Impact of deuteron data on the transversity extraction

CLAS Collaboration meeting
October 2015

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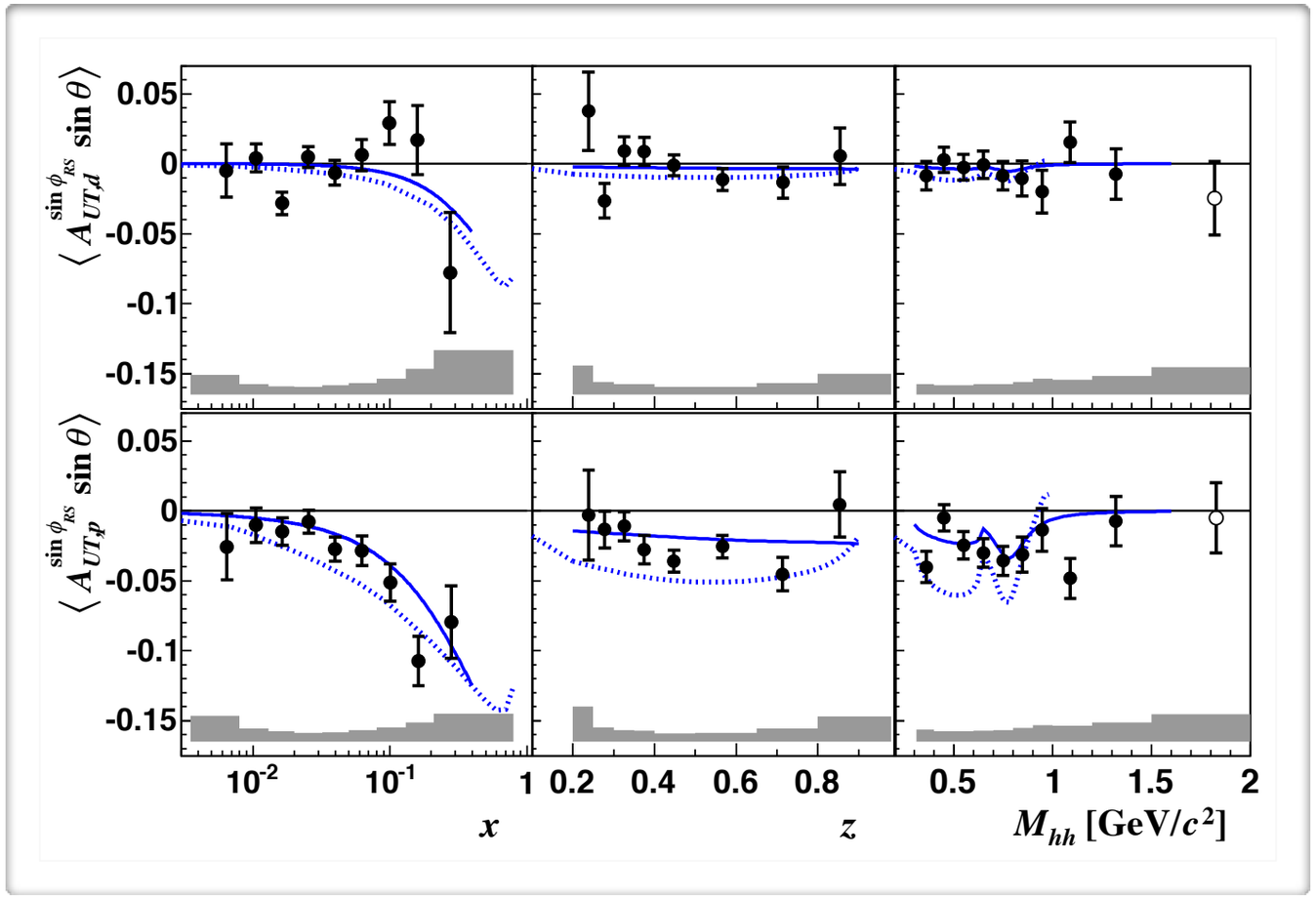
Consejo Nacional de Ciencia y Tecnología

SIDIS production of pion pairs on both proton & deuteron @ COMPASS

2002-4 Deuteron Data

2007 Proton Data



$$A_{\mathrm{DIS}}(x,z,M_h^2,Q^2) = -C_y \frac{\sum_q e_q^2\, h_1^q(x,Q^2)\, \frac{|\bar{R}|}{M_h}\, H_{1,sp}^{q\to\pi^+\pi^-}(z,M_h^2,Q^2)}{\sum_q e_q^2\, f_1^q(x,Q^2) \qquad D_1^{q\to\pi^+\pi^-}(z,M_h^2,Q^2)}$$

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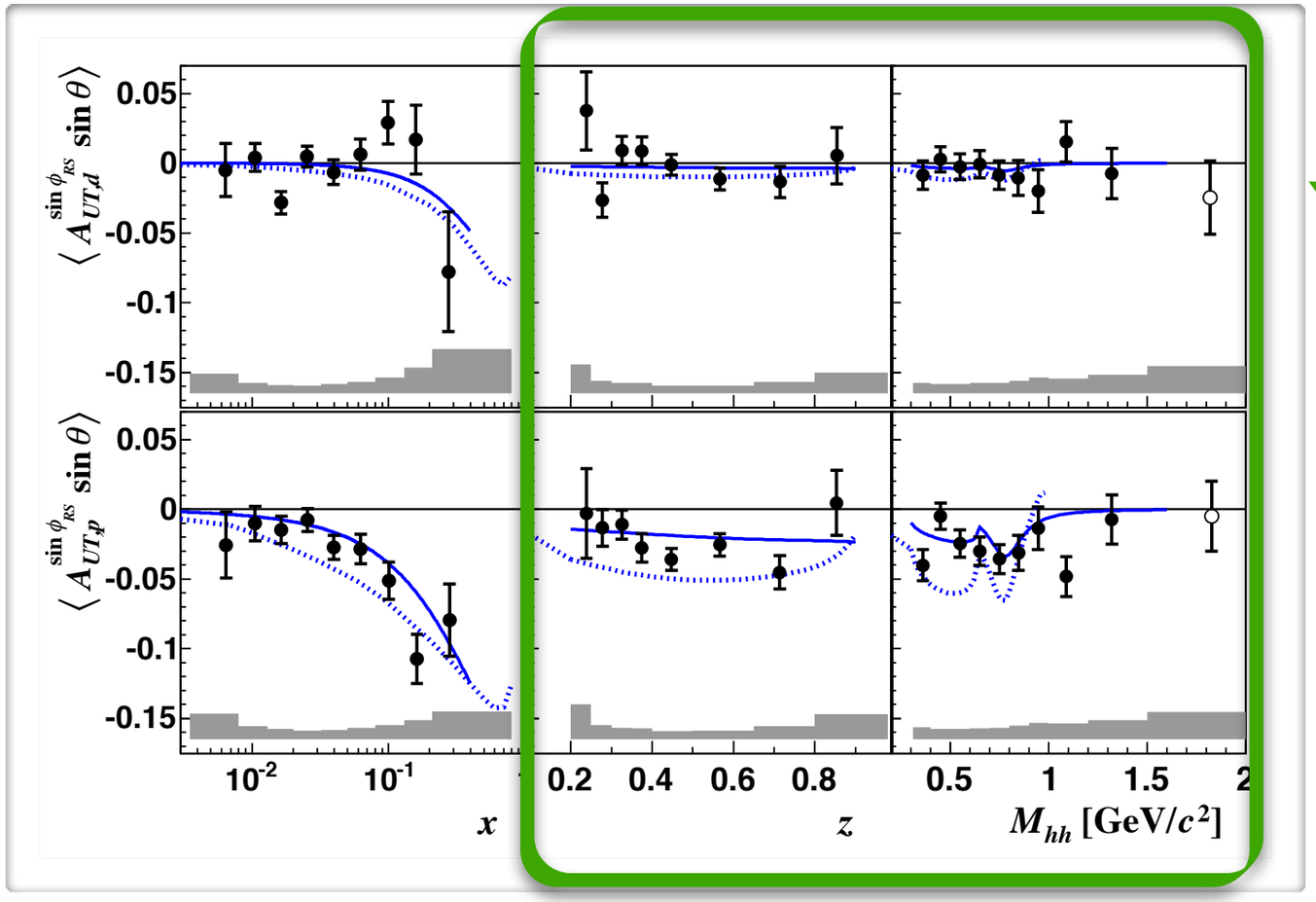

(z, M_h)-dpdence determined by DiFF from Belle

[A.C., Bacchetta, Radici, Bianconi, Phys.Rev. D85]

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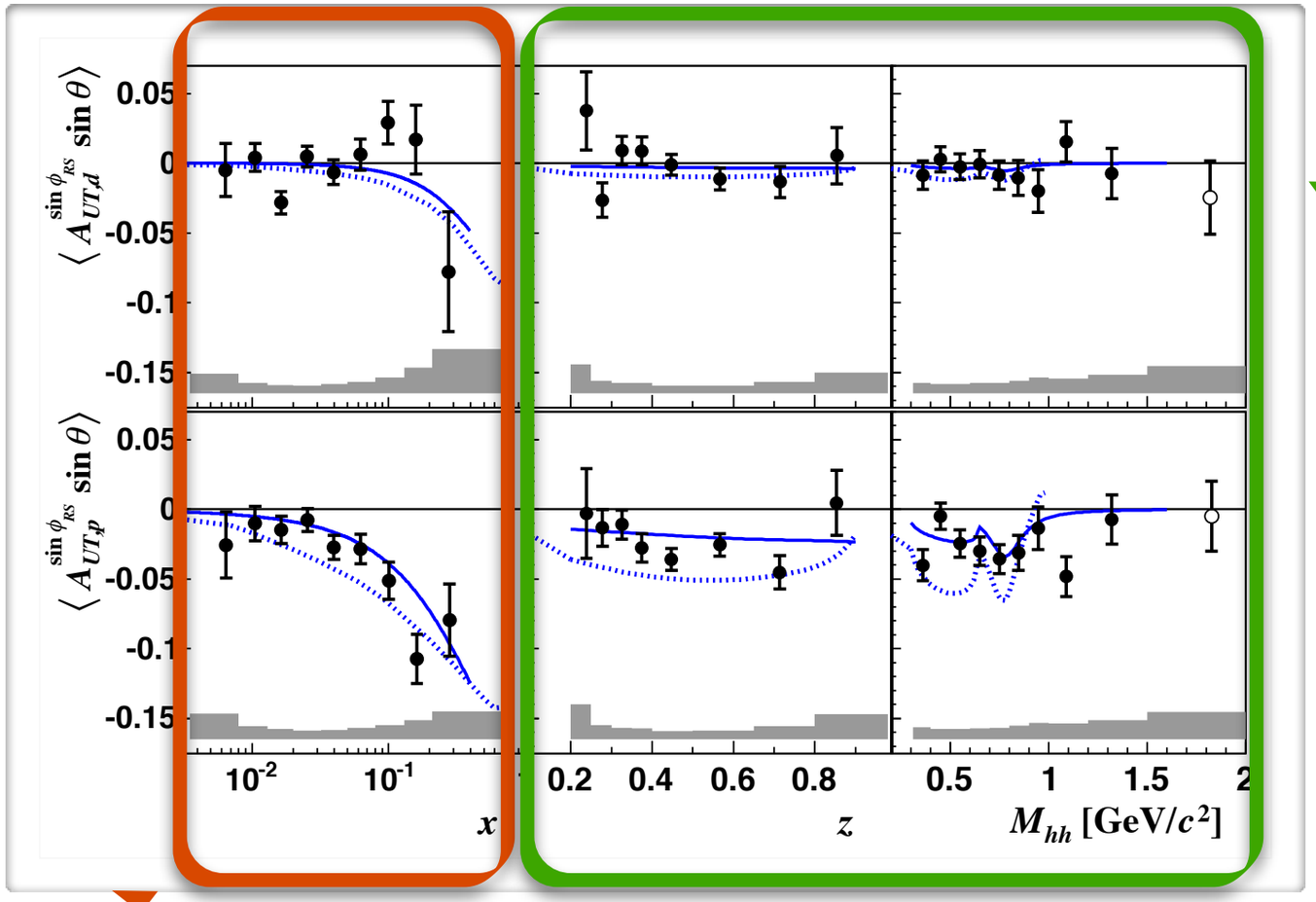

x-dependence only from Transversity

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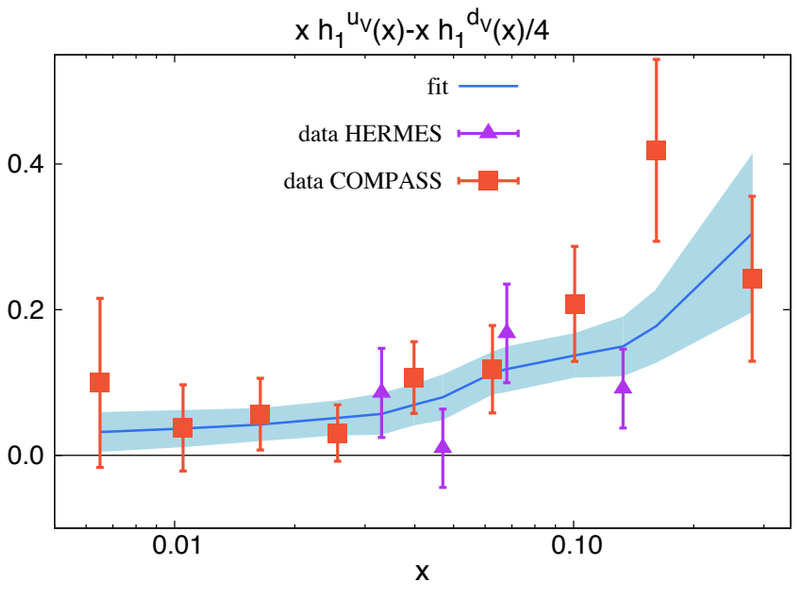
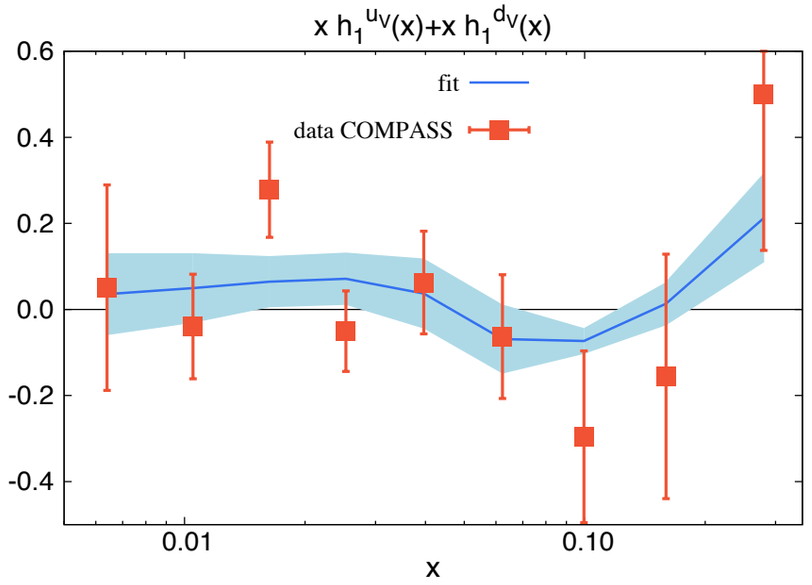
Comparison with extraction

[A.C., Bacchetta, Radici, JHEP 2013 & 2015]

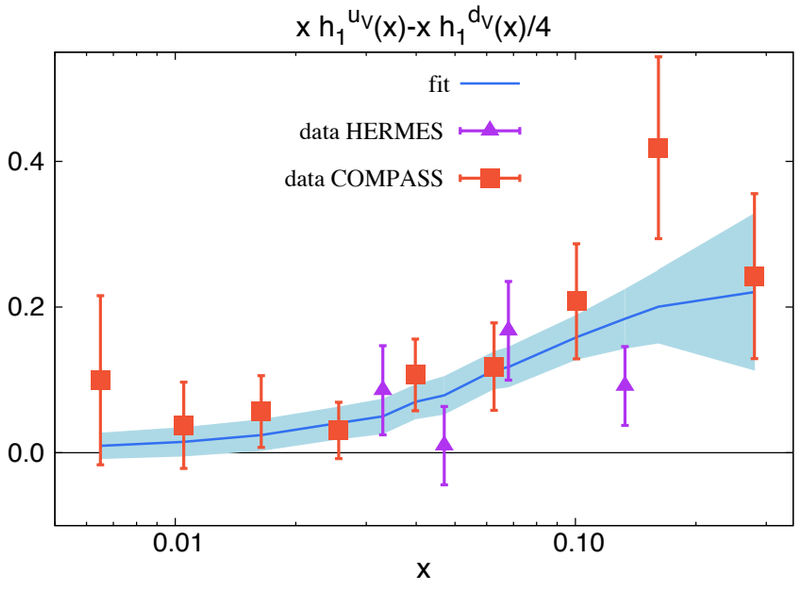
PROTON



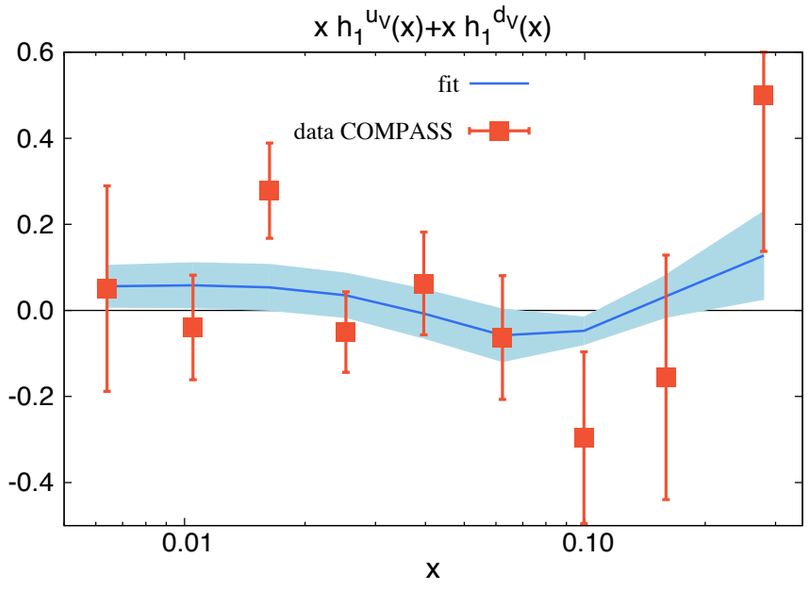
DEUTERON



flexible functional form



rigid functional form



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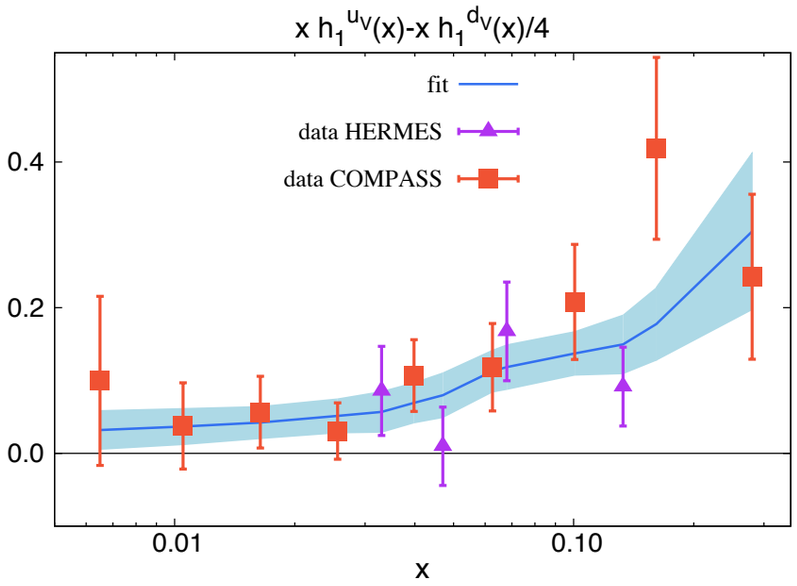
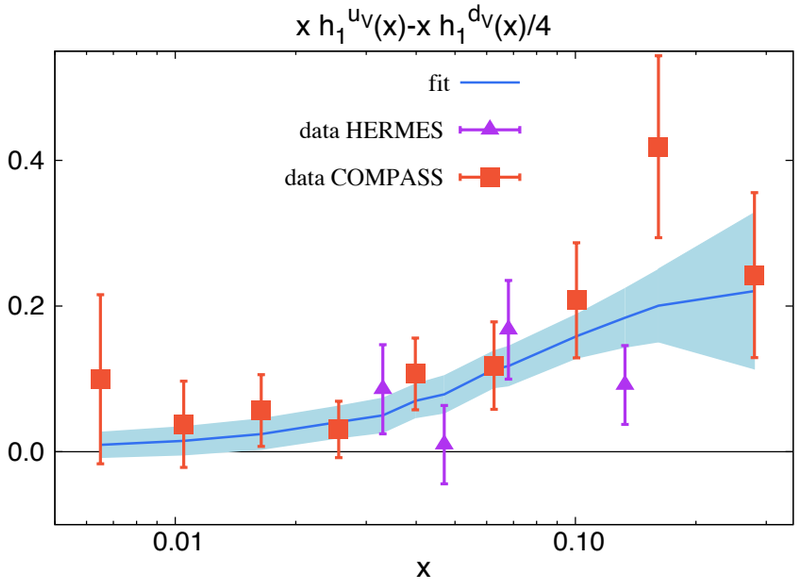
[A.C., Bacchetta, Radici, JHEP 2013 & 2015]

PROTON

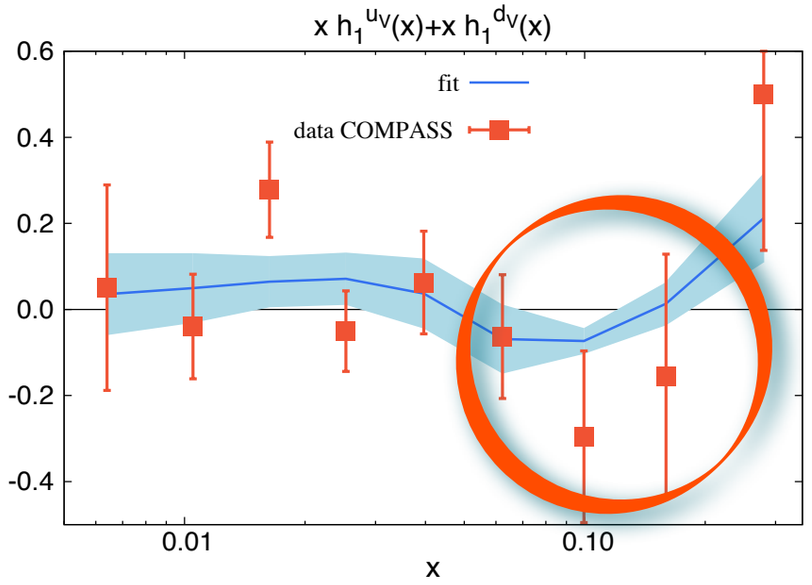


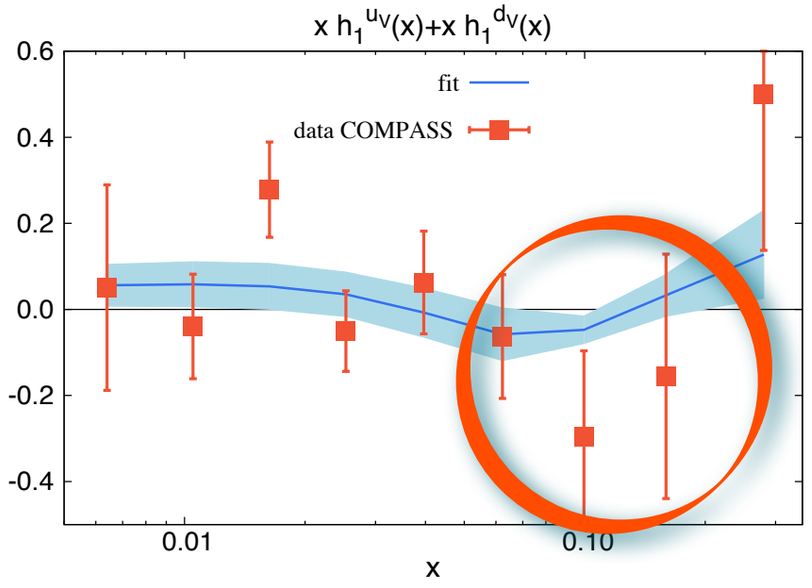


flexible functional form

rigid functional form

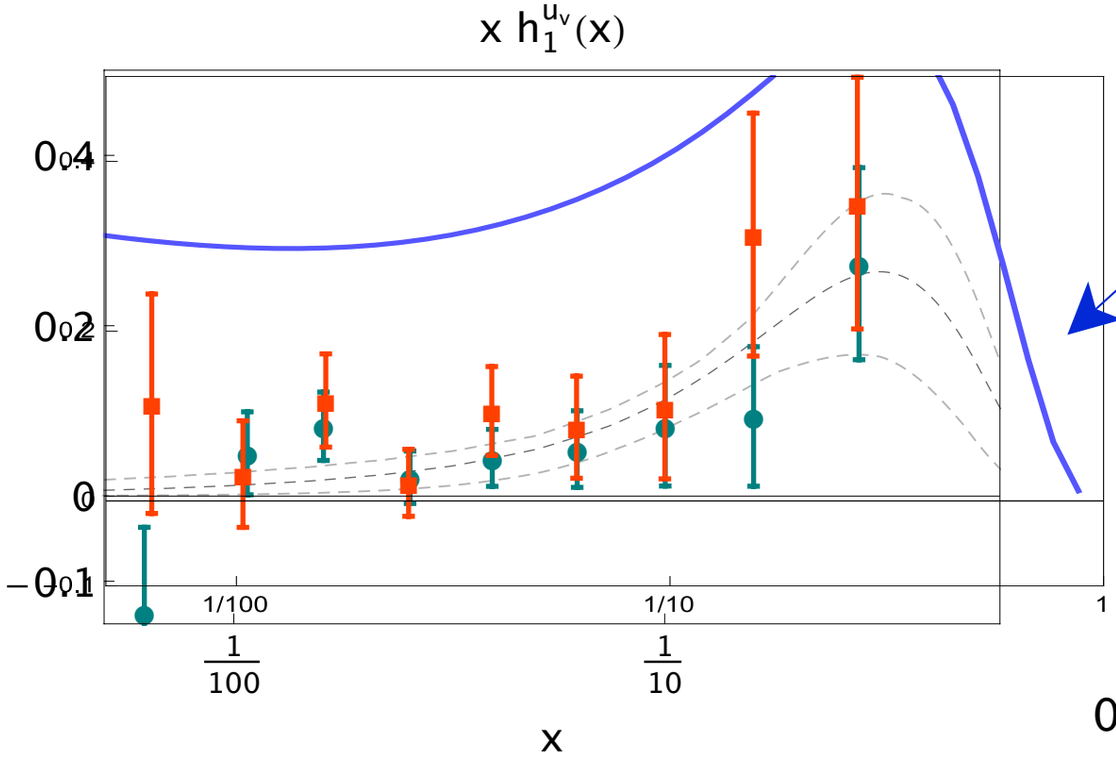
DEUTERON





Off the record: COMPASS data on Proton 2010

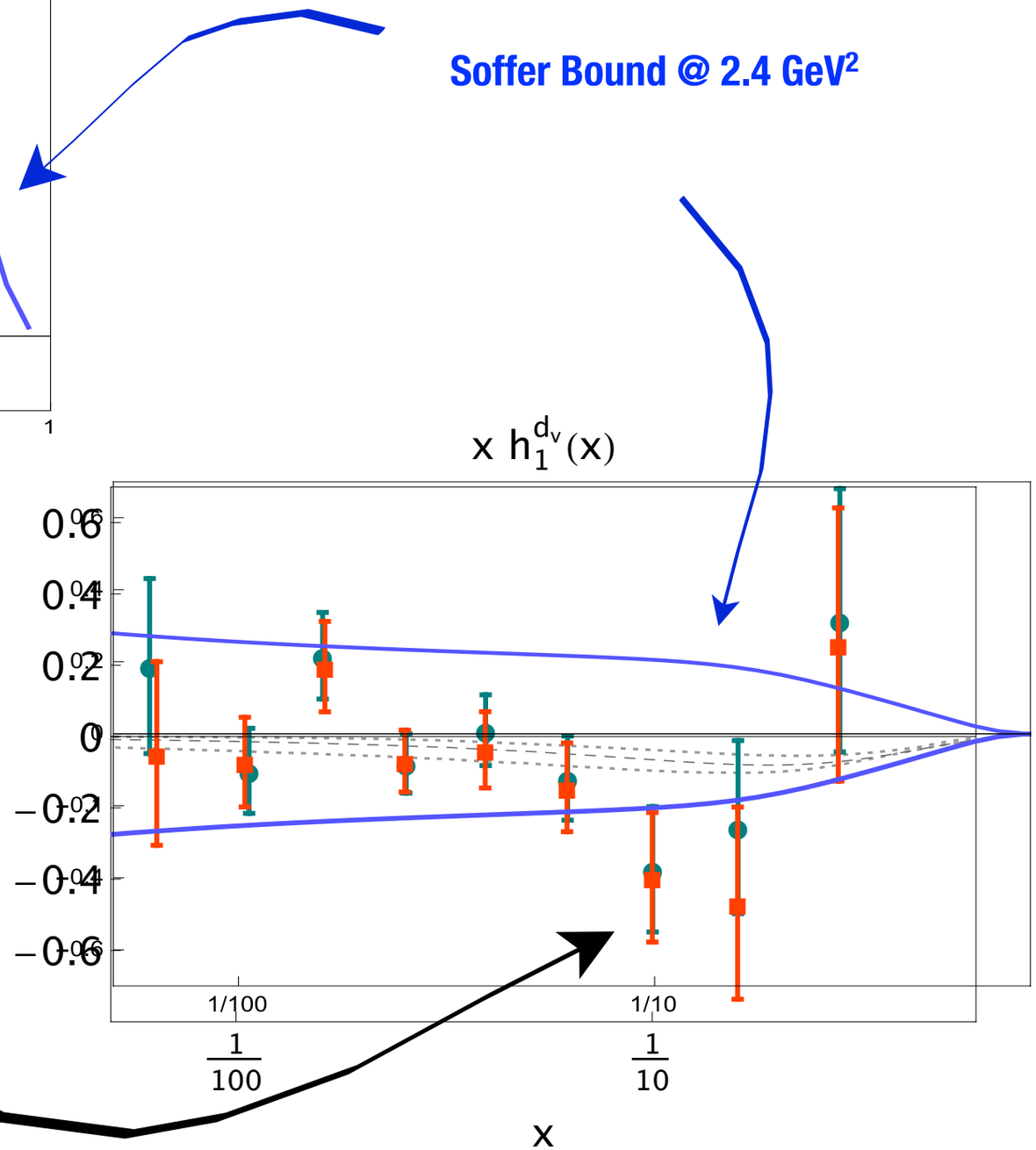
2nd order polynomial



COMPASS 2004 (P) & 2007 (D)

COMPASS 2010 (P) & 2007 (D)

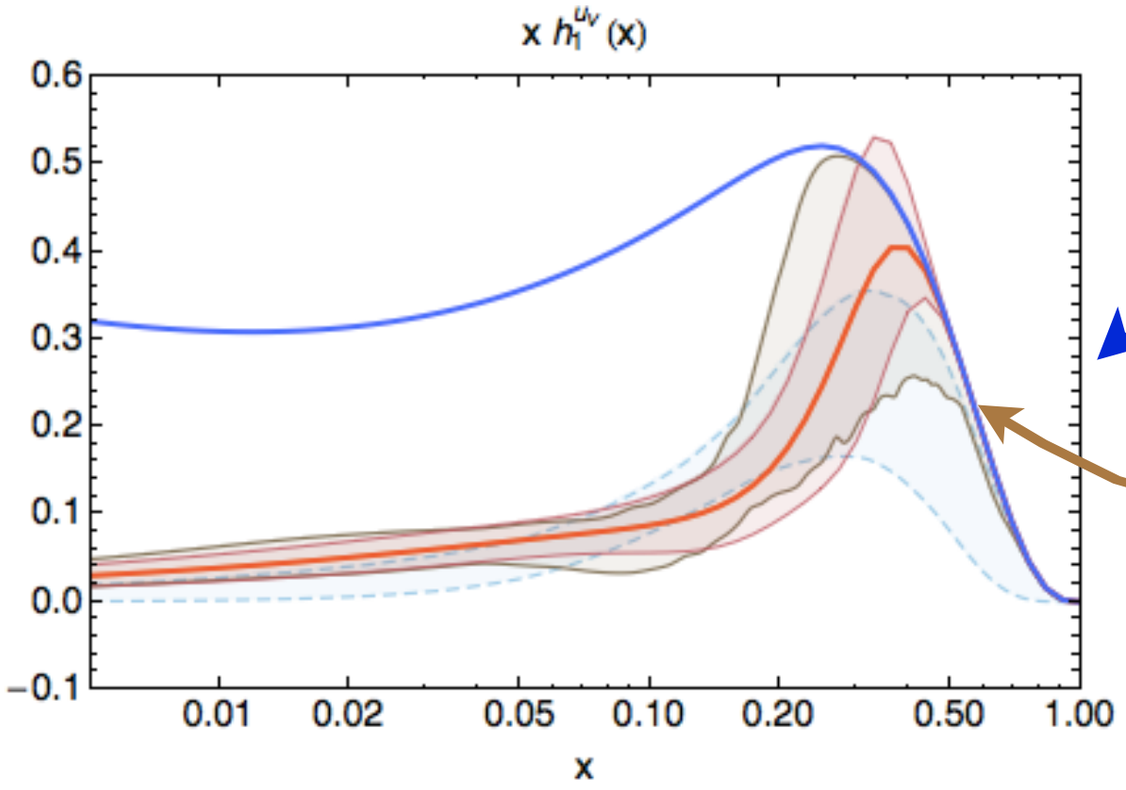
Soffer Bound @ 2.4 GeV^2



Error on deuteron too big to conclude!

The Error Analysis: *the Monte Carlo approach*

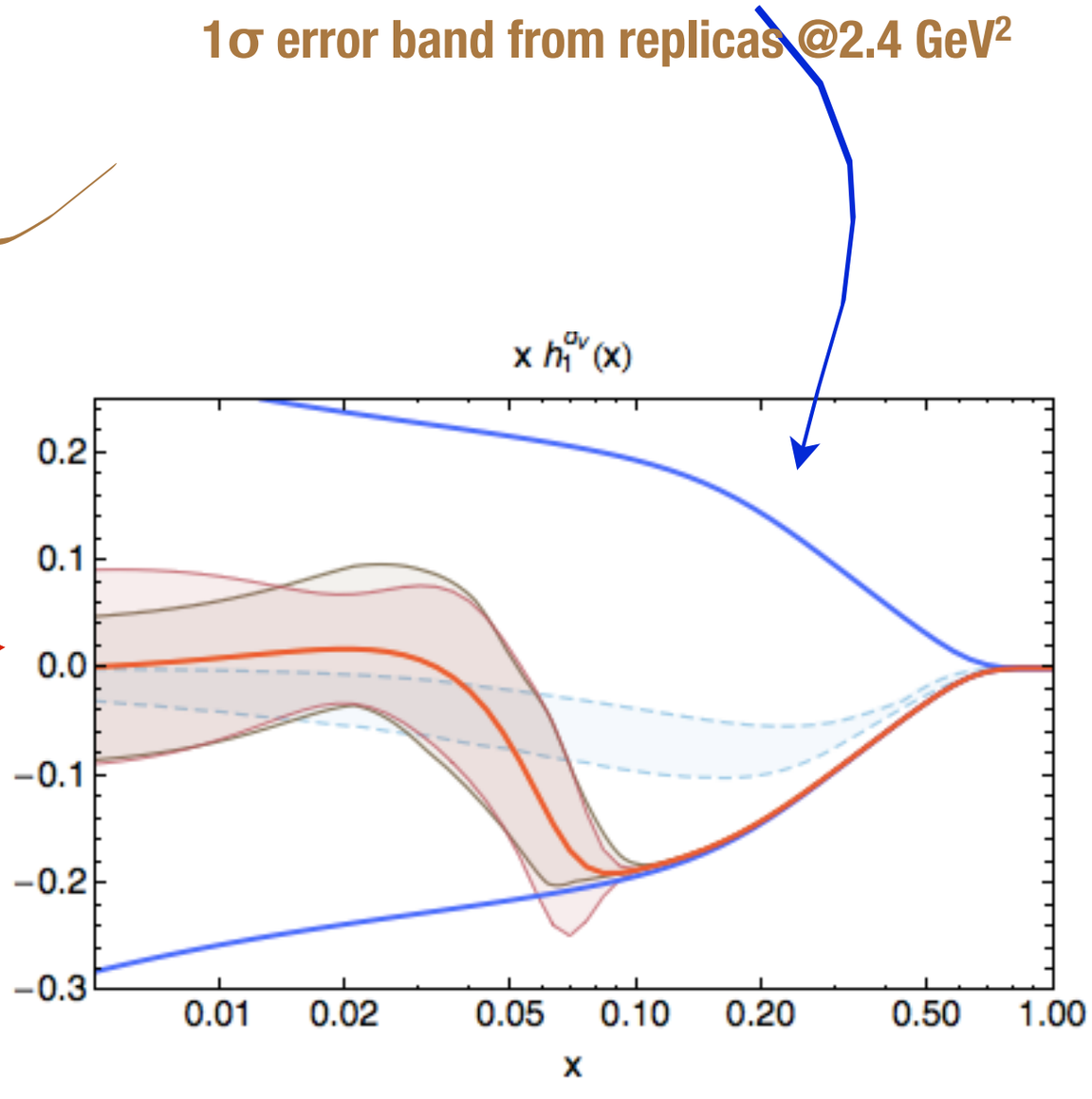
2nd order polynomial



Soffer Bound @ 2.4 GeV²

1σ error band from replicas @2.4 GeV²

Best fit central curve @2.4 GeV²
and standard 1σ error band



Monte Carlo Approach:

some illustrations

Can we find “unforeseen” replica?

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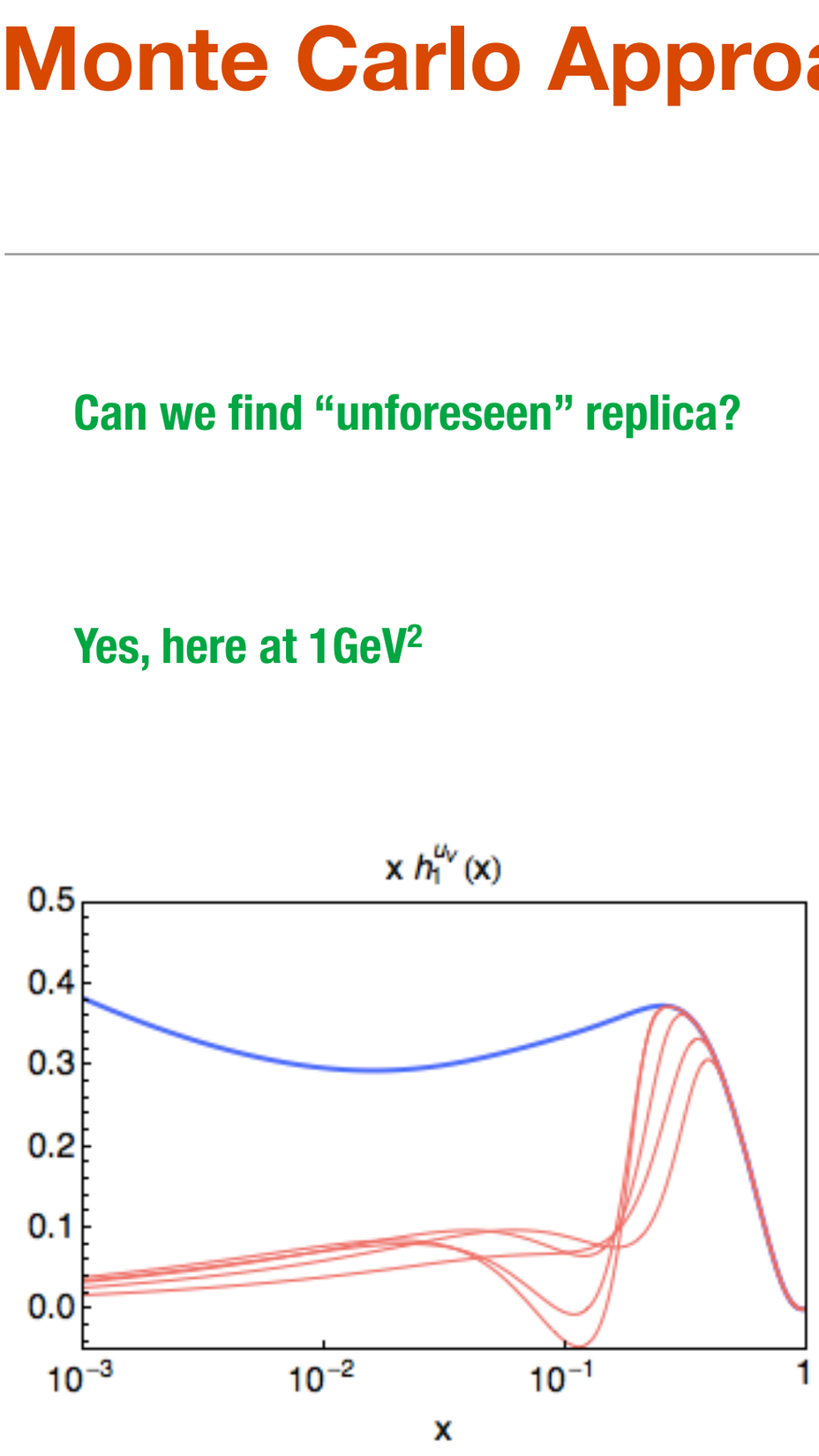
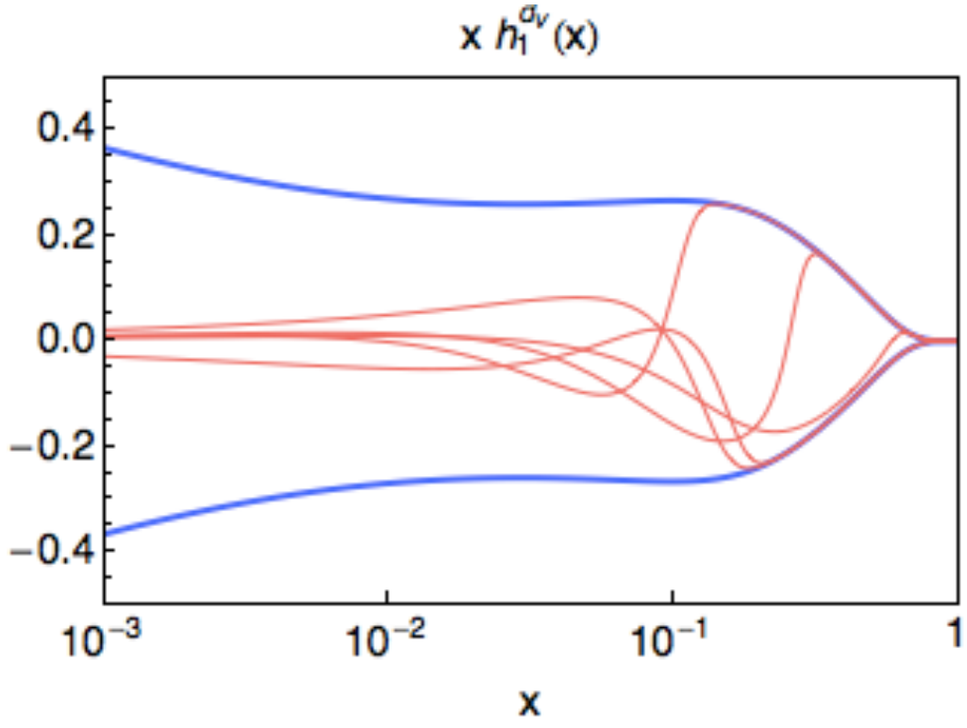
some illustrations

Can we find "unforeseen" replica?

Yes, here at 1GeV^2





X^2/dof

1.56557
1.42199
1.79911
2.07397
1.75523

Back-up slides

Transversity from $A_{UT}^{\sin(\Phi_R+\Phi_S)\sin\theta}$

$$A_{\rm DIS}(x,Q^2) = -C_y \frac{\sum_q e_q^2\, h_1^q(x,Q^2)\, n_q^{\uparrow}(Q^2)}{\sum_q e_q^2\, f_1^q(x,Q^2)\, n_q(Q^2)}$$

Using symmetries for DiFFs:

$$H_1^{\sphericalangle,\,u} = -H_1^{\sphericalangle,\,d} = -\overline{H}_1^{\sphericalangle,\,u} = \overline{H}_1^{\sphericalangle,\,d}$$

$$D_1^u = D_1^d = \overline{D}_1^u = \overline{D}_1^d \,;$$
$$D_1^s = \overline{D}_1^s\,, \quad D_1^c = \overline{D}_1^c$$

Proton

$$x h_1^{u_v}(x,Q^2) - \tfrac{1}{4}\, x h_1^{d_v}(x,Q^2) \propto -A_{\rm DIS}(x,Q^2)\, \frac{n_u(Q^2)}{n_u^{\uparrow}(Q^2)} \sum_{q=u,d,s} \frac{e_q^2}{e_u^2}\, x f_1^{q+\bar{q}}(x,Q^2)$$

Deuteron

$$x h_1^{u_v}(x,Q^2) + x h_1^{d_v}(x,Q^2) \propto \frac{5}{3} A_{\rm DIS}(x,Q^2) \frac{n_u(Q^2)}{n_u^{\uparrow}(Q^2)}\, x \left(f_1^{u+\bar{u}} + f_1^{d+\bar{d}} + \frac{2}{5} f_1^{s+\bar{s}} \right)$$

and combinations of both ...

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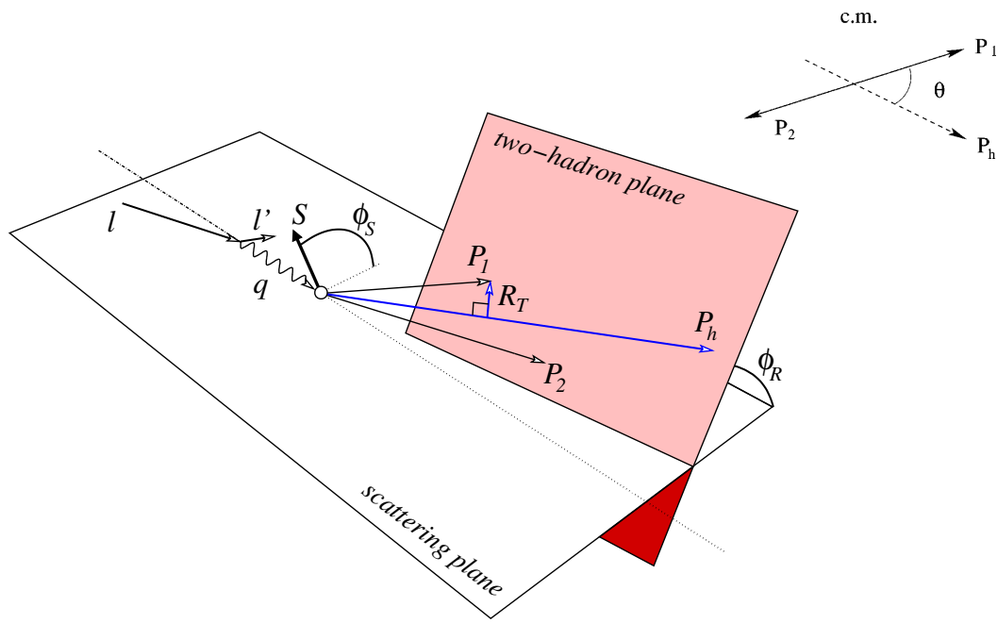
SIDIS production of pion pairs

Chiral-odd DiFF:

Distribution of hadrons inside the jet
is related to the

Direction of the transverse polarization of the fragmenting quarks



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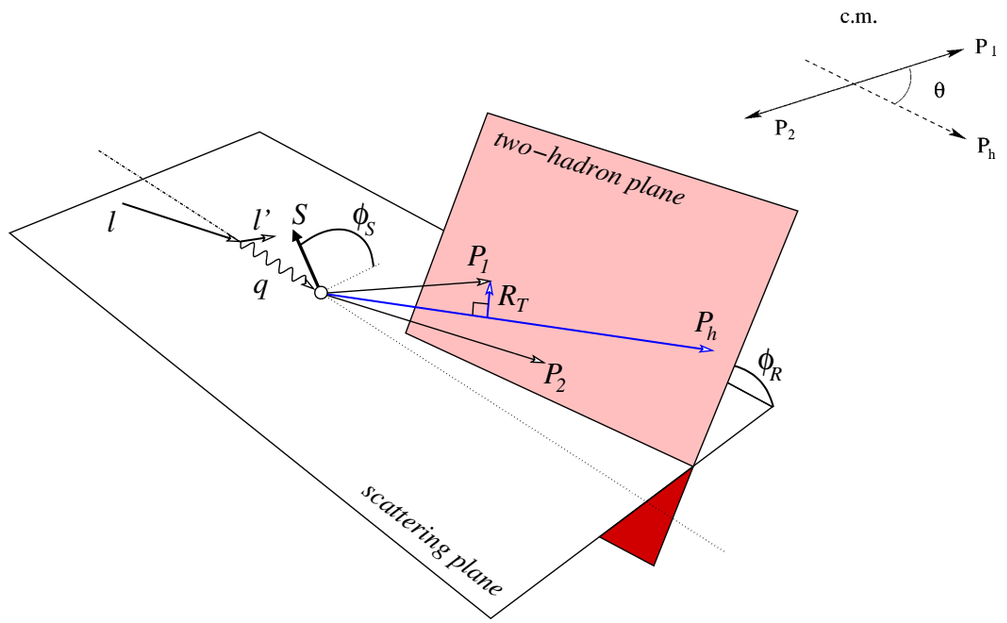

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Knowledge on DiFFs leads to $h_1(x, Q^2)$