SPIN TRANSPORT IN HMS

$$\begin{pmatrix} P_n^{fp} \\ P_t^{fp} \\ P_l^{fp} \end{pmatrix} = \begin{pmatrix} S_{nn}\ S_{nt}\ S_{nl} \\ S_{tn}\ S_{tt}\ S_{tl} \\ S_{ln}\ S_{lt}\ S_{ll} \end{pmatrix} \begin{pmatrix} P_n \\ P_t \\ P_l \end{pmatrix}$$

S_{ij} are functionals of trajectory:

$S_{ij}(\theta_{tg}, y_{tg}, \phi_{tg}, p)$ or $S_{ij}(x_{fp}, \theta_{fp}, y_{fp}, \phi_{fp}, p)$

SPIN vs VELOCITY PROPAGATION

$$\frac{d\vec{S}}{dt} = \frac{e}{m\gamma}\vec{S} \times \left[\frac{g}{2}\vec{B}^{\parallel} + \left(1 + \frac{g-2}{2}\gamma\right)\vec{B}^{\perp}\right]$$

$$\frac{d\vec{v}}{dt} = \frac{e}{m\gamma}\vec{v} \times \vec{B}^{\perp}$$

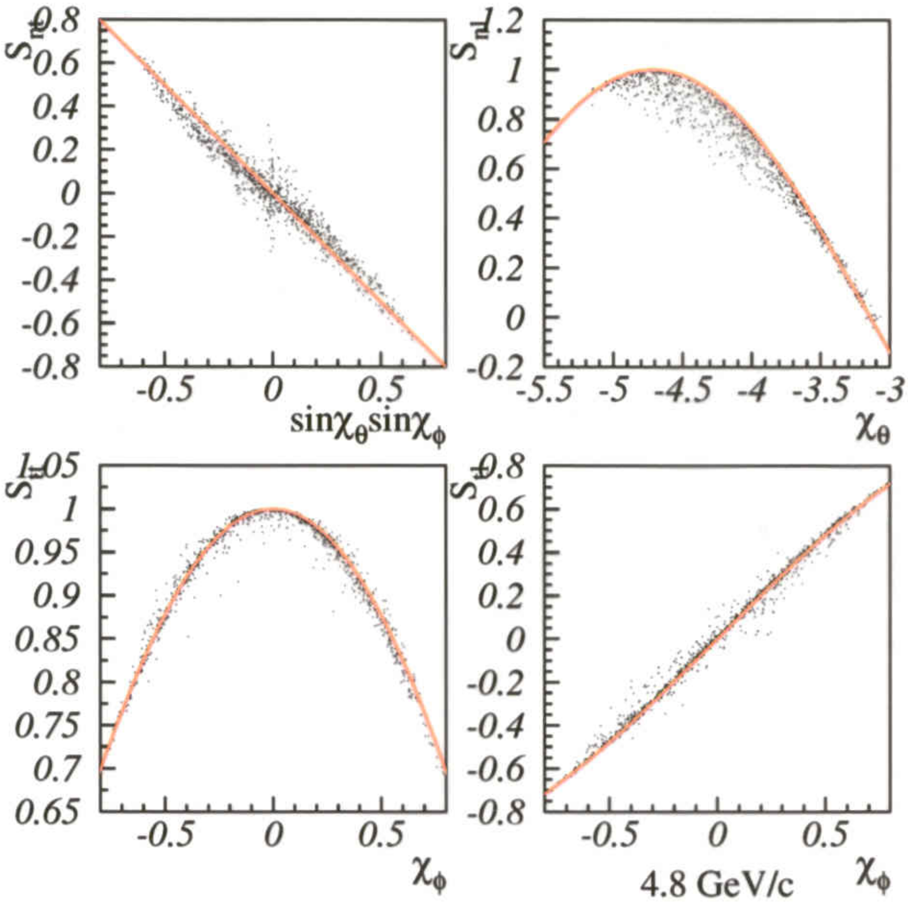
- $\vec{B}^{\parallel} = 0$

$$\chi_\theta = \gamma\left(\frac{g}{2} - 1\right)\Delta\theta = f \cdot \Delta\theta$$

$$\chi_\phi(s) = \int_0^s cos\chi_\theta(s) f d\phi(s) \simeq f \cdot \Delta\phi,$$

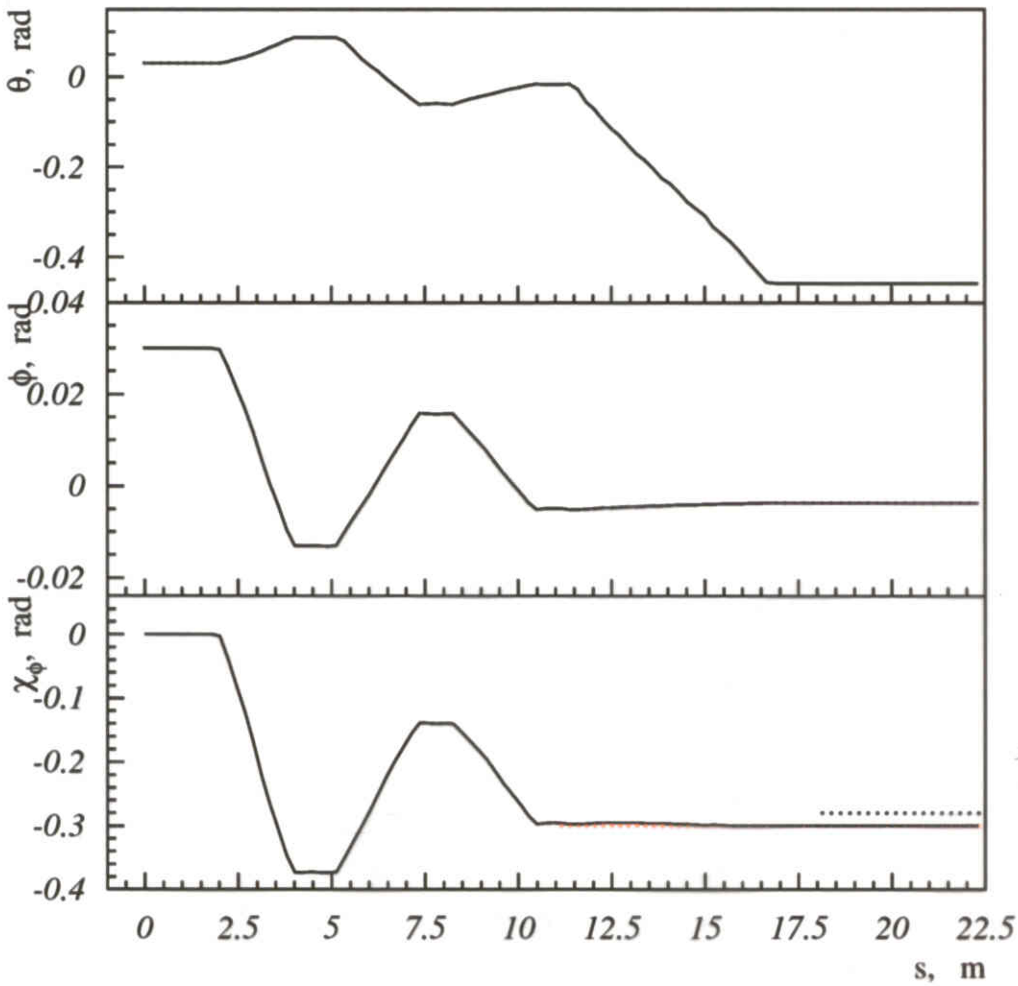
$$S_{nt} = -sin\chi_\theta sin\chi_\phi \qquad S_{nl} = sin\chi_\theta$$

$$S_{tt} = cos\chi_\phi \qquad S_{tl} = sin\chi_\phi$$



HMS is the best spectrometer for polarization measurements

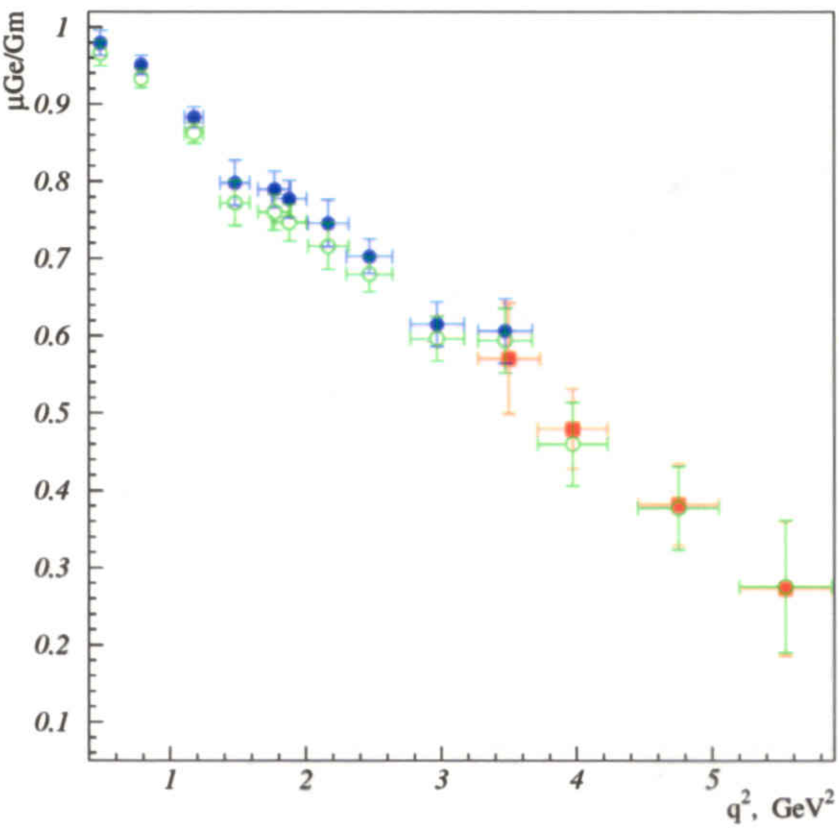
$$\chi_\phi(s) = \int_0^s cos\chi_\theta(s) f d\phi(s) \qquad \chi_\theta = f \cdot \Delta\theta$$

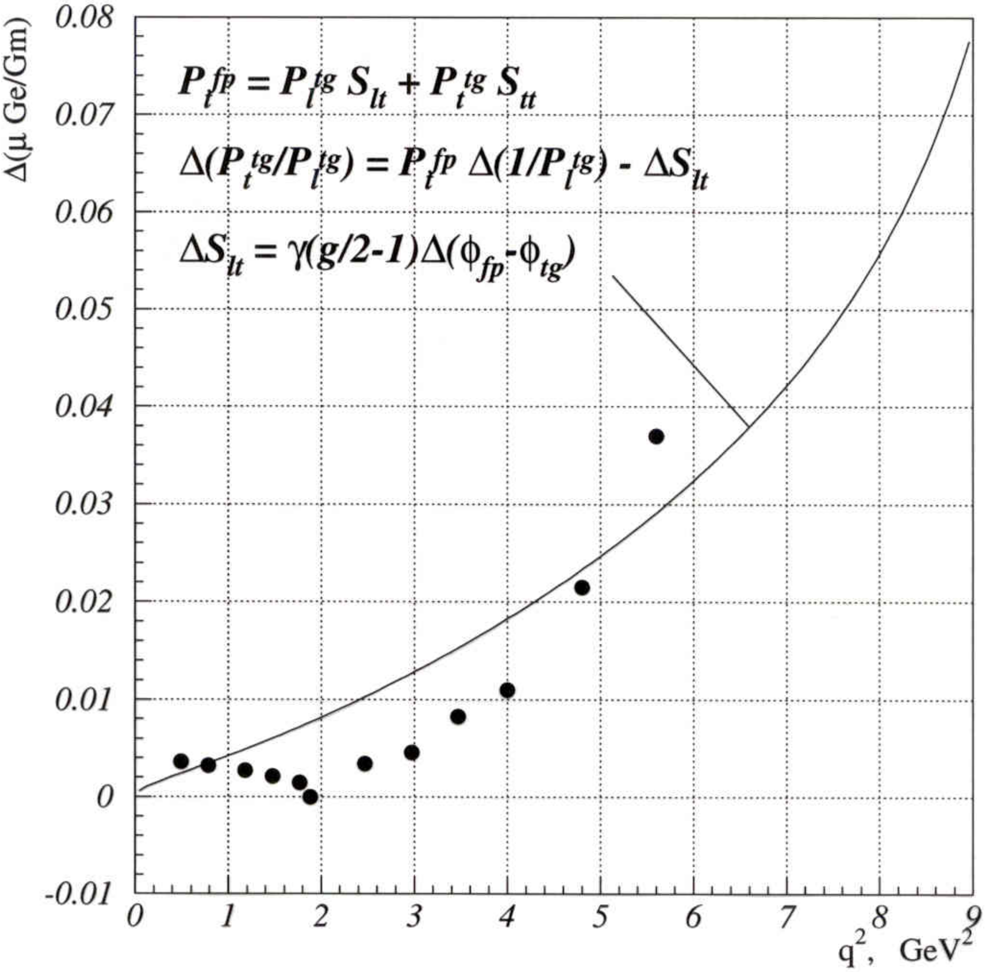


$$\chi_\phi(s) = \int_0^s cos(\sim 0) f d\phi(s) + \int_0^s cos\chi_\theta(s) f \cdot 0,$$

$$\chi_\phi(s) = \qquad f \cdot \Delta\phi \qquad + 0,$$

$\mu G_e/G_m$

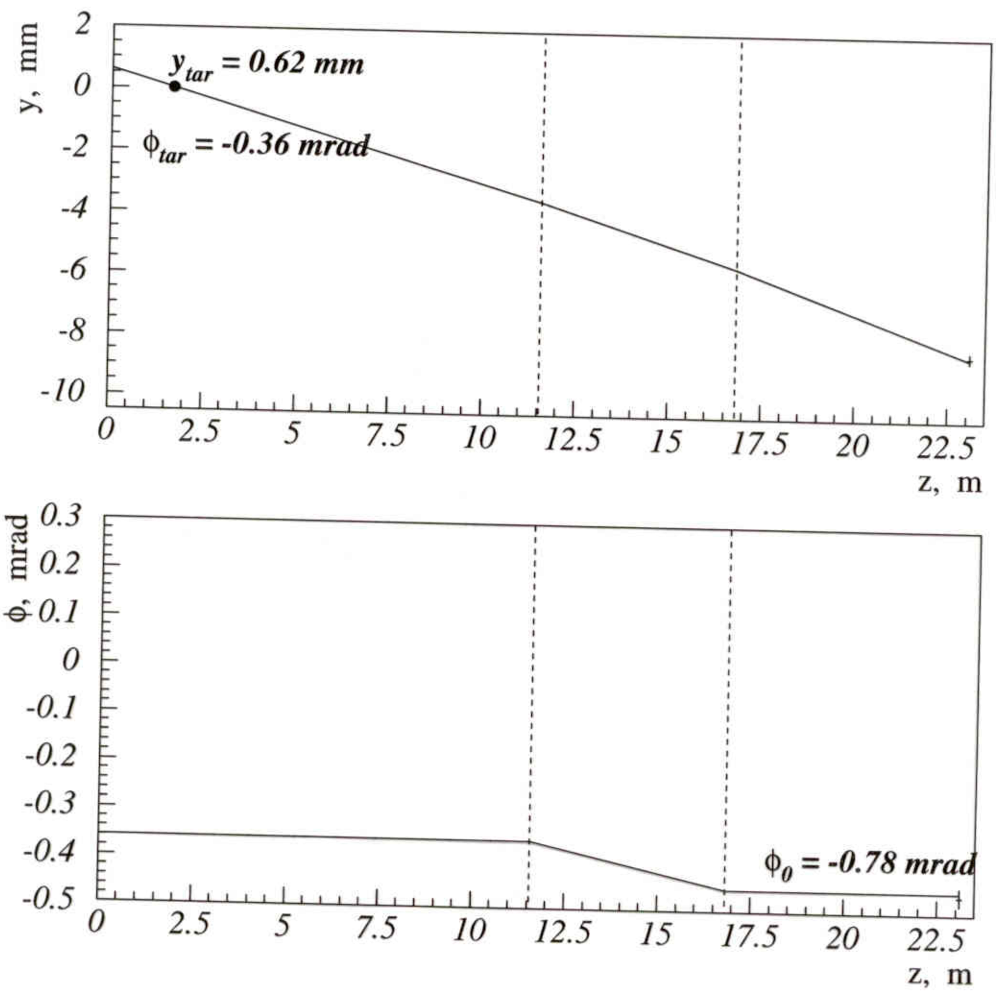




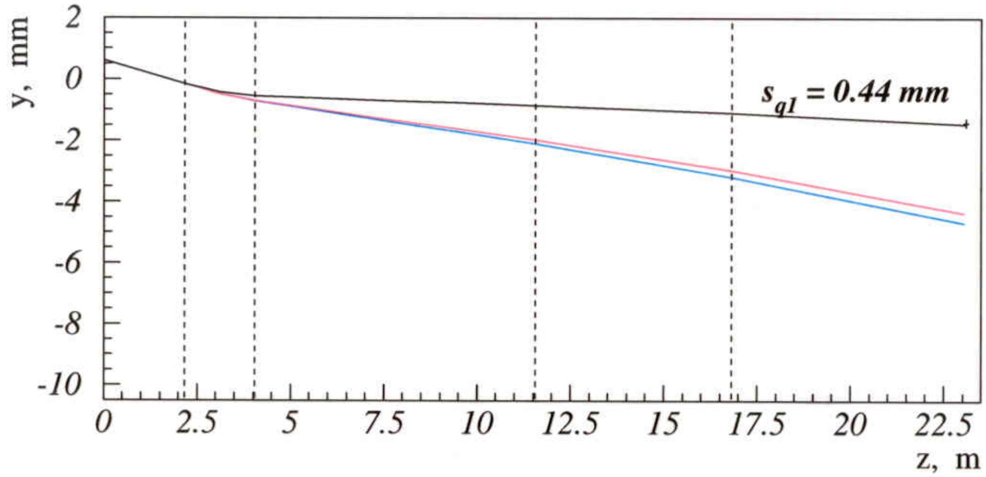
$$\Delta(\phi_{fp} - \phi_{tg}) = 1mrad$$

Elastic scattering of a $1.202GeV$ beam on $0.69cm$ carbon target at 13.15^0 with sieve slit

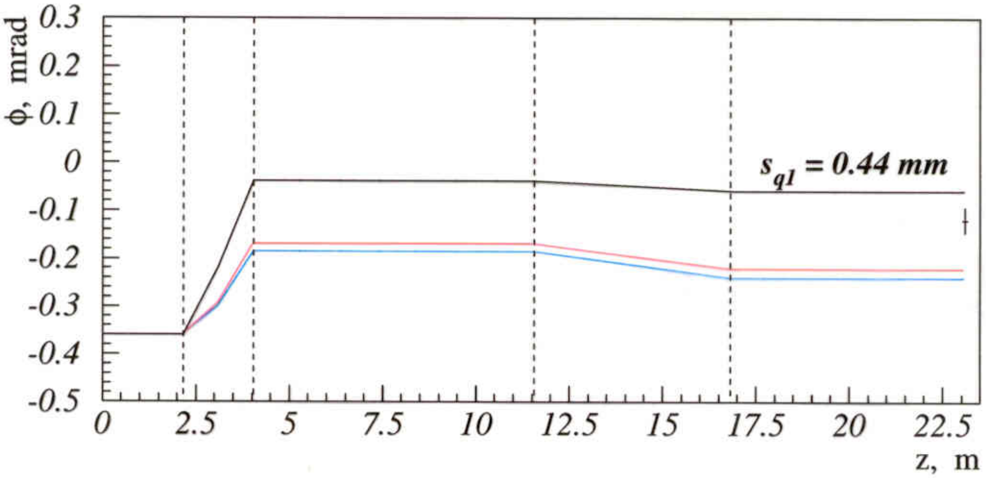
$Name$	$Q1$	$Q2$	$Q3$	
nom.	1	1	1	√
"d"	0	0	0	√
"q1"	-0.7003	0	0	√
"q2"	0	0.3959	0	√
"q3"	0	0	-0.5745	√
"q1r"	0.7	1	1	
"q2r"	1	0.7	1	
"q3r"	1	1	0.7	



dipole only

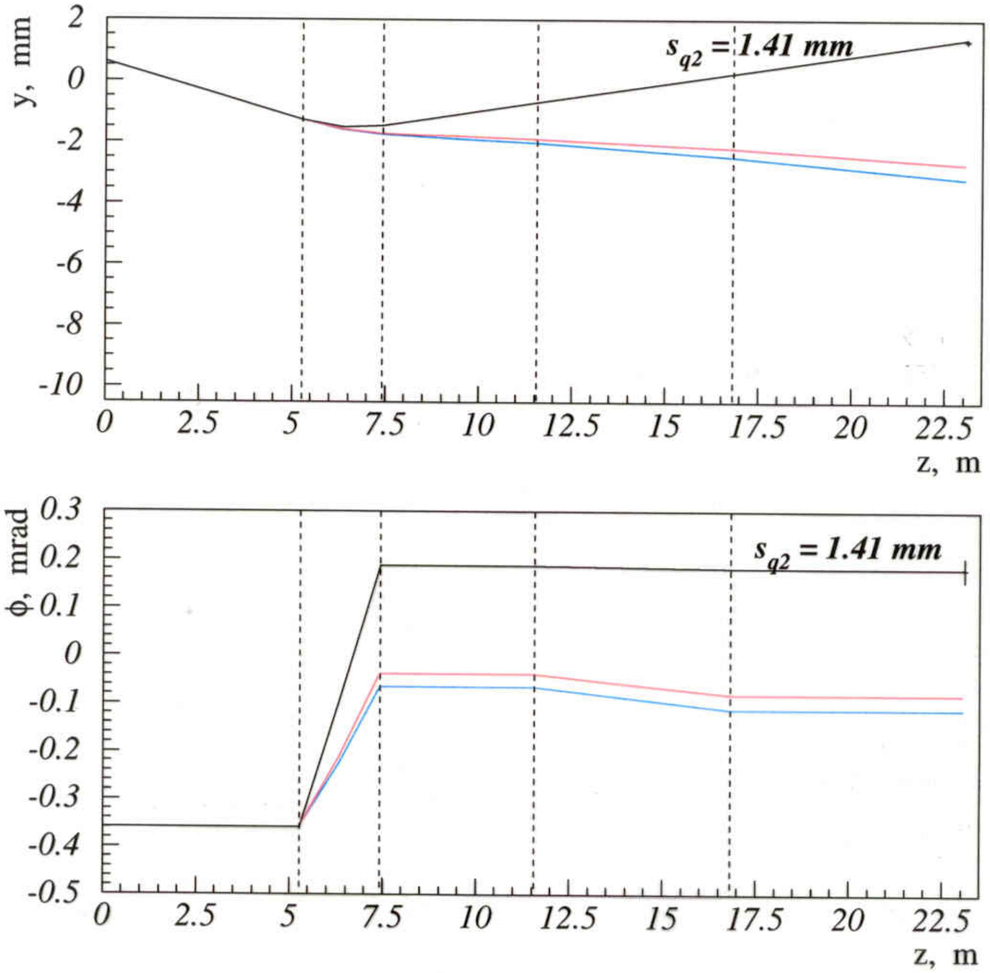


y, mm
2
0
-2
-4
-6
-8
-10
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
z, m
s_{q1} = 0.44 mm



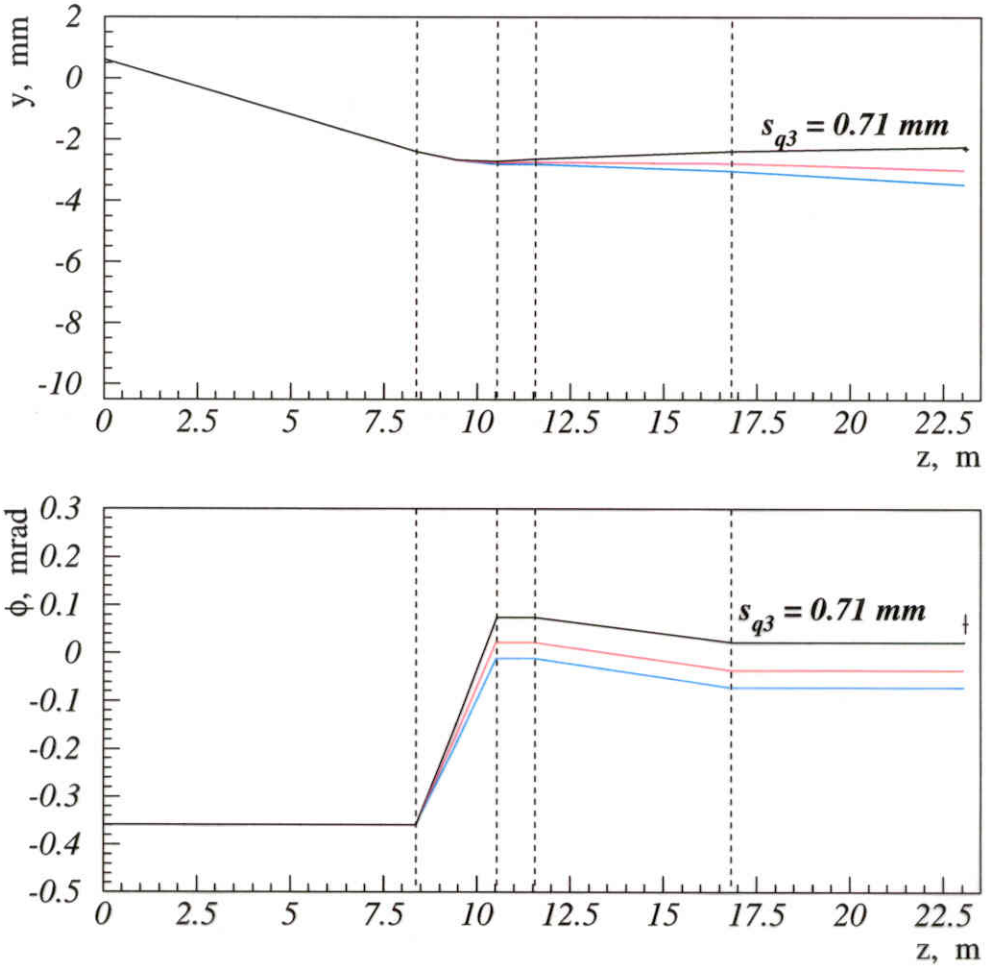
φ, mrad
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
z, m
s_{q1} = 0.44 mm

dipole +q1

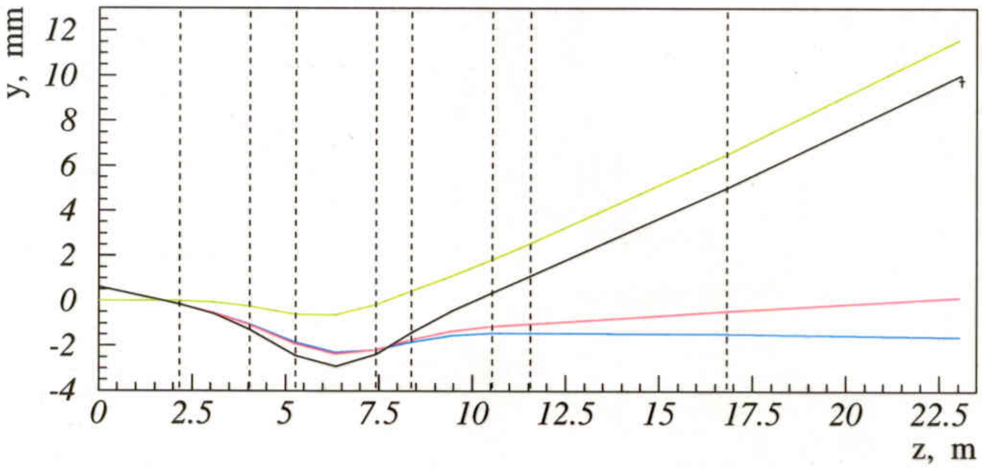


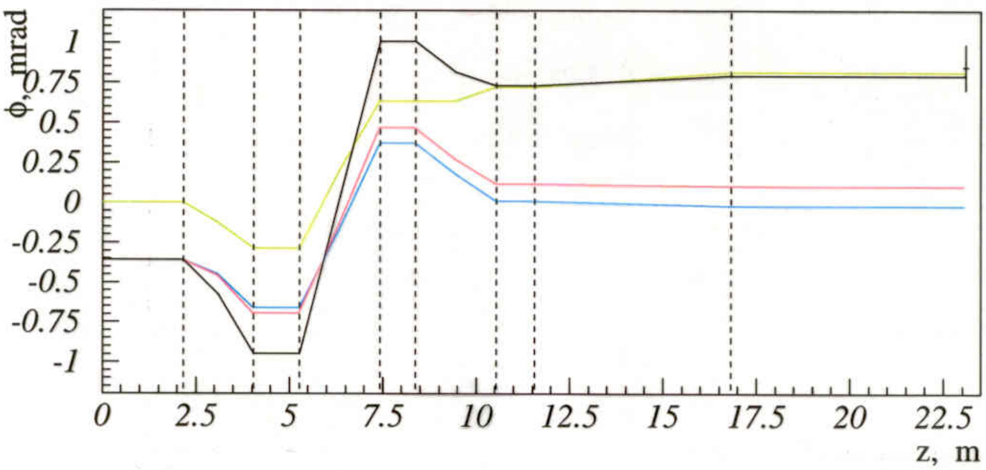
y, mm
2
0
-2
-4
-6
-8
-10
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
z, m
s_{q2} = 1.41 mm
ϕ, mrad
0.3
0.2
0.1
0
-0.1
-0.2
-0.3
-0.4
-0.5
0
2.5
5
7.5
10
12.5
15
17.5
20
22.5
z, m
s_{q2} = 1.41 mm

dipole + q2

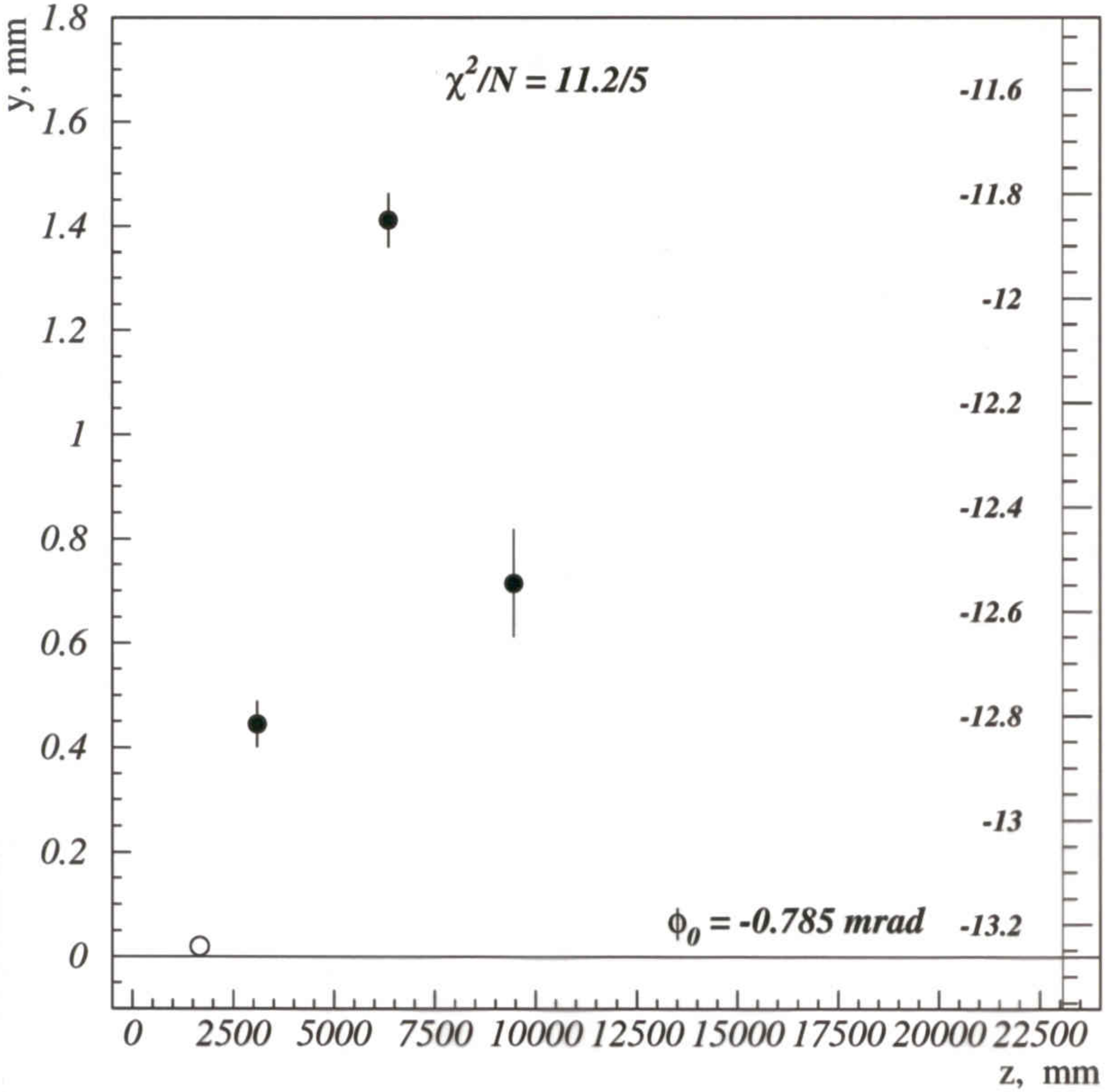


dipole + q3





nominal setting



uncertainty of $\Delta\phi < 0.3 mrad$

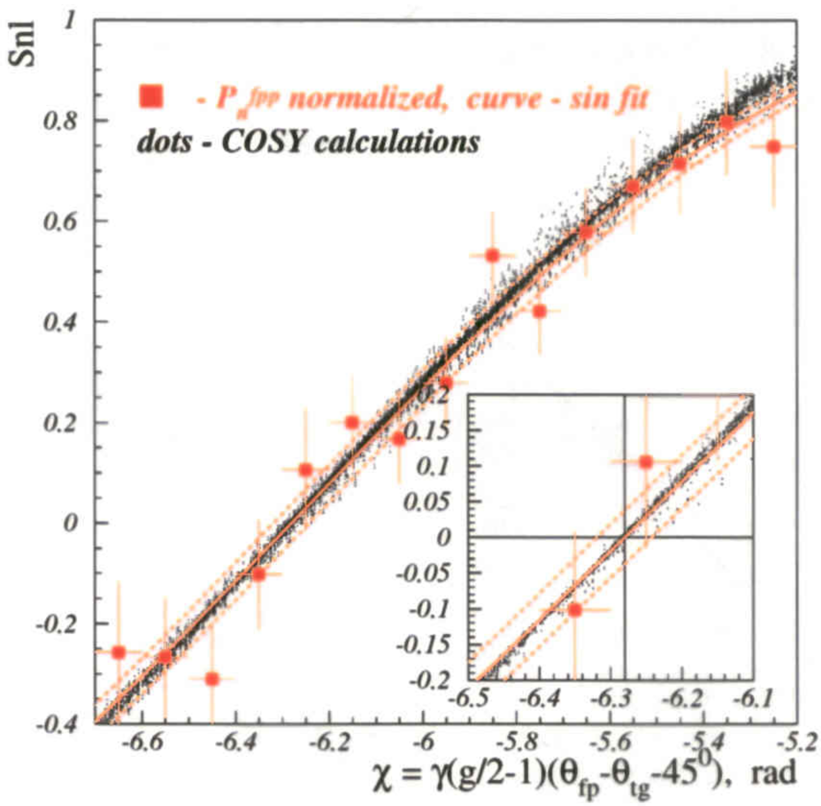
Measuring the total bending angle in dispersive plane

$$P_n^{fpp} \sim S_{nl}$$

$$\Delta\chi = 35mrad$$

$$\Delta\theta = 4.4mrad$$

GEP-II experiment for $Q^2 = 5.6GeV^2$



CONCLUSIONS

- For HMS, the spin matrix elements with very good precision are functions only of the bend angles, therefore, HMS is very good for spin measurements
- The total bend angle in the non-dispersive plane $\Delta\phi$ has been measured with a precision of less than $0.3 mrad$