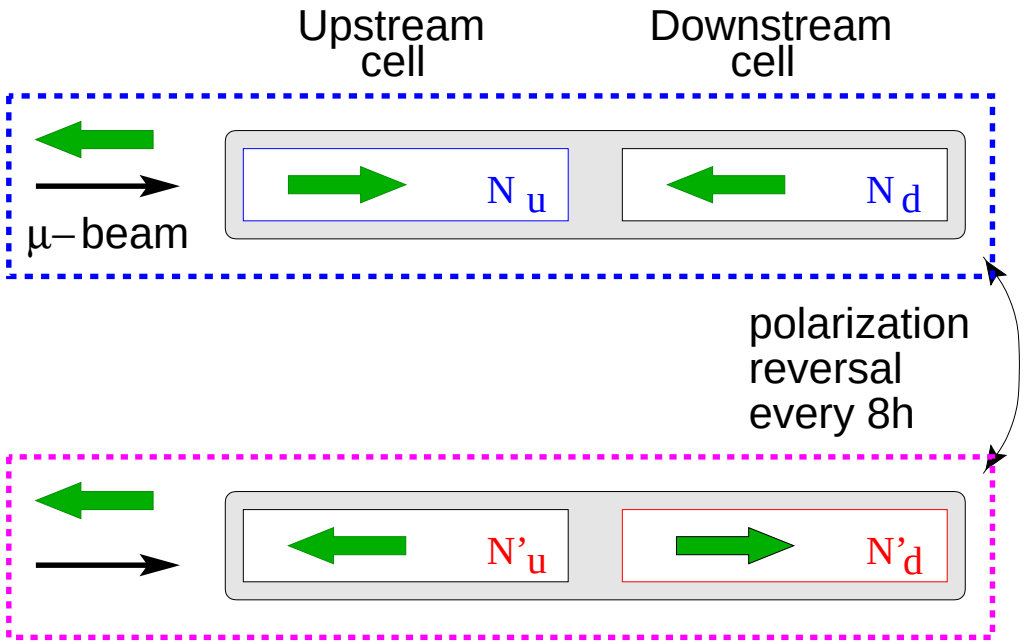
Polarised Muon Beam

- M2 muon beam line of the CERN SPS
- μ^+ Energy 160 GeV
- Intensity $2 \cdot 10^8$ μ/Spill
- Polarisation ≈ 76 %



Polarised Target





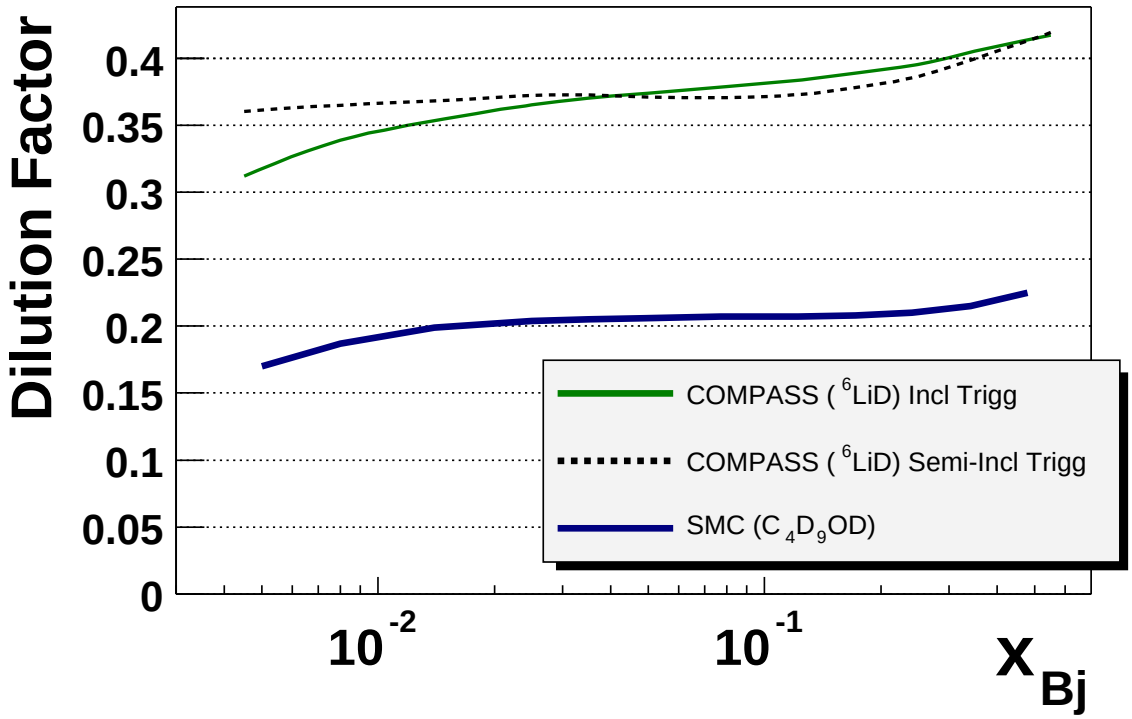
- **Take average Asymmetry:**

$$A = \frac{A_1 + A_1'}{2} = \frac{1}{2}\left(\frac{N_u - N_d}{N_u + N_d} - \frac{N_u' - N_d'}{N_u' + N_d'}\right)$$

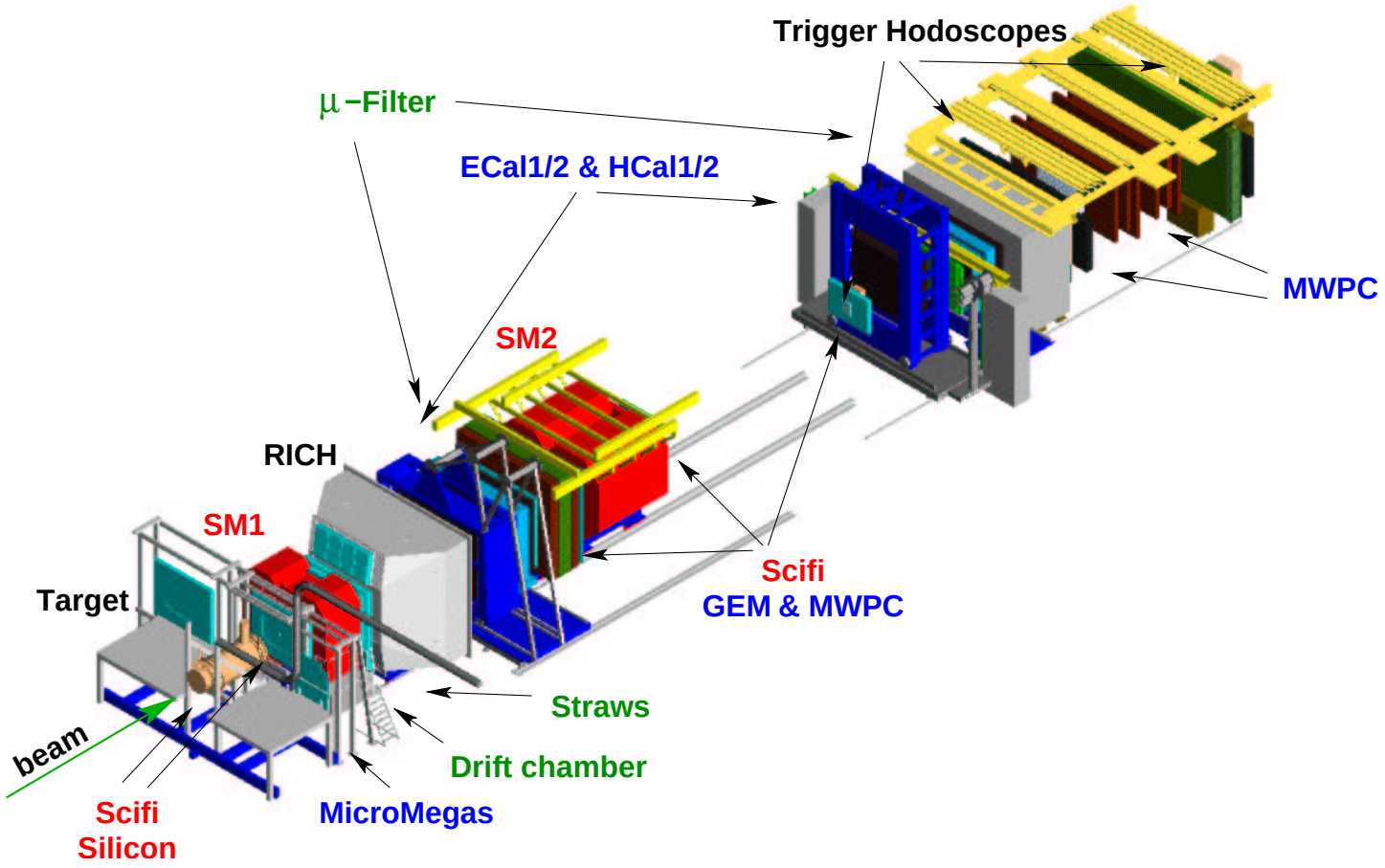
- **Polarisation:** $\approx$ **50 %**

- **Target material:** ^{6}**LiD**
$(^6LiD \approx 2D + 1\alpha)$

$$f = \frac{n_d \sigma_d}{n_d \sigma_d + \sum_A n_A \sigma_A} \approx 0.4$$



The COMPASS Spectrometer



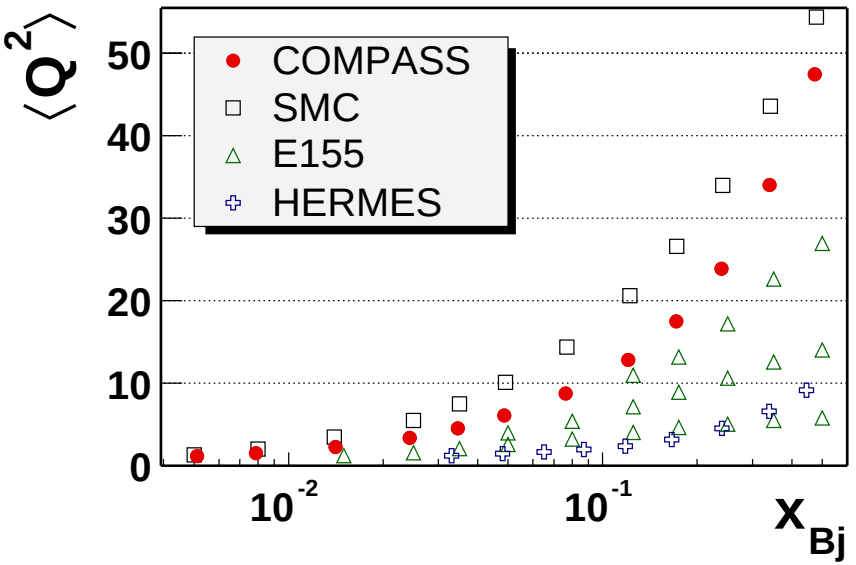
The Inclusive Measurement

$$A_1 = \frac{1}{2} \cdot \frac{1}{P_t f P_b D} \cdot \left(\frac{N_u - N_d}{N_u + N_d} - \frac{N'_u - N'_d}{N'_u + N'_d} \right)$$

Event Selection

- **General cuts**
  - Primary Vertex is in the Target and has beam μ and μ'
  - Beam μ would have passed both target cells
  - μ' is in the trigger hodoscopes

- **Kinematic cuts**
  - 140 GeV $< E_\mu <$ 180 GeV
  - $Q^2 > 1$ (GeV/c)^2
  - $0.1 < y < 0.9$



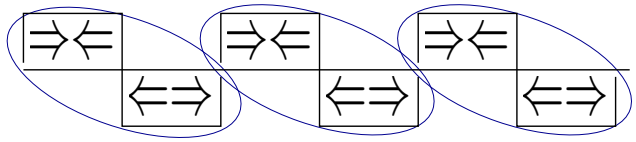
Statistics available for the A_1 analysis:

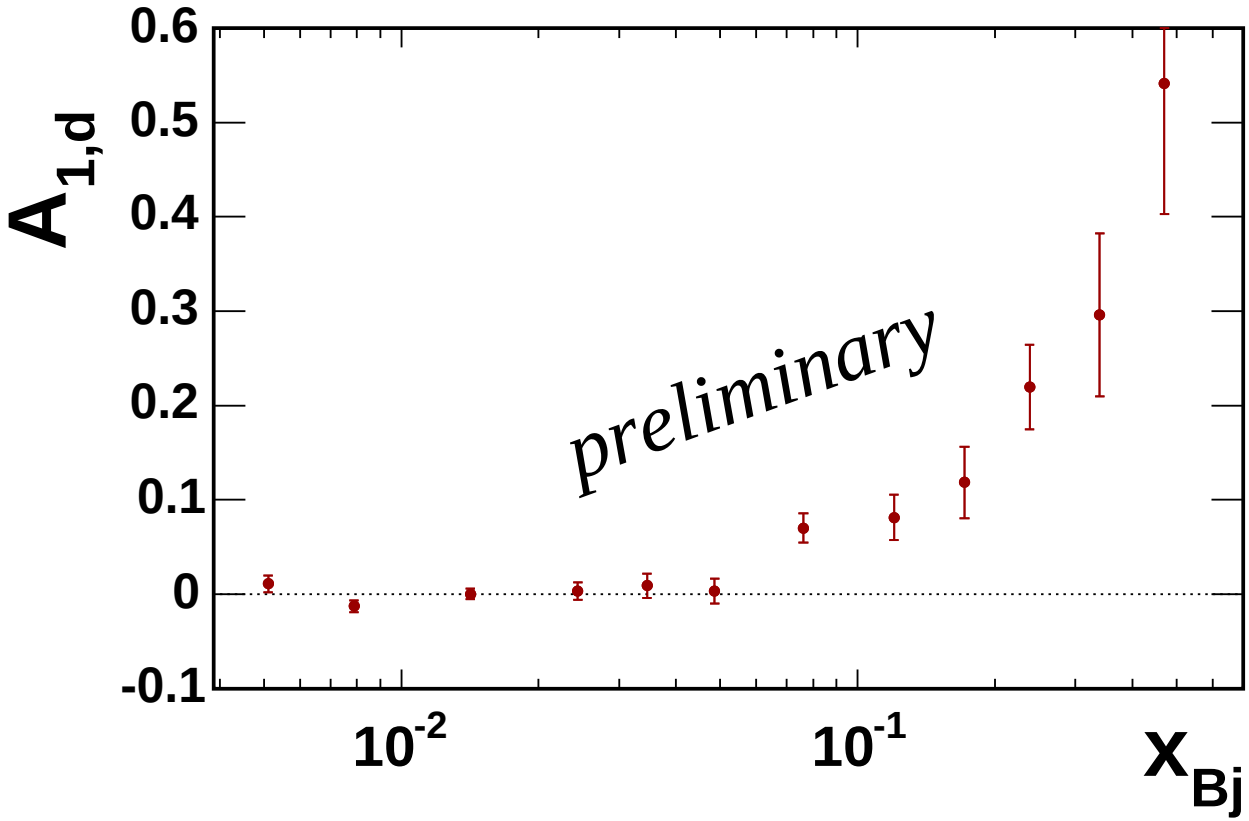
2002: $10.1 \cdot 10^6$ evs

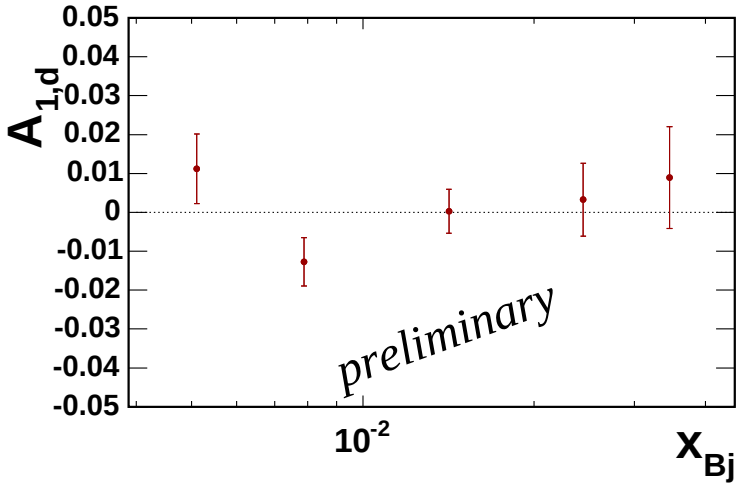
2003: $24.4 \cdot 10^6$ evs **Total:** $34.5 \cdot 10^6$**events**

Asymmetry A_1^d

- **Combining Data**

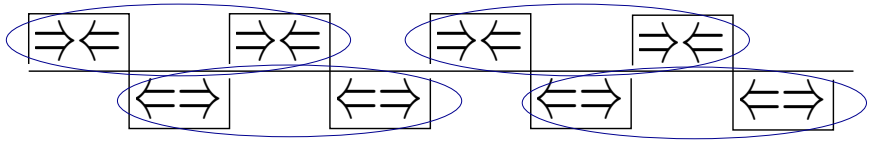






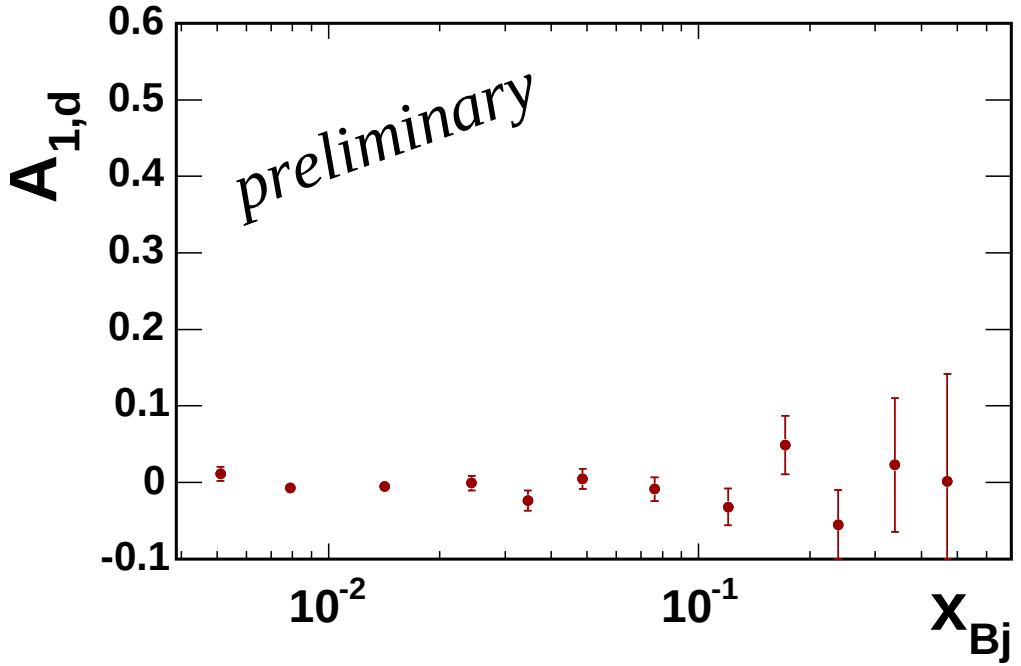
Systematic sources:

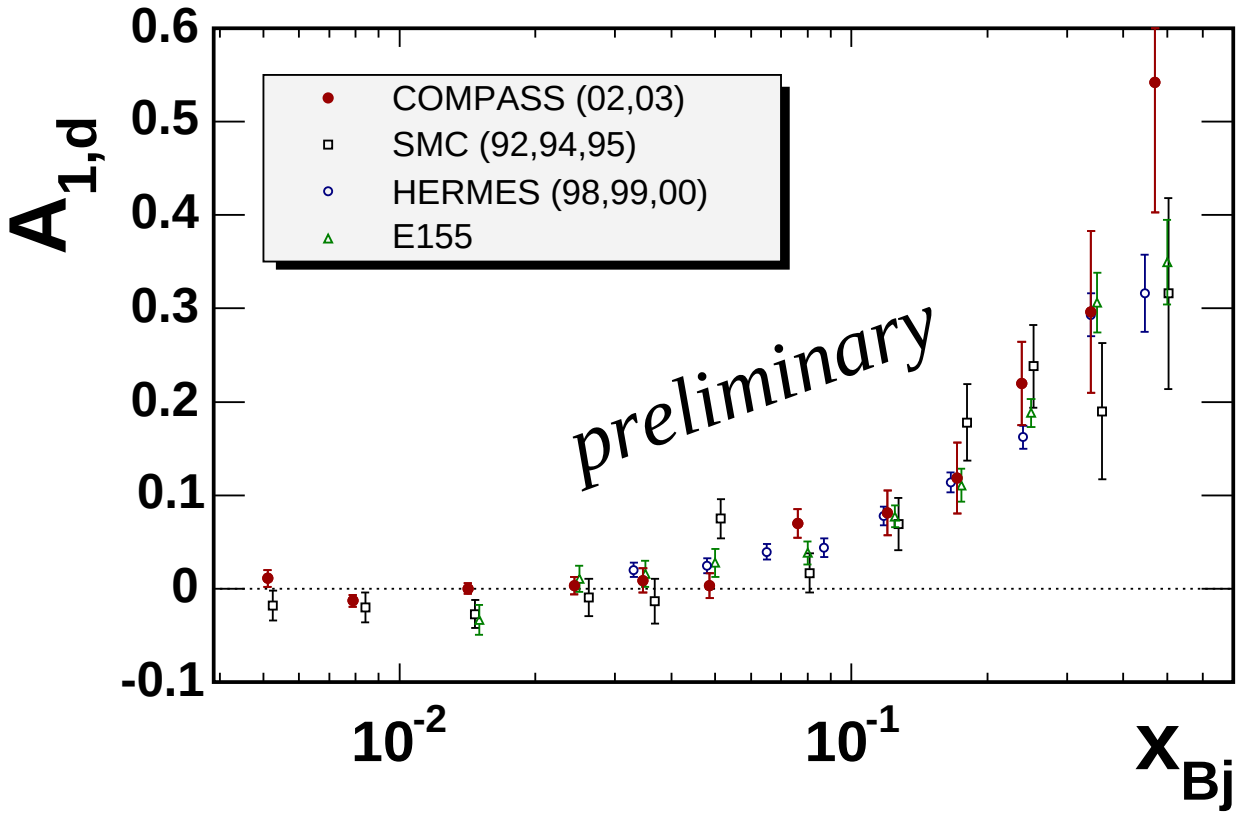
ΔP_t	ΔP_b	Δf	ΔD
5 %	3 %	5 %	$< 5\%$

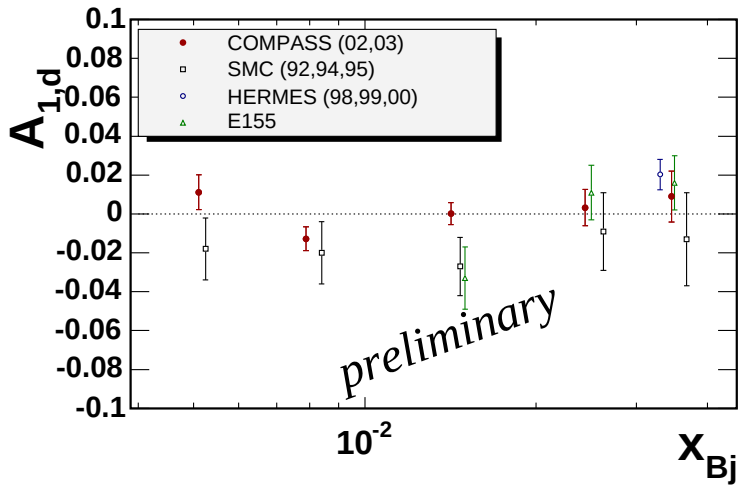


False Asymmetries:

- **Data**
- fake configuration A_1
- different Microwave Setting A_1
- different subsample setting A_1
- **Monte-Carlo**
- due to efficiency fluctuation




A1,d
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
COMPASS (02,03)
SMC (92,94,95)
HERMES (98,99,00)
E155
preliminary
10-2
10-1
XBj


A1,d
0.1
0.08
0.06
0.04
0.02
0
-0.02
-0.04
-0.06
-0.08
-0.1
COMPASS (02,03)
SMC (92,94,95)
HERMES (98,99,00)
E155
preliminary
10-2
XBj

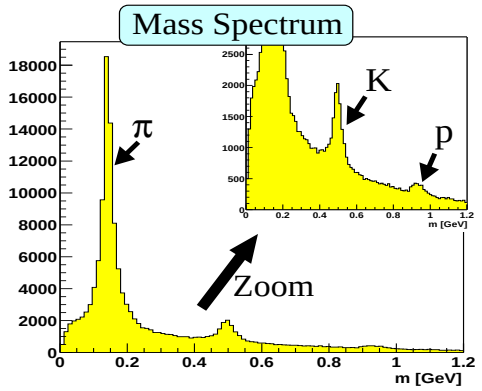
Status of the Semi-Inclusive Asymmetries

$$\vec{A}_1 = \{ A_1, A_1^{h+}, A_1^{h-}, A_1^{K+}, A_1^{K-}, A_1^{K_S^0} \}$$

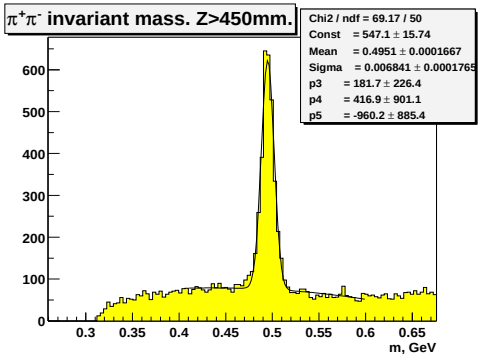
Inclusive Asymmetry

90% of hadrons are pions

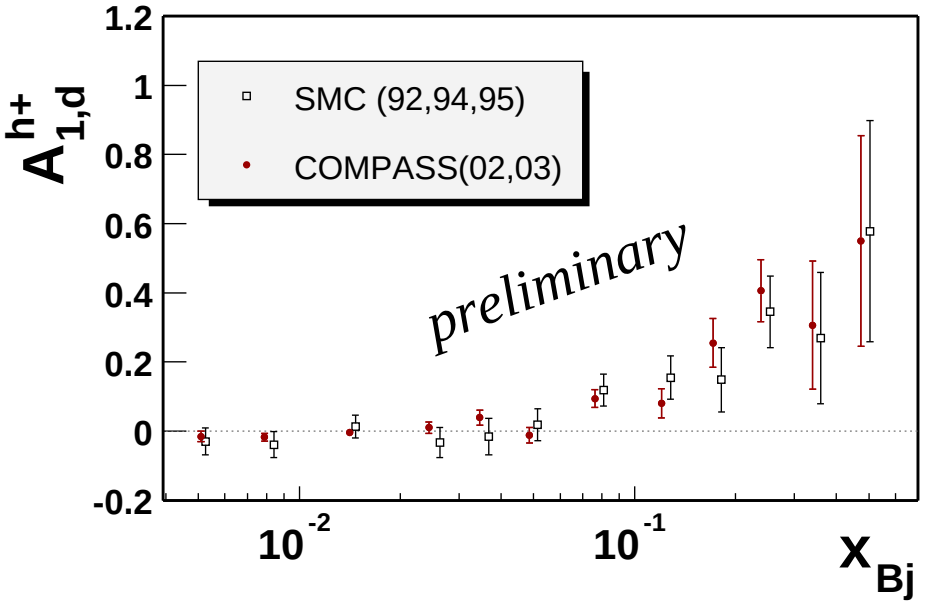
RICH PID
Threshold: p_K>9 GeV

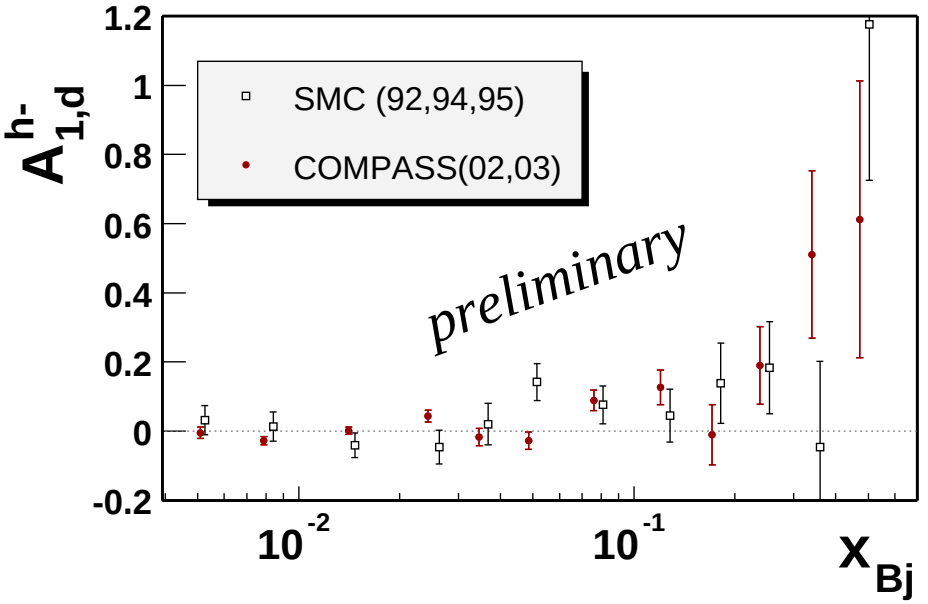


Secondary vertices produced by track coming from interac−tion point



Status of the Semi-Inclusive Asymmetries





h+ events

$11.15 \cdot 10^6$

h- events

$9.2 \cdot 10^6$

Conclusion

- New result on A_1 from 2002-2003 data
- $34.5 \cdot 10^6$ events at $Q^2 > 1$ (GeV/c)^2
- Good accuracy for $x < 0.1$
- Determination of the systematic errors in progress
- The analysis of the semi-inclusive asymmetries is in progress
- More statistics will come