COMPASS results on the transverse spin asymmetry in identified hadron-pair production in SIDIS

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on behalf of the **COMPASS** collaboration

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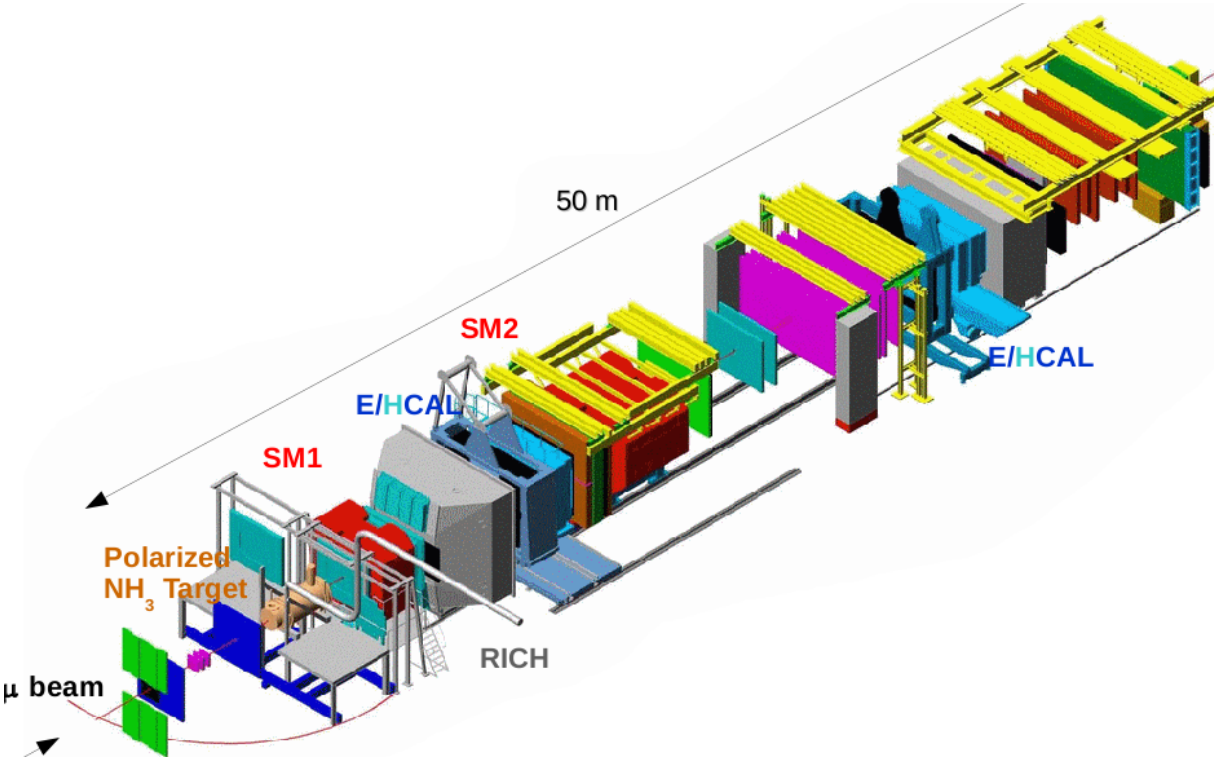
XXII. International Workshop on Deep-Inelastic Scattering and Related Subjects
April 29th 2014, Warsaw, Poland

Outline

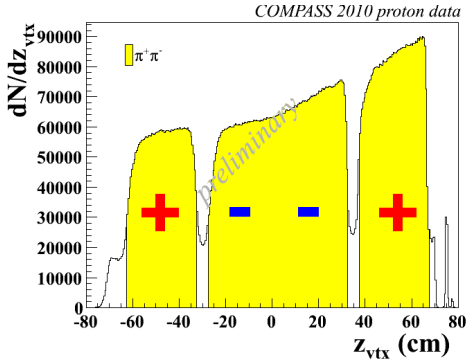
The COMPASS experiment

The COMPASS experiment

The COMPASS experiment



e.g. COMPASS setup 2007



deuteron (^{6}LiD):

- polarization $\langle P_T \rangle \approx 0.50$
- dilution factor $\langle f \rangle \approx 0.40$

proton (NH_3):

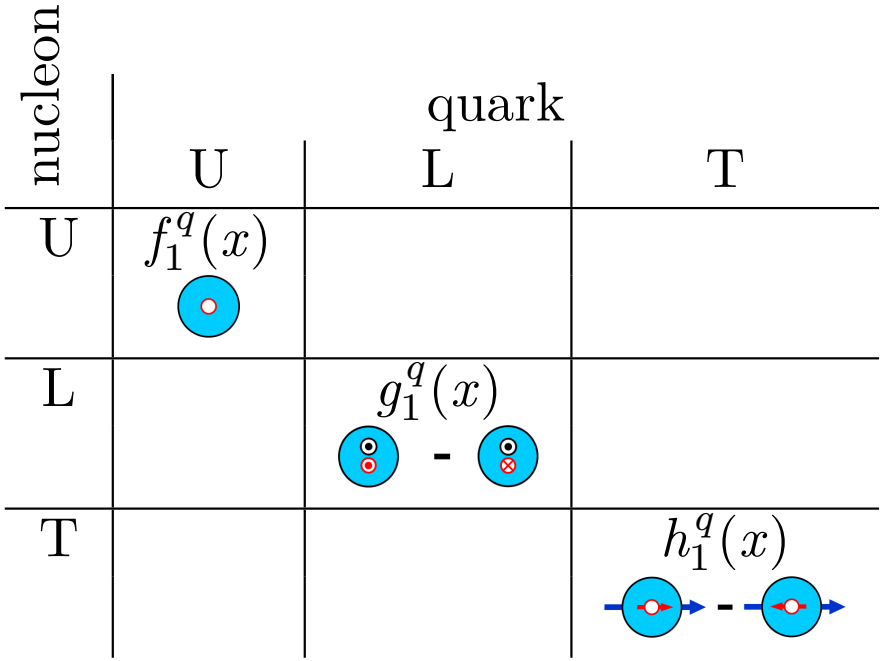
- $\langle P_T \rangle \approx 0.85$
- $\langle f \rangle \approx 0.16$

- 2-stage spectrometer with tracking, calo and PID (RICH)
- Longitudinally polarized 160 GeV/c μ^+-beam
- 2002-04 transv. polarized lithium deuteride 2-cell target
- 2007 & 2010 transv. polarized ammonia 3-cell target
- Polarization reversed every week via microwave

Theoretical framework

Theoretical framework ▶ from spin structure to Transversity

3 independent parton distribution functions (PDFs) are necessary to describe the spin structure of the nucleon in leading order in the collinear case:



Quark distribution:
$f_1^q(x) = q^+(x) + q^-(x)$

Helicity distribution:
$g_1^q(x) = q^+(x) - q^-(x)$

Transversity distribution:
$h_1^q(x) = q^{\uparrow\uparrow}(x) - q^{\uparrow\downarrow}(x)$

Chiral-odd partner to the Transversity function:

Collins FF: $\ell N^\uparrow \to \ell' h X$ (*cf.* talk by K. Rith)

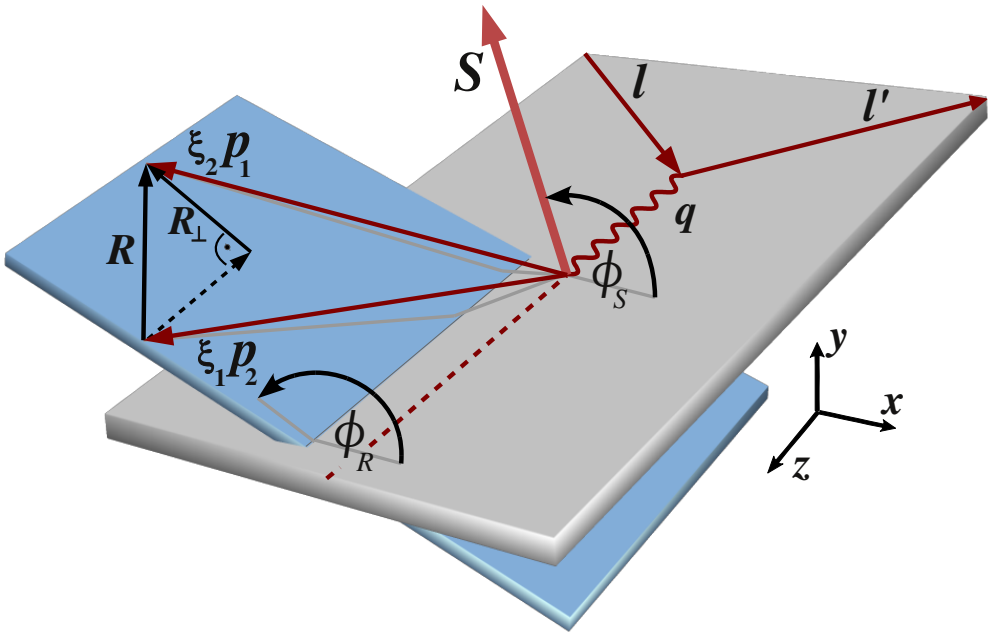
DiFF: $\ell N^\uparrow \to \ell' h h X$

cf. talk by S. A. Pereira for sub-leading twist modulations

Theoretical framework ▶ angle definitions

$\ell\ N^{\uparrow} \to \ell'\ h_1\ h_2\ X$

Fragmentation of a transversely polarized quark into a pair of unpolarized hadrons



- $\boldsymbol{l}$, $\boldsymbol{l'}$ and $\boldsymbol{q}$ are 3-momenta of incoming, scattered lepton and virtual photon
- $\phi_{\boldsymbol{S}}$ azimuthal angle of the spin $\boldsymbol{S}$ of the fragmenting quark
- $\boldsymbol{p_i}$ is the 3-momenta of h_i
- z_i is the fraction of the virtual-photon energy carried by h_i
- $\boldsymbol{R} = \frac{z_2 \boldsymbol{p_1} - z_1 \boldsymbol{p_2}}{z_1 + z_2} = \xi_2 \boldsymbol{p_1} - \xi_1 \boldsymbol{p_2}$
- $\boldsymbol{R_T}$ is the component of $\boldsymbol{R}$ perpendicular to $\boldsymbol{q}$
- Azimuthal angle of $\boldsymbol{R}$:

$$\phi_R = \frac{(\boldsymbol{q}\times\boldsymbol{l})\cdot\boldsymbol{R}}{|(\boldsymbol{q}\times\boldsymbol{l})\cdot\boldsymbol{R}|} \arccos\left(\frac{(\boldsymbol{q}\times\boldsymbol{l})\cdot(\boldsymbol{q}\times\boldsymbol{R})}{|\boldsymbol{q}\times\boldsymbol{l}||\boldsymbol{q}\times\boldsymbol{R}|}\right)$$

Theoretical framework ▶ hadron-pair cross section

The differential hadron-pair cross section is:

$$\frac{\mathrm{d}^7\sigma}{\mathrm{d}x\,\mathrm{d}y\,\mathrm{d}z\,\mathrm{d}\phi_R\,\mathrm{d}\phi_S\,\mathrm{d}\cos\theta\,\mathrm{d}M_h^2} = \frac{2\alpha^2}{4\pi\,Q^2\,y}\sum_q e_q^2 \Big[A(y) f_1^q(x) D_1^q(z,\cos\theta,M_h^2) + \lambda_e S_L \frac{C(y)}{2} g_1^q(x) D_1^q(z,\cos\theta,M_h^2) + B(y)\frac{|\boldsymbol{S}_T||\boldsymbol{R}_T|}{M_h}\sin\phi_{RS} h_1^q(x) H_1^{\sphericalangle q}(z,\cos\theta M_h^2)\Big]$$

with $\phi_{RS} = \phi_R + \phi_S - \pi$, $A(y) = \left(1 - y + \frac{y^2}{2}\right)$, $B(y) = (1-y)$, and $C(y) = y(2-y)$.

Where $h_1(x)$ is the Transversity PDF and $H_{1,q}^{\sphericalangle}$ is the hadron-pair fragmentation function, which describes the Fragmentation of a transversely polarized quark into two unpolarized hadrons. $D_{1,q}$ is the unpolarized hadron-pair fragmentation function, which is measured at *e.g.* BELLE[1].

[1] *cf.* talk by F. Giordano

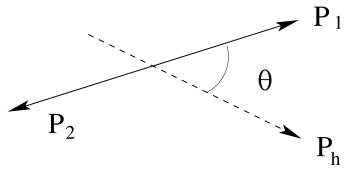
Theoretical framework ▶ asymmetries extraction

The hadron-pair asymmetry then is:

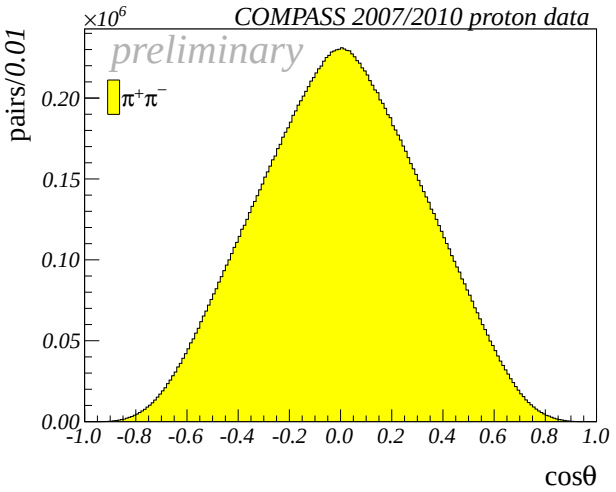
$$A_{UT}^{\sin\phi_{RS}} = |\boldsymbol{S}_T| \frac{B(y)}{A(y)} \frac{\sum_q e_q^2 h_1^q \int \mathrm{d}\cos\theta \frac{|\boldsymbol{R}_T|}{2M_h} H_1^{\sphericalangle,q}(z,\cos\theta,M_h^2)}{\sum_q e_q^2 f_1^q \int \mathrm{d}\cos\theta D_1^q(z,\cos\theta,M_h^2)}$$

We measure:

$$N_{2h}(x,y,z,M_{inv}^2,\theta,\phi_{RS}) \propto$$
$$\sigma_{UU}(1 \pm f P_T D_{NN} A_{UT}^{\sin\phi_{RS}} \sin\theta \sin\phi_{RS})$$



h^+h^- center of mass frame



σ_{UU} = unpolarized cross section

$\pm$ indicates nucleon spin orientation

f = target dilution factor

P_T = target polarization

D_{NN} = transv. spin transfer coef.

$D_{NN} = \frac{1-y}{1-y+\frac{y^2}{2}}$

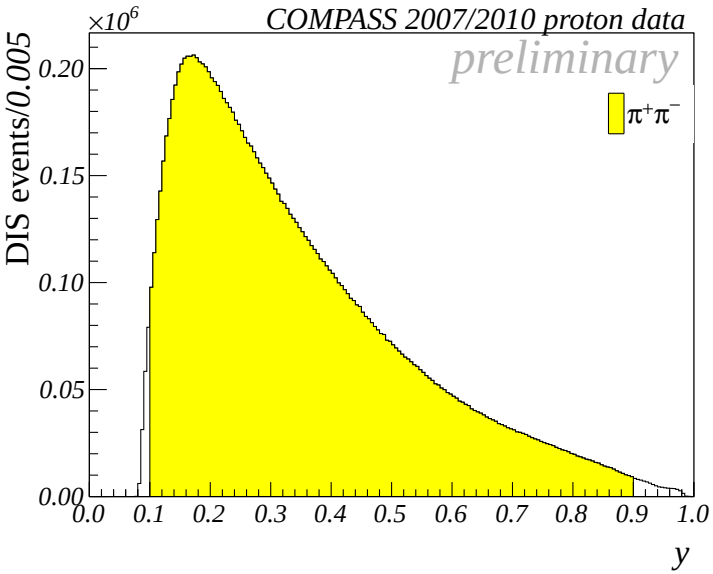
Data selection

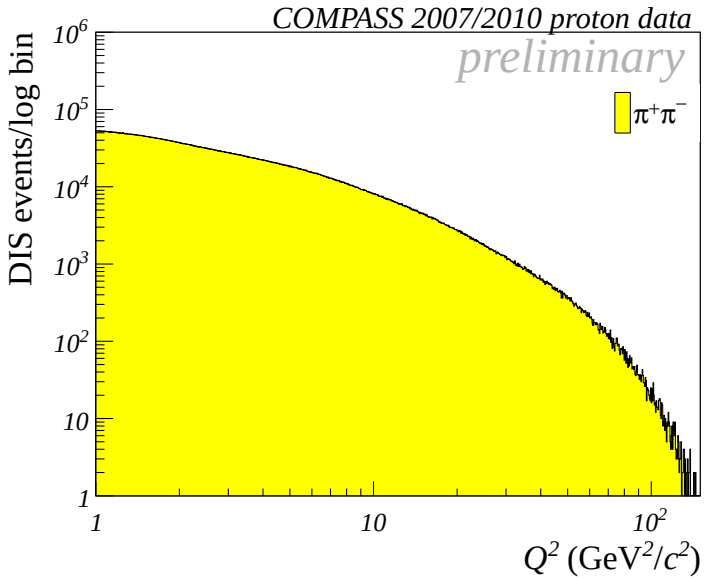
Data selection ▶ DIS cuts

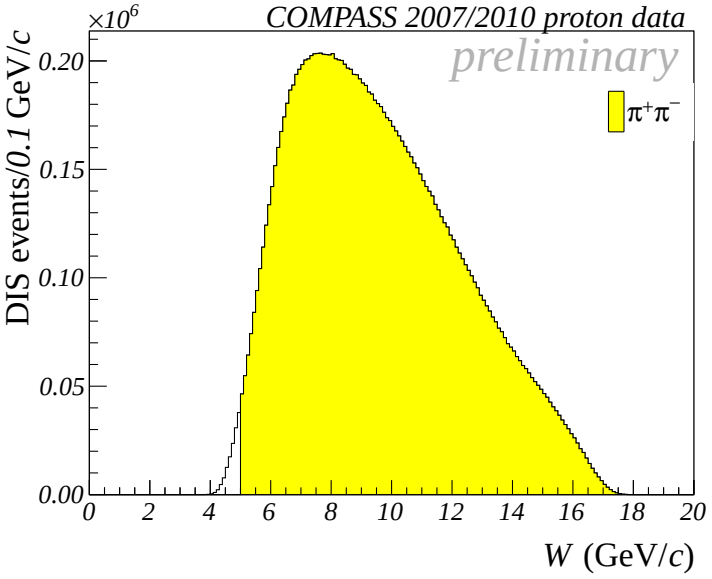
DIS cuts on events:

- $Q^2 > 1\,(\mathrm{GeV}/c)^2$
- $0.1 < y < 0.9$
- $W > 5\,\mathrm{GeV}/c^2$

- spectrometer acceptance:
  $0.003 < x < 0.7$



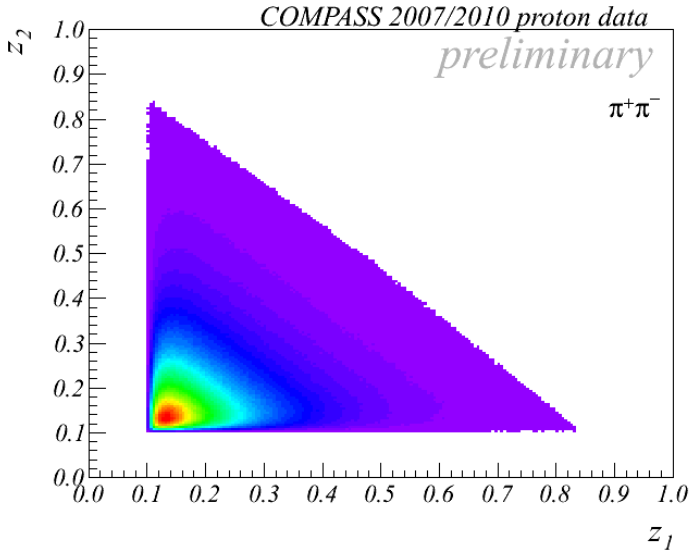


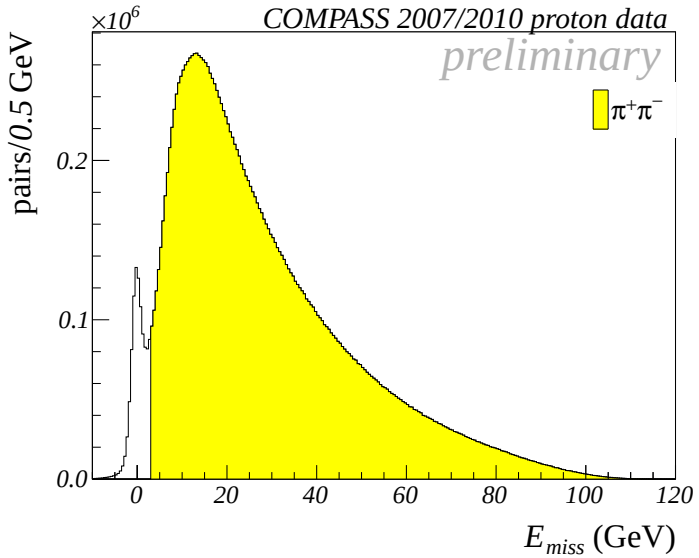


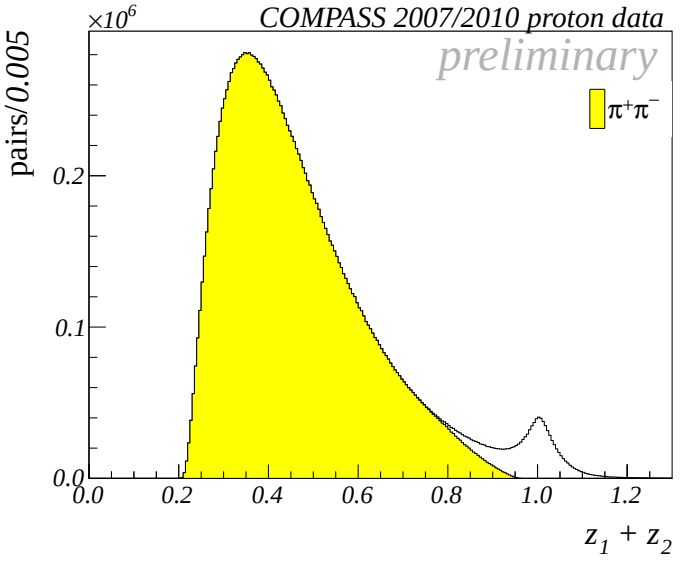
Data selection ▶ hadron & hadron pair cuts

hadron & hadron pair cuts:

- at least 2 outgoing hadrons with opposite charge
- $z > 0.1$ for each hadron
- $x_F > 0.1$ for each hadron
- $E_{miss} > 3$ GeV for each pair
- $R_T > 0.07$ GeV/c for each pair



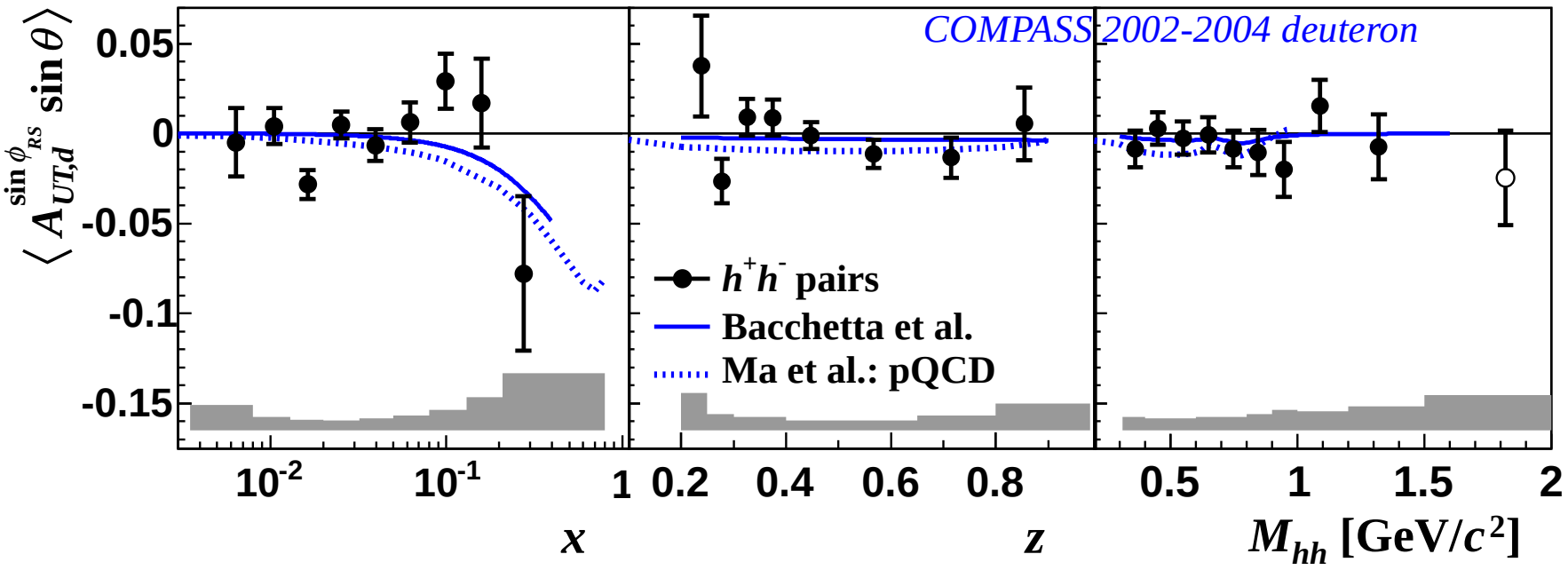




hadron-pair asymmetries:

deuteron data

Results ▶ deuteron data ▶ all hadron h^+h^- pairs

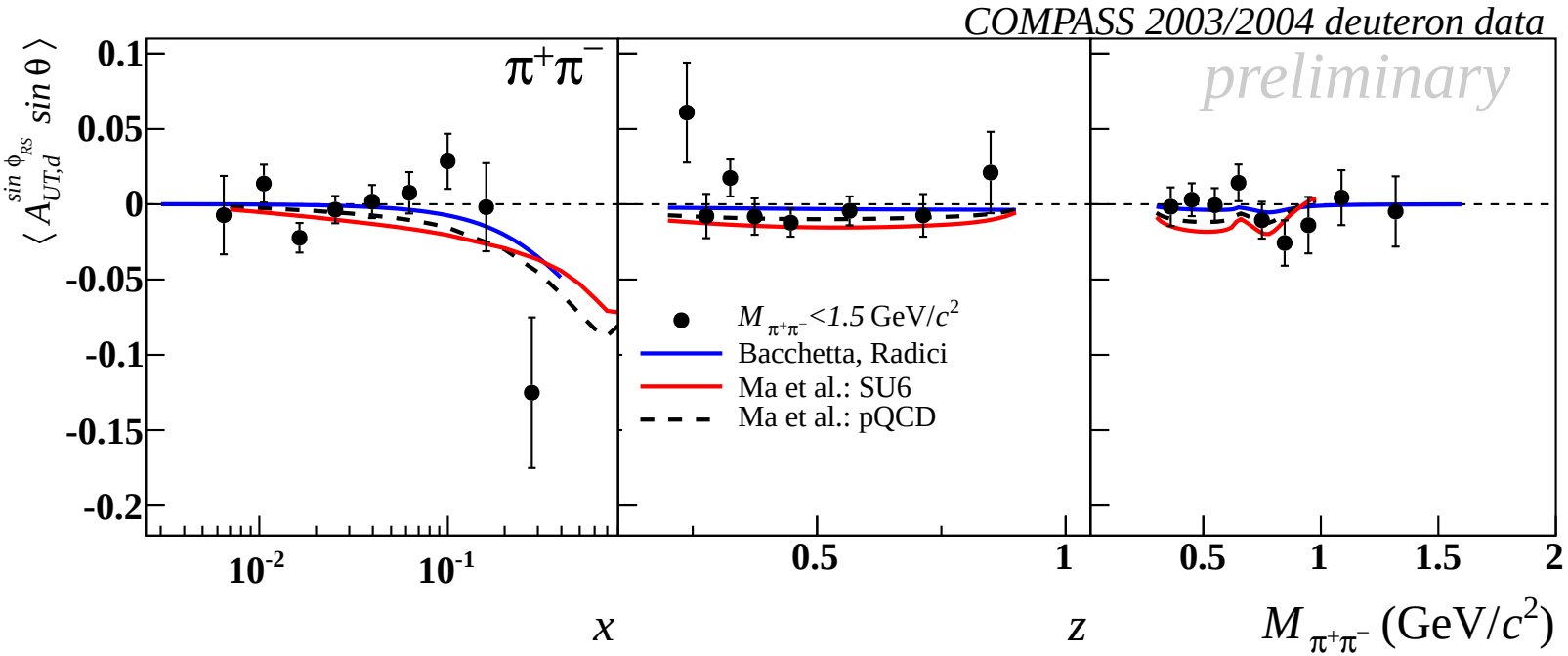


from: Adolph C. *et al.* [COMPASS Collaboration], Phys. Lett. B **713** (2012) 10
blue solid line: Bacchetta A. and Radici M., Phys. Rev. D **74** (2006) 114007
blue dashed line: Ma B.-Q. *et al.*, Phys. Rev. D **77** (2008) 014035

↪ Asymmetries of h^+h^- pairs from the deuteron target compatible with zero within the uncertainties

Interpreted as a close-to-complete cancellation of the u and d quark contributions from the transversity PDFs on the deuteron as an isoscalar target.

NEW Results ▶ deuteron data ▶ $\pi^+\pi^-$ pairs

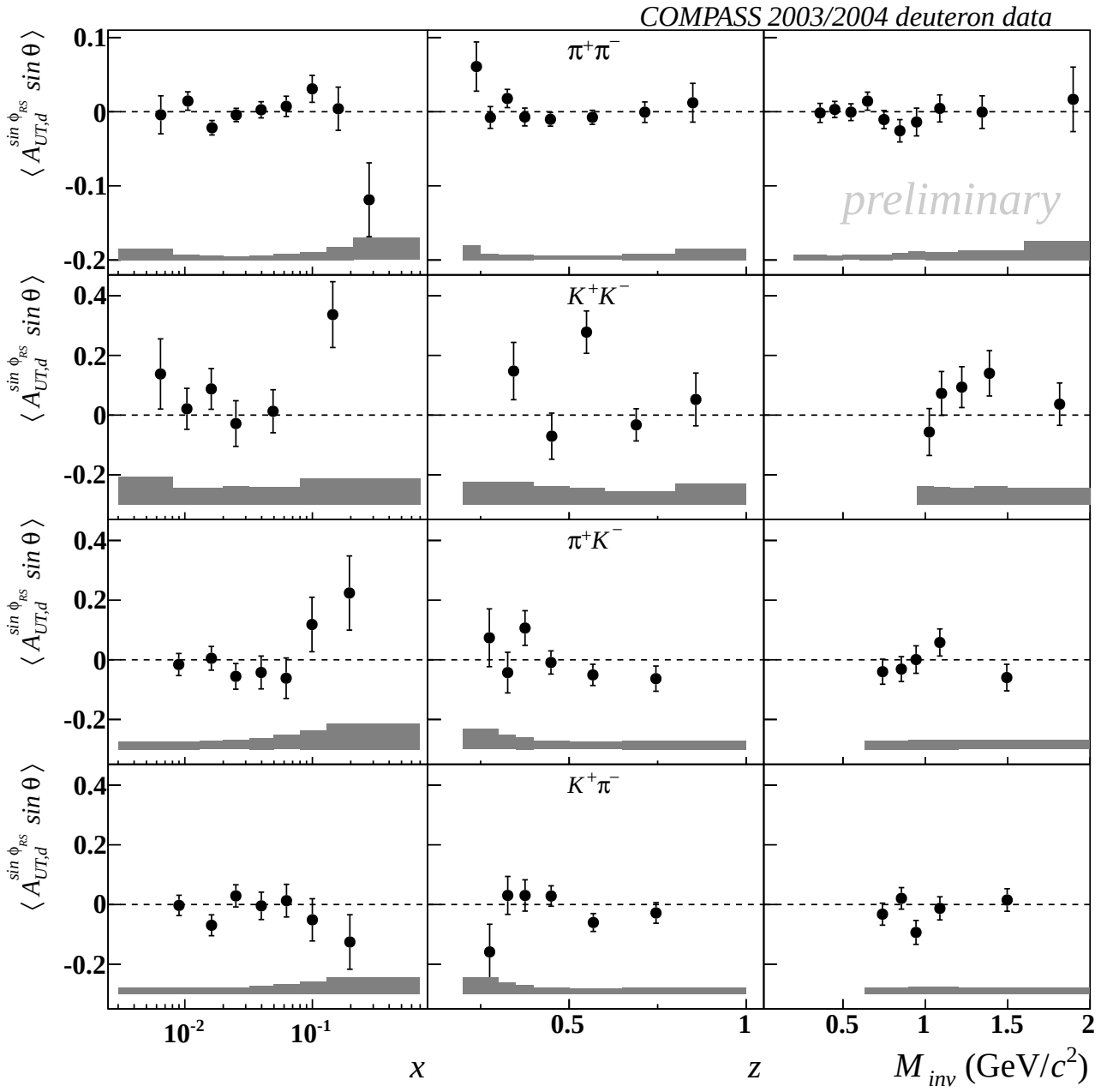


blue line: Bacchetta A. and Radici M., Phys. Rev. D **74** (2006) 114007
red and dashed lines: Ma B.-Q. *et al.*, Phys. Rev. D **77** (2008) 014035

From a complete reanalysis of the deuteron data with unified cuts and methods w.r.t. to proton data.

↪ Asymmetries of $\pi^+\pi^-$ pairs from the deuteron target compatible with zero within the uncertainties.

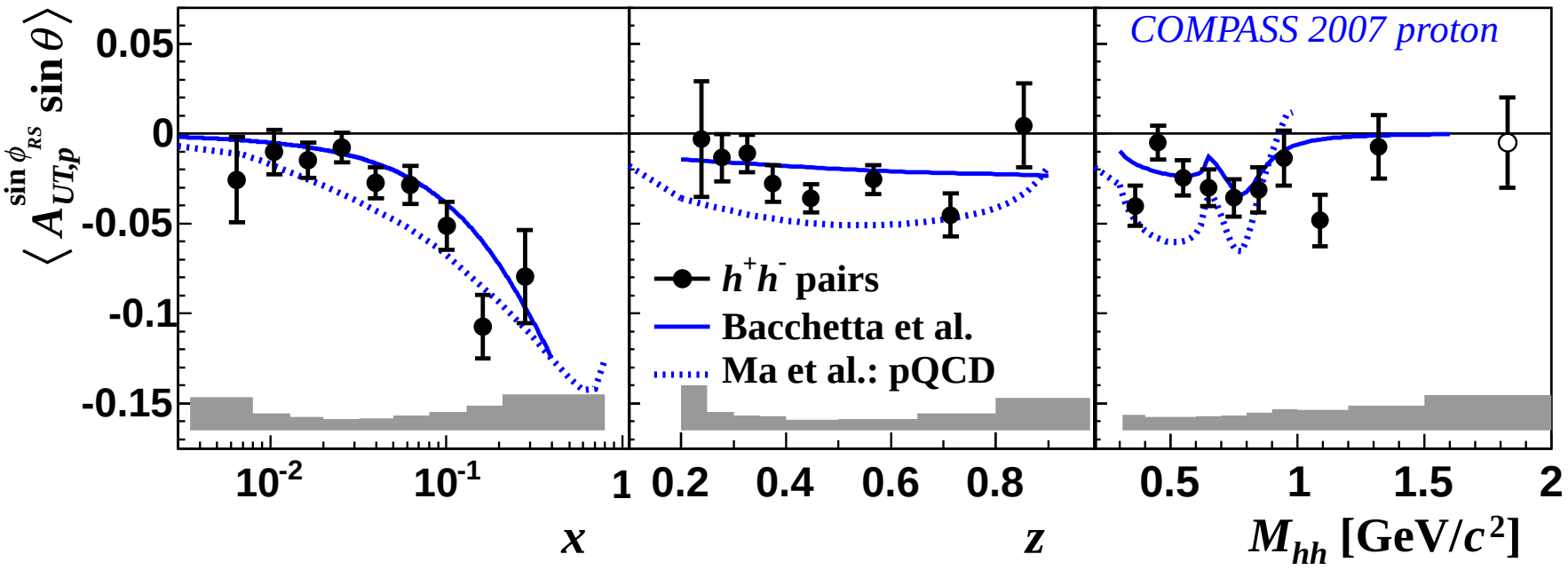
NEW Results ▶ deuteron data ▶ all identified pairs



hadron-pair asymmetries:

proton data

Results ▶ proton 2007 data ▶ all hadron h^+h^- pairs

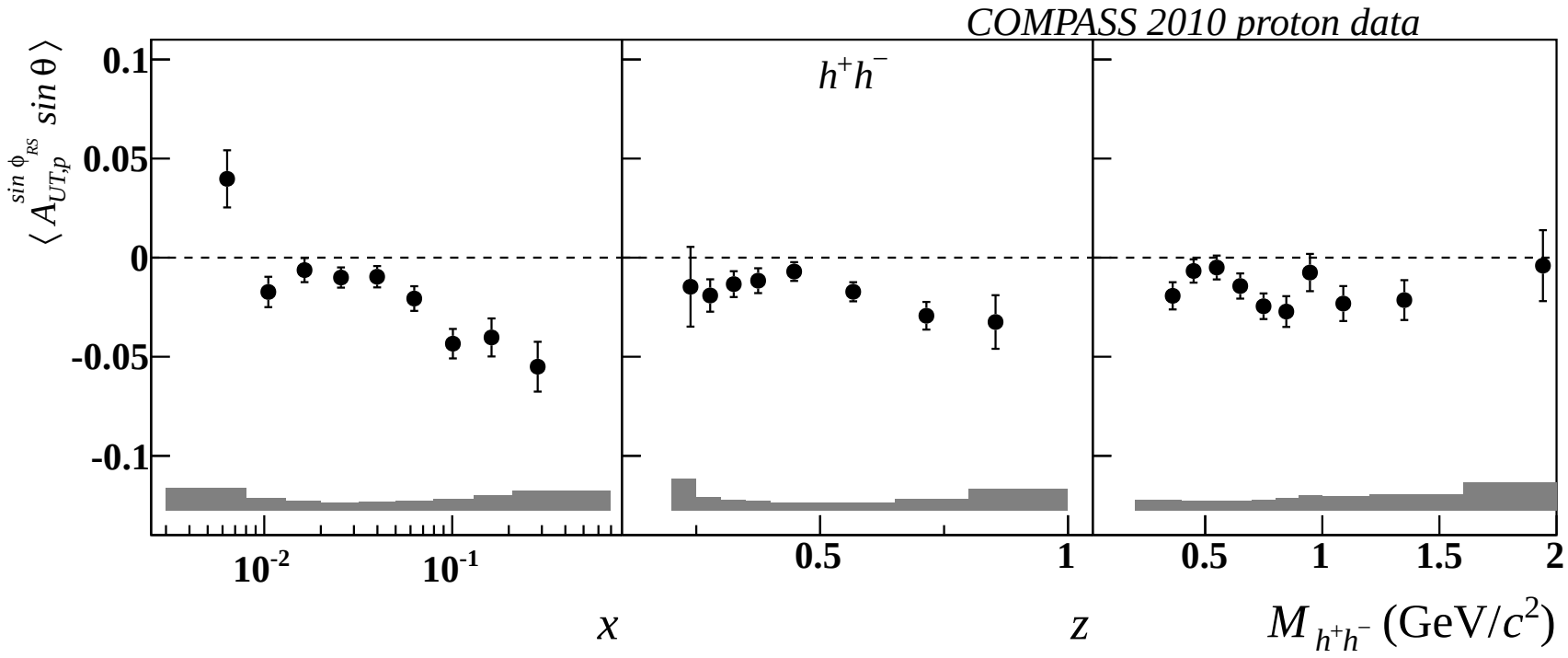


from: Adolph C. *et al.* [COMPASS Collaboration], Phys. Lett. B **713** (2012) 10

↪ Large asymmetries of h^+h^- pairs on the proton target in x dependence up to -10 %

Qualitative agreement with model predictions

Results ▶ proton 2010 data ▶ all hadron h^+h^- pairs

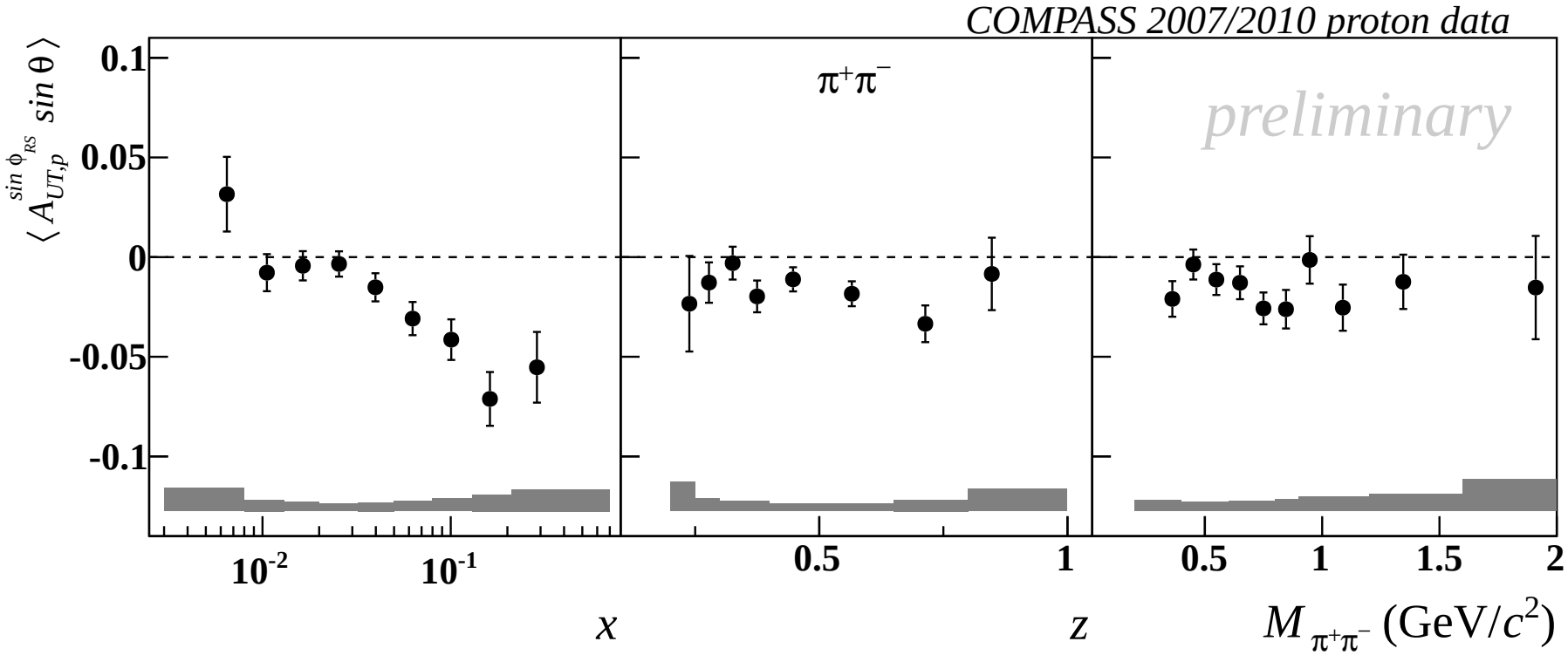


NEW from: Adolph C. *et al.* [COMPASS Collaboration], CERN preprint PH-EP-2014-013 [arXiv:1401.7873] submitted to Nucl.Phys.B.

↪ Large asymmetries of h^+h^- pairs on the proton target in x dependence up to -6 %

See recent paper [arXiv:1401.7873] for a discussion on the relation between hadron-pair and Collins asymmetries.

Results ▶ proton data ▶ $\pi^+\pi^-$ pairs



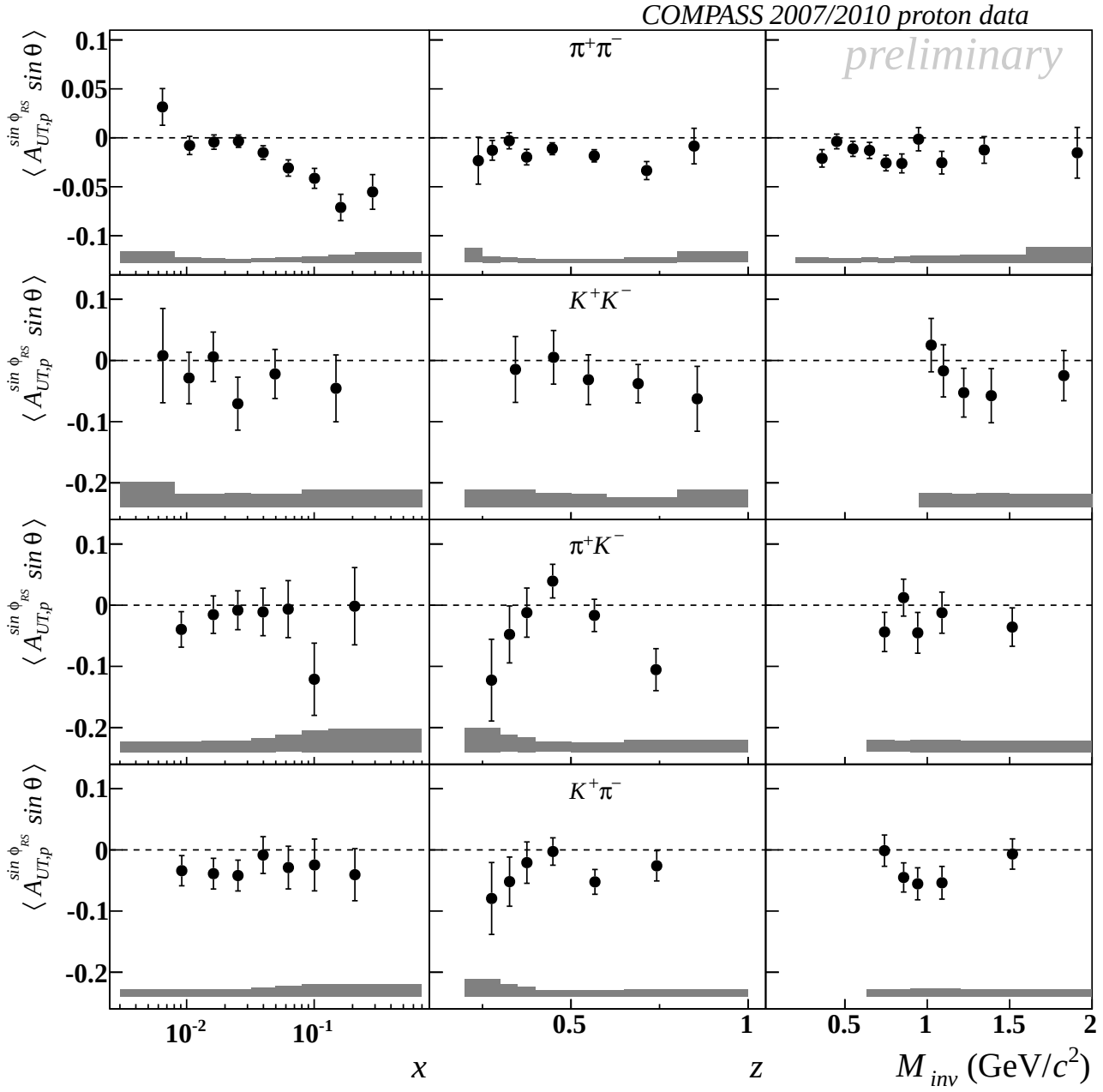
↪ Clear asymmetries of $\pi^+\pi^-$ pairs

x up to -7 %

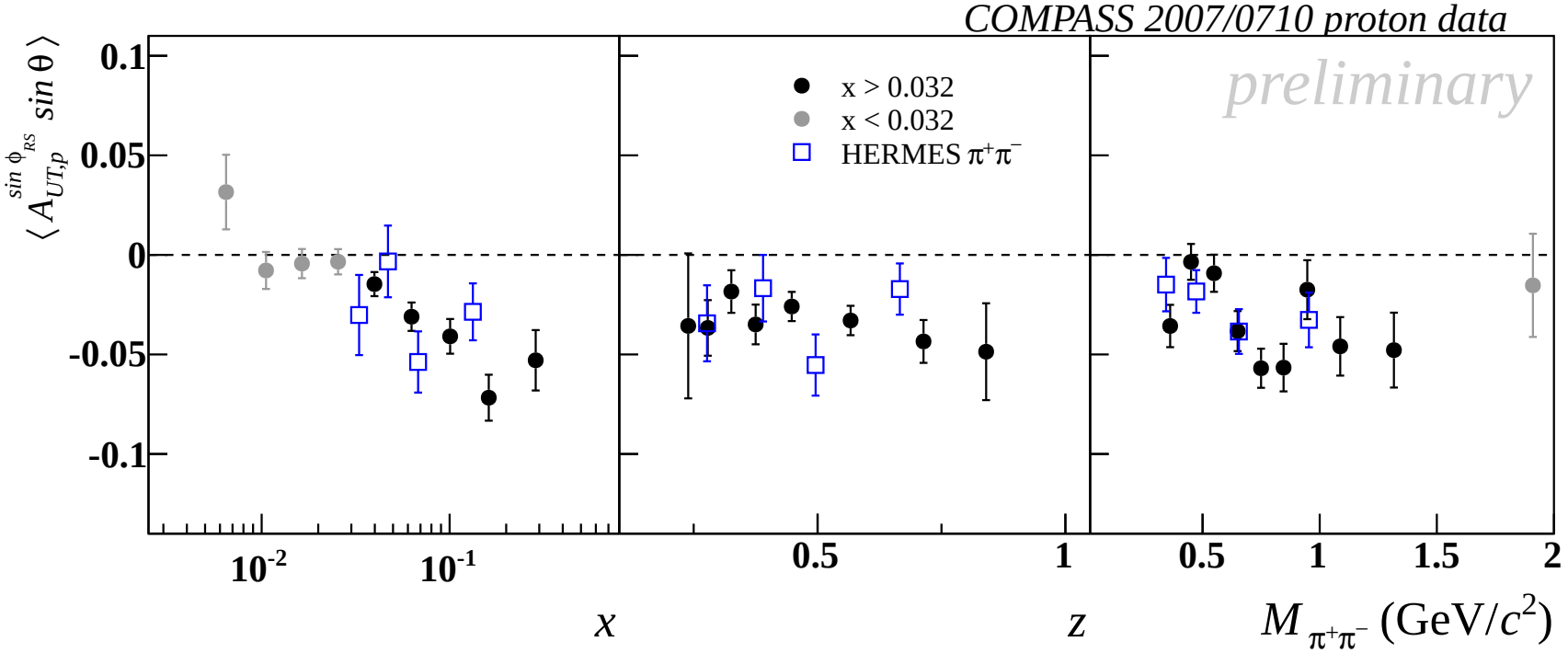
z no clear trend

M_{inv} indication of a dip around ρ^0 mass

NEW Results ▶ proton data ▶ all identified pairs



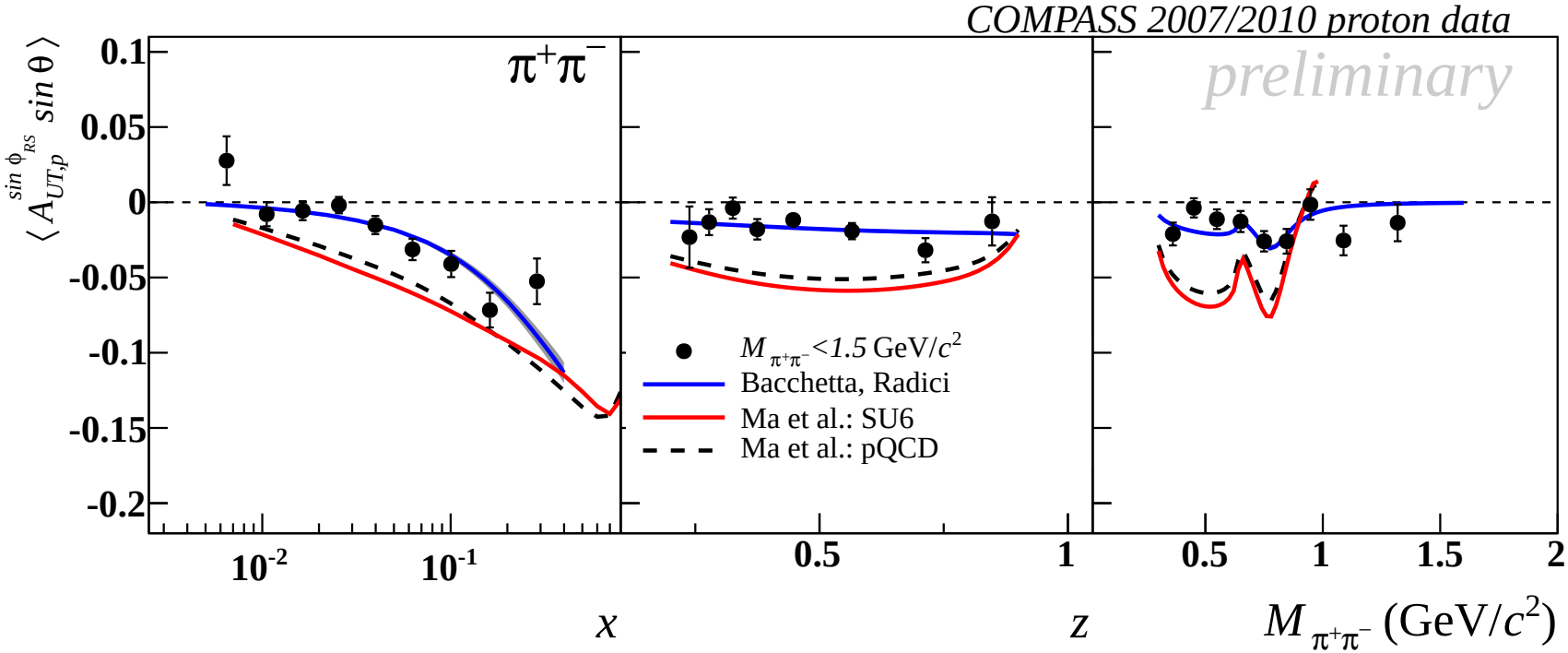
Results ▶ proton data ▶ comparison with HERMES



from: Airapetian A. et al. *et al.* [HERMES collaboration], J. High Energ. Phys. **06** (2008) 017
scaled with $\frac{1}{D_{nn}}$ and sign changed

↪ Good agreement within the uncertainties,
bearing in mind the larger kinematic range of COMPASS

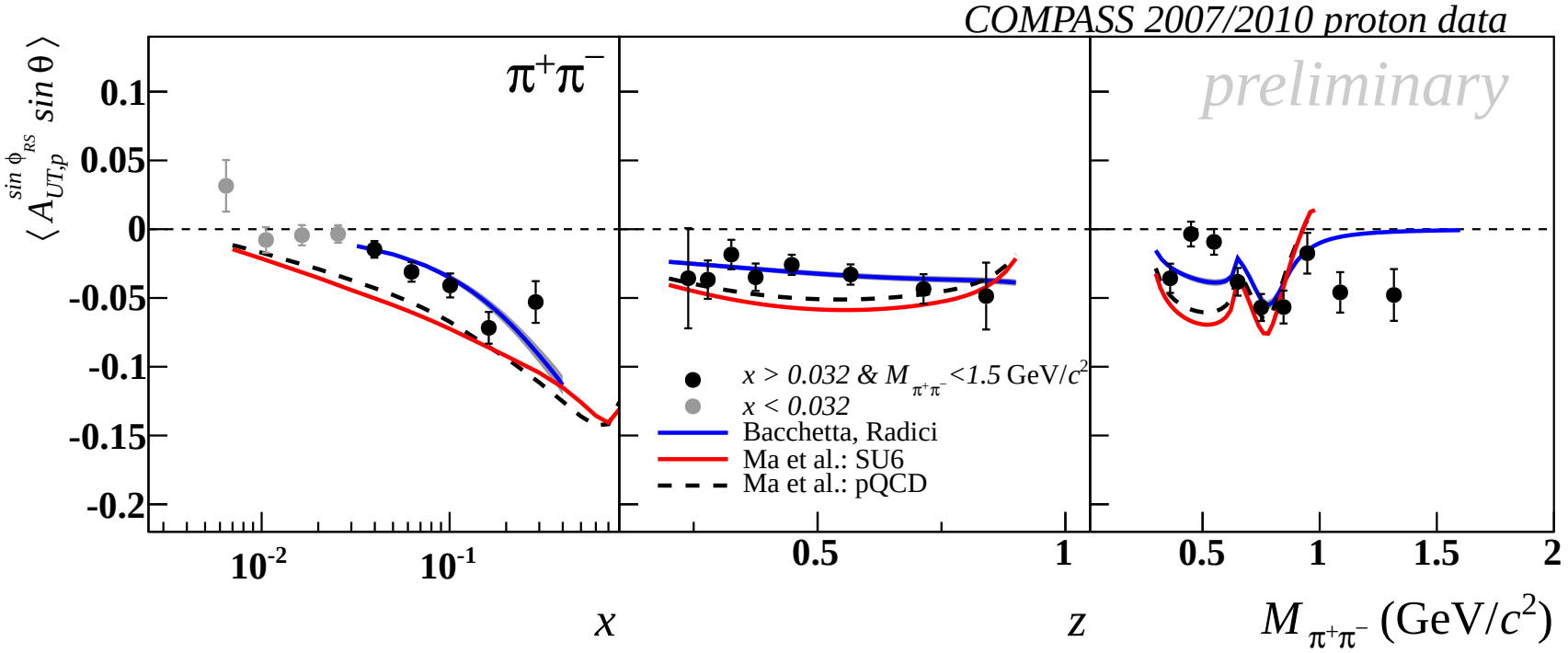
Results ▶ proton data ▶ $\pi^+\pi^-$ model predictions



blue line: Bacchetta A. and Radici M., Phys. Rev. D **74** (2006) 114007
red and dashed lines: Ma B.-Q. *et al.*, Phys. Rev. D **77** (2008) 014035

↪ x: *Ma* trend confirmed | *Bachetta* good agreement
↪ z: *Ma* too large | *Bachetta* compatible
↪ M_{inv}: *Ma* too large | *Bachetta* good agreement around ρ^0 mass

Results ▶ proton data ▶ $\pi^+\pi^-$ model predictions



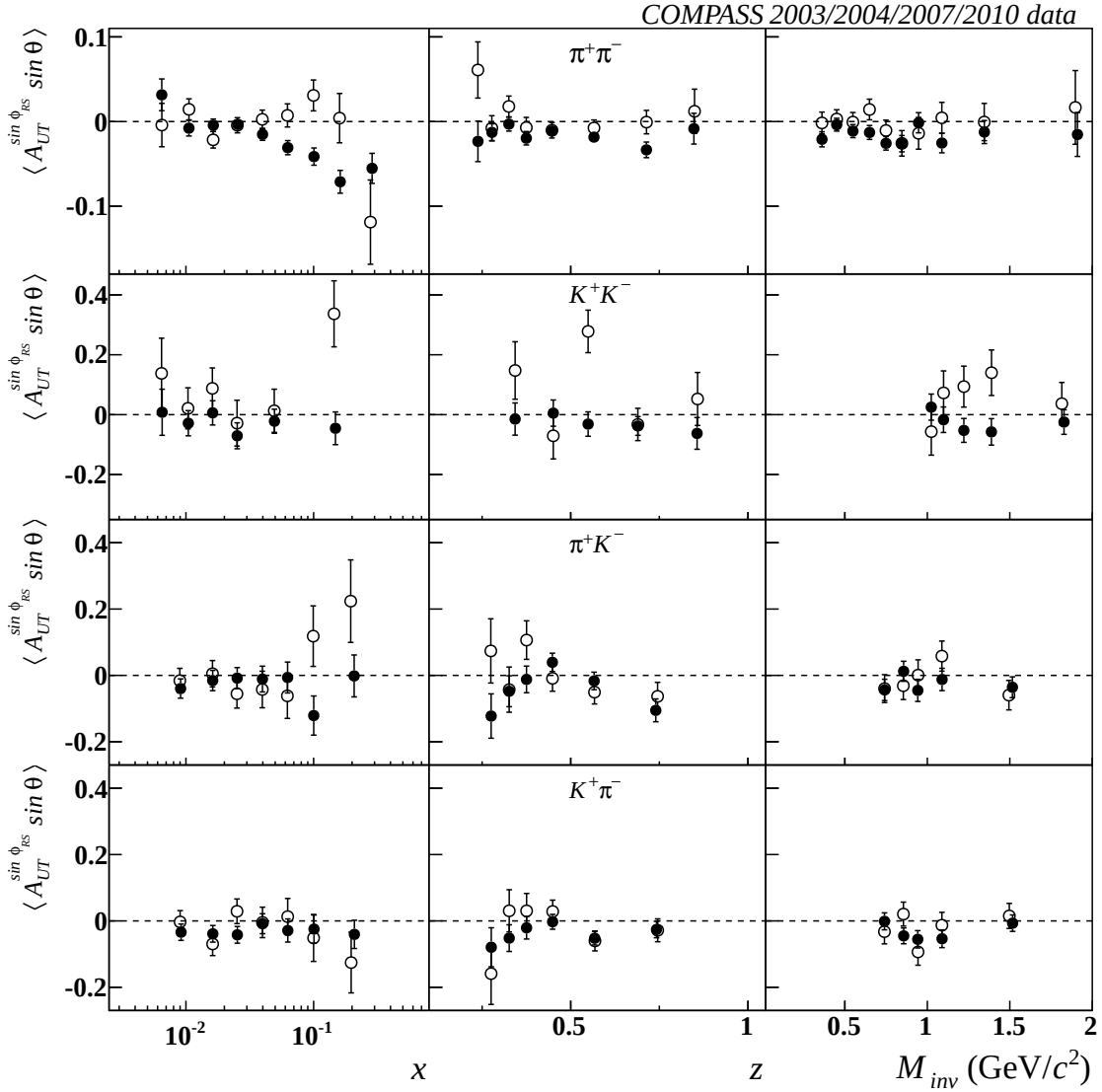
blue line: Bacchetta A. and Radici M., Phys. Rev. D **74** (2006) 114007
red and dashed lines: Ma B.-Q. *et al.*, Phys. Rev. D **77** (2008) 014035

Improved agreement with Ma model if only the valence region is considered.

Transversity extraction

of u and d valence quarks

NEW Results ▶ deuteron & proton data ▶ all identified pairs



First complete set of identified hadron-pair asymmetries with unified cuts, binning and fit method from deuteron and proton targets.

Transversity extraction ▶ motivation & theory

A transversely polarized deuteron target gives access to:

$$xh_{1,d}(x;Q^2) = xh_1^u(x;Q^2) + xh_1^d(x;Q^2)$$

A transversely polarized proton target gives access to:

$$xh_{1,p}(x;Q^2) = xh_1^u(x;Q^2) - \tfrac{1}{4}xh_1^d(x;Q^2)$$

→ Bacchetta *et al.* in JHEP03 (**13**) 119 extracted
$xh_{1,d}(x;Q^2)$ and $xh_{1,p}(x;Q^2)$
from HERMES $\pi^+\pi^-$ and COMPASS h^+h^- results
[PLB **713** (12) 10].

⇒ Use their method together with the new full set of $\pi^+\pi^-$ results to extract the u and d valence quark transversity distributions bin-by-bin.

Explicit expressions:

For a proton target, the SSA (2.13) simplifies to [33]

$$A^{p}_{\mathrm{SIDIS}}(x,z,M_h;Q^2) = -C_y\,\frac{|\boldsymbol{R}|}{M_h}H^{\sphericalangle\, u}_{1,sp}(z,M_h;Q^2)\,\left[h_1^{u_v}(x;Q^2)-\frac{1}{4}h_1^{d_v}(x;Q^2)\right] \times\left\{f_1^{u+\bar u}(x;Q^2)\,D_1^{u}(z,M_h;Q^2)+\frac{1}{4}f_1^{d+\bar d}(x;Q^2)\,D_1^{d}(z,M_h;Q^2) +\frac{1}{4}\,f_1^{s+\bar s}(x)\,D_1^{s+\bar s}(z,M_h;Q^2)\right\}^{-1}, \tag{2.16}$$

and for a deuteron target to

$$A^{D}_{\mathrm{SIDIS}}(x,y,z,M_h;Q^2) = -C_y\,\frac{3}{4}\,\frac{|\boldsymbol{R}|}{M_h}H^{\sphericalangle\, u}_{1,sp}(z,M_h;Q^2)\,\left[h_1^{u_v}(x;Q^2)+h_1^{d_v}(x;Q^2)\right] \times\left\{\left[f_1^{u+\bar u}(x;Q^2)+f_1^{d+\bar d}(x;Q^2)\right]\times \left[D_1^{u}(z,M_h;Q^2)+\frac{1}{4}\,D_1^{d}(z,M_h;Q^2)\right] +\frac{1}{2}\,f_1^{s+\bar s}(x;Q^2)\,D_1^{s+\bar s}(z,M_h;Q^2)\right\}^{-1}, \tag{2.17}$$

where $h_1^{q_v}\equiv h_1^{q}-h_1^{\bar q}$ and $f_1^{q+\bar q}\equiv f_1^{q}+f_1^{\bar q}$.

Bacchetta *et al.* JHEP03 (13) 119

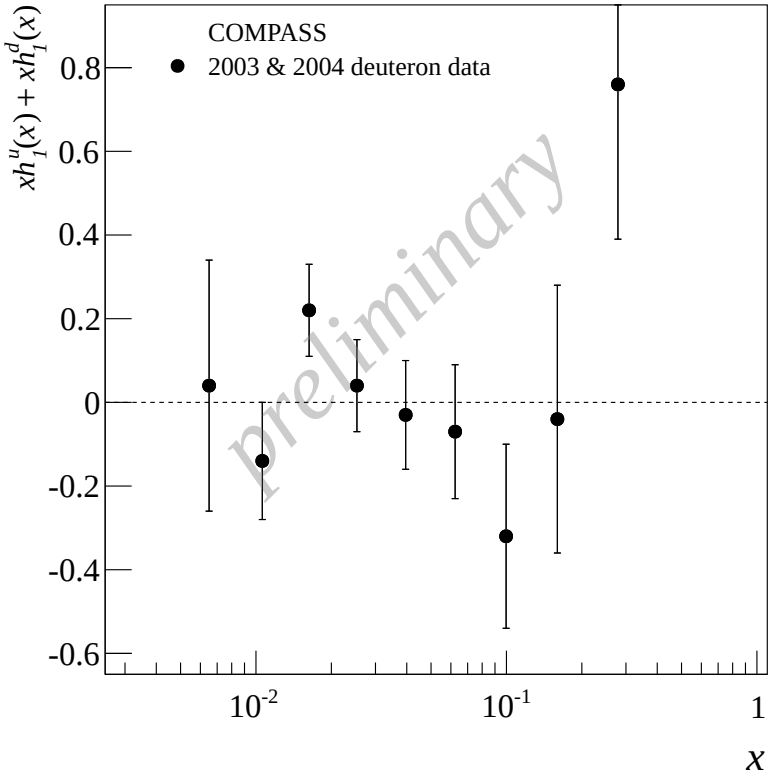
Extraction of Transversities ▶ 1st step

	HERMES	data		
x	y	$Q^2[\mathrm{GeV}^2]$	A_{SIDIS}	$h_1^{u_v} - h_1^{d_v}/4$
0.033	0.734	1.232	0.015 ± 0.010	0.086 ± 0.061
0.047	0.659	1.604	0.002 ± 0.011	0.010 ± 0.054
0.068	0.630	2.214	0.035 ± 0.011	0.167 ± 0.069
0.133	0.592	4.031	0.020 ± 0.010	0.092 ± 0.054
	COMPASS	proton	data	
x		$Q^2[\mathrm{GeV}^2]$	A_{SIDIS}	$h_1^{u_v} - h_1^{d_v}/4$
0.0065		1.232	0.026 ± 0.030	0.10 ± 0.12
0.0105		1.476	0.010 ± 0.016	0.038 ± 0.059
0.0164		1.744	0.015 ± 0.013	0.057 ± 0.049
0.1330		2.094	0.008 ± 0.010	0.031 ± 0.039
0.0398		2.802	0.027 ± 0.011	0.107 ± 0.049
0.0626		4.342	0.029 ± 0.014	0.118 ± 0.060
0.1006		6.854	0.051 ± 0.016	0.208 ± 0.079
0.1613		10.72	0.108 ± 0.023	0.42 ± 0.12
0.2801		21.98	0.080 ± 0.033	0.24 ± 0.11
	COMPASS	deuteron	data	
x		$Q^2[\mathrm{GeV}^2]$	A_{SIDIS}	$h_1^{u_v} + h_1^{d_v}$
0.0064		1.253	0.005 ± 0.024	0.05 ± 0.24
0.0105		1.508	-0.004 ± 0.012	-0.04 ± 0.12
0.0163		1.792	0.028 ± 0.010	0.28 ± 0.11
0.0253		2.266	-0.005 ± 0.009	-0.051 ± 0.094
0.0396		3.350	0.006 ± 0.011	0.06 ± 0.12
0.0623		5.406	-0.006 ± 0.014	-0.06 ± 0.14
0.0996		8.890	-0.029 ± 0.019	-0.30 ± 0.20
0.1597		15.65	-0.017 ± 0.030	-0.16 ± 0.28
0.2801		33.22	0.078 ± 0.054	0.50 ± 0.36

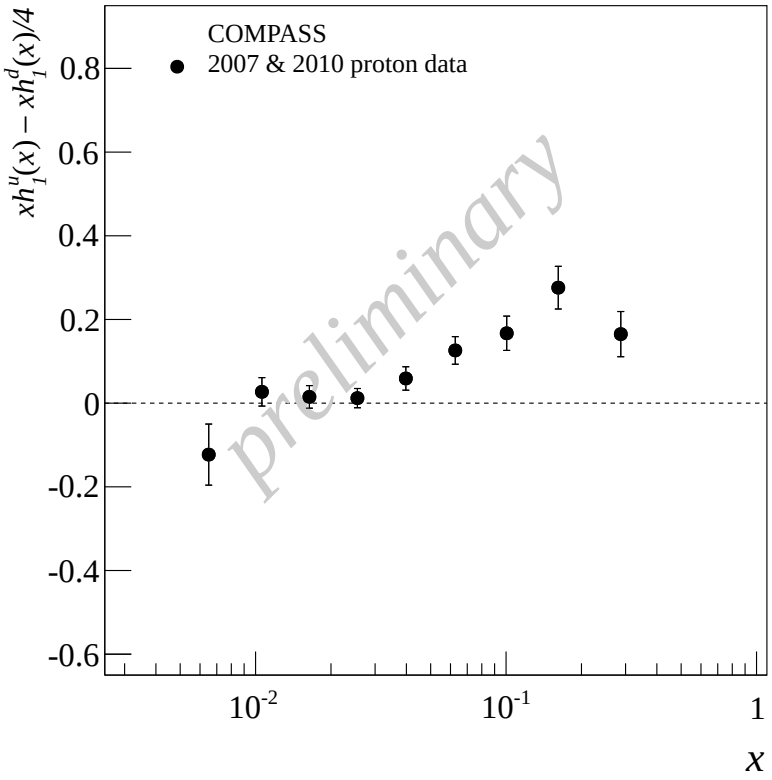
Tab.1 of JHEP03 (13) 119

Transversity extraction ▶ 1st step ▶ results

$xh_{1,d} = xh_1^u(x;Q^2) + xh_1^d(x;Q^2)$
from deuteron data:



$xh_{1,p} = xh_1^u(x;Q^2) - \frac{1}{4}xh_1^d(x;Q^2)$
from proton data:

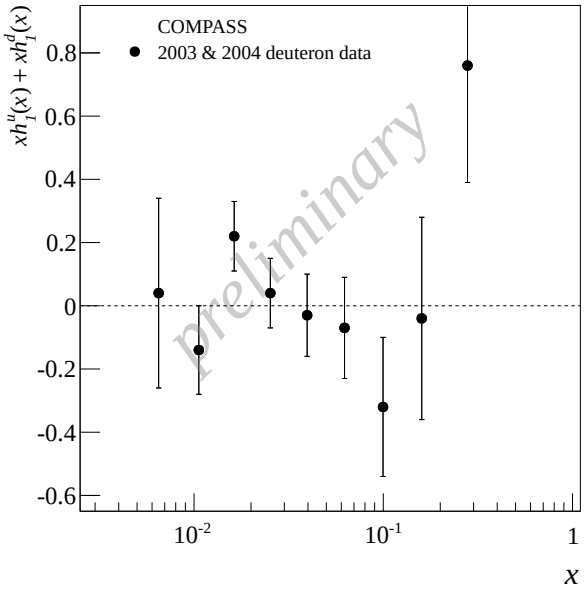


↪ $xh_{1,d}$ compatible with zero within the uncertainties
↪ $xh_{1,p}$ sizable signal at large x

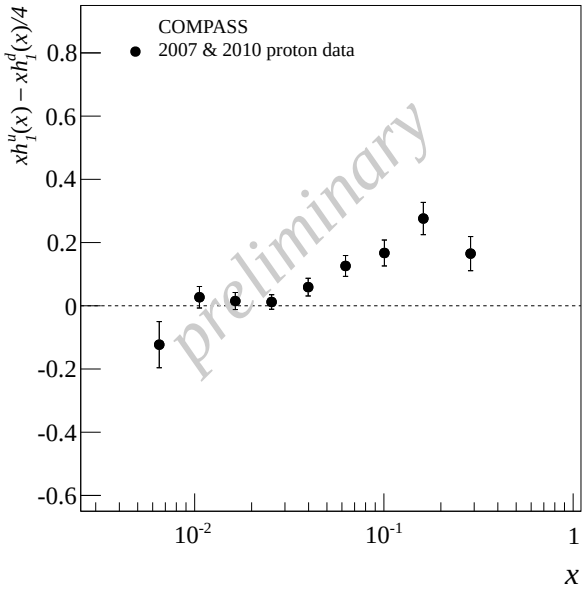
Extraction of Transversities ▶ 1st step ▶ comparison

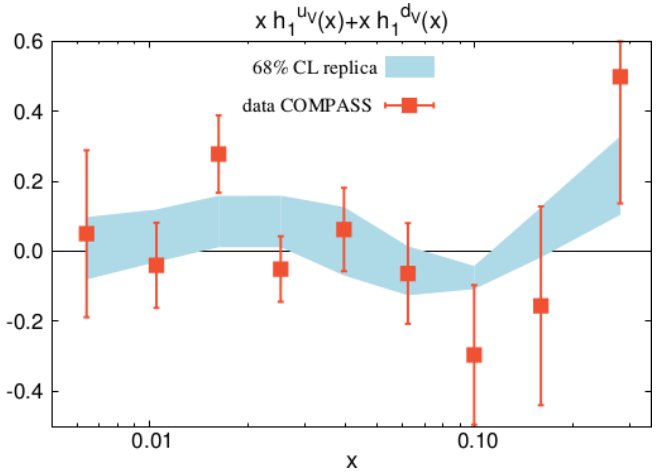
Comparison with results in JHEP03 (13) 119 Bacchetta *et al.*:
(2002/03/04/07 h^+h^- *data*)

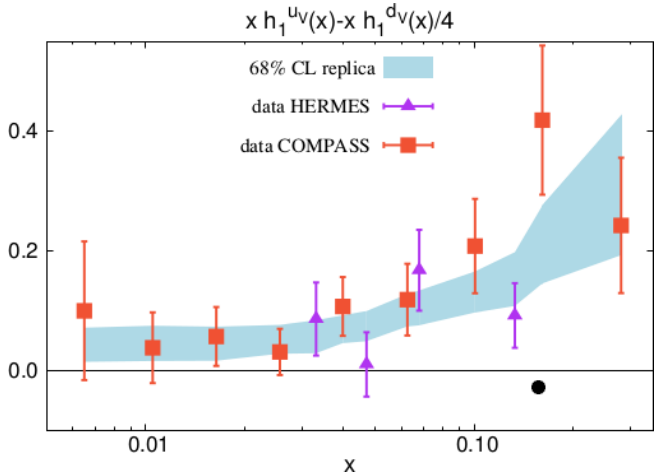
$xh_{1,d}$



$xh_{1,p}$



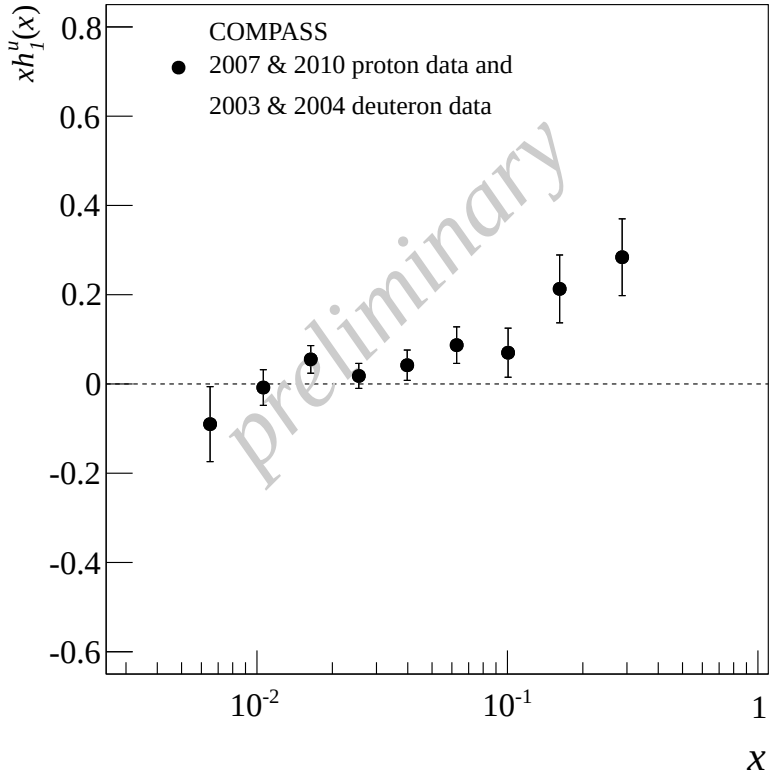




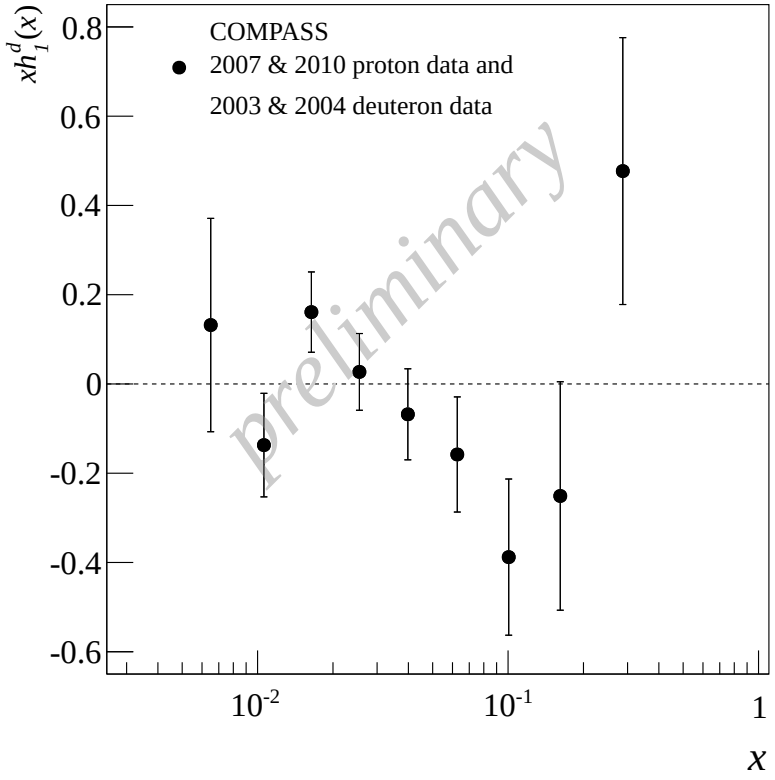
Extraction of Transversities ▶ 2nd step ▶ results

xh_1^u and xh_1^d are obtained by solving the system of equations:

$xh_1^u(x;Q^2)$



$xh_1^d(x;Q^2)$



$\hookrightarrow$ xh_1^u clear transversity signal

$\hookrightarrow$ xh_1^d suffers from low deuteron data statistics

Extraction of Transversities ▶ global fit

In JHEP03 (13) 119 Bacchetta *et al.* perform fits to xh_1^u and xh_1^d extracted from HERMES and COMPASS (h^+h^- 2002-2004 and 2007) data. They use a functional from

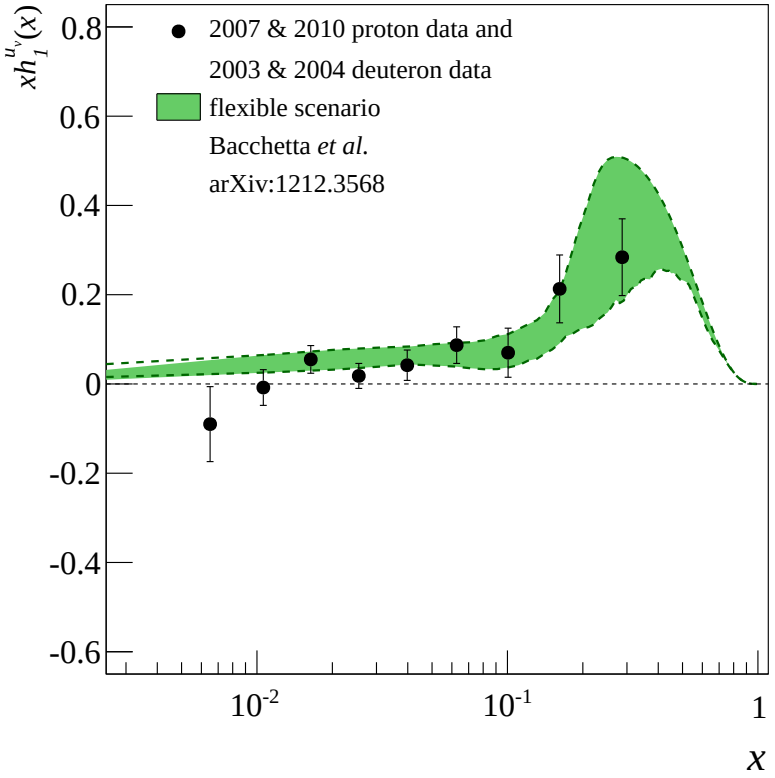
$$xh_1^q = \tanh\Big(\sqrt{x}\Big(A_q + B_q x + C_q x^2 + D_q x^3\Big)\Big)\Big(x\,\mathrm{SB}^q(x, Q^2) + x\,\mathrm{SB}^{\bar{q}}(x, Q^2)\Big)$$

- last term ensures that the Soffer bound holds true
- parameters of the polynomial argument of the tanh allow for three scenarios
  - rigid scenario: $C = D = 0\,\forall q$
  - flexible scenario: $D = 0\,\forall q$
  - extra-flexible scenario
- subsequently fit replicas are generated by scattering the data points by a Gaussian distribution with a width equal to their uncertainties
- a band containing 68 % of the replicas is used as the final result

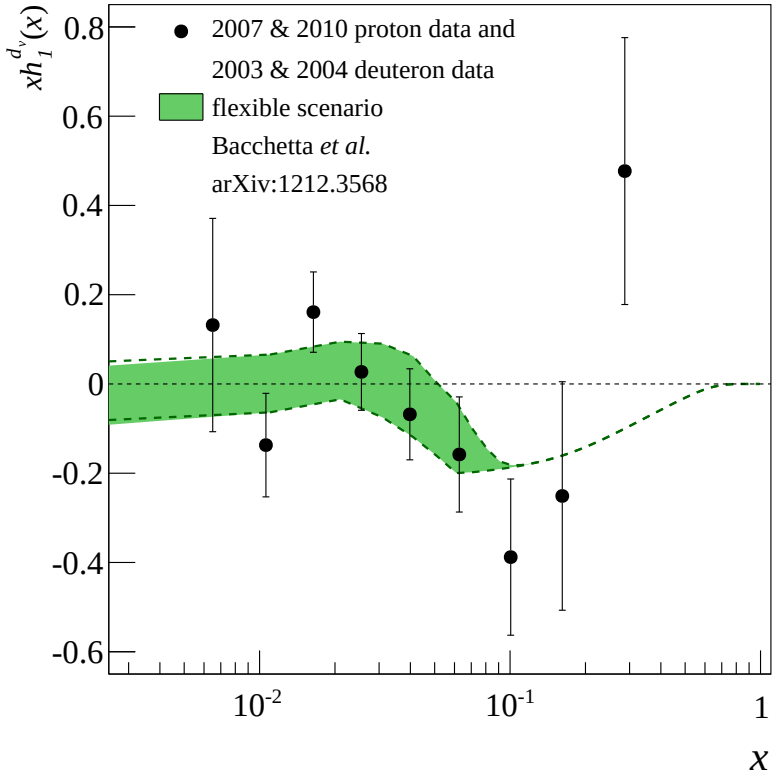
Extraction of Transversities ▶ comparison with global fit

Comparison of new results with Bacchetta *et al.* JHEP03 (**13**) 119:

$xh_1^u(x;Q^2)$



$xh_1^d(x;Q^2)$

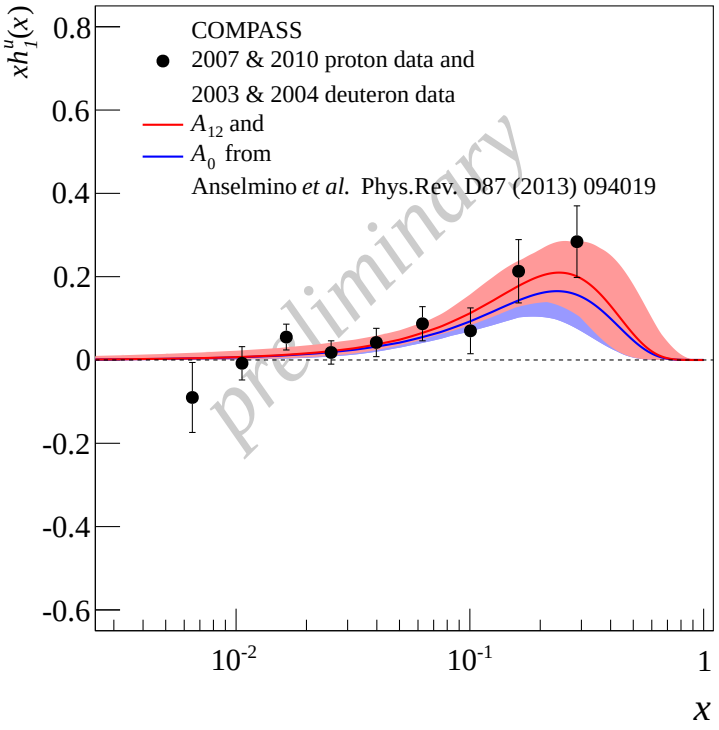


No surprise: New COMPASS data points are (still) very well compatible with the fit to the h^+h^- data.

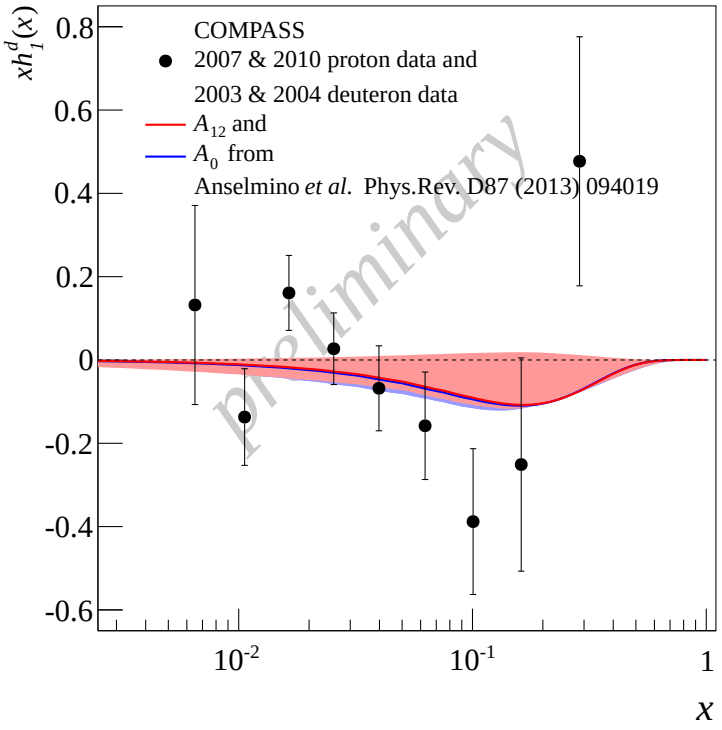
Extraction of Transversities ▶ comparison with

Comparison of results from single hadron Collins asymmetry global fit by Anselmino *et al.* Phys.Rev.D **87** (2013) 094019 [arXiv:1303.3822]:

$xh_1^u(x;Q^2)$



$xh_1^d(x;Q^2)$



Very good agreement for the u-quark Transversity and fair agreement for d-quark.

Better agreement with A_{12} BELLE e^+e^- results than A_0.

Conclusions & Outlook

- Deuteron and proton 2007 h^+h^- results published [PLB **713** (12) 10]
- Combined 2007/2010 proton h^+h^- results submitted to Nucl.Phys.B [arXiv:1401.7873]
- Preliminary 2003-2004 deuteron data identified pair results
- Preliminary 2007/2010 proton data identified pair results

1. Complete sets of $\pi^+\pi^-$ asymmetries with unified cuts, binning and fit method from deuteron and proton targets
2. COMPASS $\pi^+\pi^-$ data is in good agreement with HERMES results
3. Good agreement with model predictions
4. First bin-by-bin extraction with the final COMPASS results of the transversity distribution of u and d valence quarks using the method by Bacchetta *et al.* [JHEP03 (**13**) 119]

Outlook:

- Paper on identified asymmetries: deuteron 2003-2004 and combined proton 2007/2010 data
- Multidimensional analysis in e.g. Q^2, x, M_{inv}, ...
- Asymmetries of pairs including π^0

Thank you for your attention!

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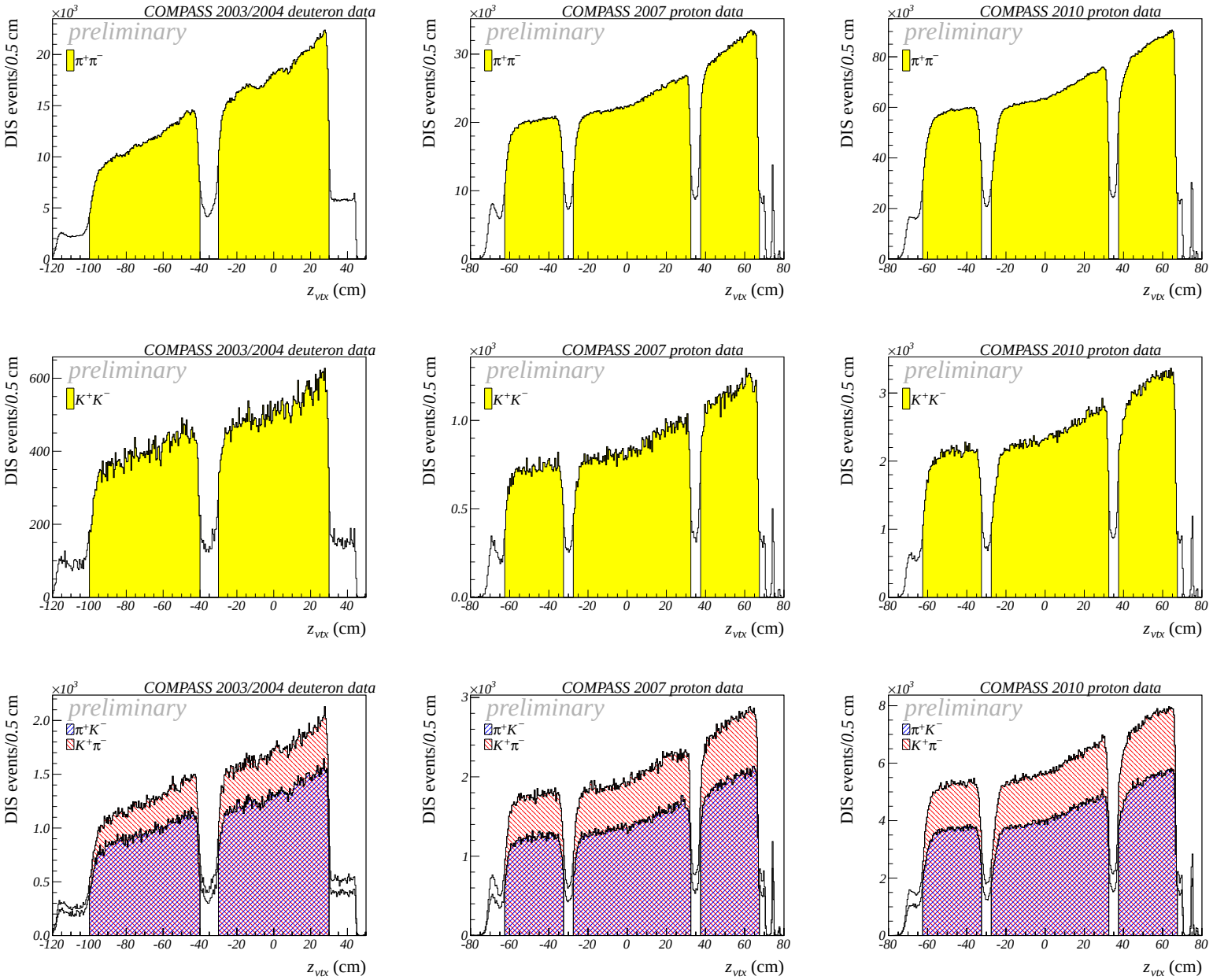
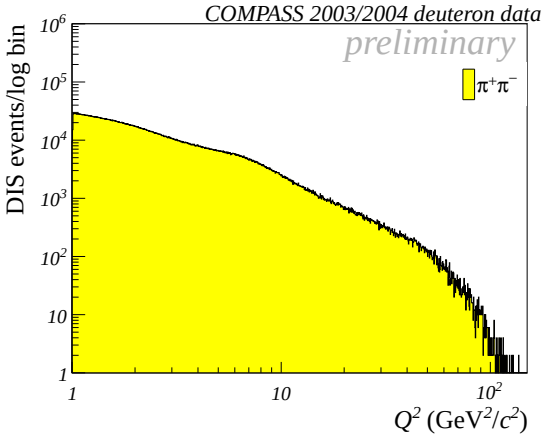
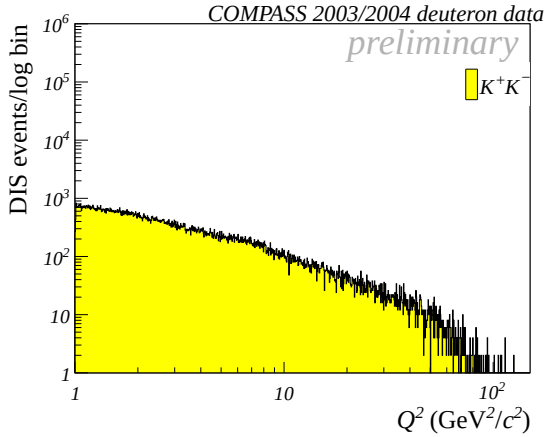
Back up

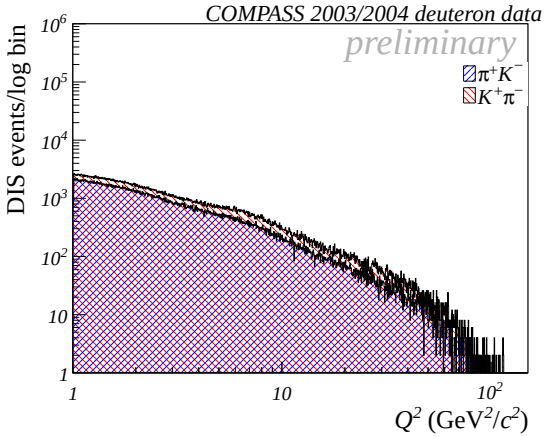
Results ▶ kinematic distributions ▶ vertex Z position

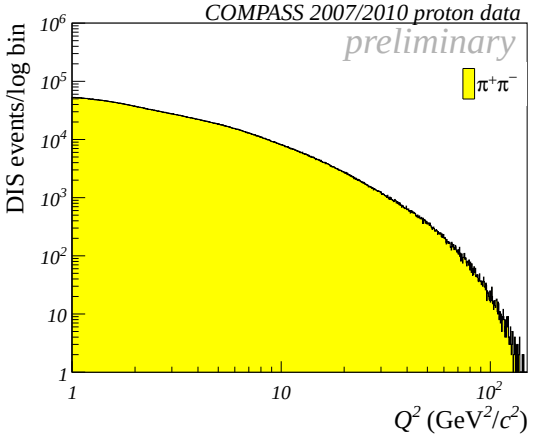


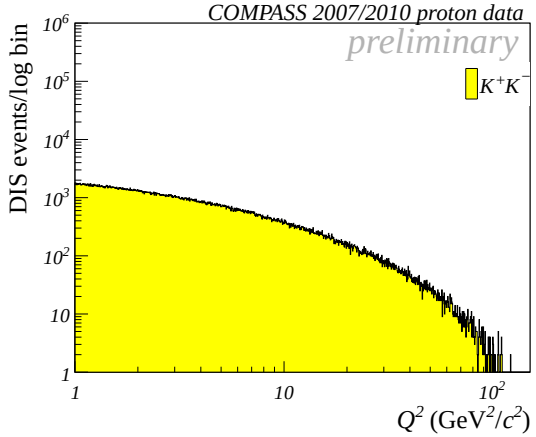
Results ▶ kinematic distributions ▶ DIS events ▶ Q^2

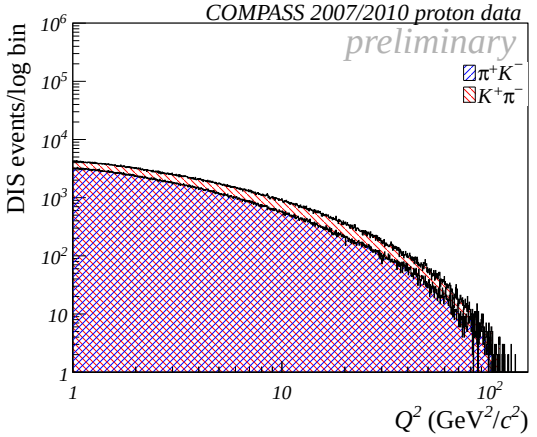




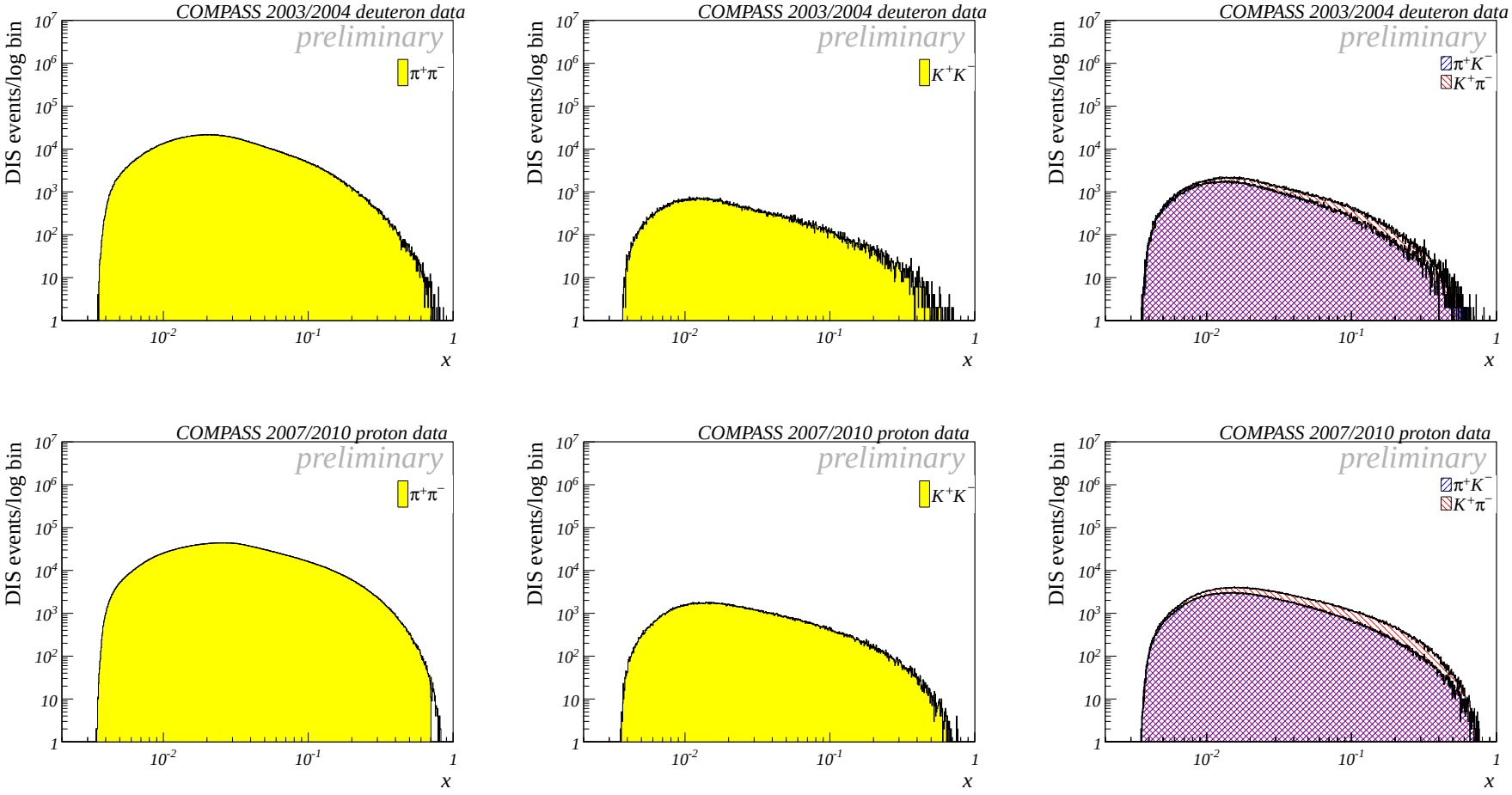




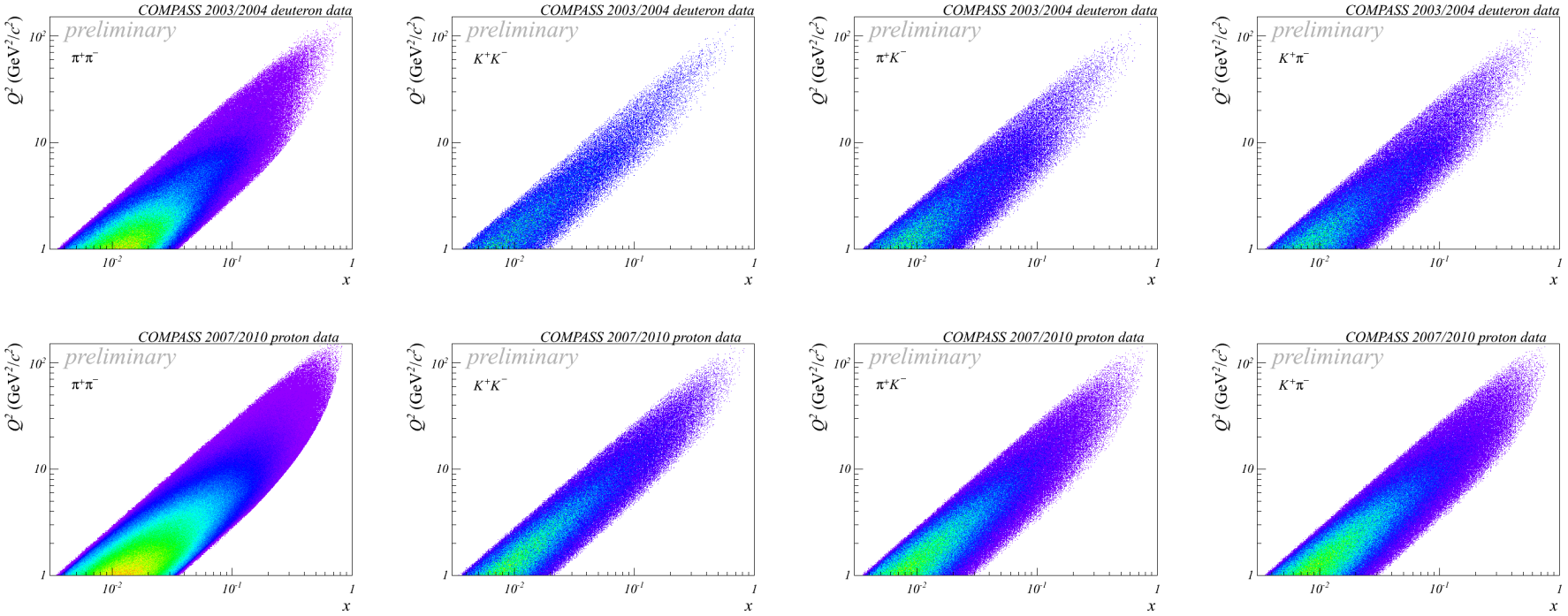




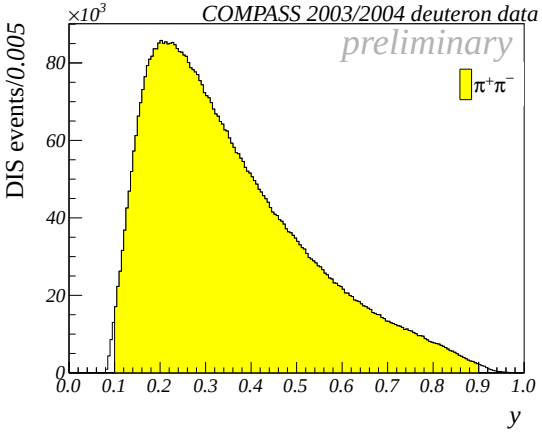
Results ▶ kinematic distributions ▶ DIS events ▶ x

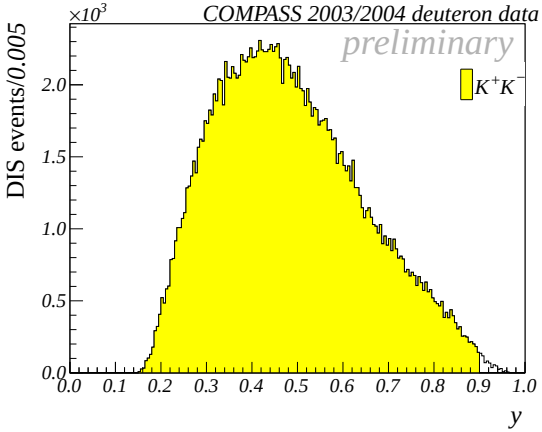


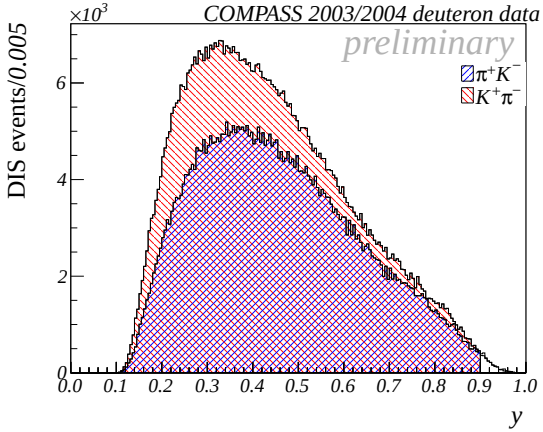
Results ▶ kinematic distributions ▶ hadrons ▶ Q^2 vs. x

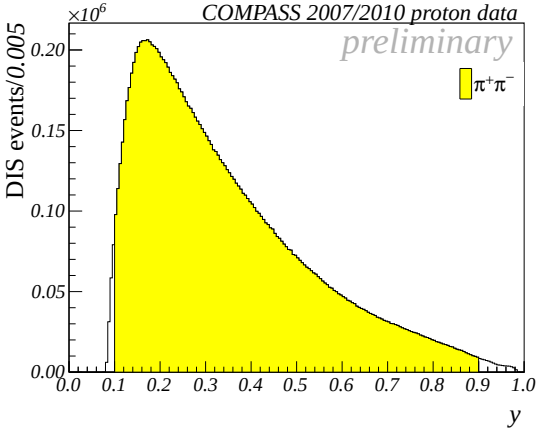


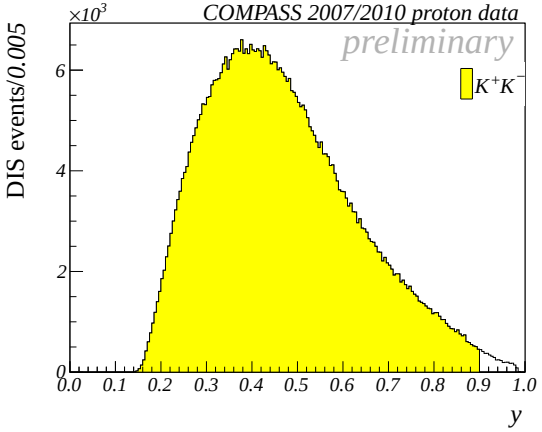
Results ▶ kinematic distributions ▶ DIS events ▶ y

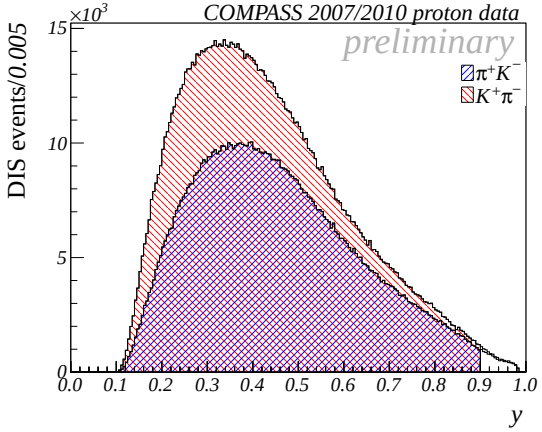




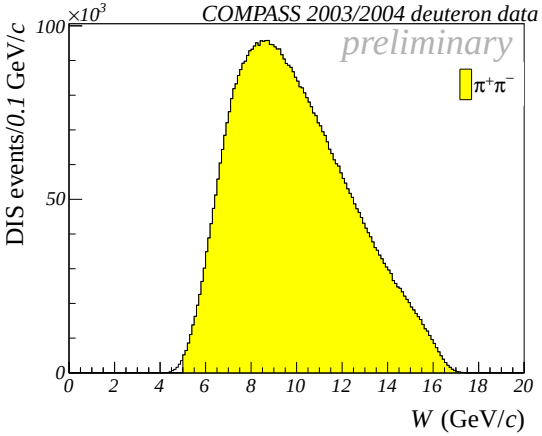


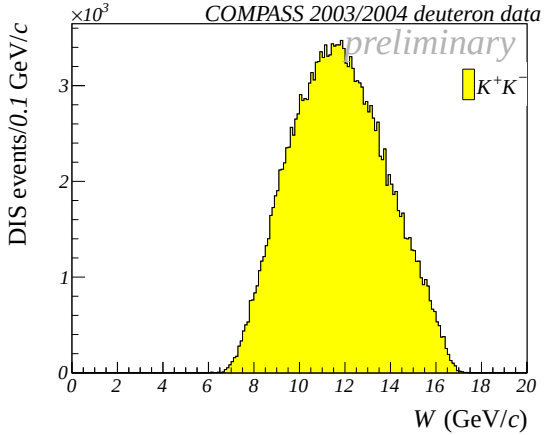


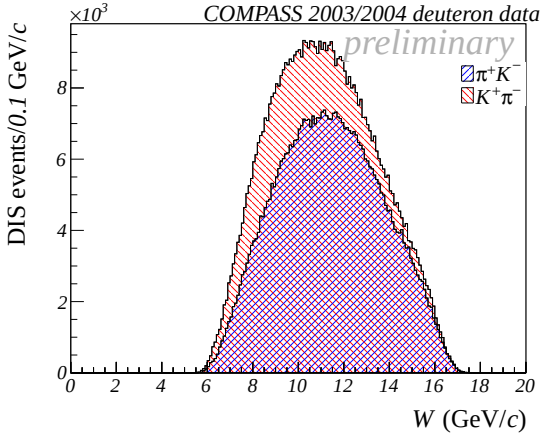


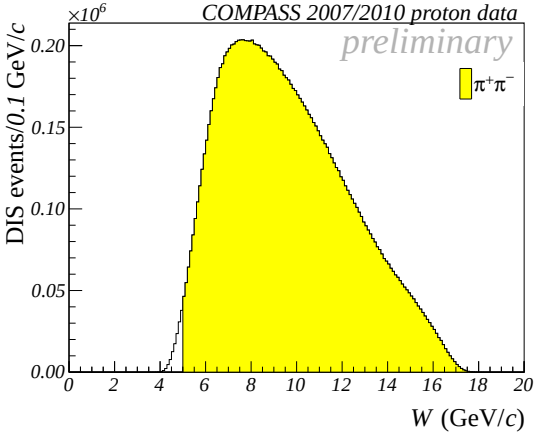


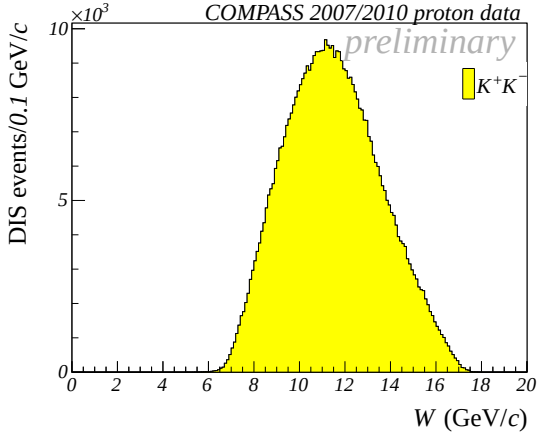
Results ▶ kinematic distributions ▶ DIS events ▶ y

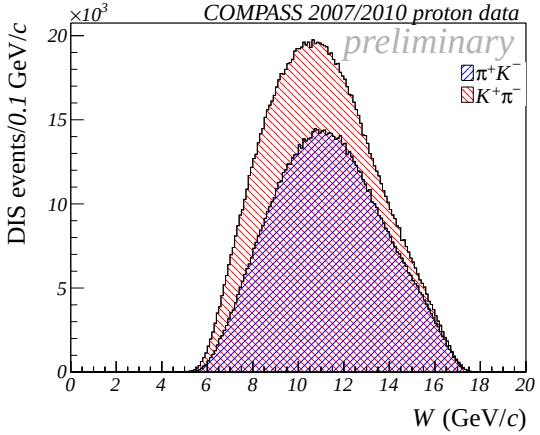




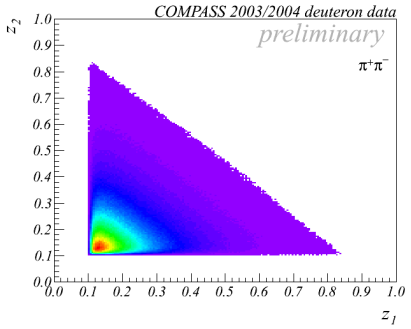


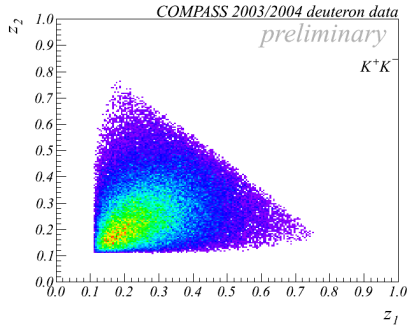


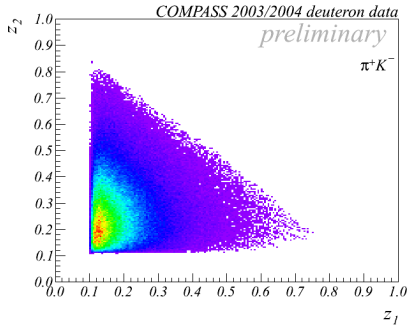


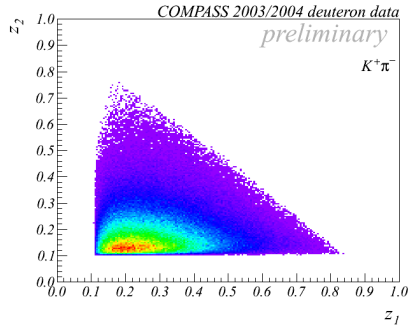


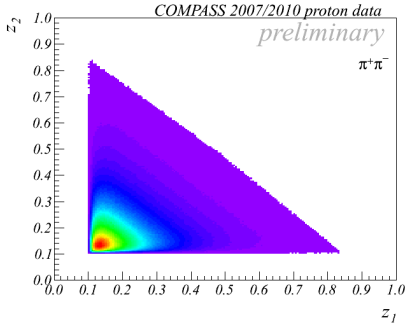
Results ▶ kinematic distributions ▶ hadrons ▶ z_1 vs. z_2

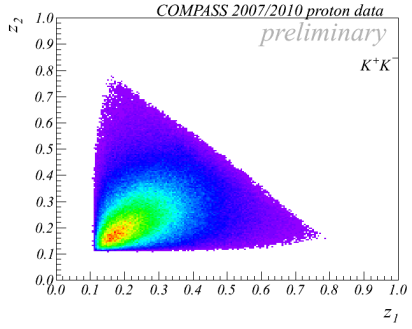


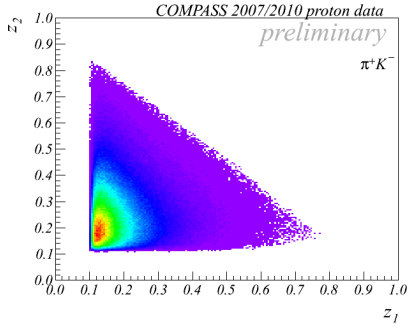


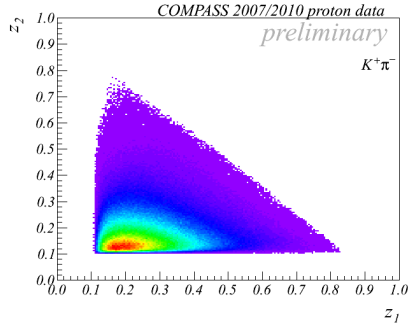




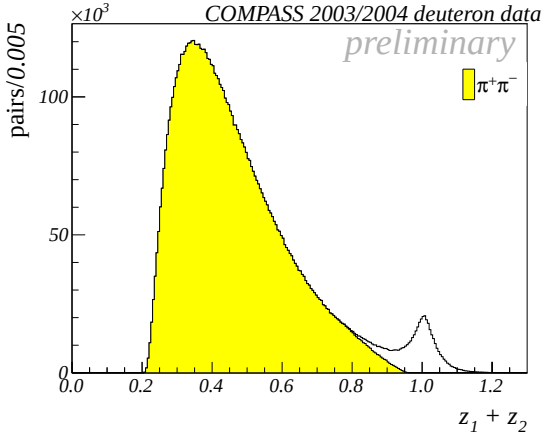


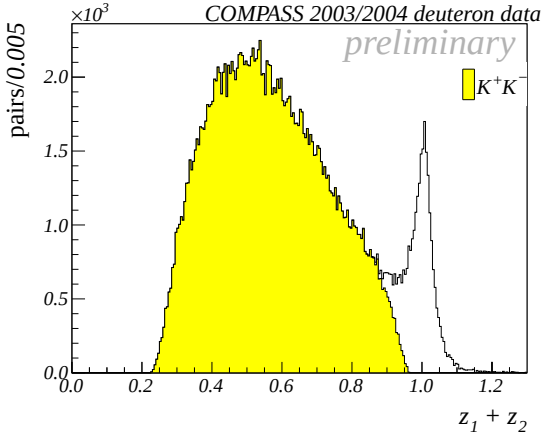


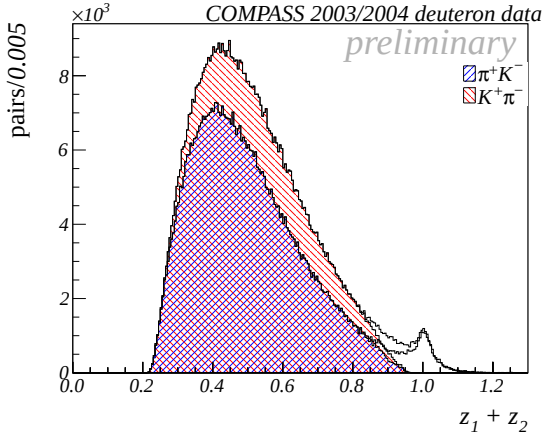


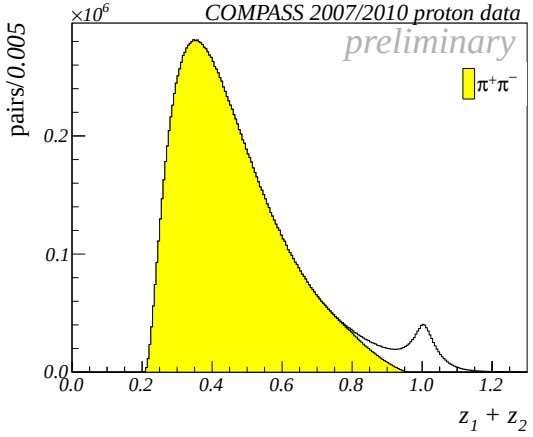


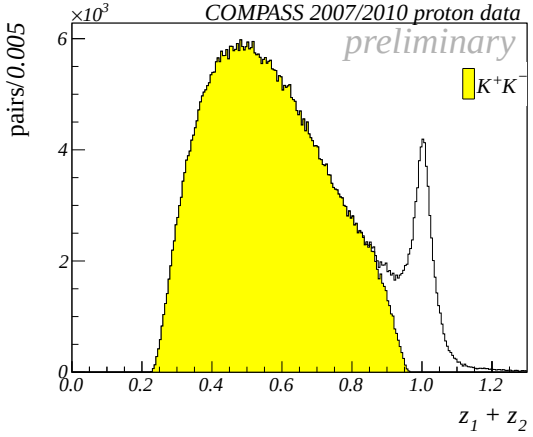
Results ▶ kinematic distributions ▶ hadron-pair ▶ $Z = z_1 + z_2$

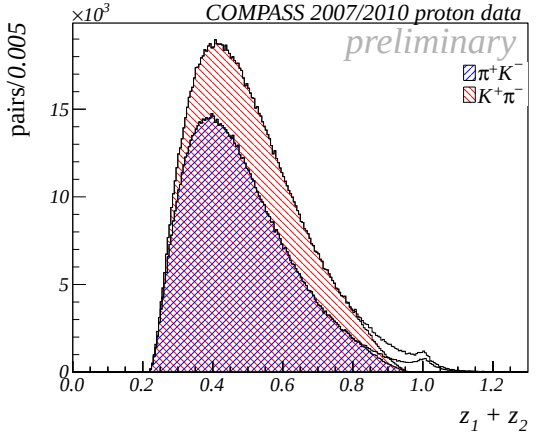




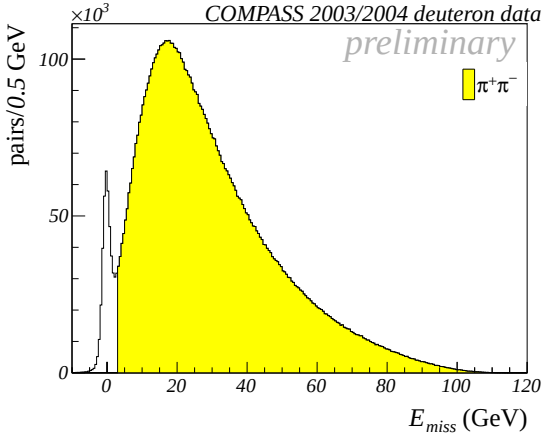


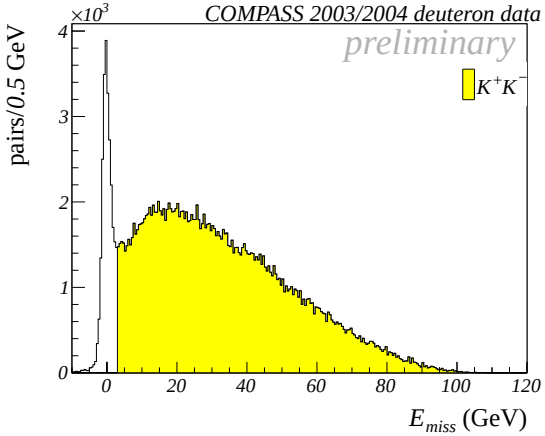


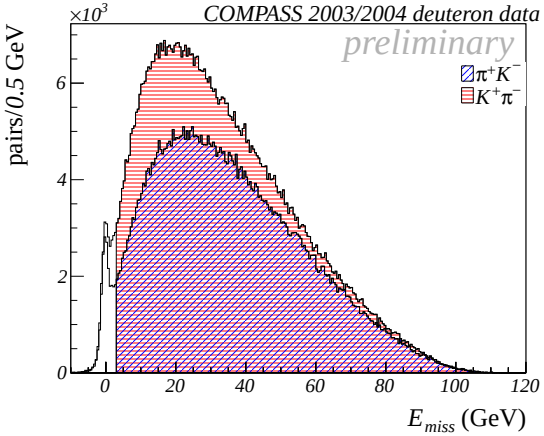


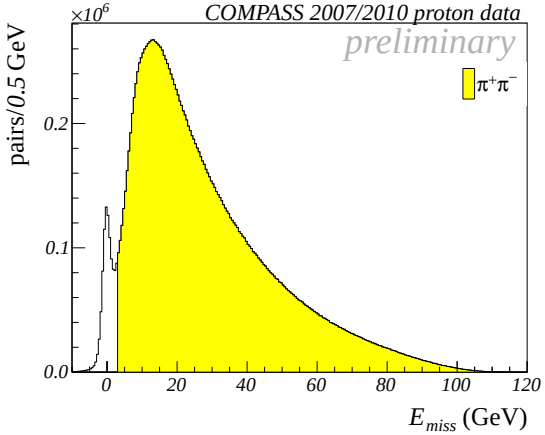


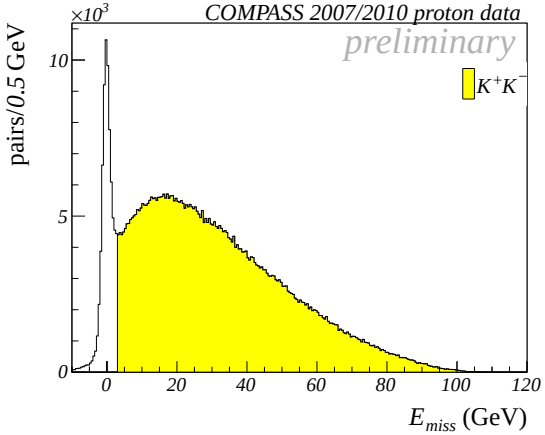
Results ▶ kinematic distributions ▶ hadron-pair ▶ E_{miss}

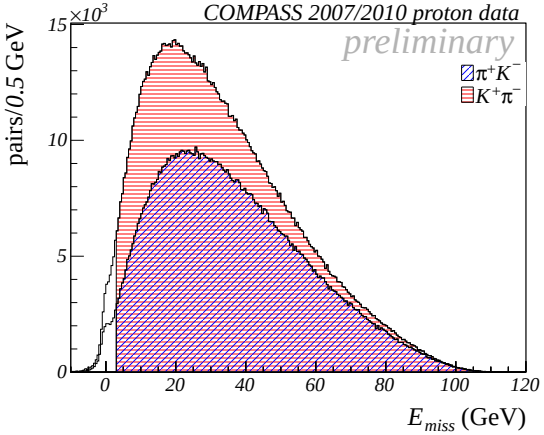




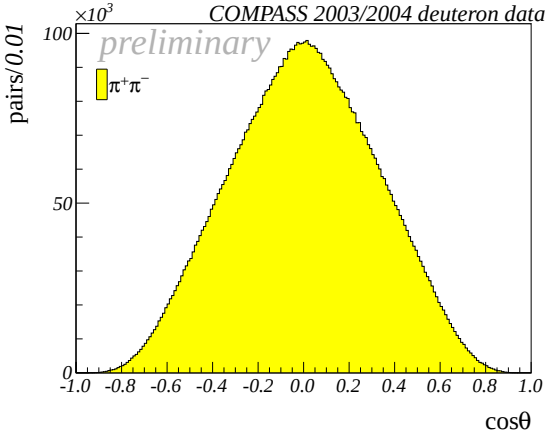


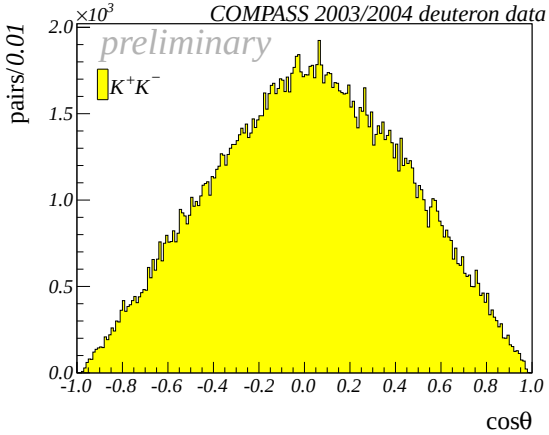


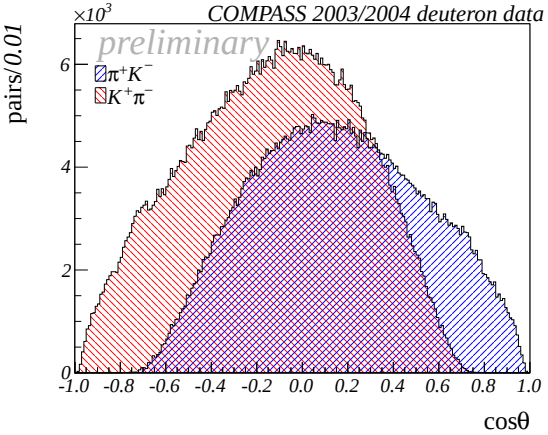


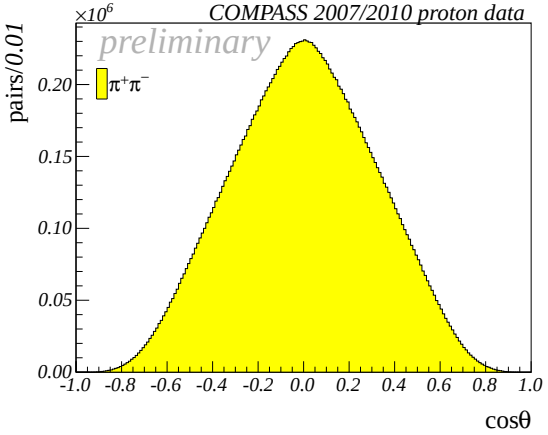


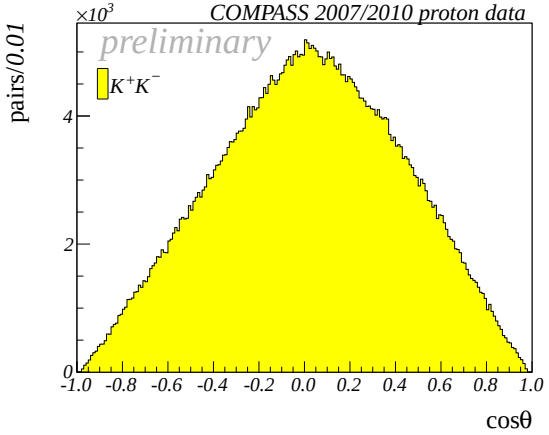
Results ▶ kinematic distributions ▶ hadron-pair ▶ $\cos\theta$

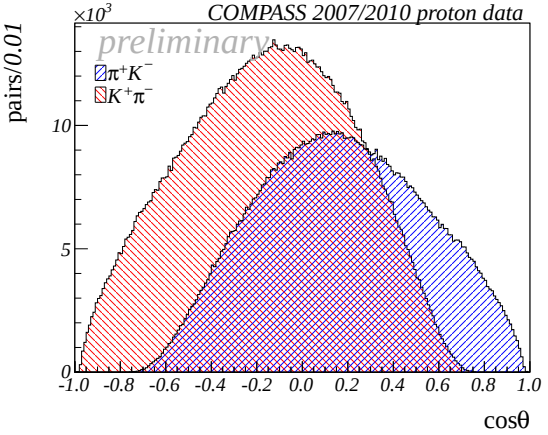




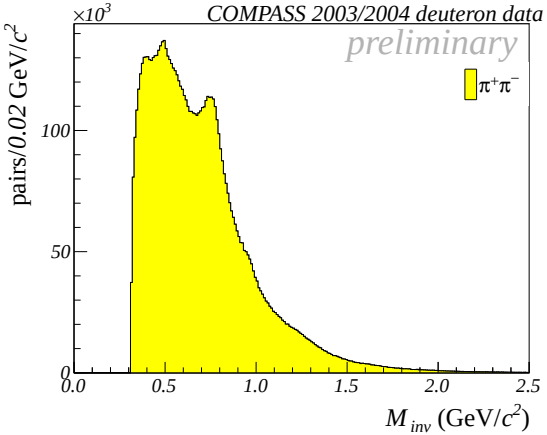


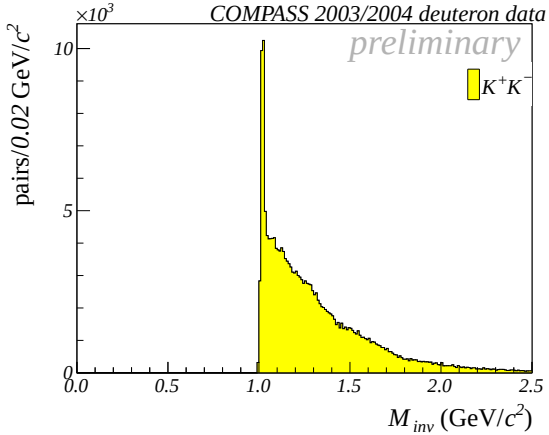


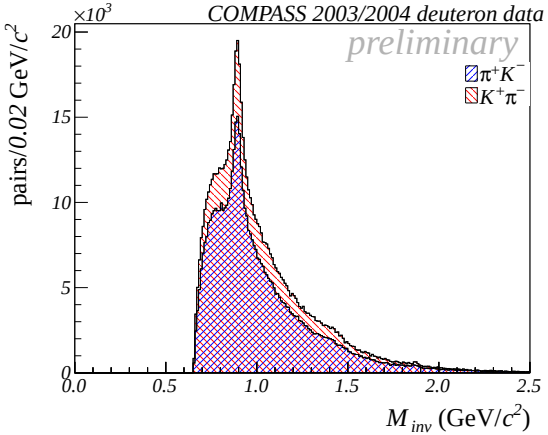


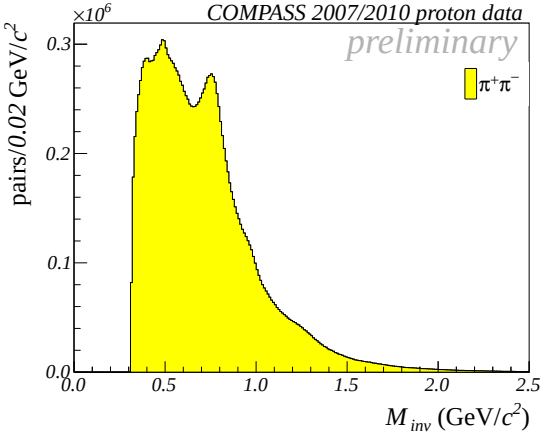


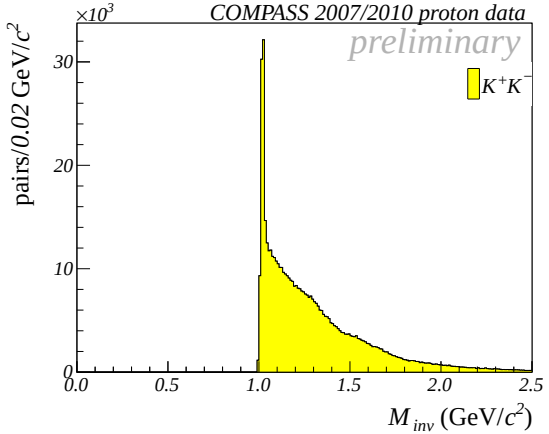
Results ▶ kinematic distributions ▶ hadron-pair ▶ M_{inv}

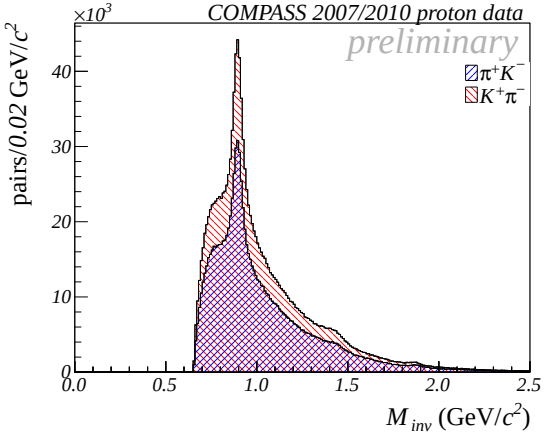






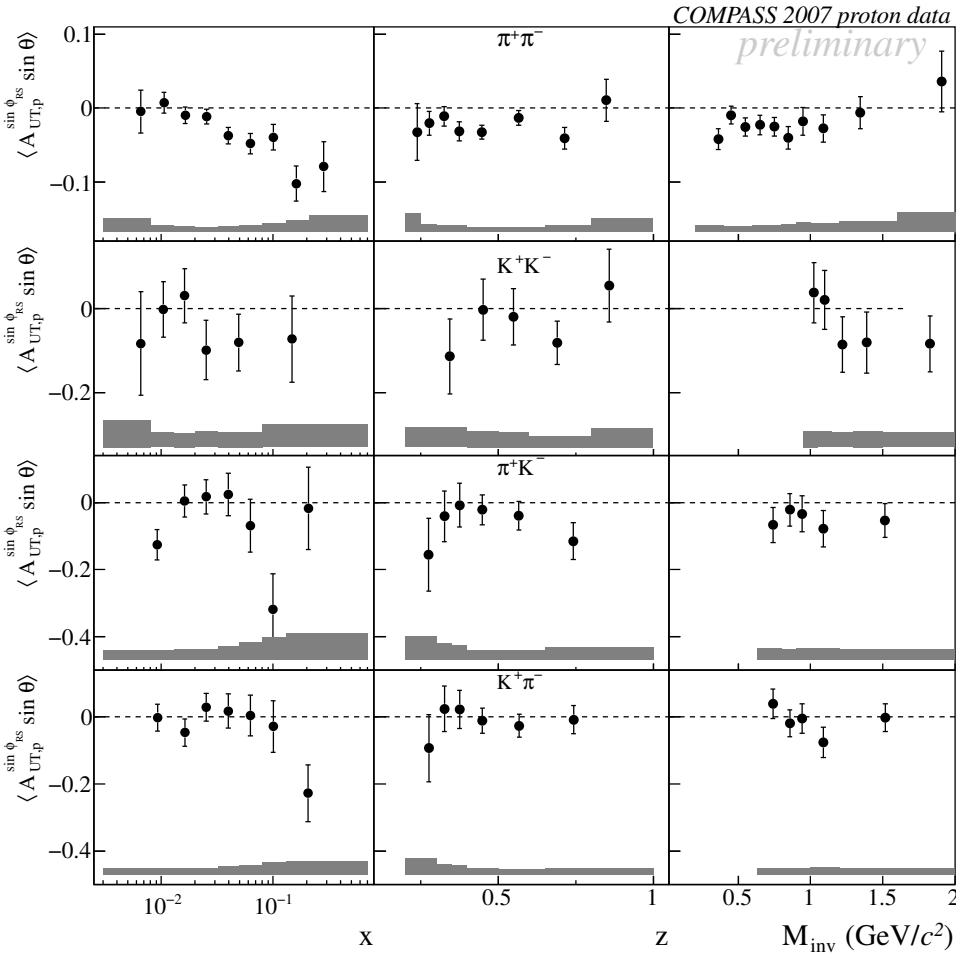




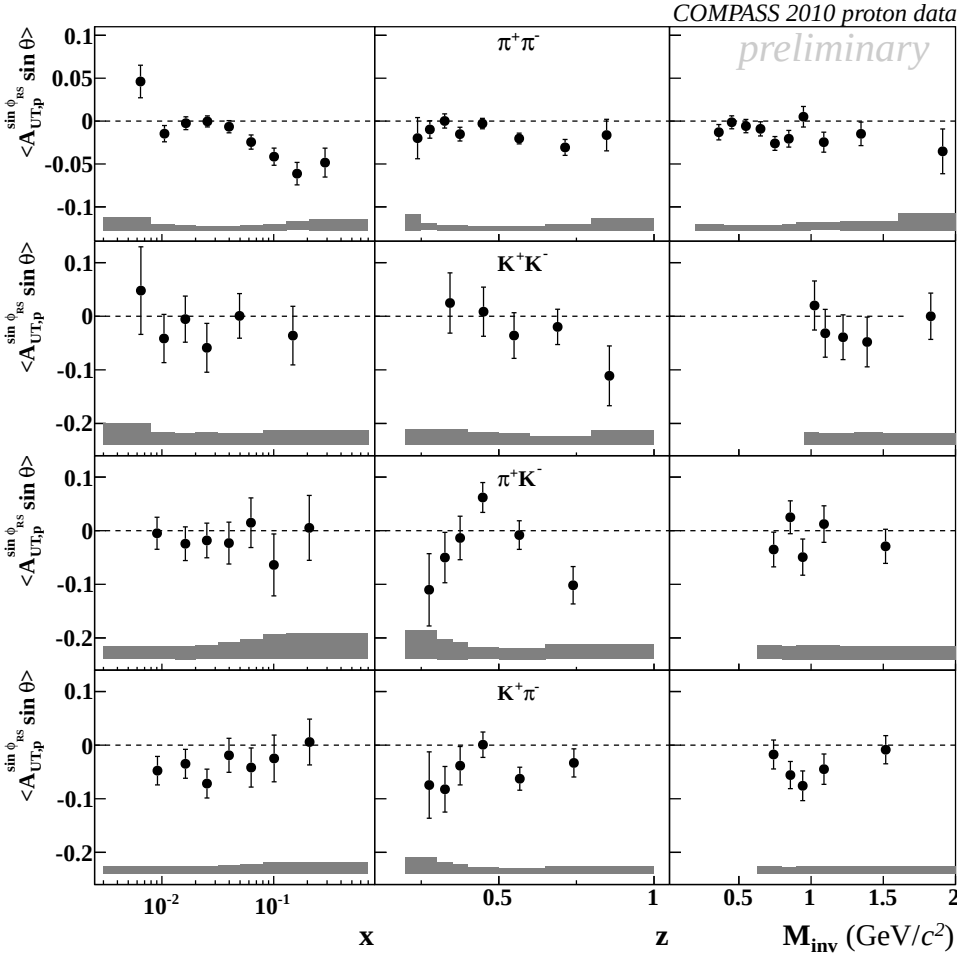


NEW Results ▶ proton data ▶ all identified pairs

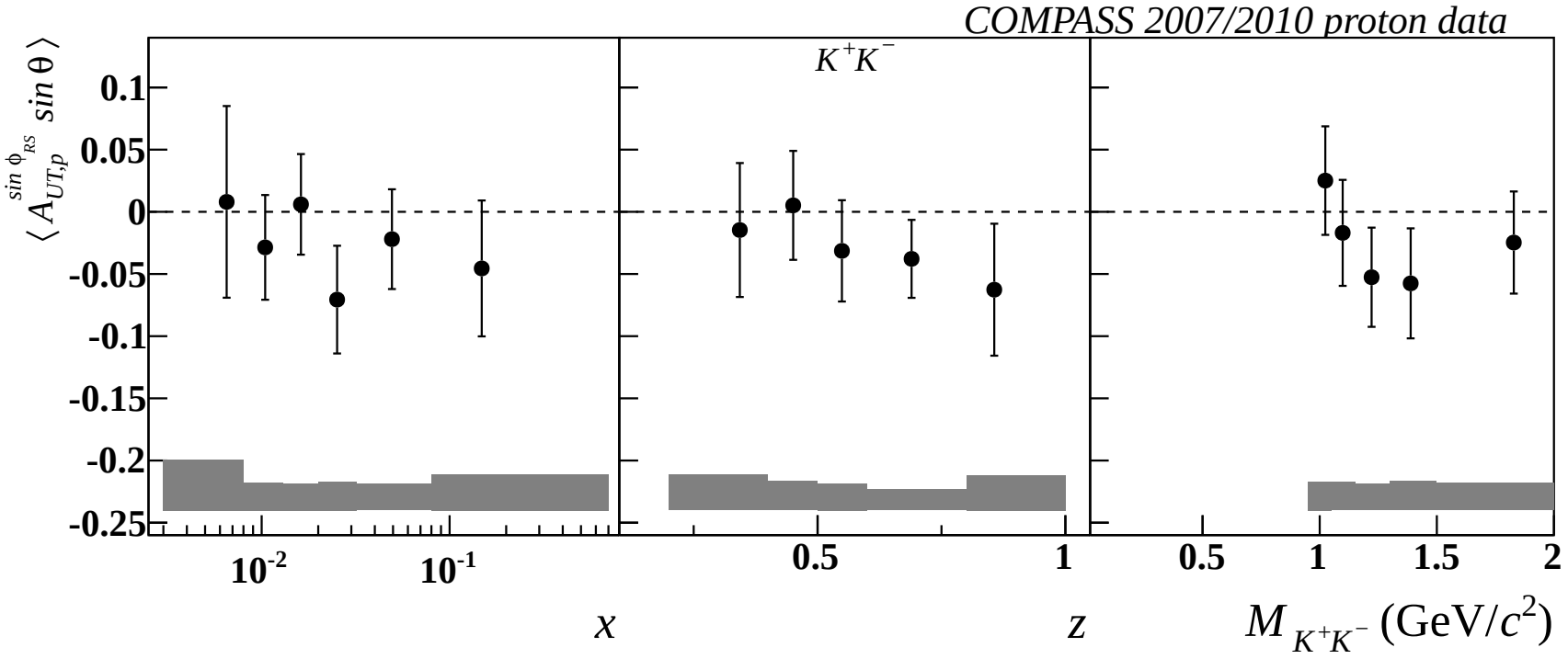
2007 data



2010 data



NEW Results ▶ proton data ▶ K^+K^- pairs

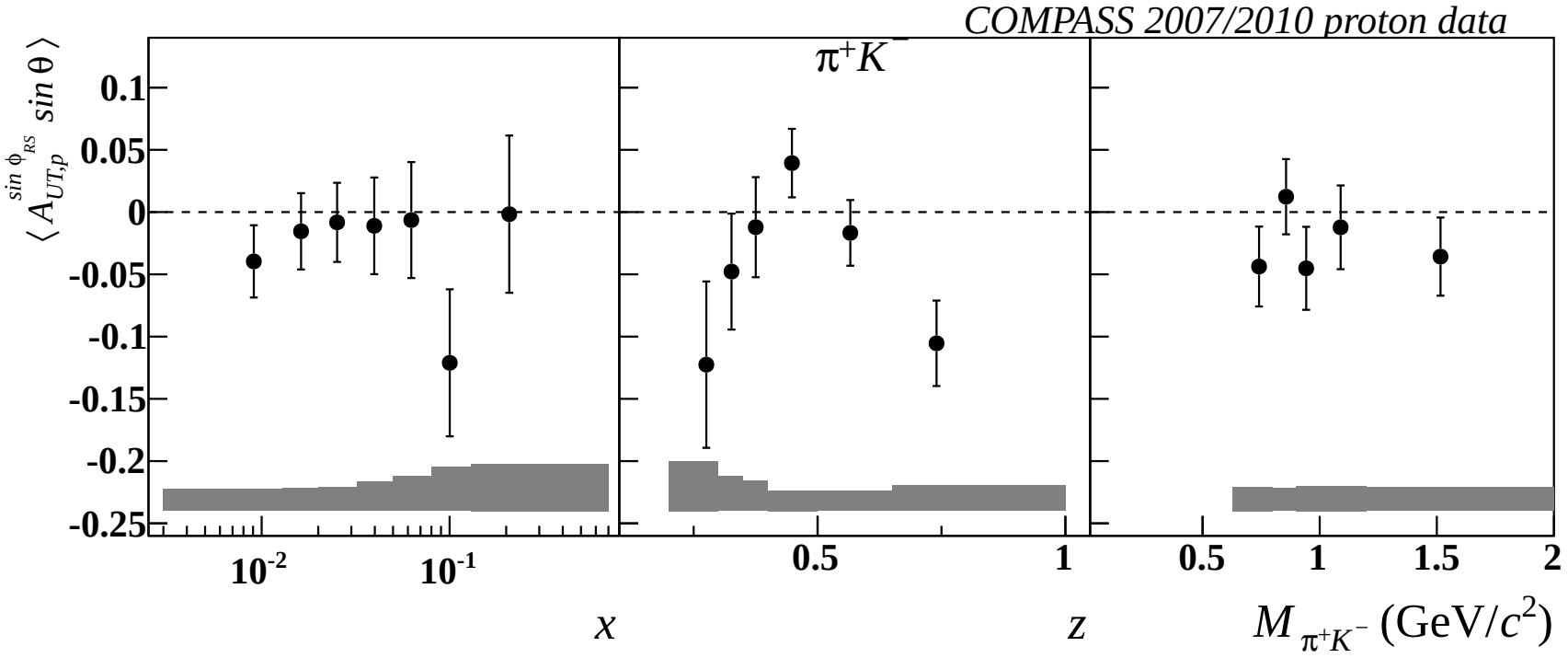


↪ no clear trend

↪ compatible with zero within the statistical uncertainties

negative mean value

NEW Results ▶ proton data ▶ $\pi^+ K^-$ pairs



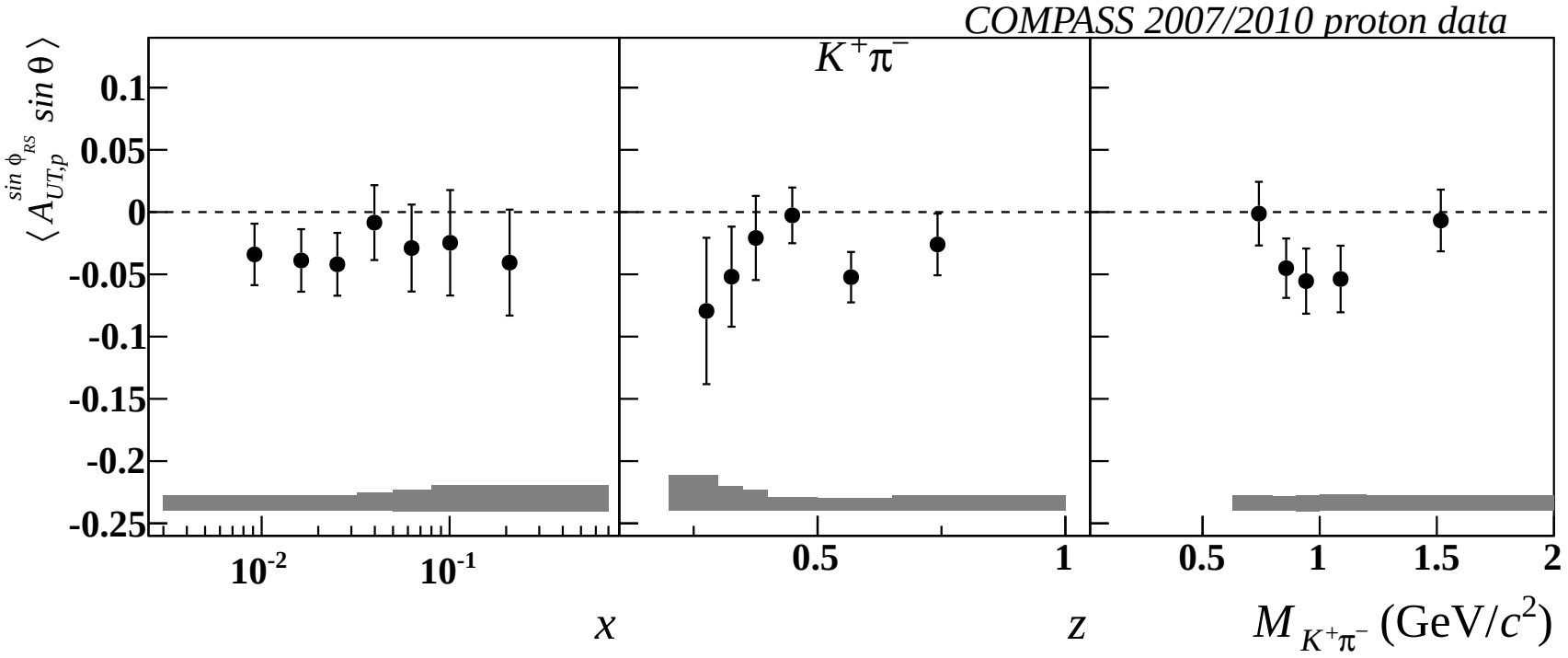
↪ compatible with zero within the statistical uncertainties

x no signal

z significant slopes with a relative maximum around ≈ 0.45

M_{inv} no clear signal

NEW Results ▶ proton data ▶ $K^+\pi^-$ pairs



↪ compatible with zero within the statistical uncertainties

x no clear signal & negative mean value

z no clear signal & negative mean value

M_{inv} minimum around $\approx 0.9\,\mathrm{GeV}/c^2$

Extraction of Transversities ▶ 1st step ▶ details

1. What about the difference in the $\langle Q^2 \rangle$ values between our results in PLB 713 (12) 10 and the new analysis? Might this have a significant impact on the results?

answer from M. Radici: "In my opinion, it does not. The uncertainties on $H_1^{\sphericalangle}$ (because of BELLE large errors) have a much larger impact. Also the HERMES/COMPASS error bars on A_{SIDIS} play a role."

2. What do the factors

$$\frac{x h_1^{D/p}}{A_{UT,D/p}^{\sin\phi_{RS}}}$$

contain?

$$A_{UT}^{\sin(\phi_R+\phi_S+\pi)}(x, z, M_{inv}; Q^2) \propto \frac{|\boldsymbol{R}|}{M_{inv}} \frac{\sum_q e_q^2 h_1^q(x;Q^2) H_1^{\sphericalangle,q}(z,M_{inv};Q^2)}{\sum_q e_q^2 f_1^q(x;Q^2) D_1^q(z,M_{inv};Q^2)}$$

$\Rightarrow f_1^q(x; Q^2)$, $D_1^q(z, M_{inv}; Q^2)$ and $H_1^{\sphericalangle,q}(z, M_{inv}; Q^2)$

Extraction of Transversities ▶ 1st step ▶ details

$f_1^q(x; Q^2)$ taken from the MSTW08LO [arXiv:0901.0002] set. In order to implement the Soffer bound, the helicity distribution function g_1 is needed at any scale and x, taken from parametrizations of DSSV [arXiv:hep-ph/0310196].

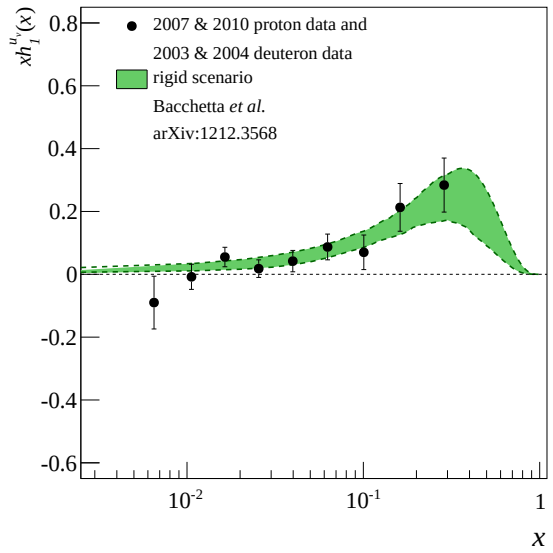
$D_1^q(z, M_{inv}; Q^2)$ The cross-section for the production of an unpolarized pair is generated in the BELLE's MC. This is then fitted with the corresponding formula that involves a parametrization for D_1^q. (Since there is no data for e^+e^- unpolarized cross section for hadron-pair production.)

$H_1^{\sphericalangle,q}(z, M_{inv}; Q^2)$ extracted from BELLE's polarized data [arXiv:0805.2975] together with the D_1 "extracted" from MC. Evolved by a modified HOPPET code [arXiv:0804.3755].

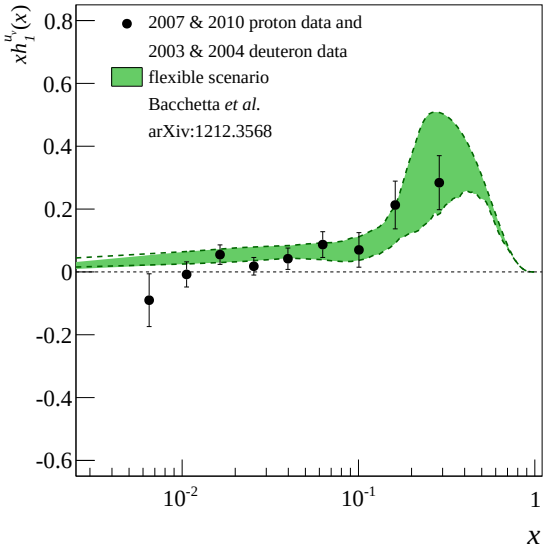
Extraction of Transversities ▶ global fit

Comparison of new results with Bacchetta *et al.* JHEP03 (13) 119 : $xh_1^u(x; Q^2)$

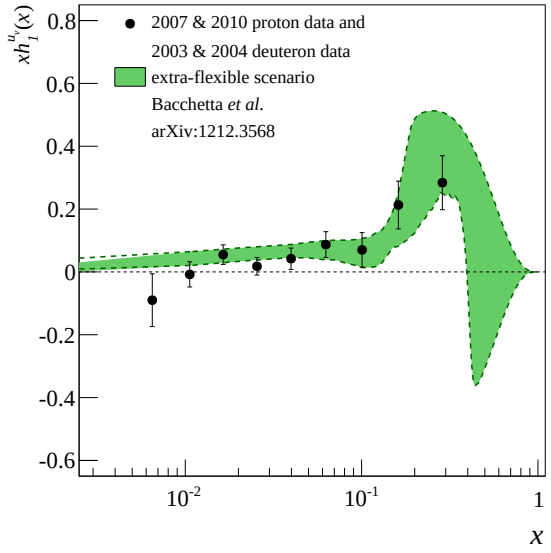
rigid scenario



flexible scenario



extra-flexible scenario

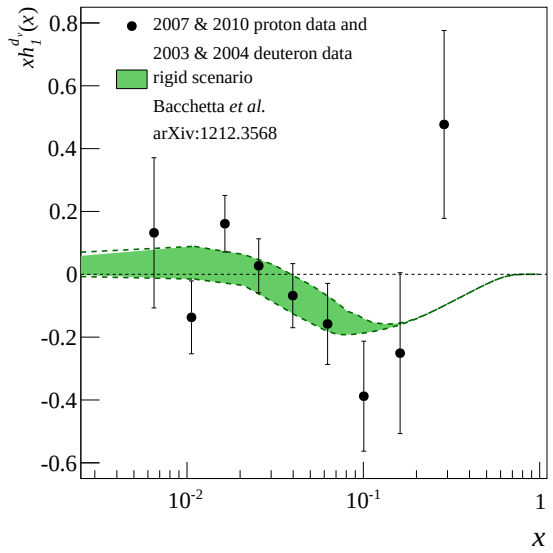


No surprise: New COMPASS data points are (still) very well compatible with all three scenarios.

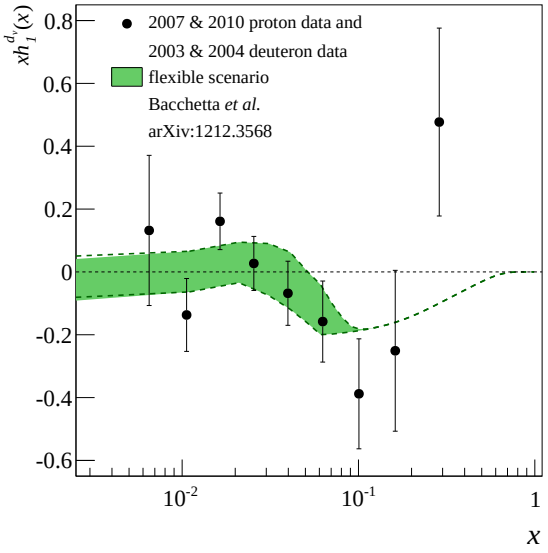
Extraction of Transversities ▶ global fit

Comparison of new results with Bacchetta *et al.* JHEP03 (13) 119 : $xh_1^d(x; Q^2)$

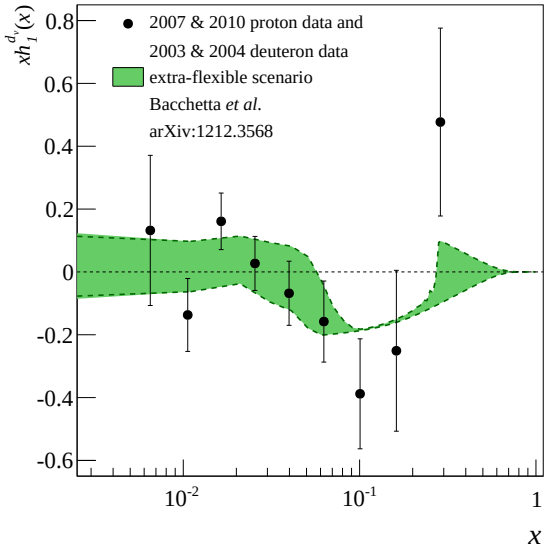
rigid scenario



flexible scenario



extra-flexible scenario



No surprise: New COMPASS data points are (still) very well compatible with all three scenarios.

(only two points are more then 1σ away)