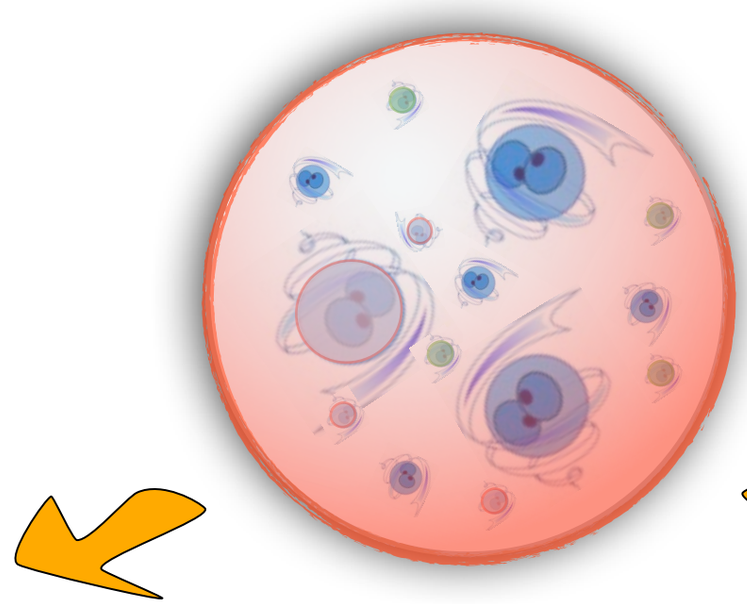
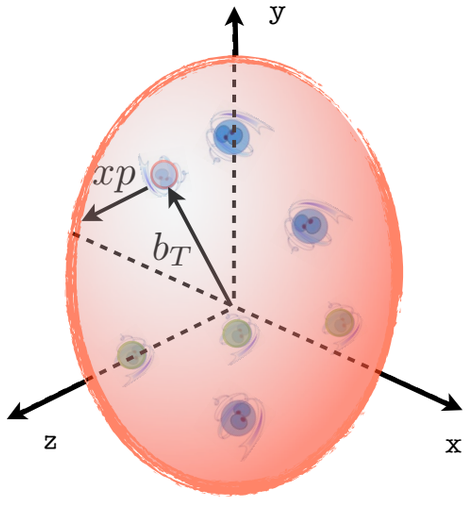
HIGHLIGHTS FROM SPIN PHYSICS

DIS2013, April 22-26, 2013, Marseille, France
Francesca Giordano (UIUC),
Alessandro Bacchetta (Uni Pavia, INFN)
Marco Contalbrigo (INFN)
Marcin Stolarski (LIP)

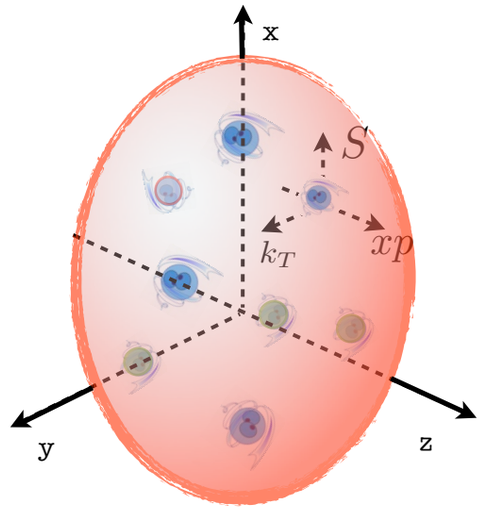
The proton structure



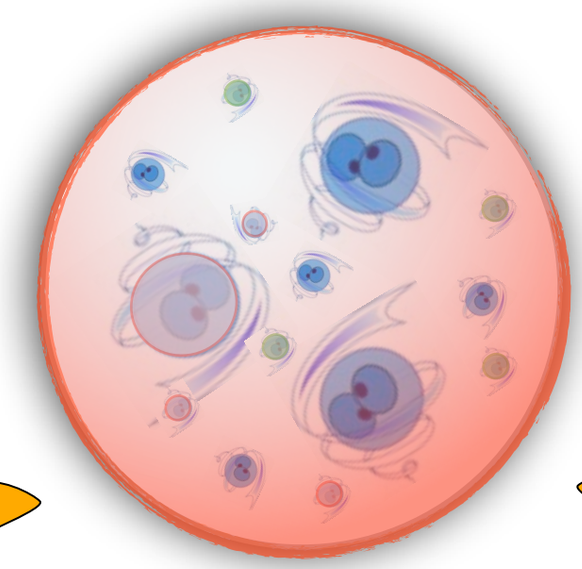
GPDs (x, b_T)



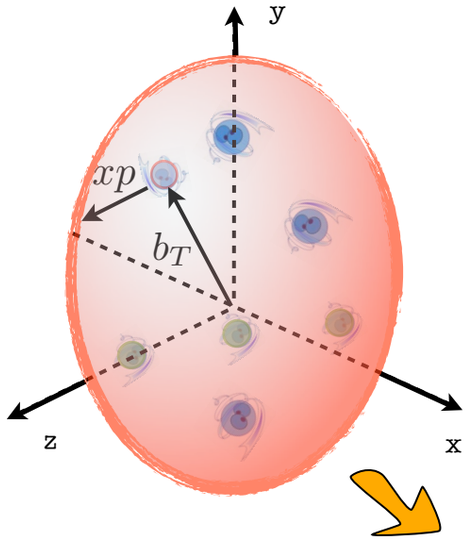
TMDs (x, k_T)



The proton structure



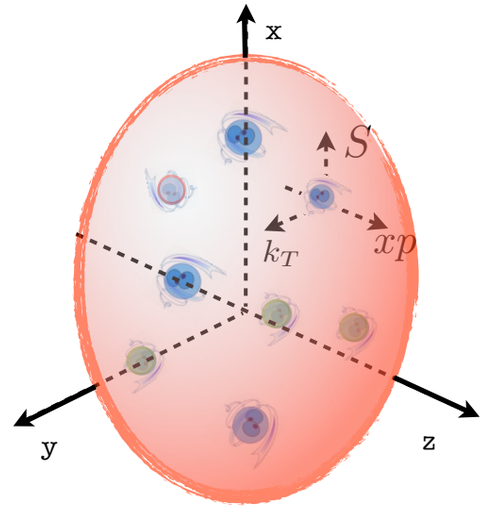
GPDs (x, b_T)



$\int$ GPDs(x,b_T) ... db_T

PDFs (x)

TMDs (x, k_T)



$\int$ TMDs(x,k_T) ... dk_T

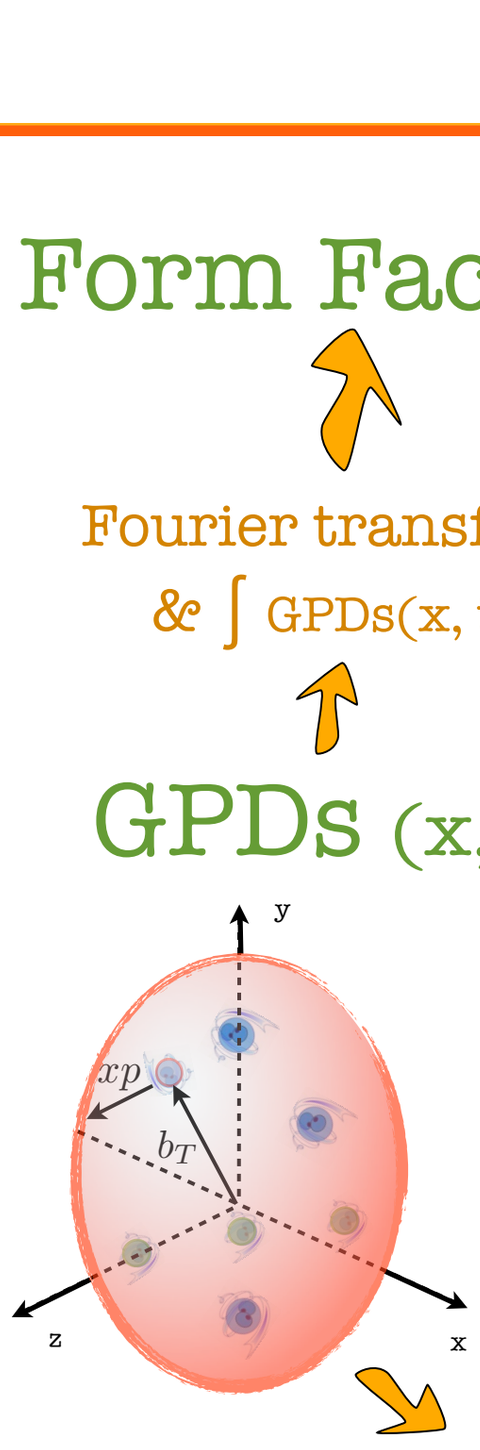
The proton structure

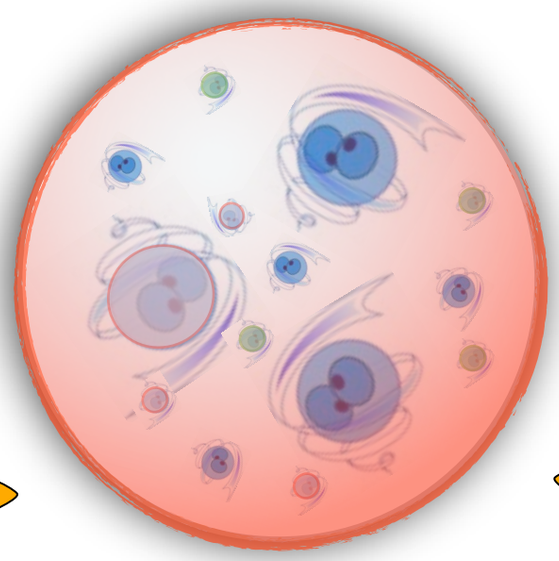
Form Factors (t)

Fourier transform (b_T)

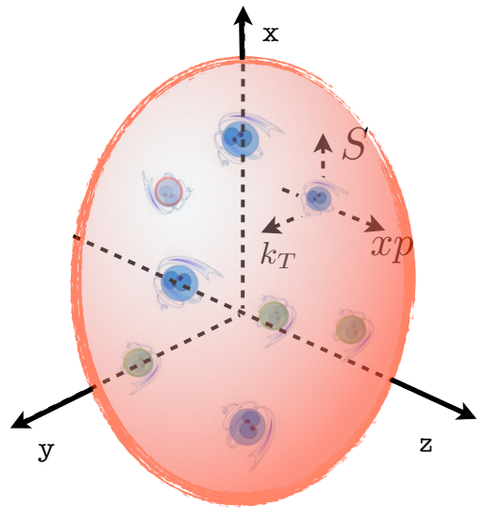
& $\int$ GPDs(x, t) ... dx

GPDs (x, b_T)





TMDs (x, k_T)



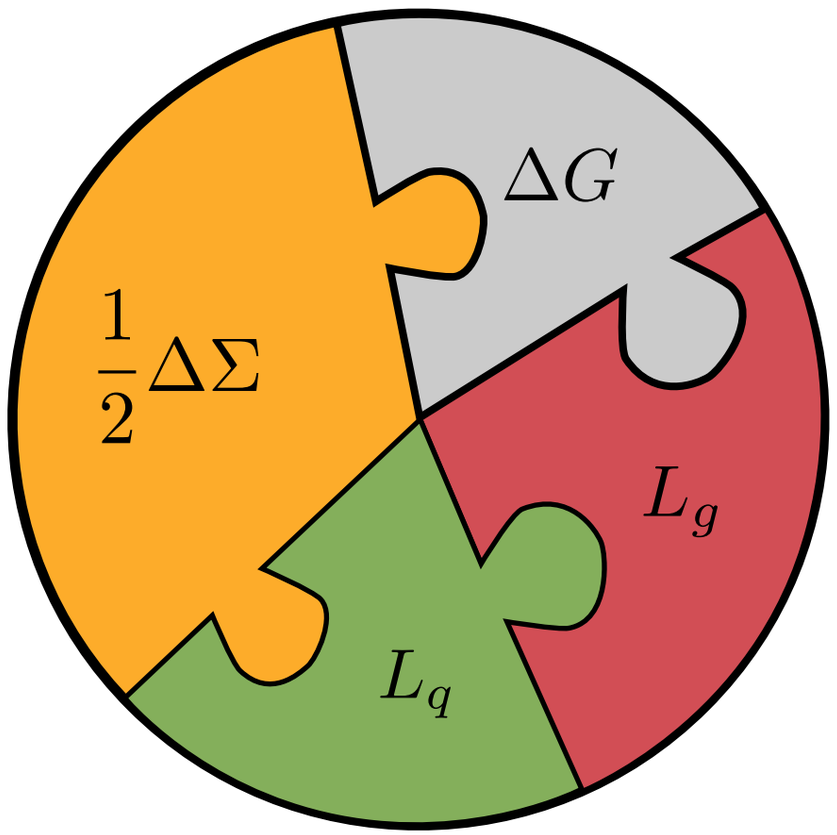
PDFs (x)

$\int$ GPDs(x,b_T) ... db_T

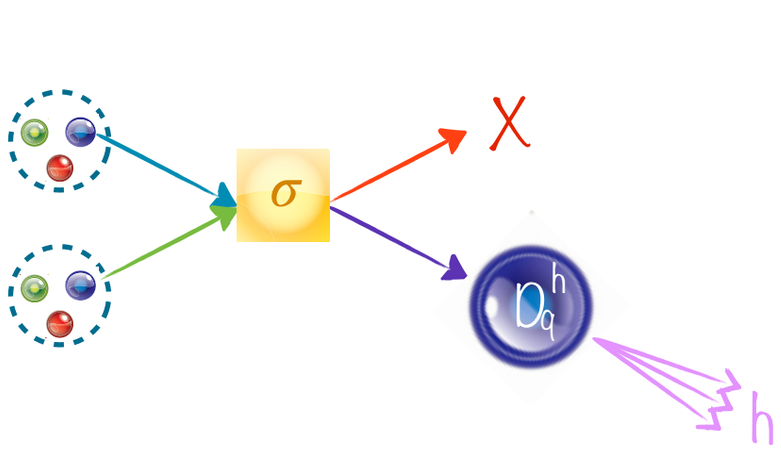
$\int$ TMDs(x,k_T) ... dk_T

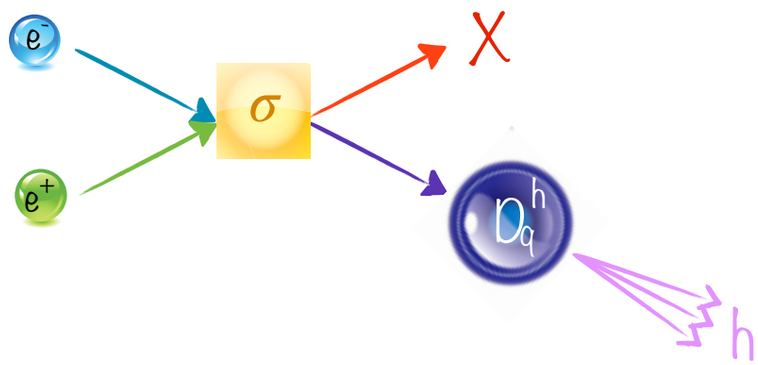
Spin puzzle

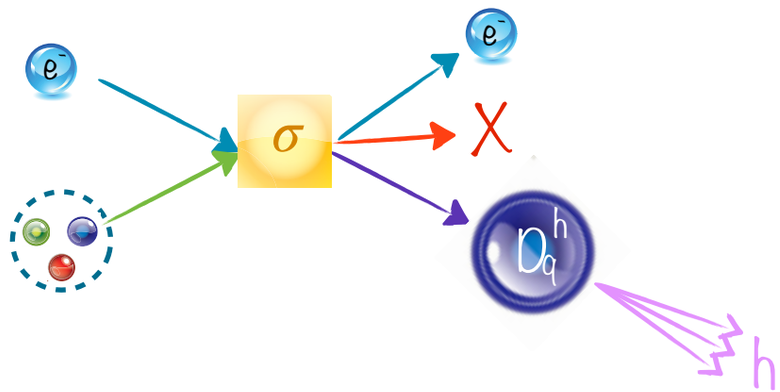
$$\frac{1}{2} = \frac{1}{2}\Delta\Sigma + L_q + \Delta G + L_g$$



Spin puzzle







Complementary reactions:

Global analyses needed!

- Evolution
- Factorization
- Universality

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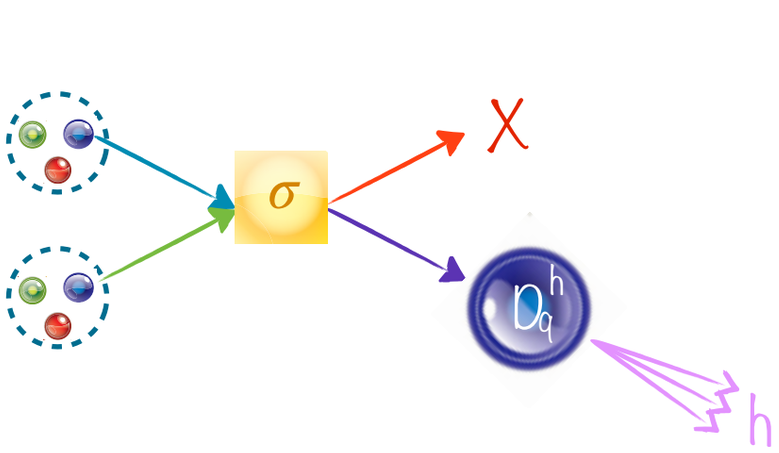
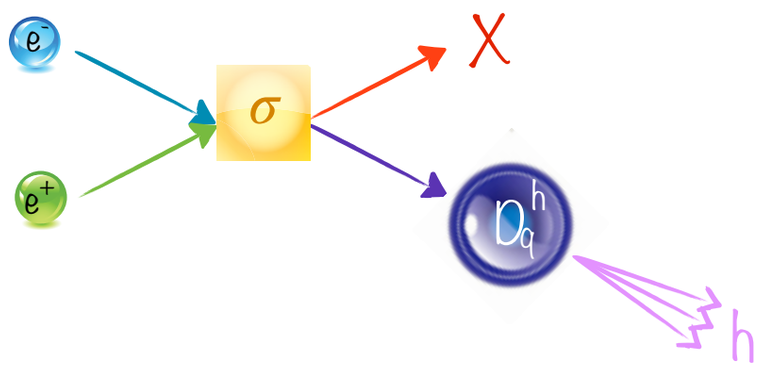
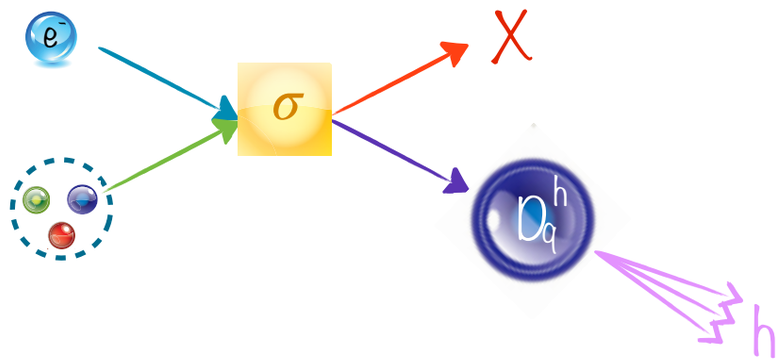
Spin puzzle







Complementary reactions:

Global analyses needed!

- Evolution
- Factorization
- Universality

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DIS 2013: spin session

Unpolarized

Gevorg KARYAN
Nour MAKKE
Charlotte VAN HULSE
Harold E JACKSON Jr
Isabella GARZIA

Quark Helicity

Hoyoung KANG
Vincent ANDRIEUX
Alberto ACCARDI
Sanghwa PARK
Bernd SURROW
Emanuele Roberto NOCERA

Gluon Helicity

Mickey CHIU
Carl GAGLIARDI
Luis SILVA
Grant WEBB
Murad SARSOUR
Stephen GLISKE

GPDs

Sergey YASCHENKO
Marat SIDDIKOV
Jakub WAGNER
Samuel WALLON
Bohdan MARIANSKI
Katharina SCHMIDT

TMD theory

Markus DIEHL
Alexei PROKUDIN
Maarten BUFFING
Ignazio SCIMENI
Wilco DEN DUNNEN
Kazuhiro TANAKA
Fabio DOMINGUEZ
Koichi KANAZAWA

TMD exp

Isabella GARZIA
Mher AGHASYAN
Anna MARTIN
Bakur PARSAMYAN
Christopher BRAUN
Stephen GLISKE

TMD phenomenology

Stefano MELIS
Aurore COURTOY
Zhun LU

pp A_N

Jacques SOFFER
Stefano MELIS
Steven HEPPELMANN
Oleg EYSER

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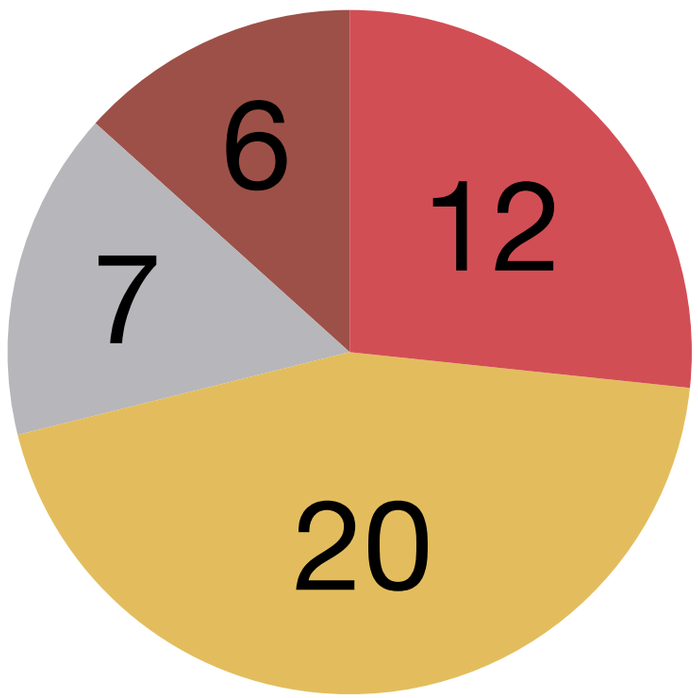

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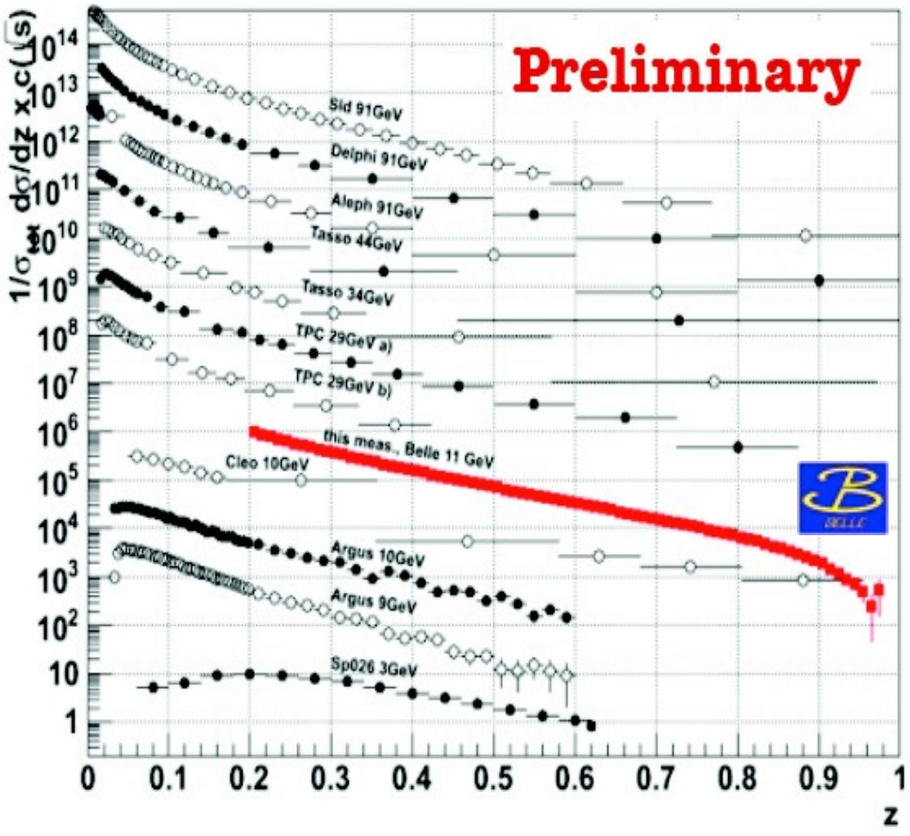
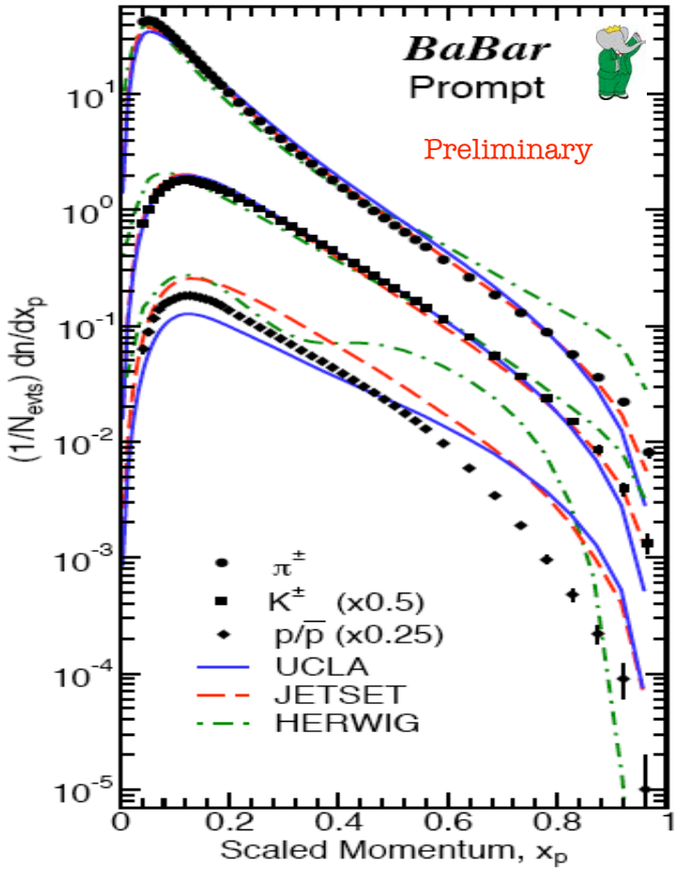
High-precision unpolarized data

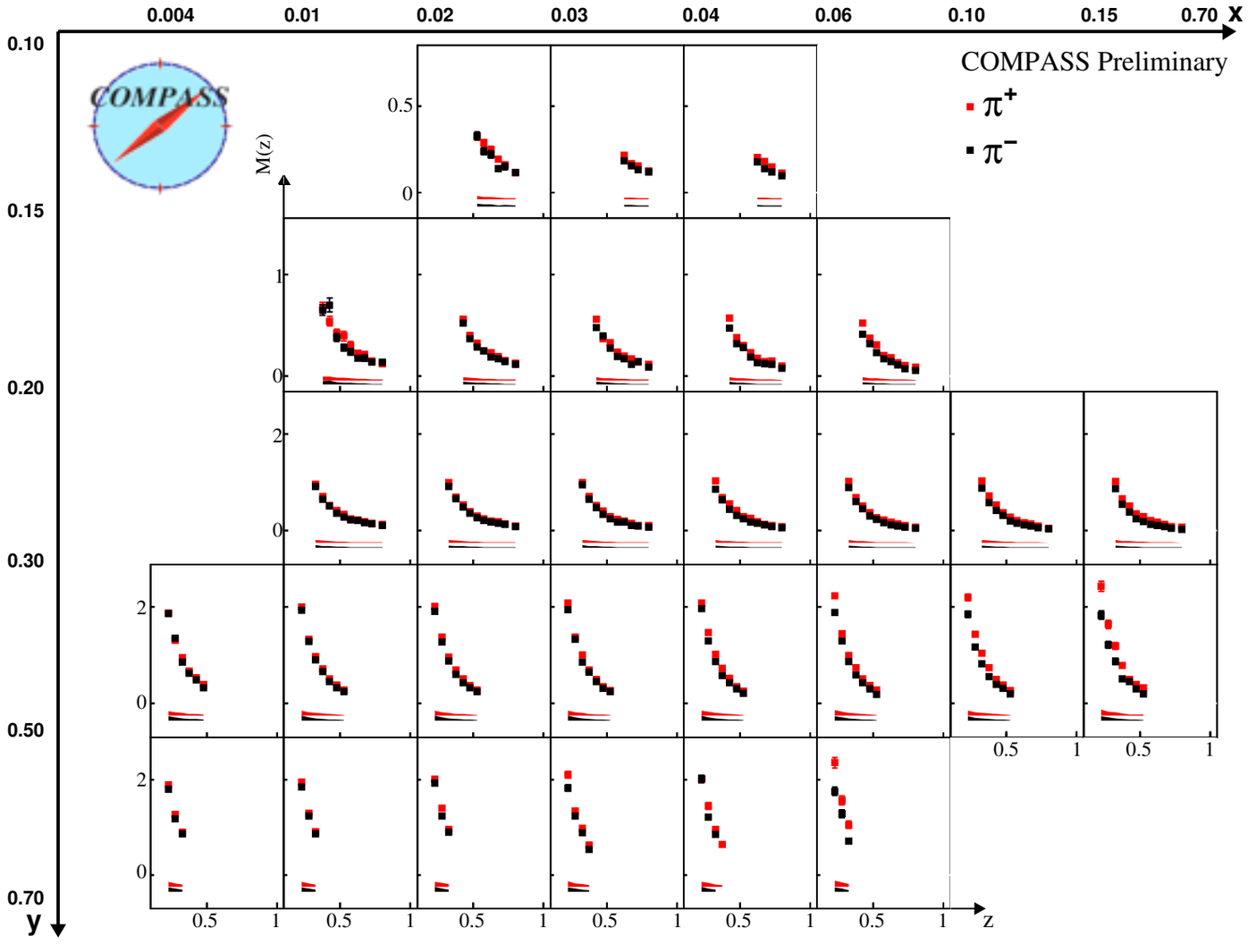
0.5% precision data!

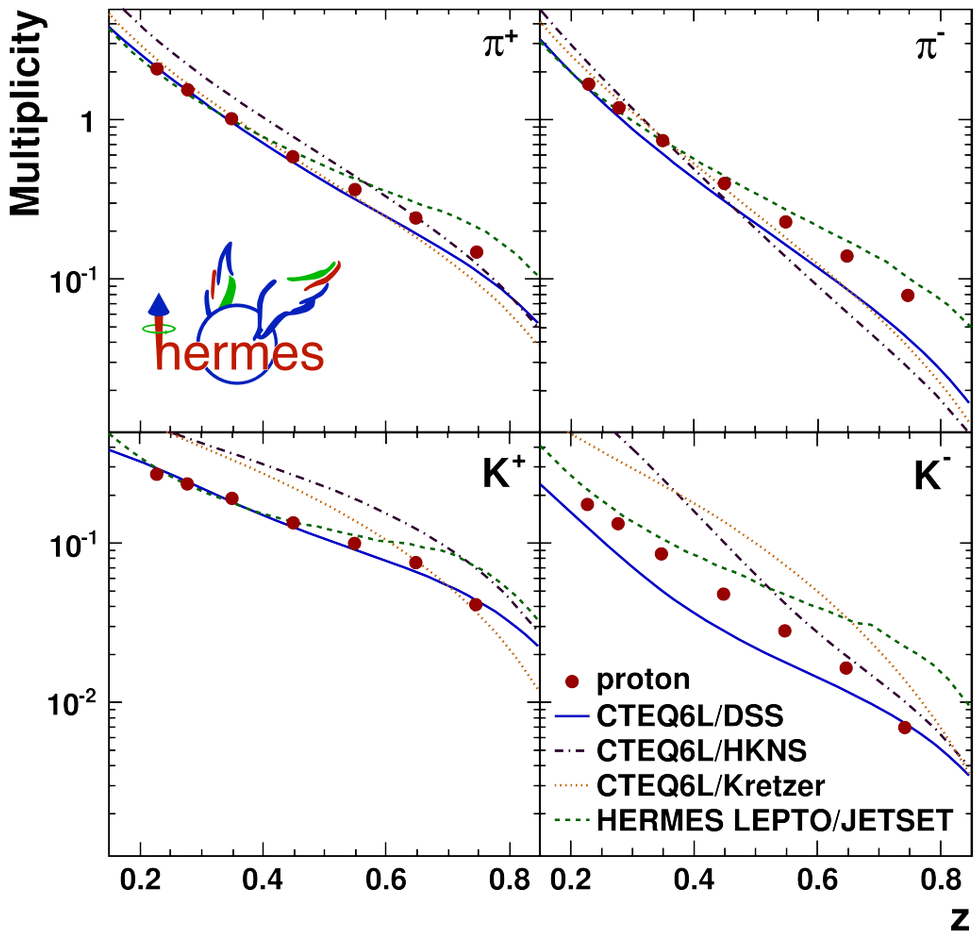




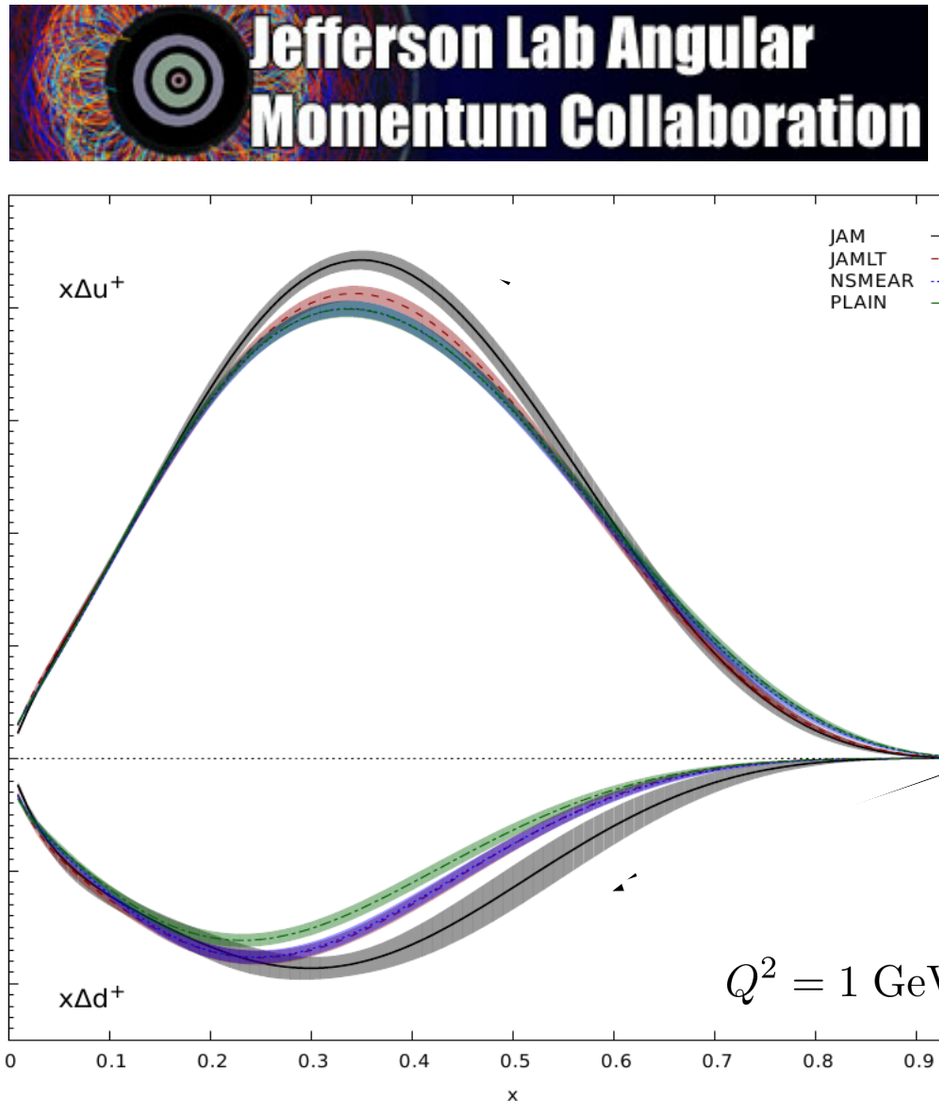
High-precision unpolarized data

SIDIS: essential for flavor separation





Progress in helicity extractions



Important corrections at high x

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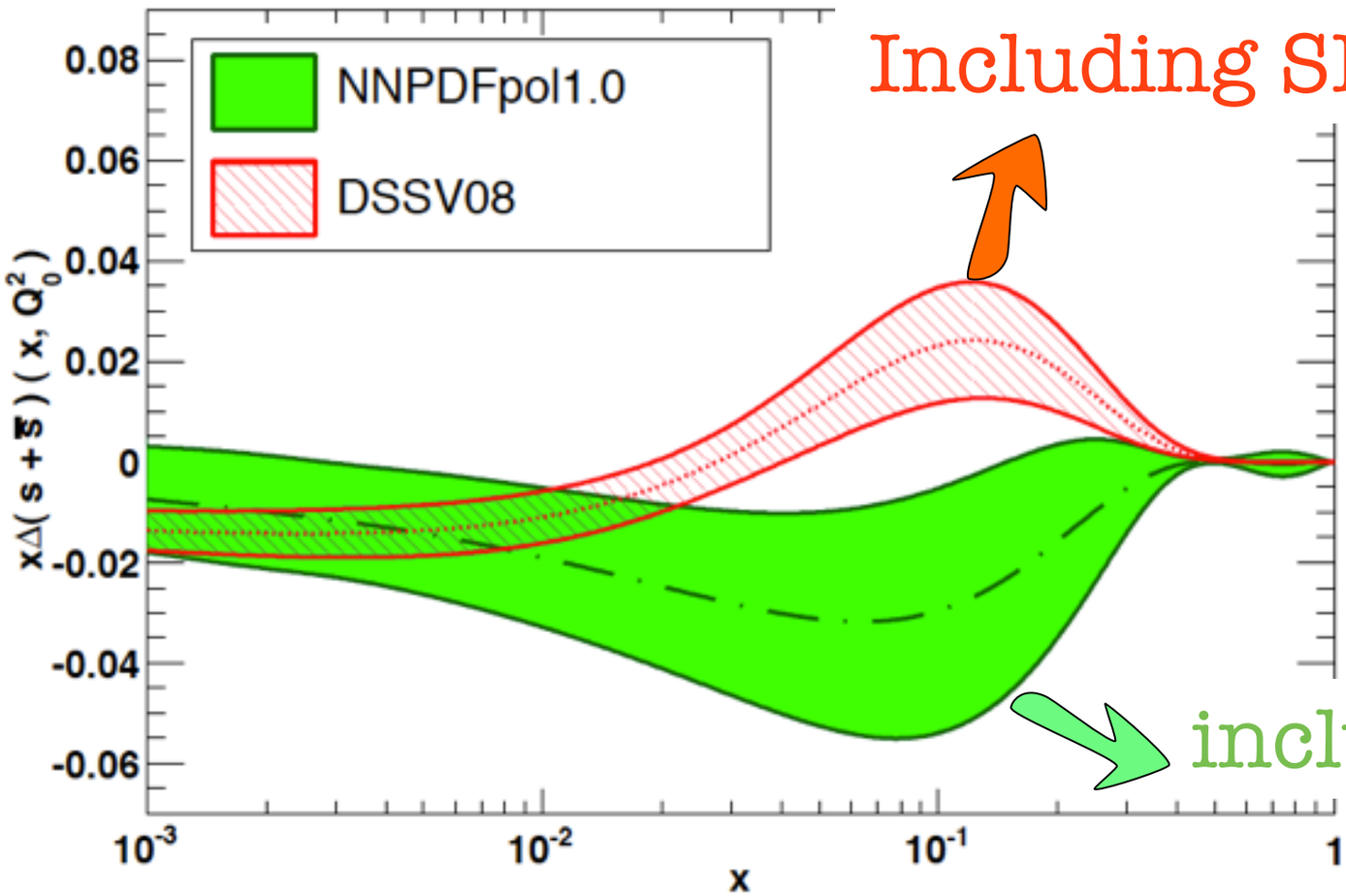
Strange helicity puzzle



Including SIDIS

inclusive DIS only

Better knowledge of Fragmentation Functions is needed for SIDIS

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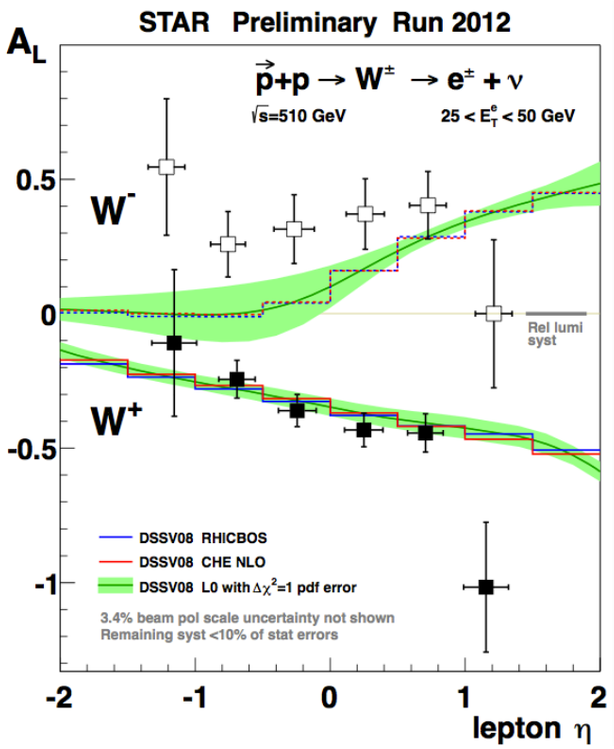
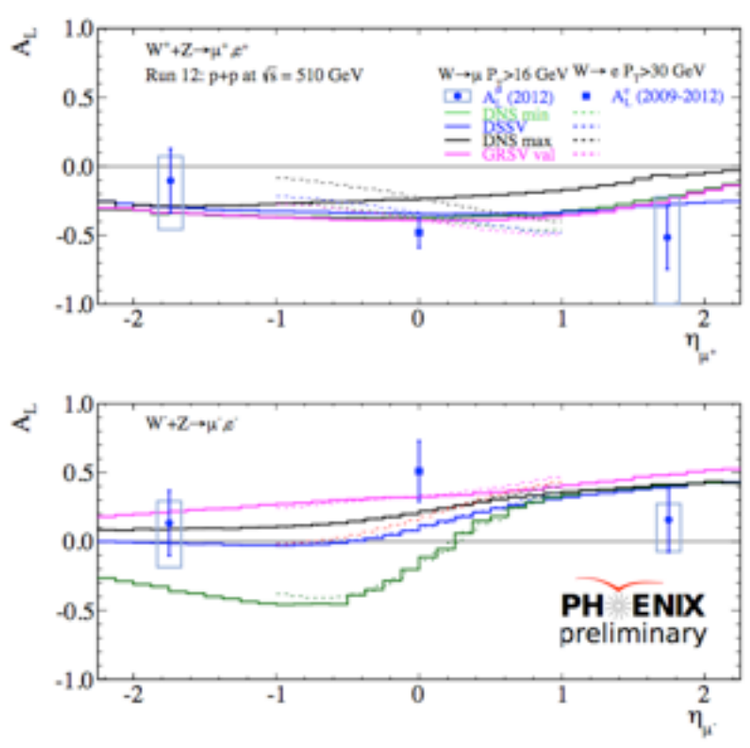
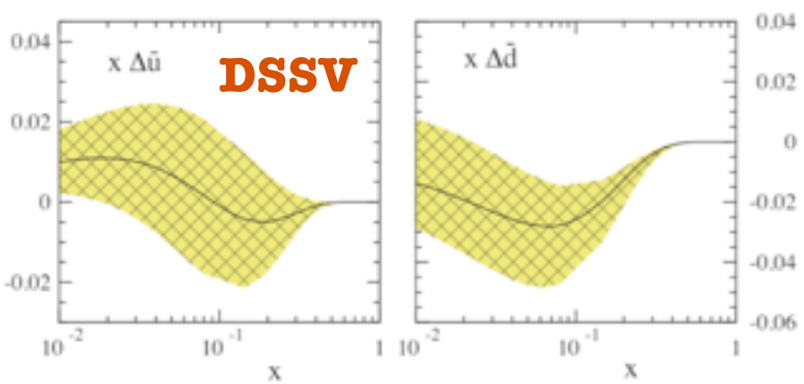
Sea helicity

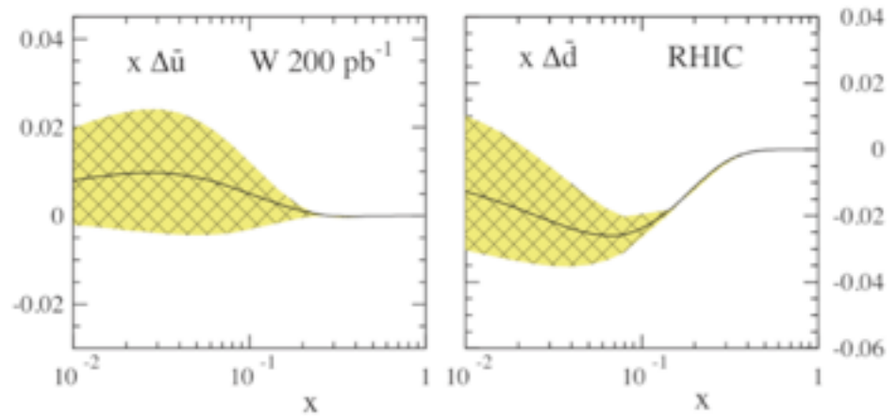




Still collecting data!

At the end of the RHIC W program we expect a significant improvement in the light sea helicity knowledge:





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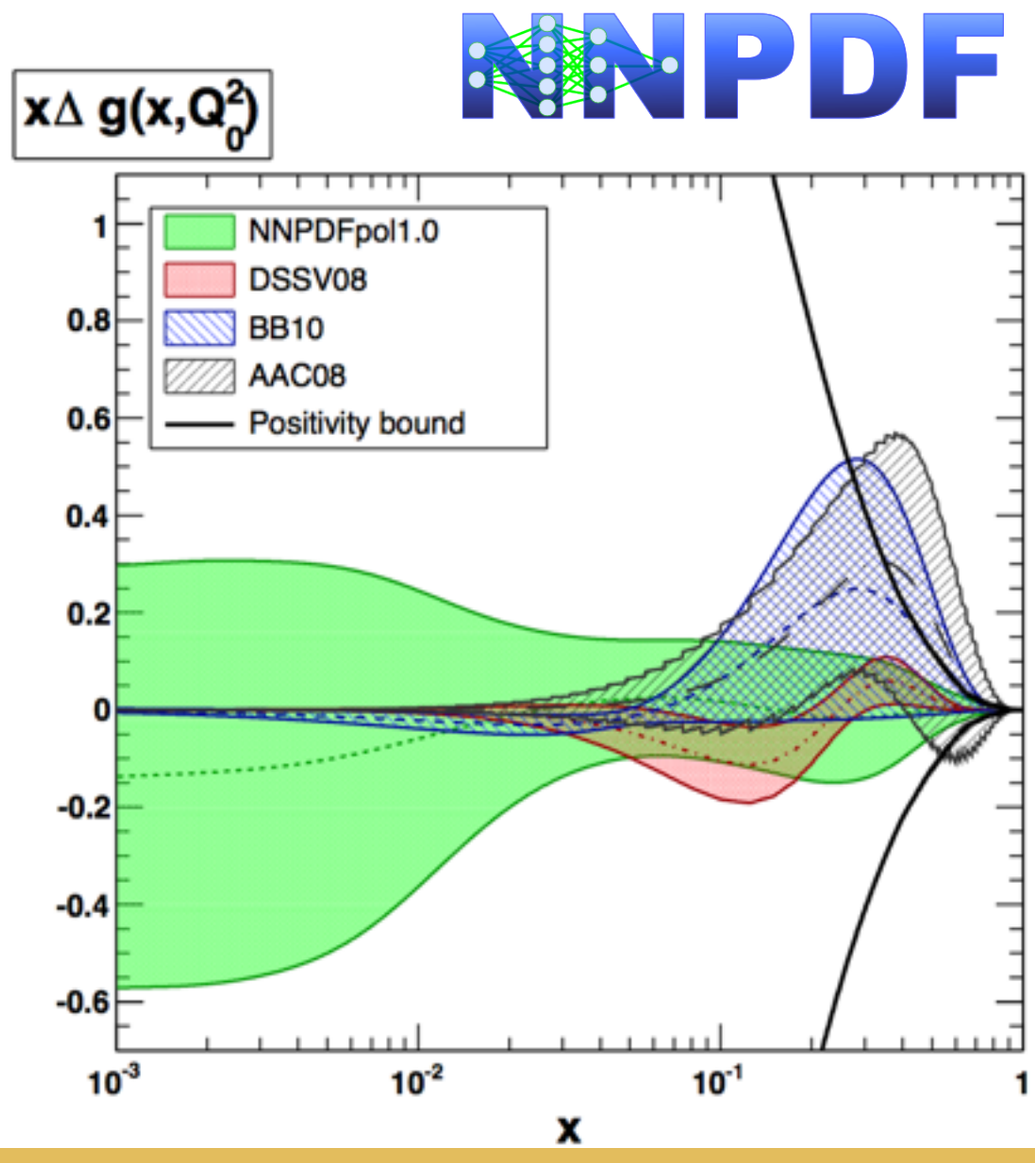
Gluon helicity



Gluon is not constrained by inclusive DIS

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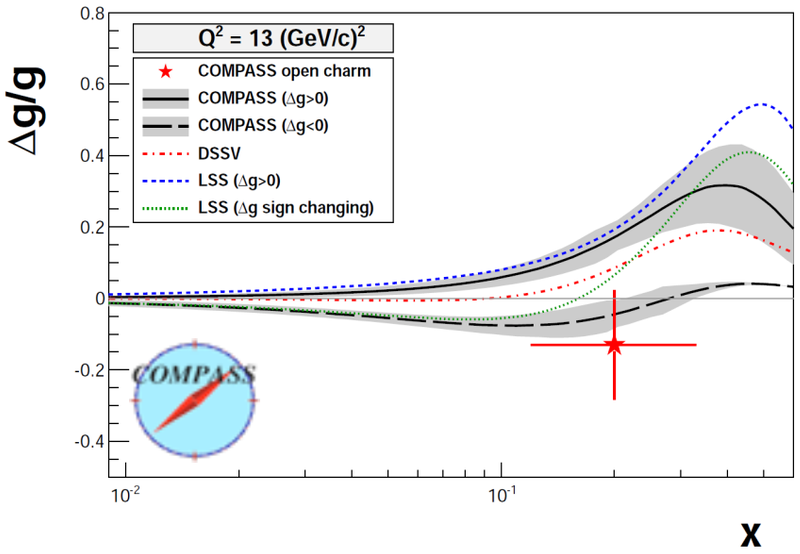
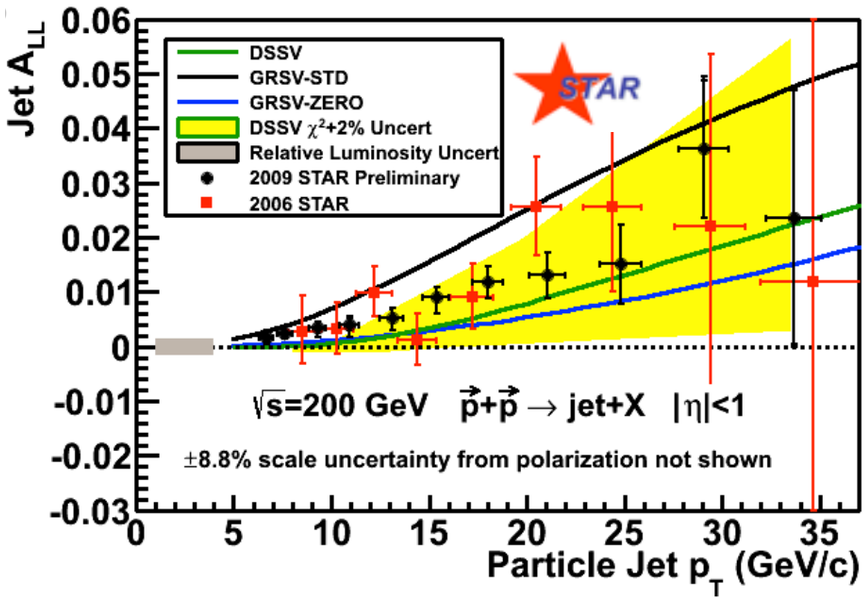
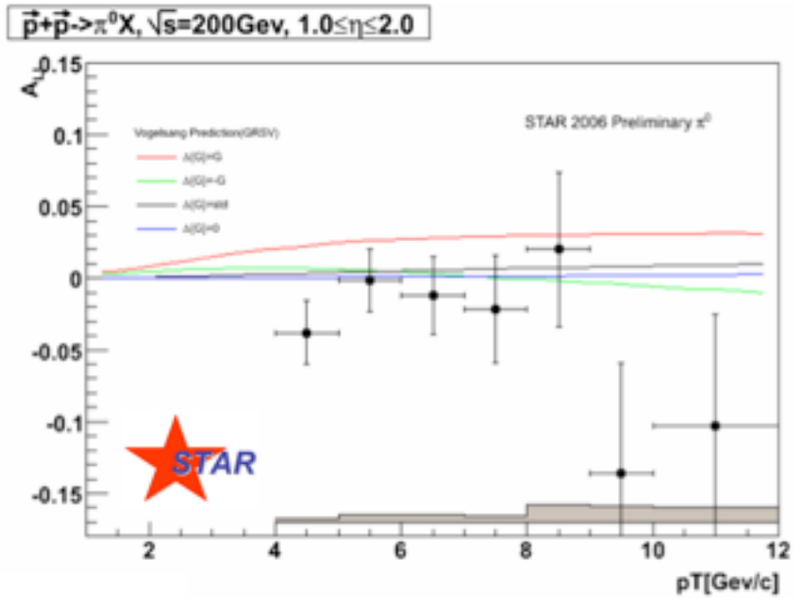
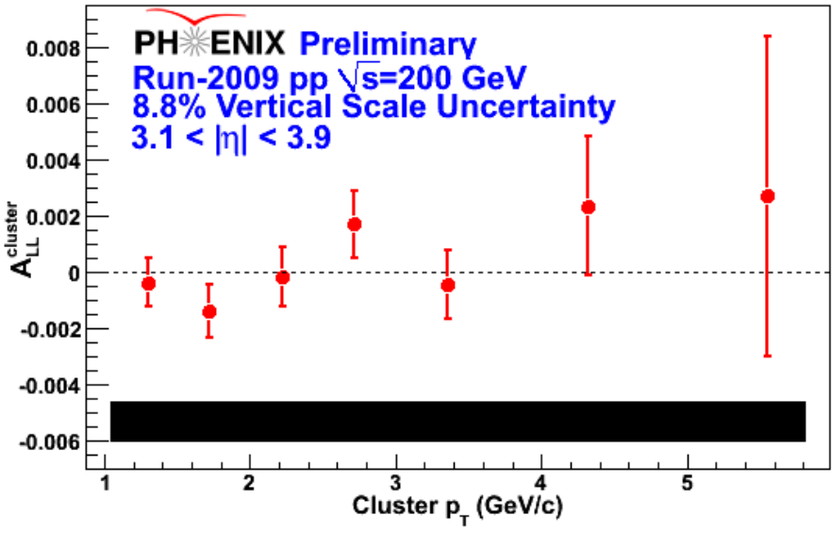
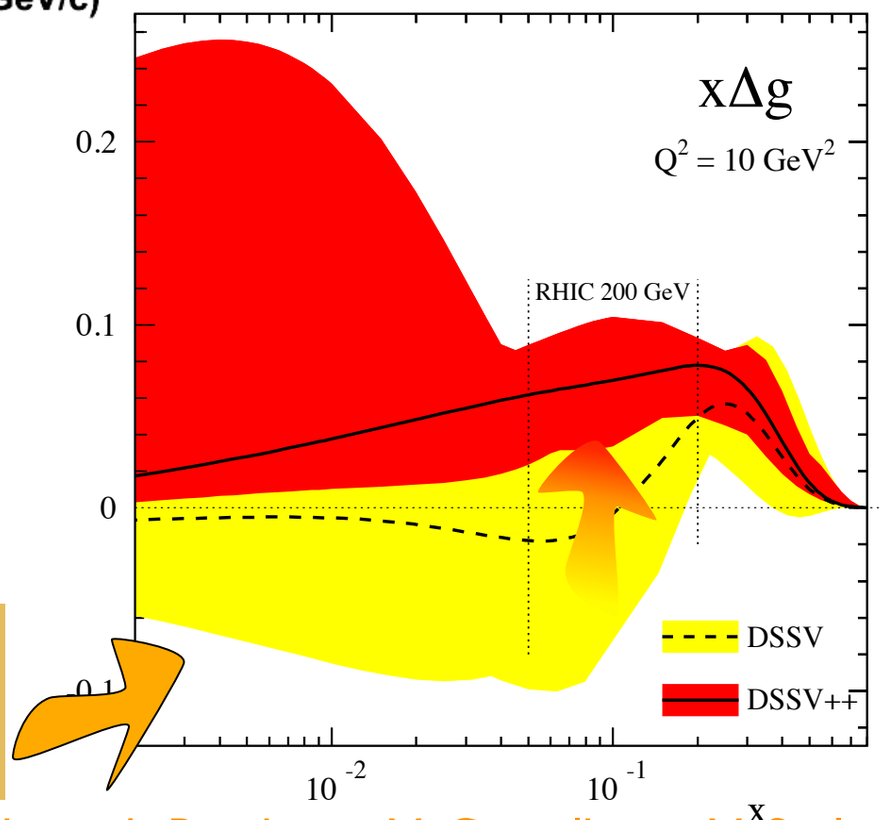
Gluon helicity











Including part of the Phenix and Star data

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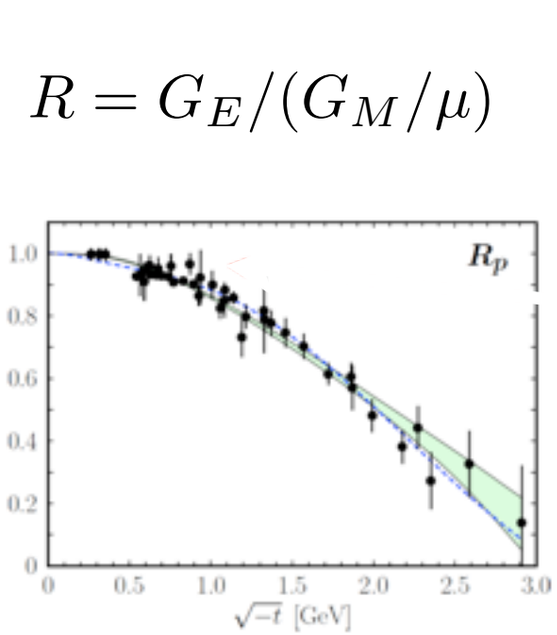
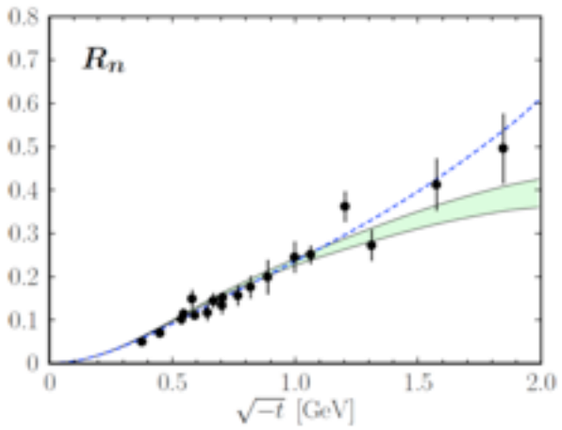
From Form Factors to GPDs

$$R = G_E/(G_M/\mu)$$

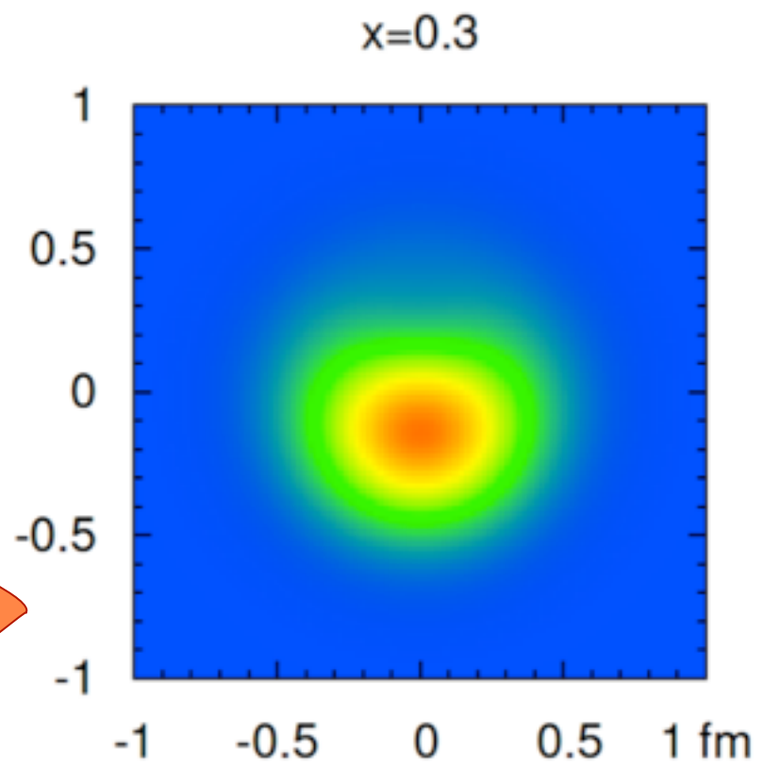




$$E_v^q(x,t) = e_v^q(x)\ \exp\left[t g_q(x)\right]$$

$$H_v^q(x,t) = q_v(x)\ \exp\left[t f_q(x)\right]$$

H, E



Ji sum rule:

$$J_v^u = 0.230^{+0.009}_{-0.024} \qquad J_v^d = -0.004^{+0.010}_{-0.016}$$

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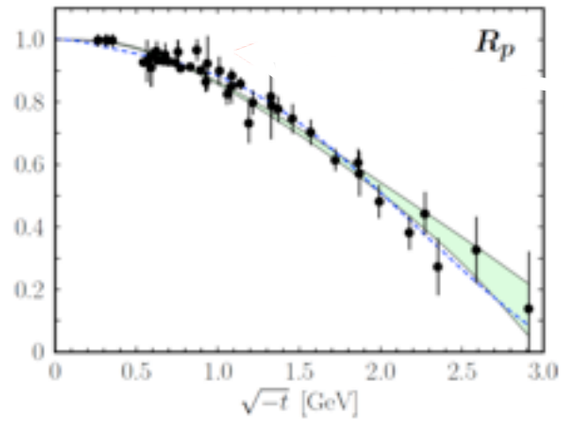
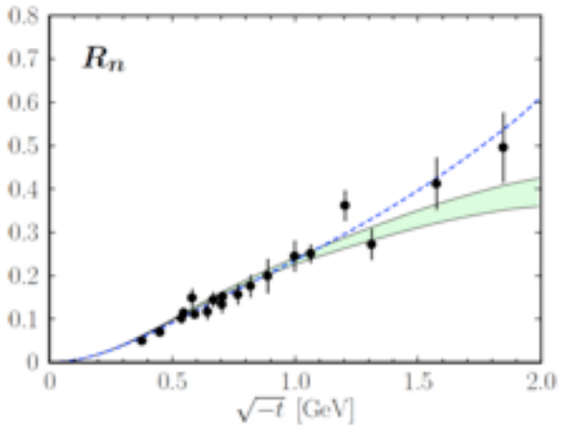
From Form Factors to GPDs

$$R = G_E/(G_M/\mu)$$





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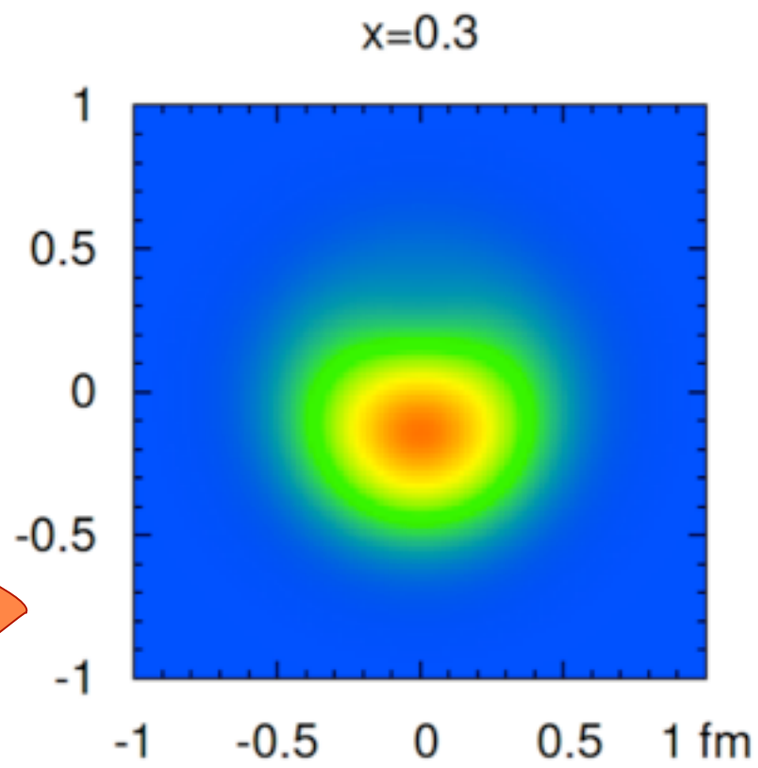
H, E



Ji sum rule:

$$J_v^u = 0.230^{+0.009}_{-0.024} \qquad J_v^d = -0.004^{+0.010}_{-0.016}$$

Compatible with (model-dependent) extraction from TMDs: Bacchetta, Radici

$$J_v^u = 0.214^{+0.009}_{-0.013} \qquad J_v^d = -0.029^{+0.021}_{-0.008}$$

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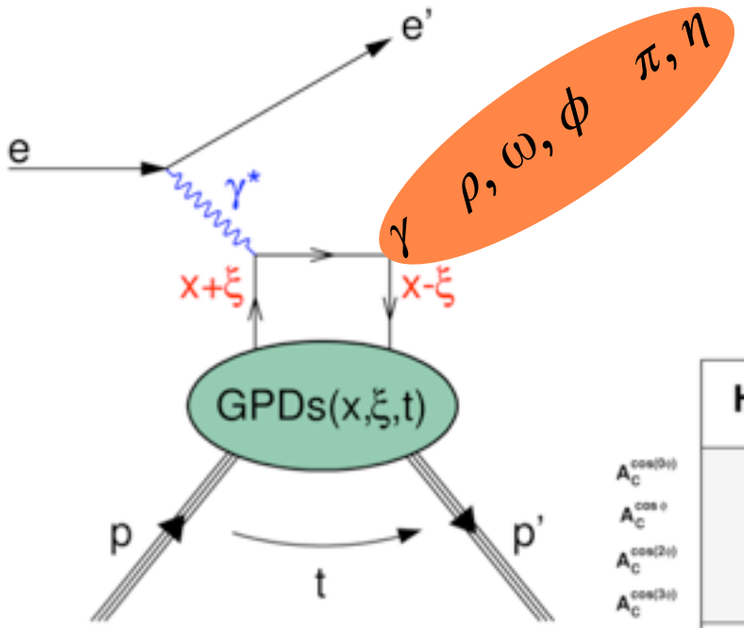
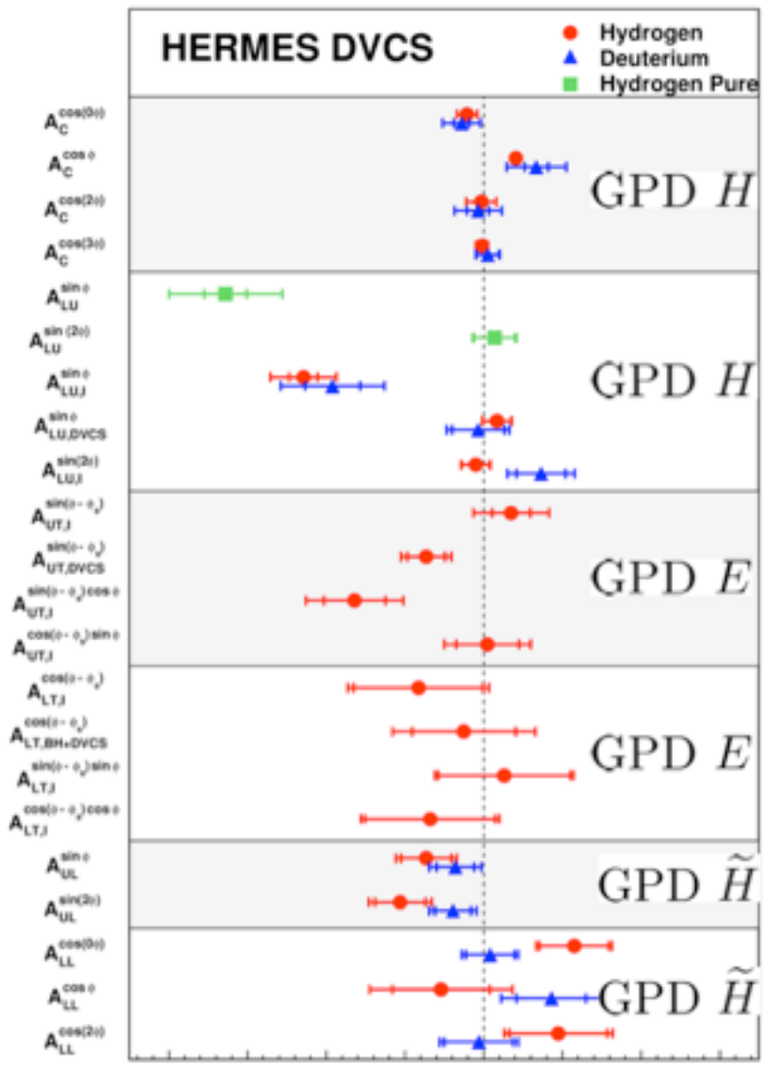
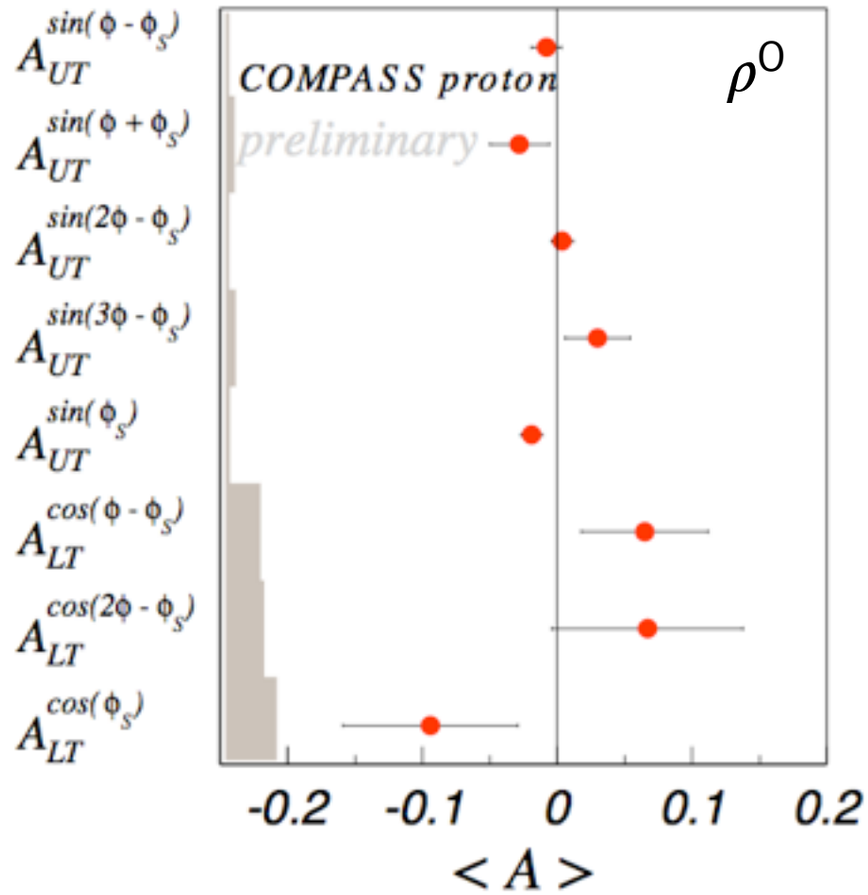
Constraining GPDs



- DVCS (γ) $\rightarrow H,\ E,\ \tilde{H},\ \tilde{E}$
- Vector mesons (ρ, ω, ϕ) $\rightarrow H,\ E$
- Pseudoscalar mesons (π, η) $\rightarrow \tilde{H},\ \tilde{E}$





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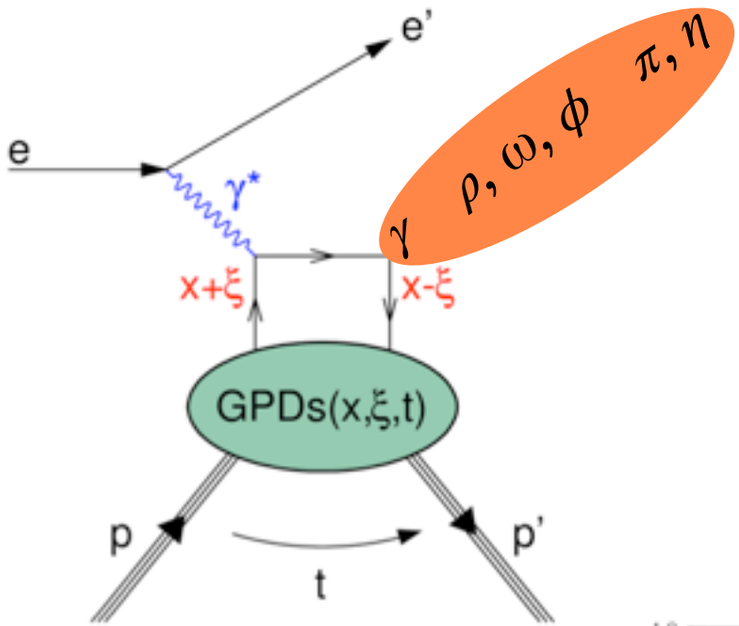
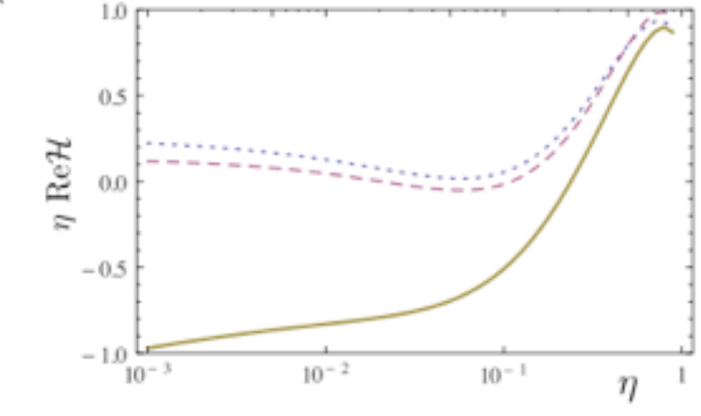
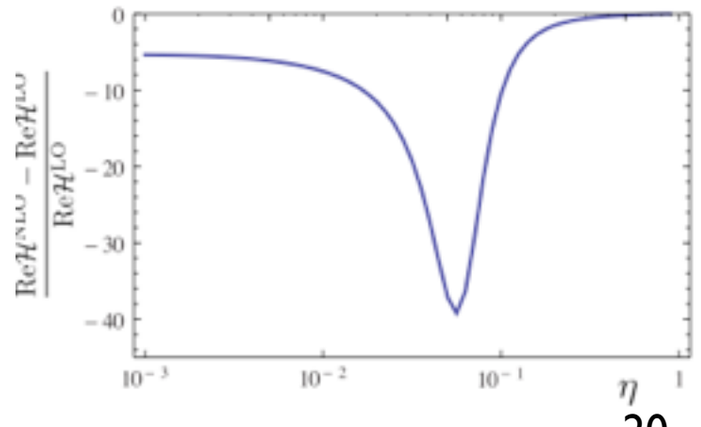
Constraining GPDs



- DVCS (γ) $\rightarrow H,\ E,\ \tilde{H},\ \tilde{E}$
- Vector mesons (ρ, ω, ϕ) $\rightarrow H,\ E$
- Pseudoscalar mesons (π, η) $\rightarrow \tilde{H},\ \tilde{E}$

BUT!!!





LO
q NLO
g+q NLO

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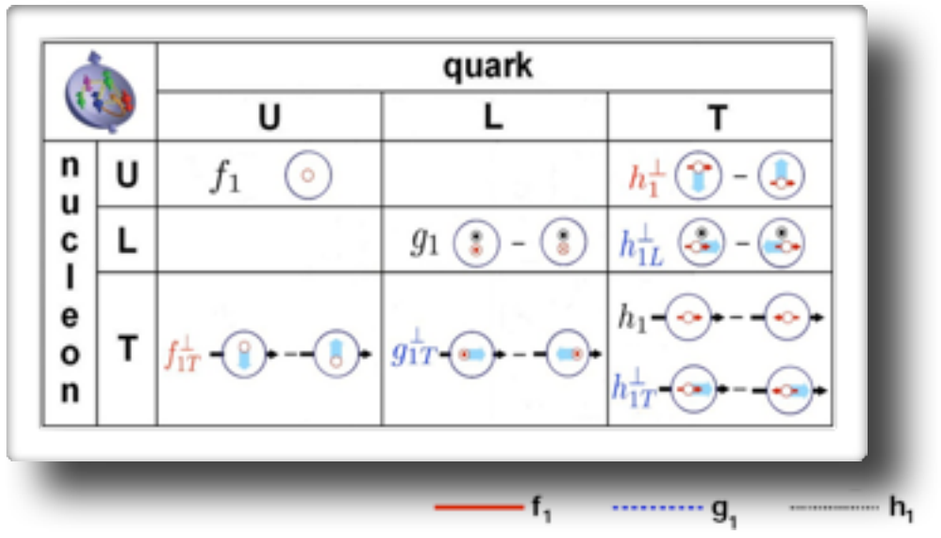
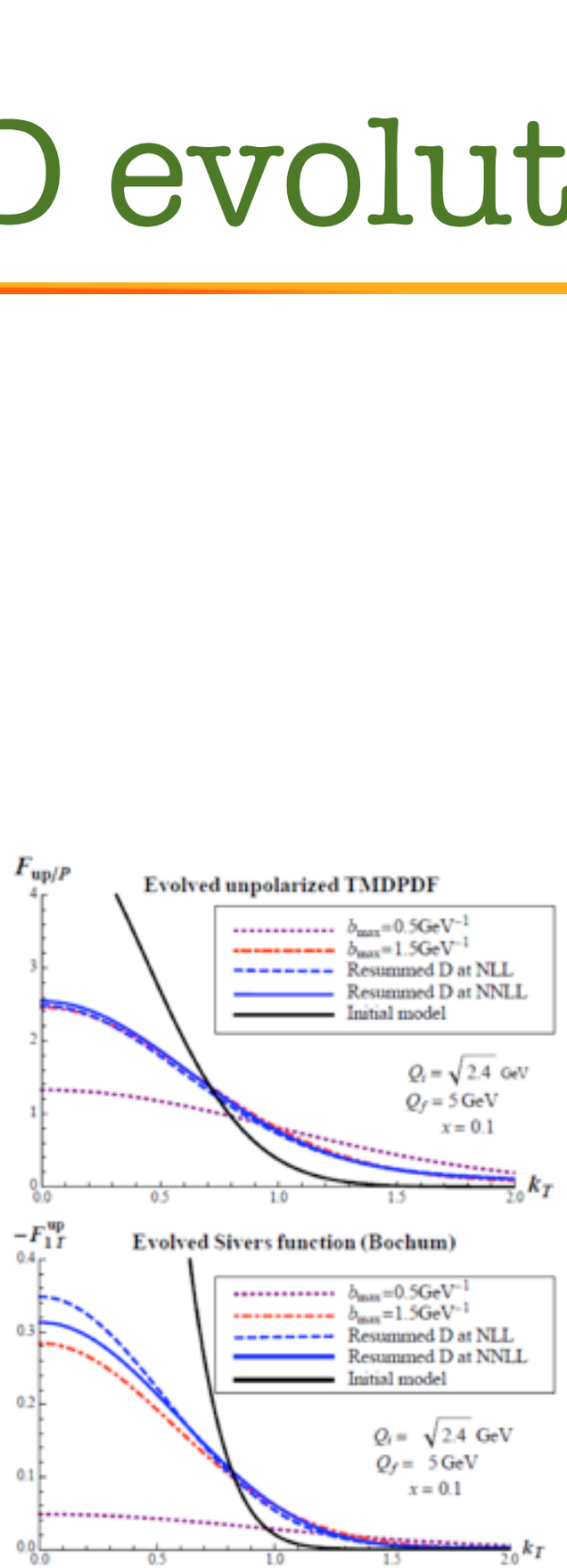
TMD evolution



but....
evolution sensitive
to the prescription!



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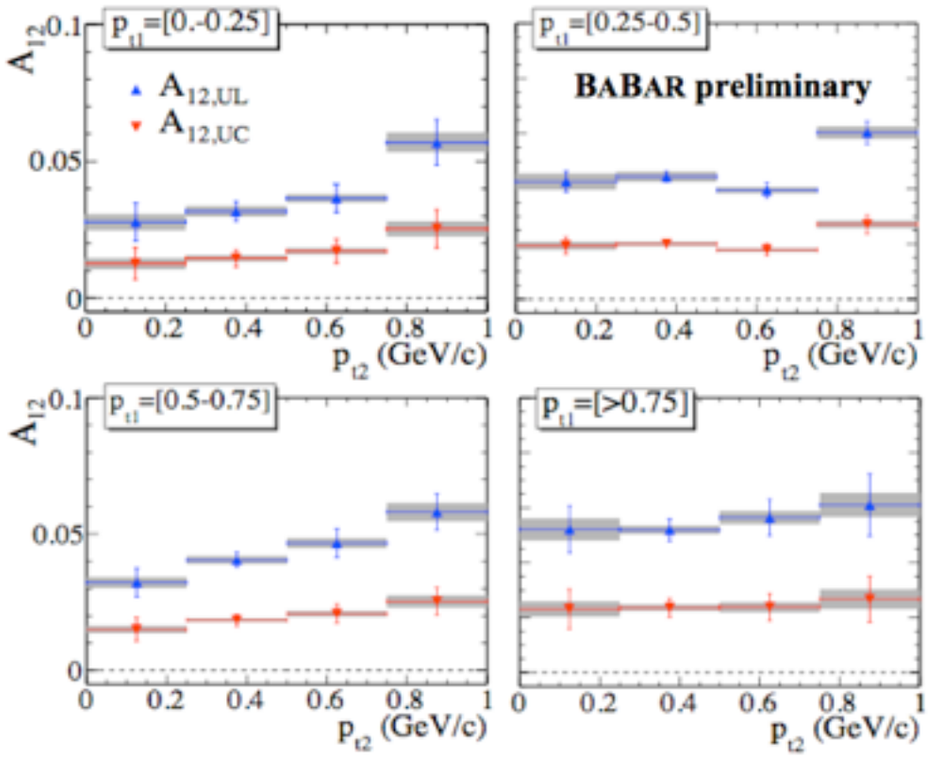
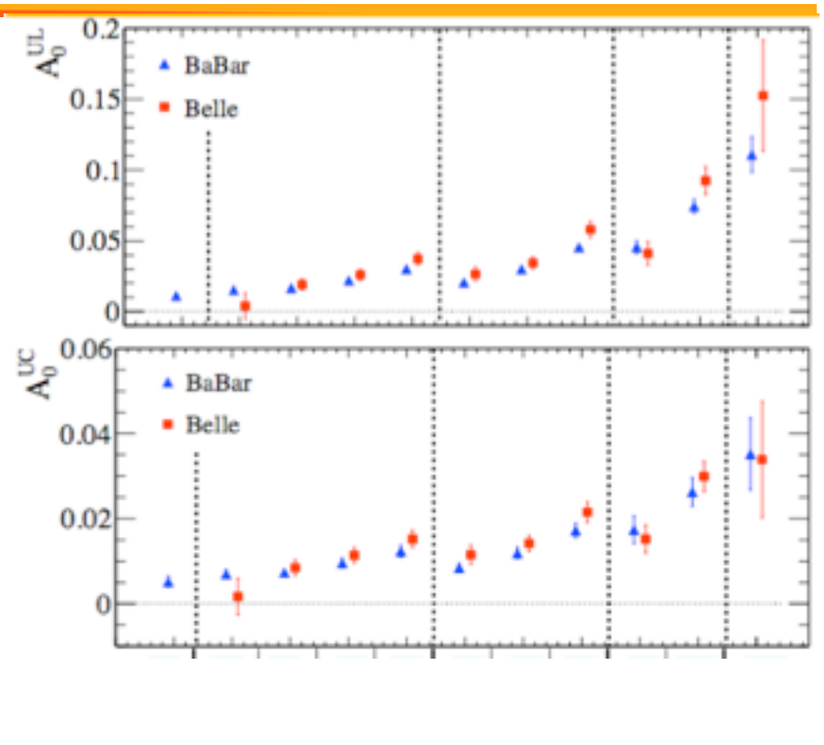
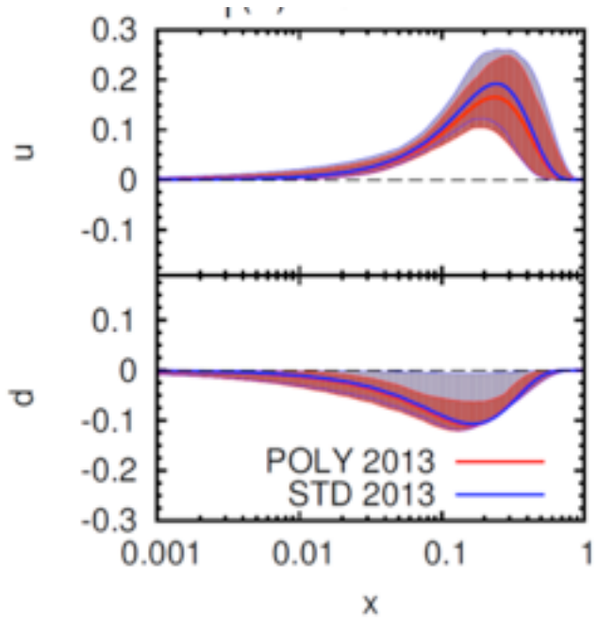
TMD transversity

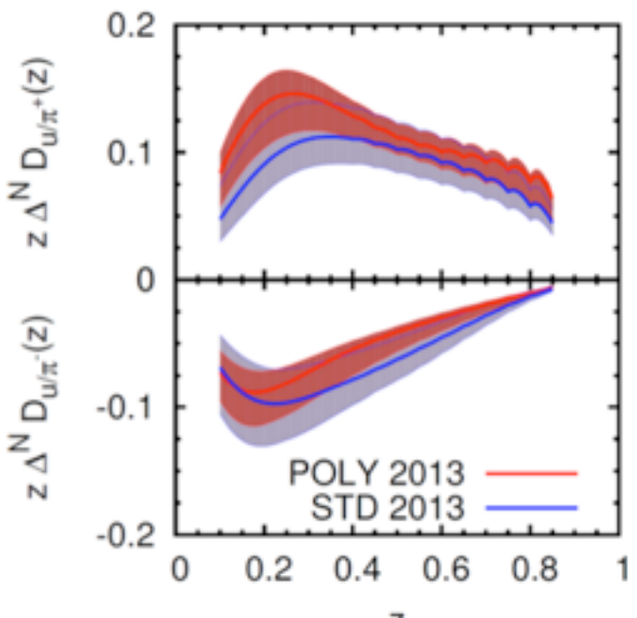
$$A_{UT} \propto h_1 \otimes H_1^{\perp}$$





Transversity and Collins extraction:





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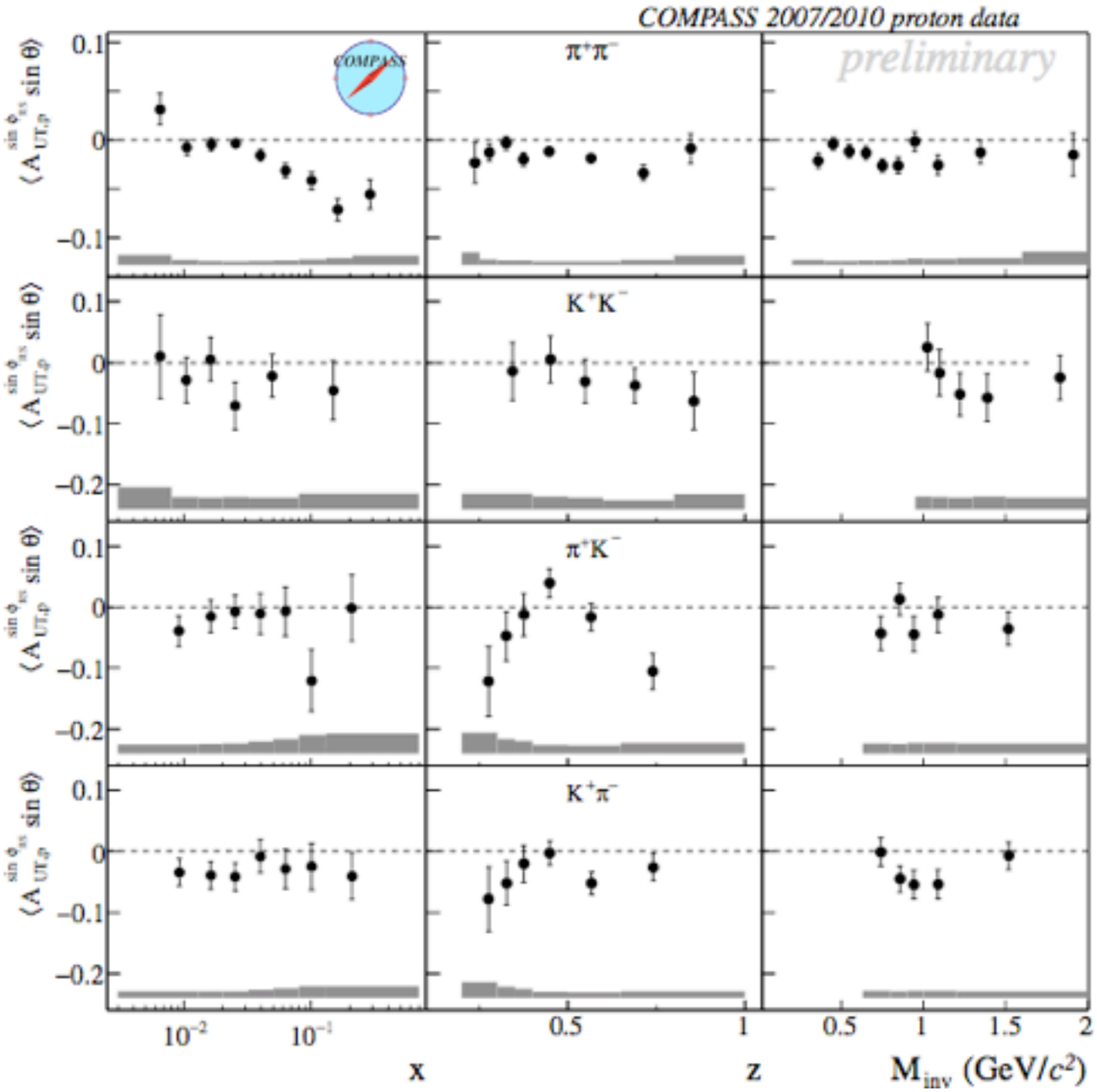
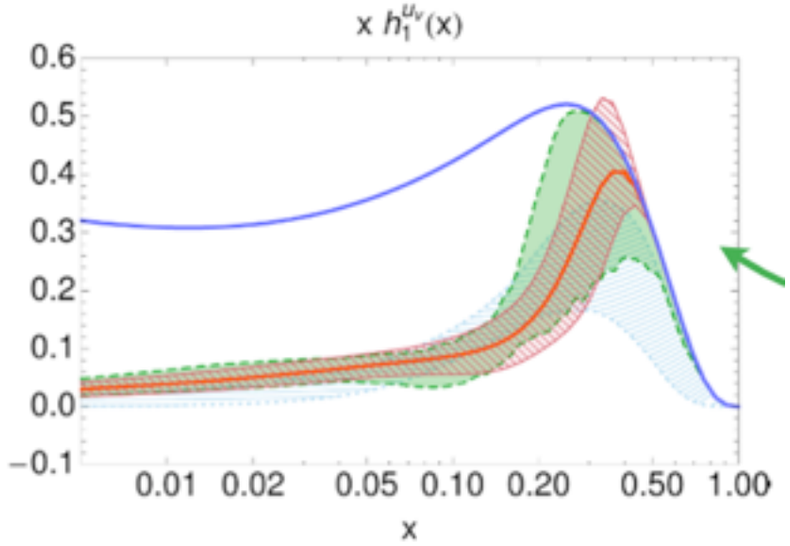
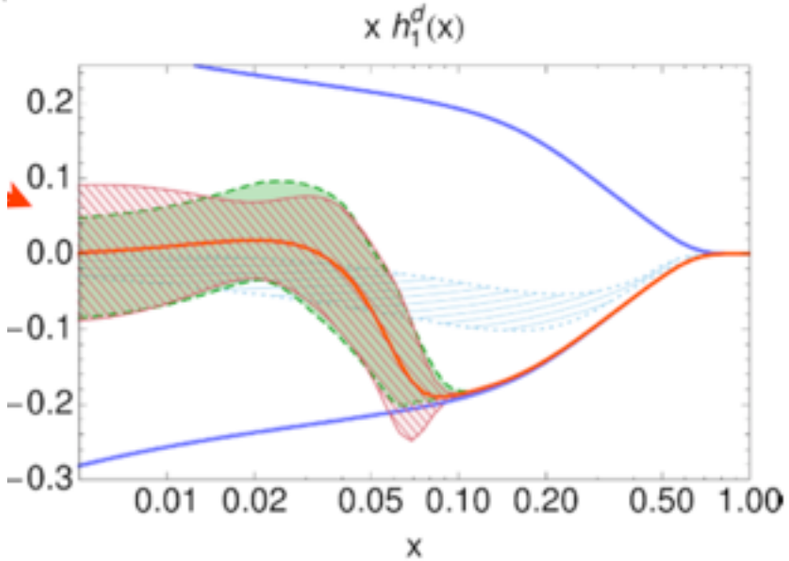
Collinear transversity

$$A_{UT} \propto h_1 \times H_1^{\sphericalangle}$$







Flavor separation!

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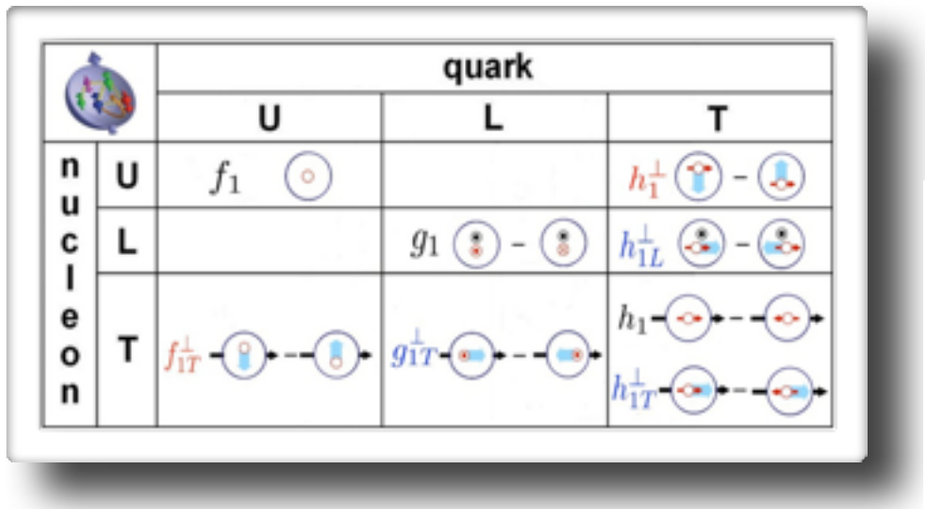
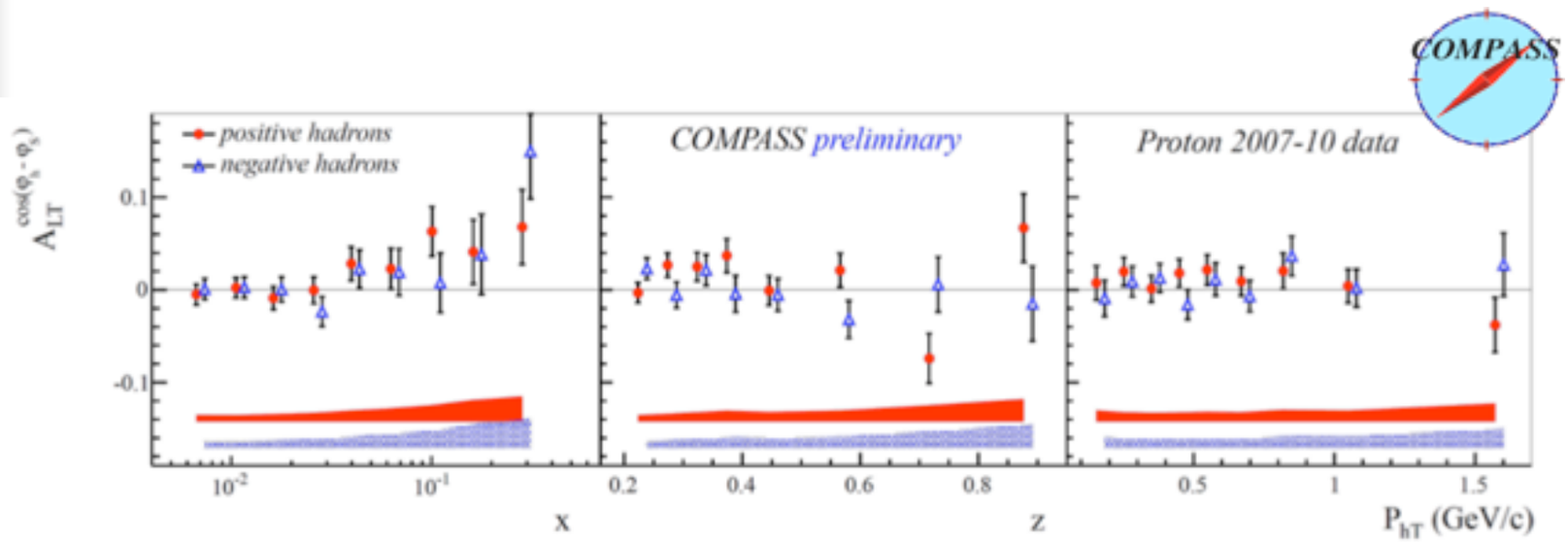
Additional TMDs …





Ongoing studies on TMDs universality:
universality broken in a calculable way
for some TMDs

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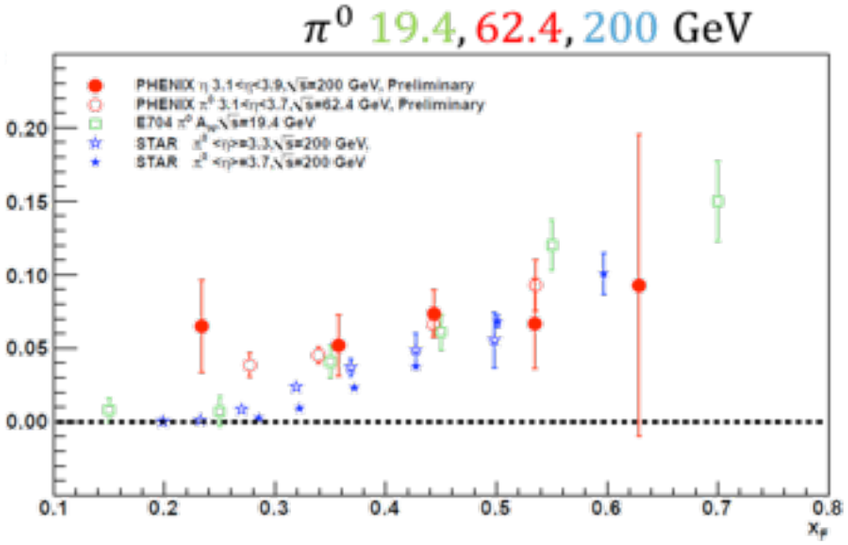
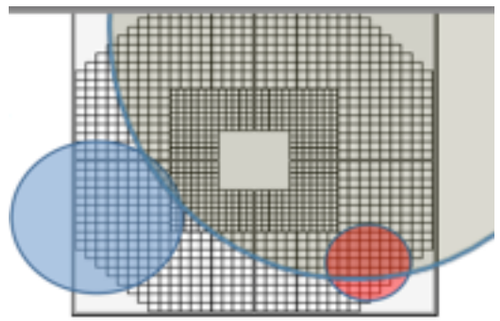
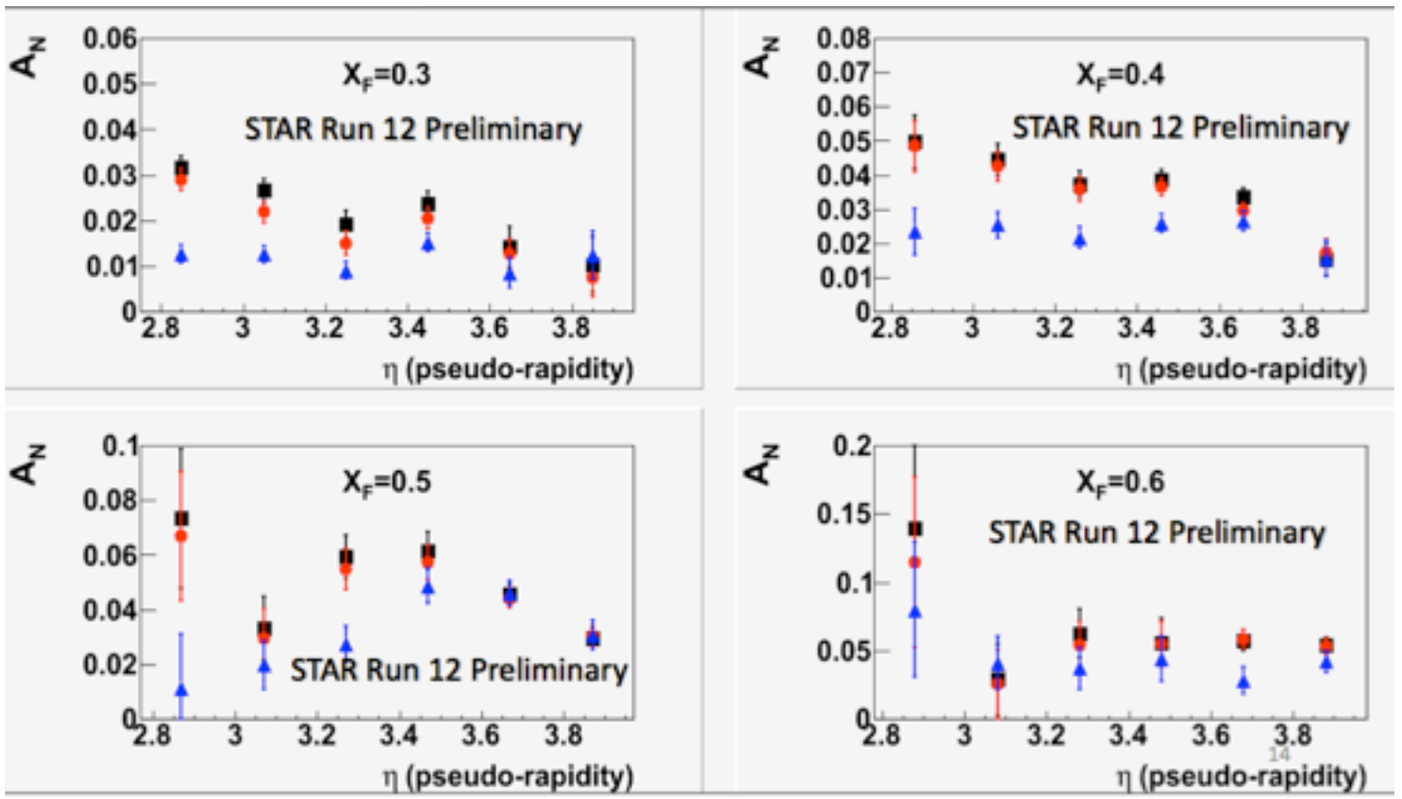
pp A_N



A_N sensitive to final state definition!



1) Isolation cone 200mR && 2 photon clusters (photonE>6 GeV) && Esoft<0.5 GeV. (Least Jet like)
2) Isolation cone 35mR && 2 photon clusters (photonE>6 GeV) && Esoft<0.5 GeV (More Jet like)
3) Isolation cone 35mR && 2 photon clusters (photonE>6 GeV) && Esoft>0.5 GeV. (Most Jet like)



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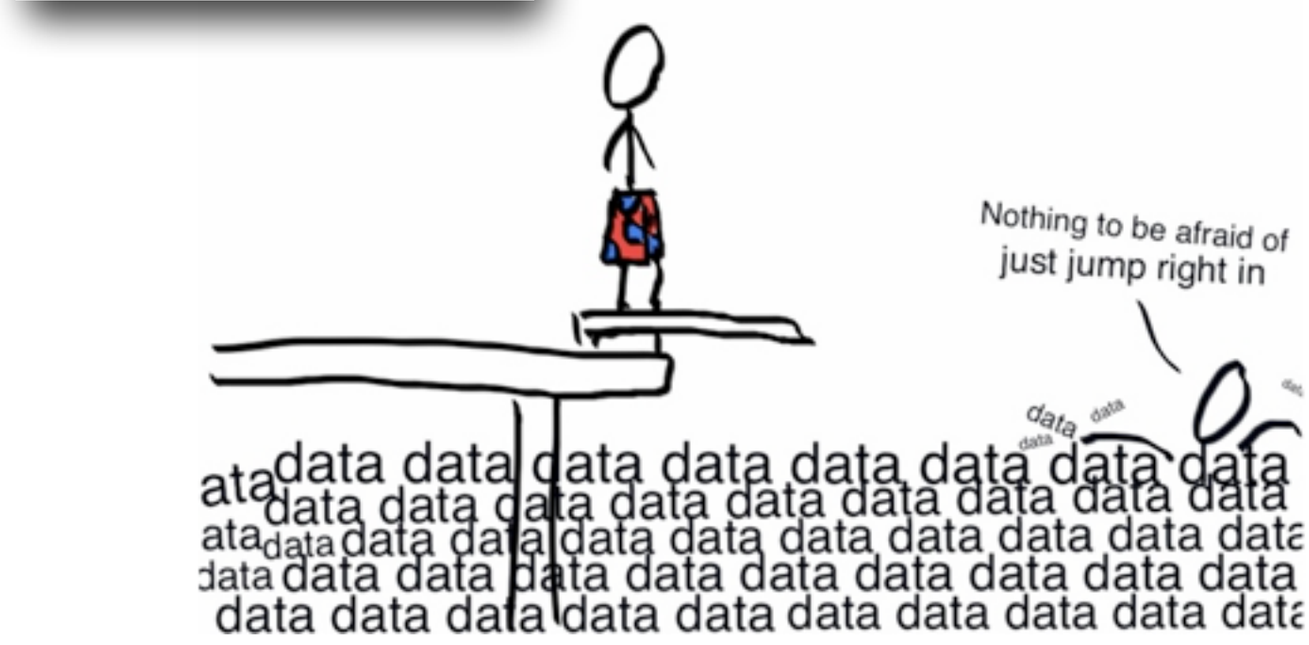
Outlook

More measurements in progress

Several upgrade and new experiments planned



Outlook

More measurements in progress

Several [illegible] planned

THANKS to all the speakers!