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TRANSVERSE PHYSICS WITH SIDIS, e^+e^- & pp

Two different topics are discussed:

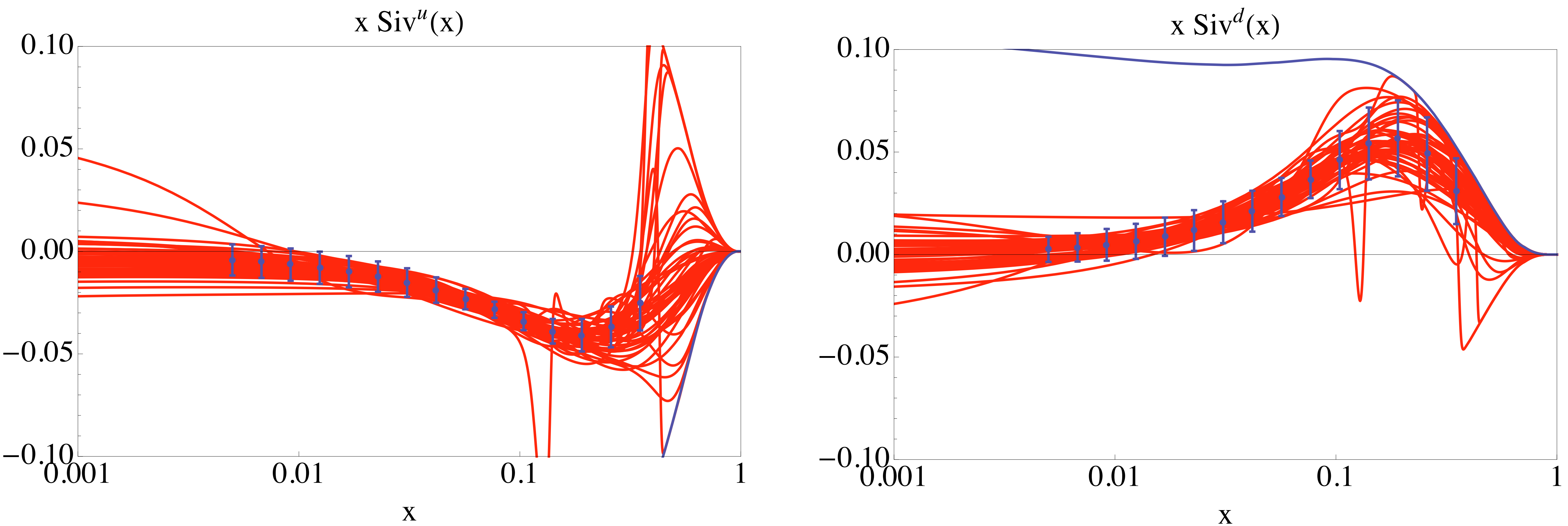
1. TMD opportunities in Drell-Yan
2. Accessing transversity with dihadron fragmentation functions

Concerning the first topic, the relevance of the sign change of the Sivers function is discussed. A simple implementation of neural-network fits is discussed as a method to critically assess the current knowledge of the Sivers function, with particular emphasis on the presence of poles.

A few other crucial questions on TMDs that can be addressed in Drell-Yan experiments are mentioned: the knowledge of unpolarized TMDs, their x dependence, their transverse-momentum shape, and their flavor dependence.

Concerning the second topic, the results of the first extraction of the transversity distribution function based on collinear factorization is discussed. The results are derived from experimental measurements in SIDIS and e^+e^- annihilation. A comparison with the transversity extracted in TMD factorization is shown.

“Toy” neural-network fit



All curves have χ^2<1.6

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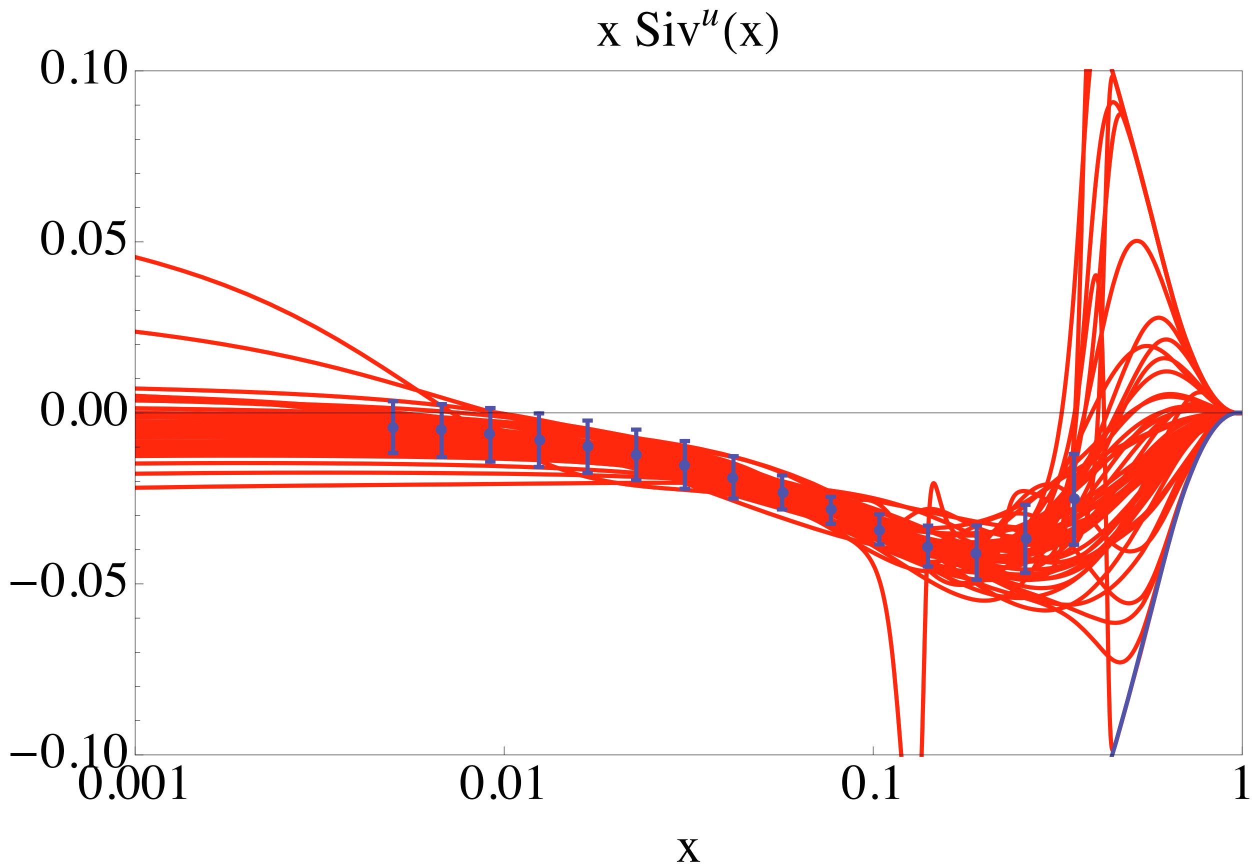

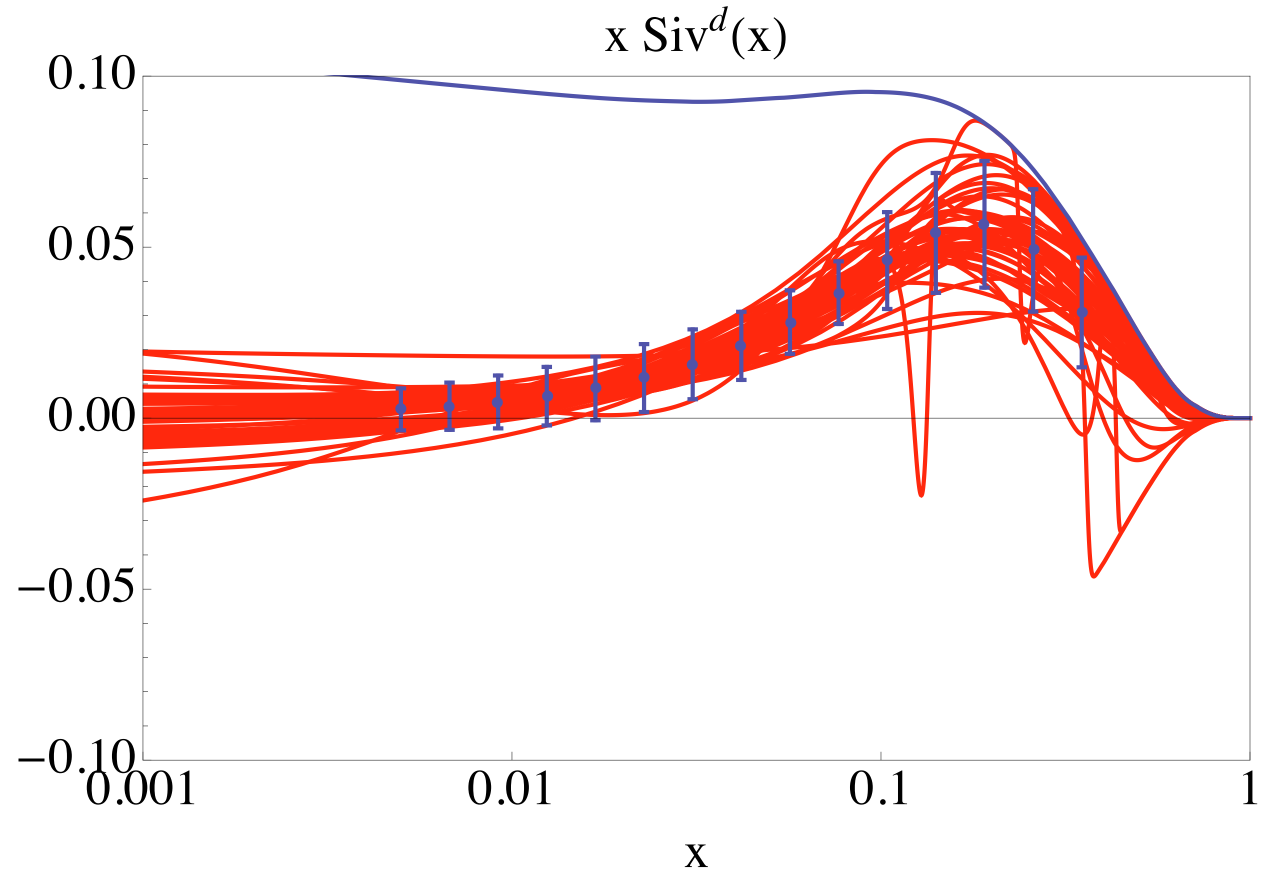

All curves have $\chi^2 < 1.6$

Neural-network fits are the best tools to avoid biased functional forms

BLNY fit

Landry, Brock, Nadolsky, Yuan, PRD67 (03)

Experiment	Reference	Reaction	$\sqrt{S}$ (GeV)	δN_{exp}
R209	[14]	$p + p \to \mu^+\mu^- + X$	62	10%
E605	[15]	$p + Cu \to \mu^+\mu^- + X$	38.8	15%
E288	[16]	$p + Cu \to \mu^+\mu^- + X$	27.4	25%
CDF-Z (Run-0)	[17]	$p + \bar{p} \to Z + X$	1800	–
DØ -Z (Run-1)	[18]	$p + \bar{p} \to Z + X$	1800	4.3%
CDF-Z (Run-1)	[19]	$p + \bar{p} \to Z + X$	1800	3.9%

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D-Y (including Z production) is the most important source of information for unpolarized TMDs

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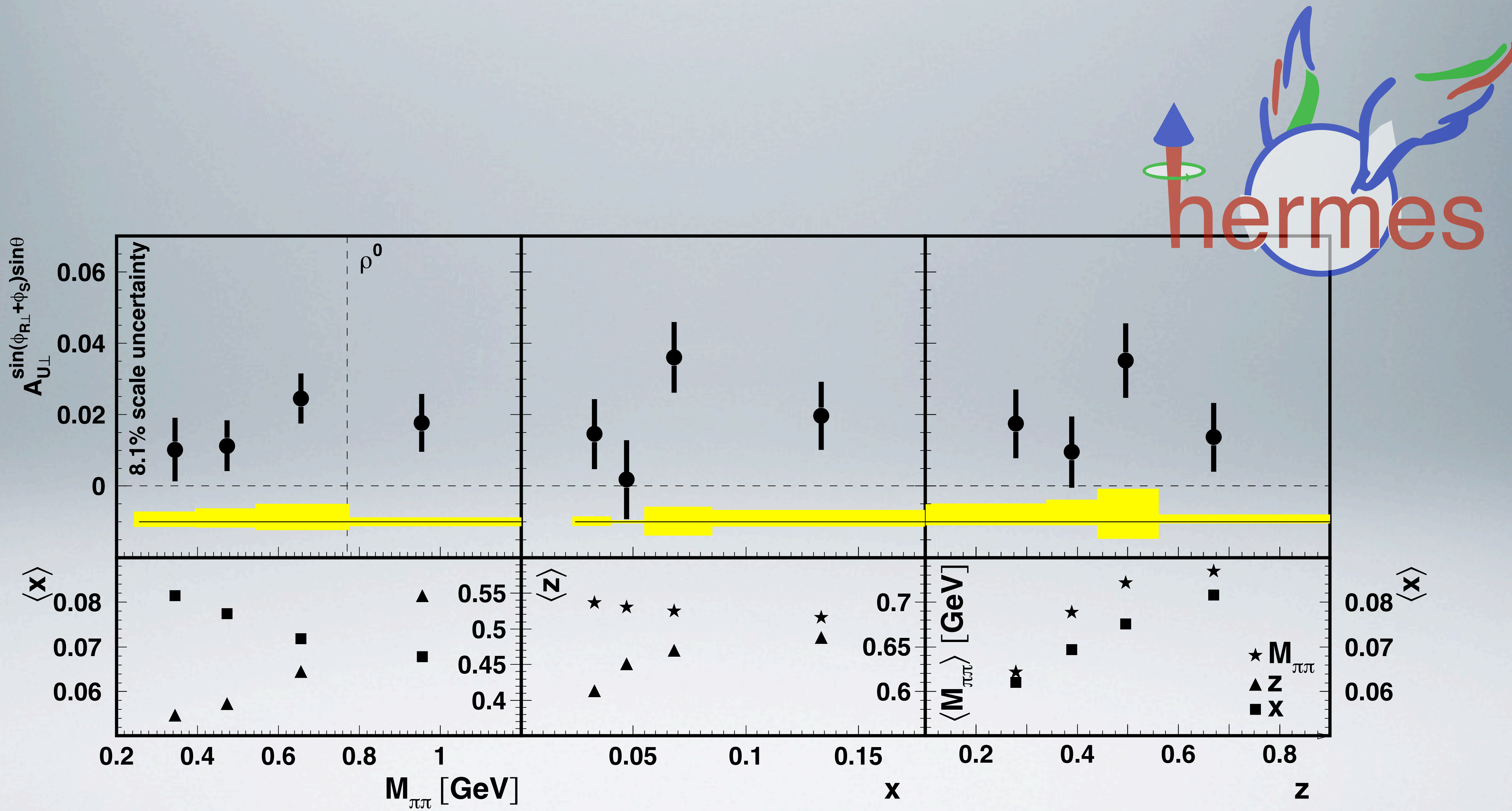
AnDY

D-Y (including Z production) is the most important source of information for unpolarized TMDs

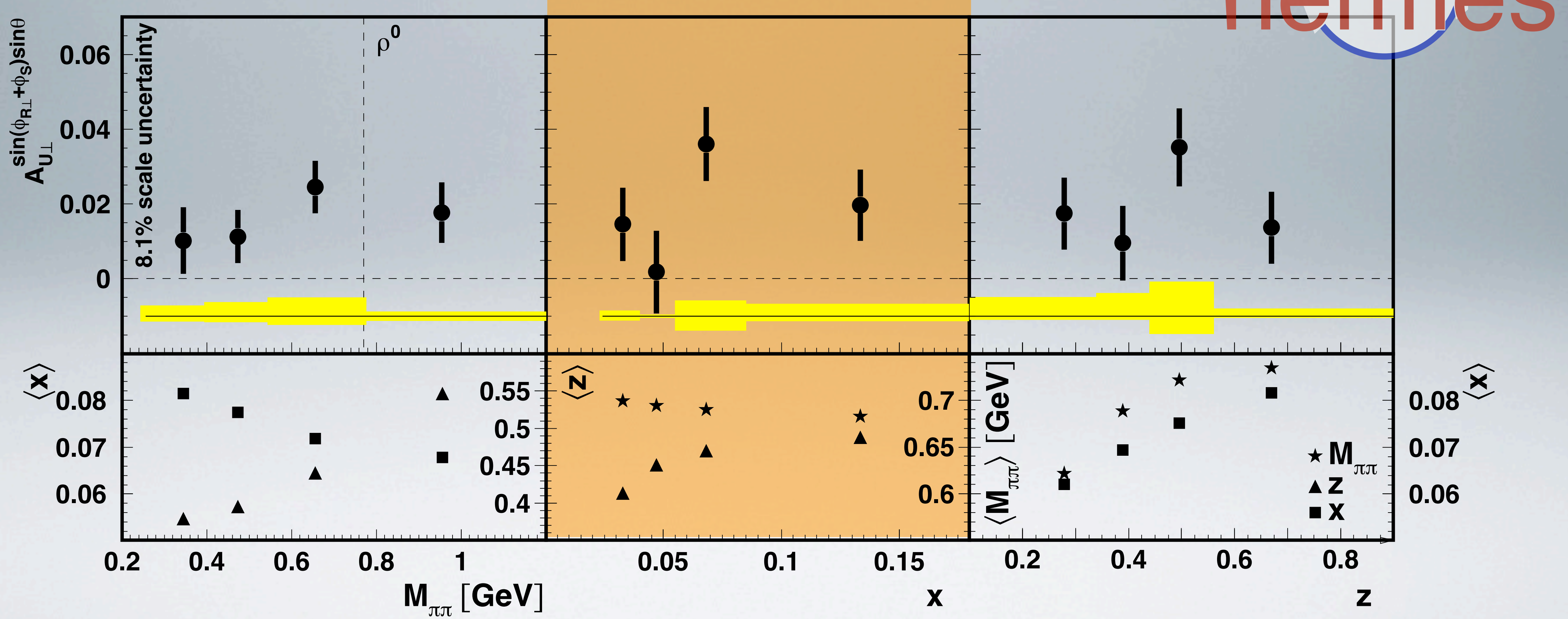
HERMES data



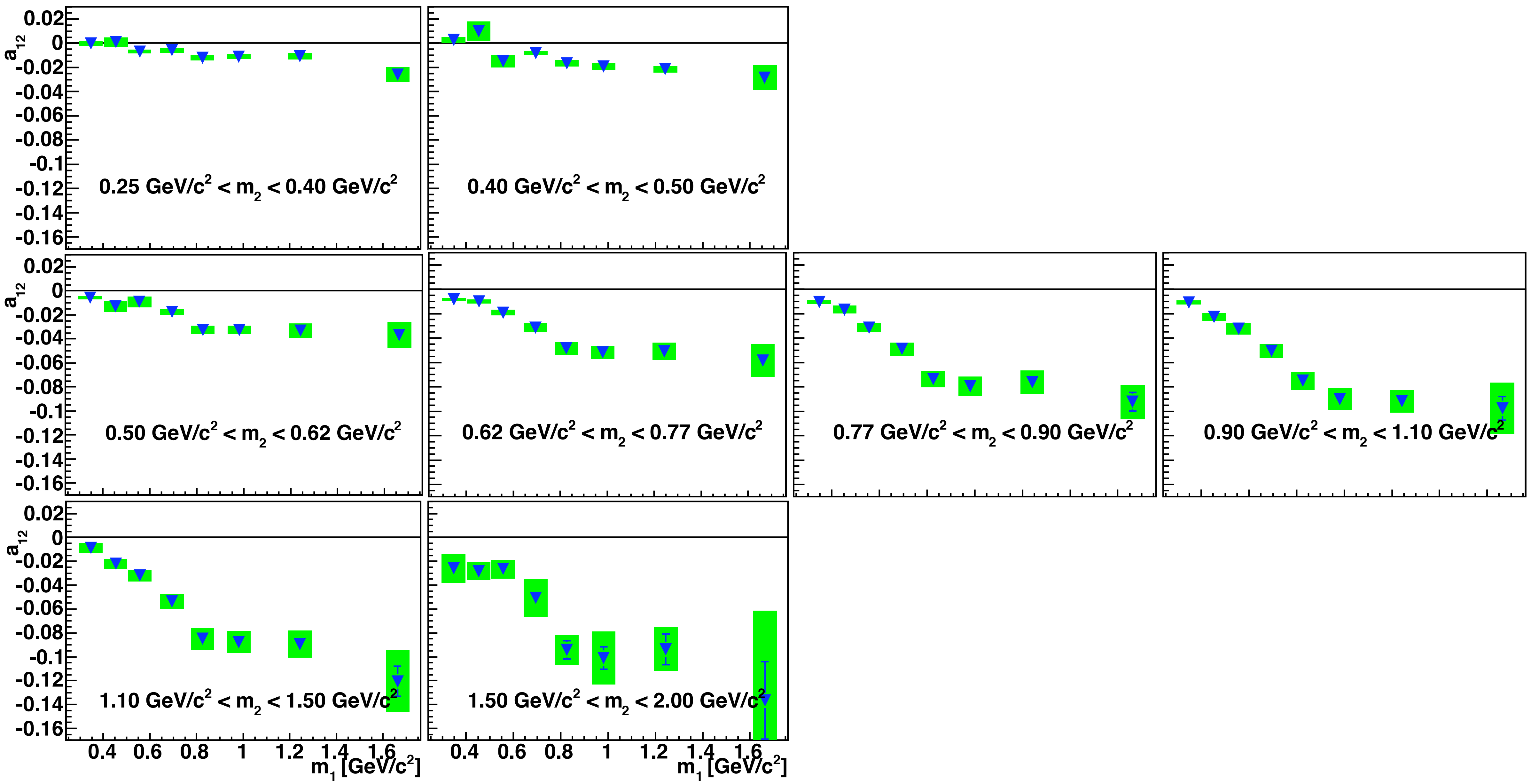
8.1% scale uncertainty
ρ^0
$A_{U\perp}^{\sin(\phi_{R\perp}+\phi_S)\sin\theta}$
$\langle x \rangle$
$\langle z \rangle$
$\langle M_{\pi\pi} \rangle$ [GeV]
$\langle x \rangle$
$M_{\pi\pi}$ [GeV]
x
z
$\star$ $M_{\pi\pi}$
$\blacktriangle$ z
$\blacksquare$ x

HERMES data

$0.5 < M_h < 1.0$ GeV



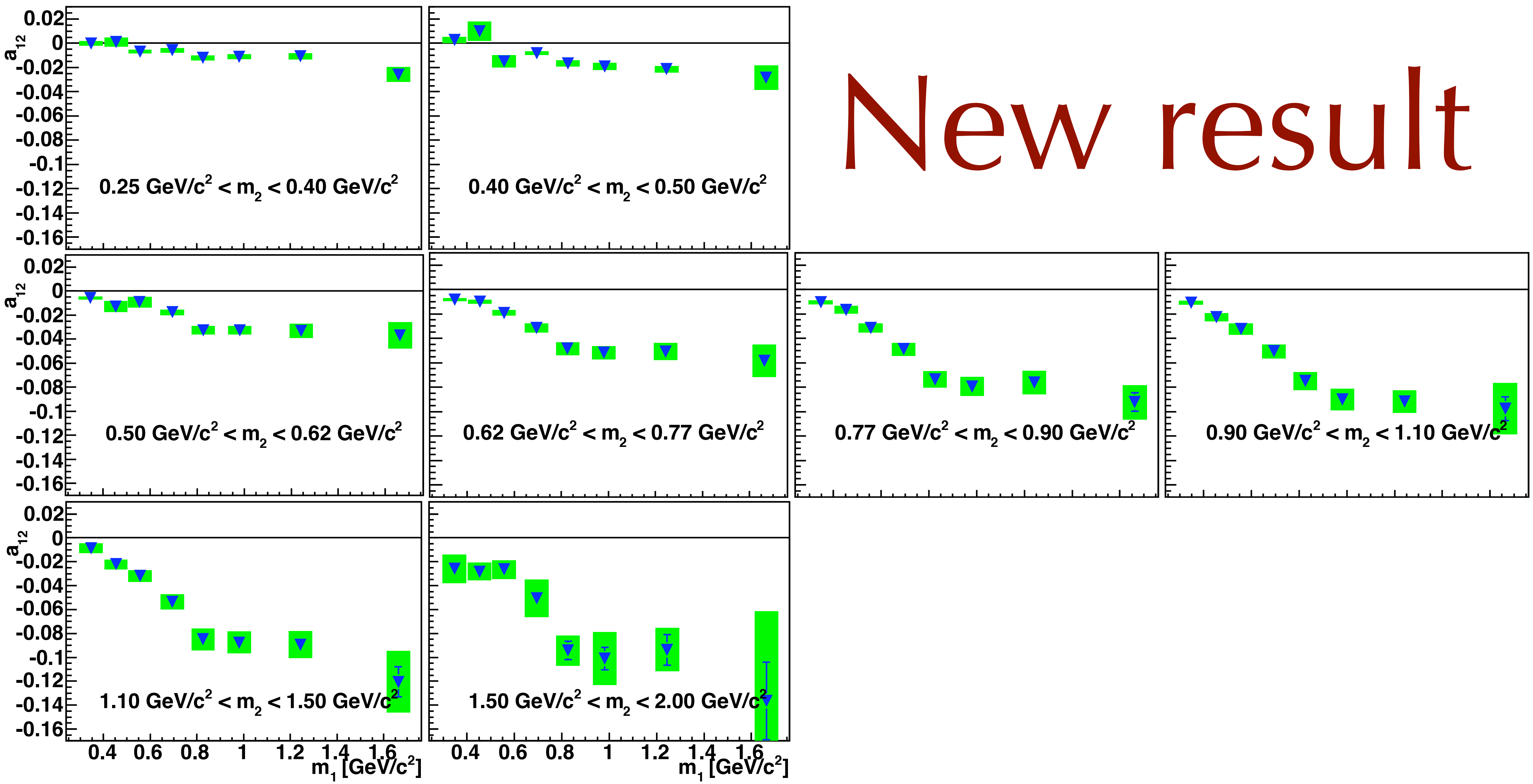
BELLE data



Vossen, Seidl et al. (Belle), arXiv:1104.2425 [hep-ex]

BELLE data

New result



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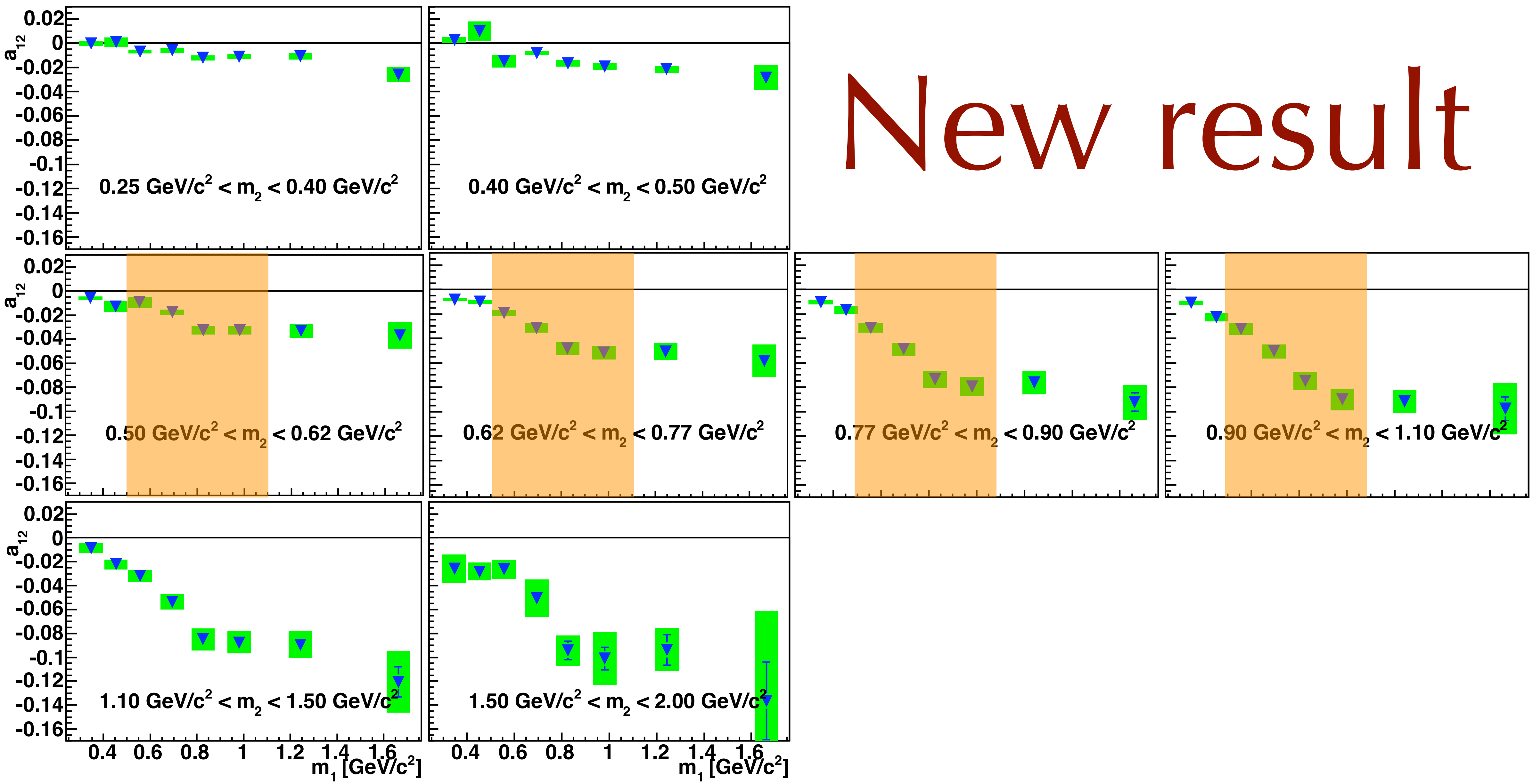

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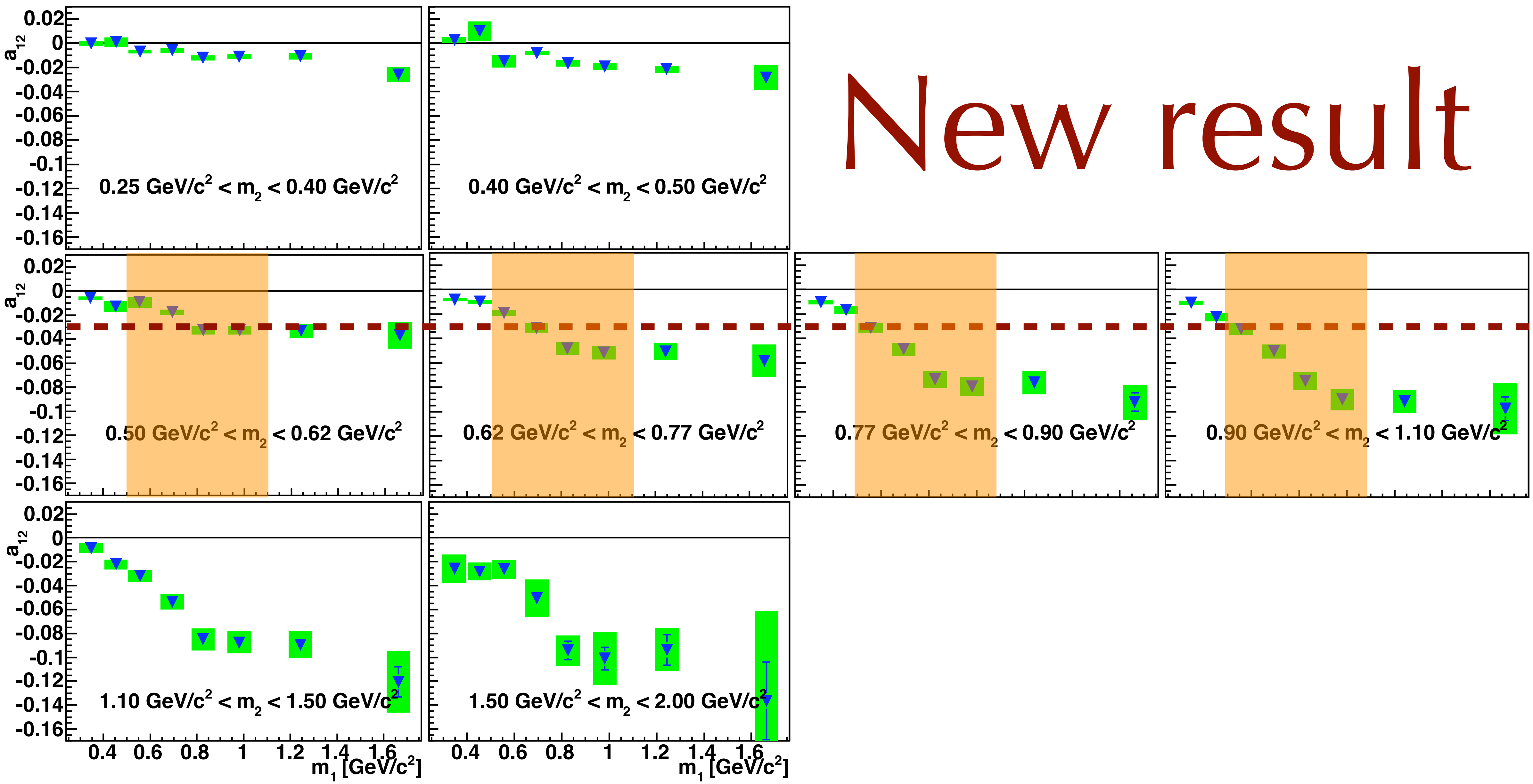

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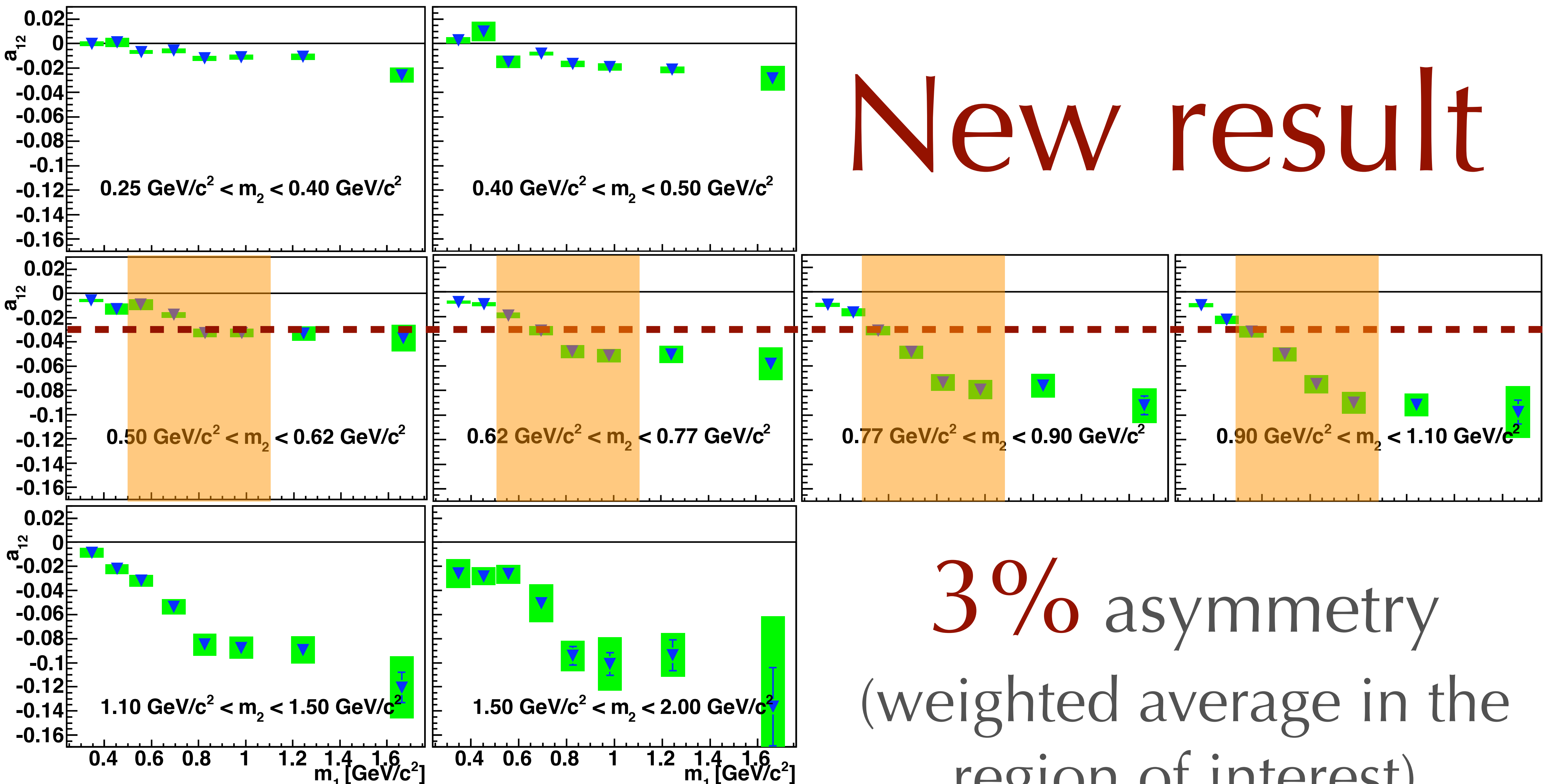

New result

3% asymmetry
(weighted average in the region of interest)

Vossen, Seidl et al. (Belle), arXiv:1104.2425 [hep-ex]

Simplified expressions

SIDIS

$$A_{DIS}(x) \approx -\langle C_y \rangle \, \frac{(h_1^{u_v}(x) - h_1^{d_v}(x)/4)}{(f_1^{u+\bar{u}}(x) + f_1^{d+\bar{d}}(x)/4)} \, \frac{n_u^{\uparrow}}{n_u}$$

e^+e^-

$$A_{e+e-} \approx \frac{-\langle \sin^2 \theta_2 \rangle}{\langle 1 + \cos^2 \theta_2 \rangle} \, \frac{\langle \sin \theta \rangle \, \langle \sin \bar{\theta} \rangle \, 5 \, (n_u^{\uparrow})^2}{5 \, n_u^2 + n_s^2 + 4 \, n_c^2}$$

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$$\frac{n_u^\uparrow}{n_u} = \frac{\iint \frac{|\boldsymbol{R}|}{M_h} H_{1,u}^{\sphericalangle}(z, M_h^2)}{\iint D_{1,u}(z, M_h^2)}$$

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From BELLE: $\frac{n_u^{\uparrow}}{n_u} = 25\%$

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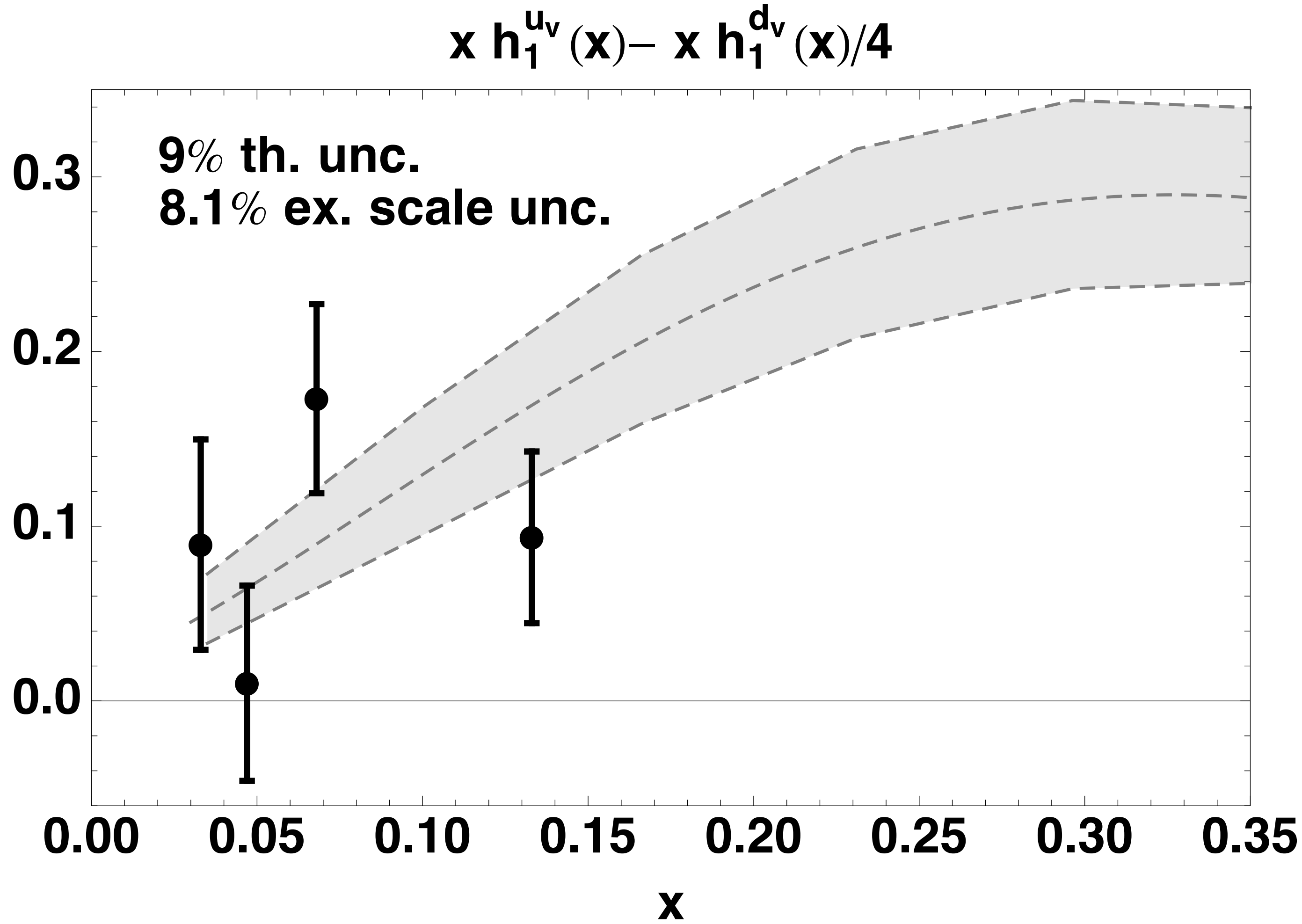
First glimpses at transversity



Not in disagreement with Anselmino et al.