COLLINEAR SSFS WITH DEUTERIUM

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How much can we learn about

- **$\Delta\Sigma$**
- **Δd ($x \rightarrow 1$)**
- **Δs at moderately large x**
- **ΔG at moderately large x**

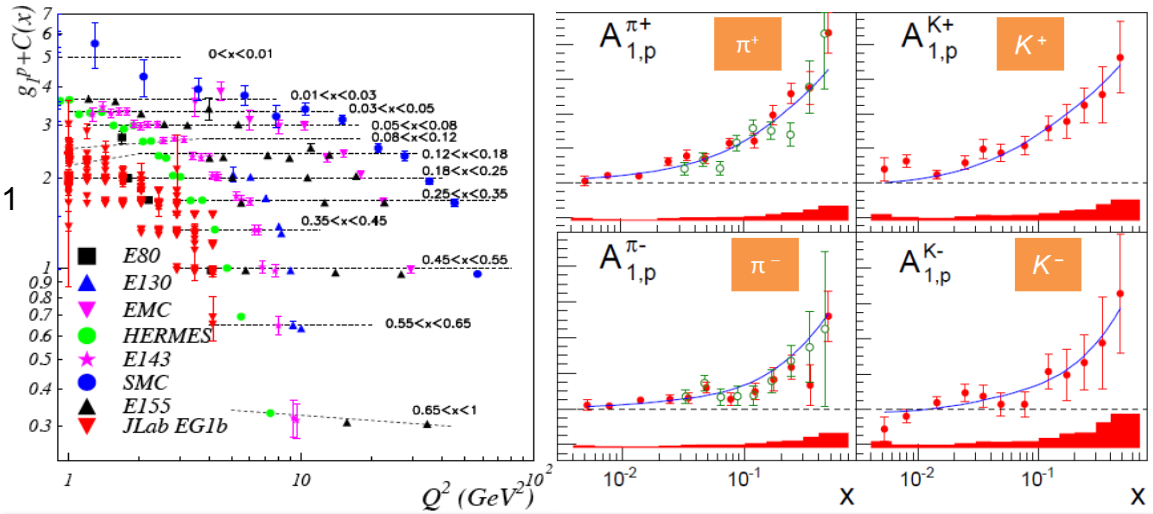
if we double the approved running time on deuterium?

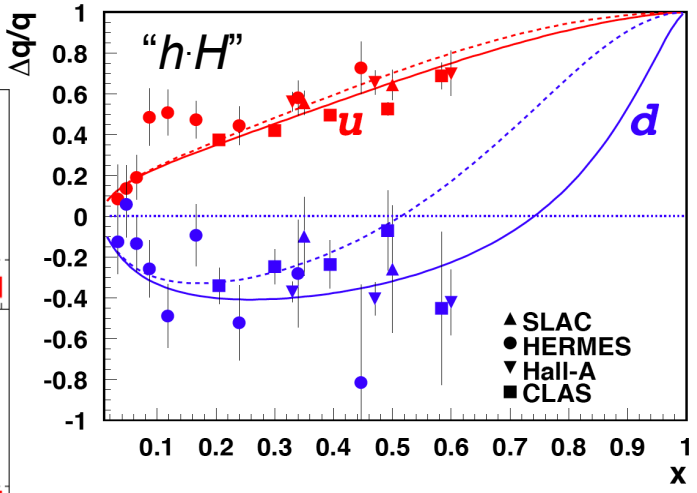
(Hint: answer will take a while!)

Tools: inclusive double spin asymmetries, p_T-integrated π and K double spin asymmetries (longitudinally polar. D)

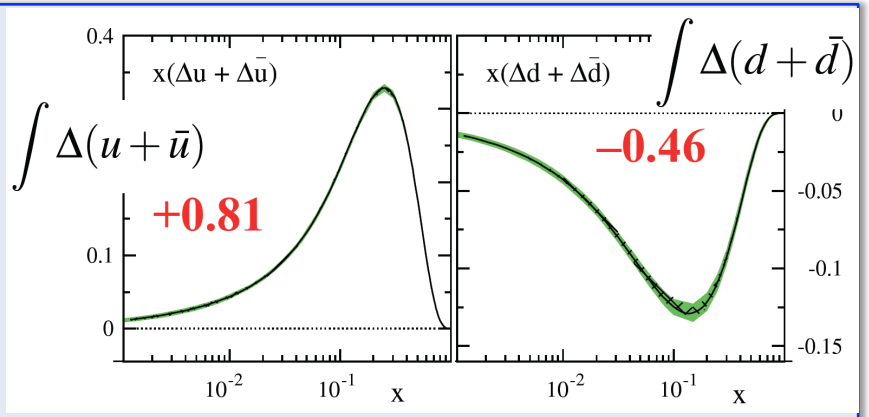
PRESENT SITUATION

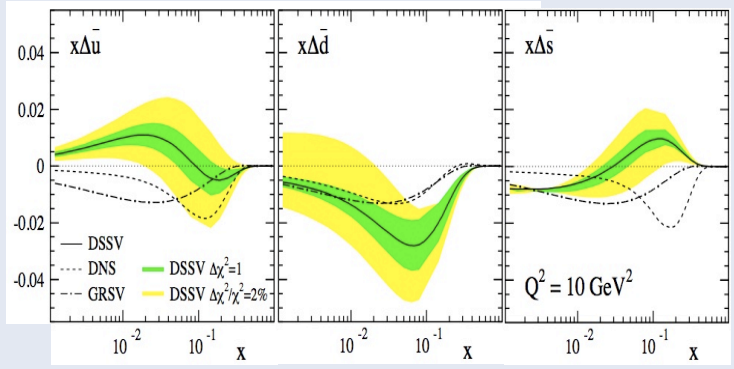
g_1

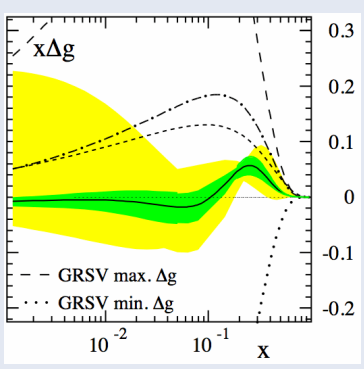




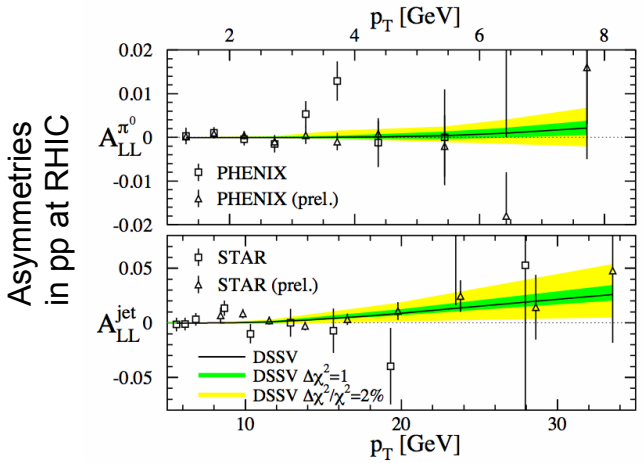
DSSV:
PRL 101, 072001 (2008)

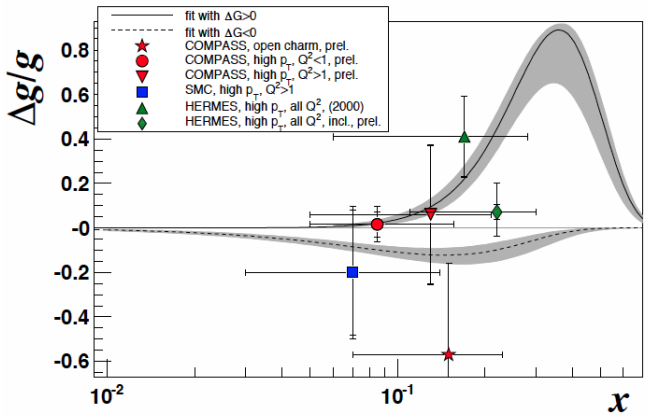






Asymmetries in pp at RHIC





WHAT'S MISSING?

- **Δu/u and Δd/d at high *x* still poorly constrained**
- **What is happening with the strange sea polarization? >0? =0? <0? Zero crossing? (Tension DIS – SIDIS)**
- **Is the sea polarization isospin-symmetric? (note: we already know $\bar{u} \neq \bar{d}$)**
- **Gluon helicity distribution at large *x* and a small *x*? What is the integral ΔG?**
- **What happens at really small x << 0.01?**
- **… and where is the rest of the nucleon spin? (only 30-40% explained by quark helicities)**
  Orbital angular momentum of quarks, total angular momentum carried by gluons…

12 GEV CAPABILITIES – HALL B

CLAS12

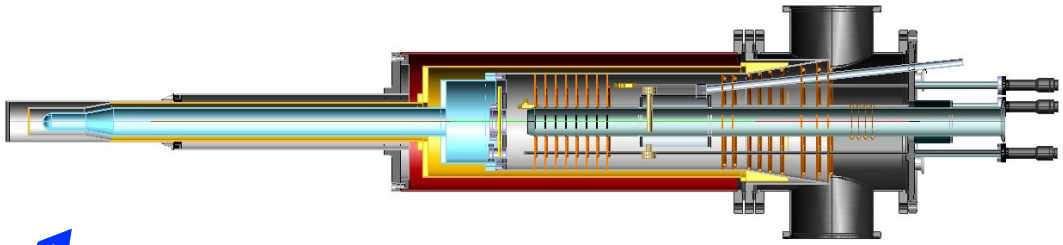
- VERY large acceptance
- Full PID (K and π)
  (K ID requires major new funds for RICH)
- Moderately high luminosity (10^{35} $cm^{-2}s^{-1}$)
  (matched to NH_3, ND_3)

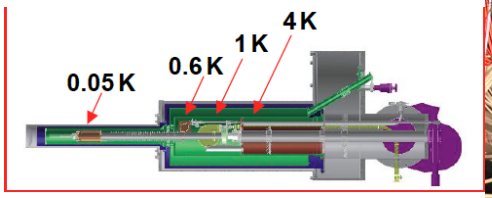
Polarized Targets

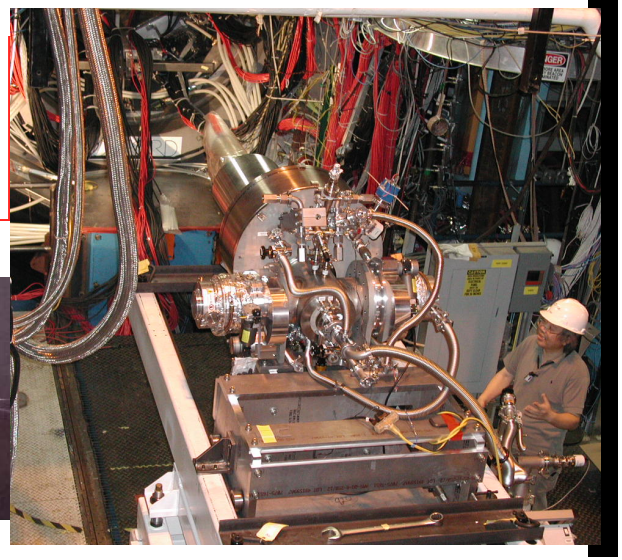
- Standard DNP longitudinal NH_3, ND_3 targets
  (funded by NSF MRI, under construction)
- HD-Ice target
  (suitability for e^- beam remains to be demonstrated)

Future longitudinally polarized target for CLAS12 (11 GeV program at Jefferson Lab)

- Horizontal ^{4}He evaporation cryostat
- 5 T B-field provided by central detector







APPROVED CLAS12 EXP. E12-06-109 (A)

E12-06-109 – Request:

- E_{beam} = 11 GeV, P_b=85%
- L ≈ 2 x 10^{35} /cm^2/s
- 25 days on p, 45 days on d, 10 days on auxiliary targets

Also: E12-09-007(b)
"Study of partonic distributions using SIDIS K production"
Contact: Kawtar Hafidi (A-)

The Longitudinal Spin Structure of the Nucleon

Update of Experiment 12-06-109 (approved by PAC 30)

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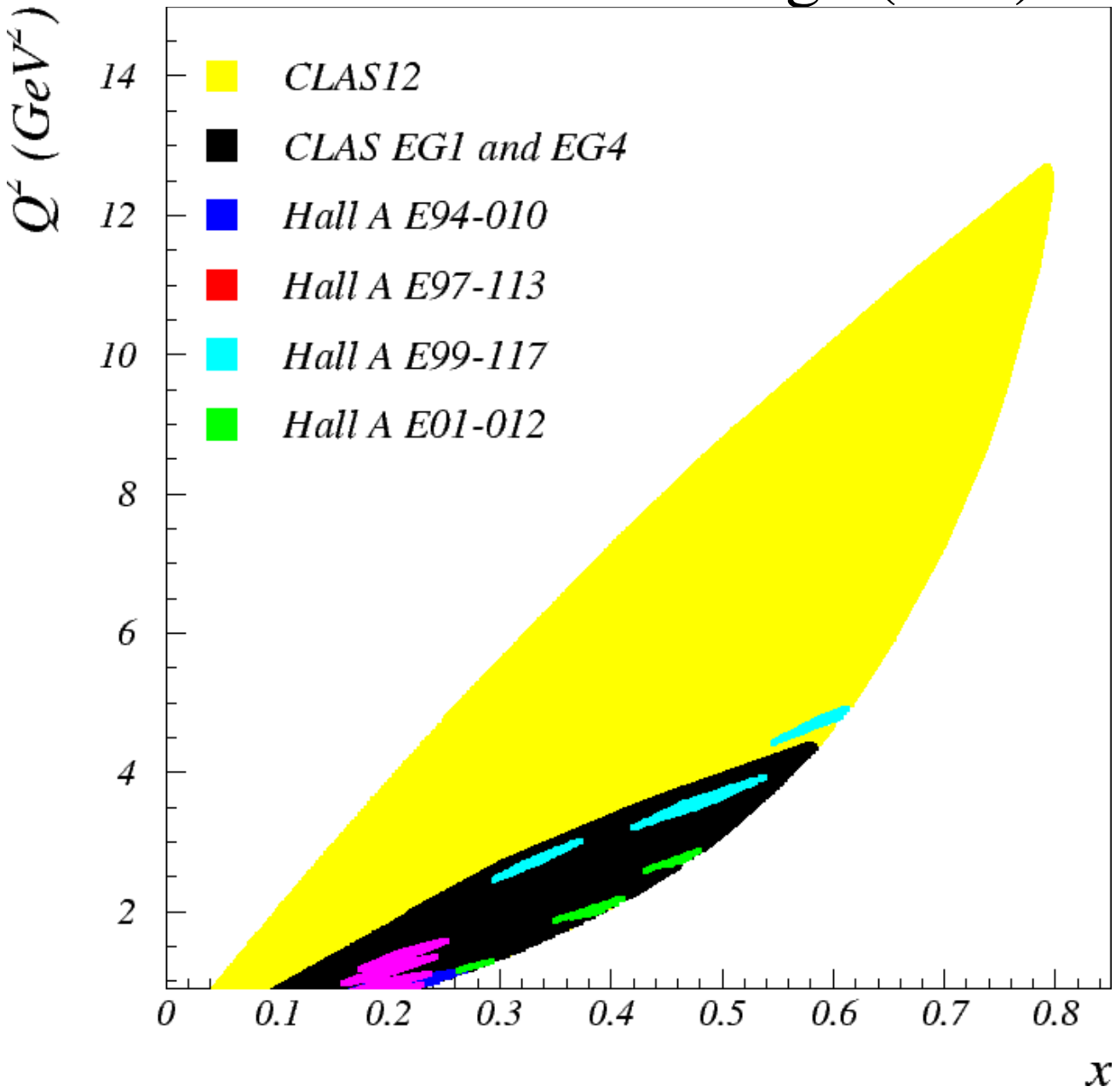
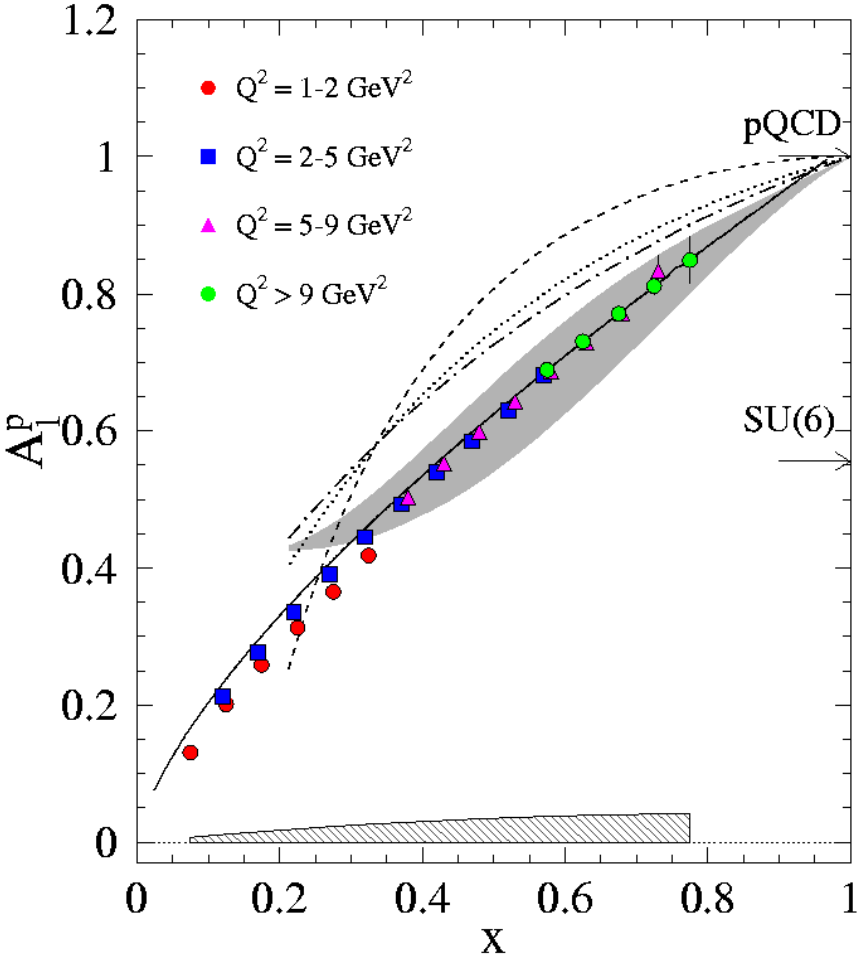
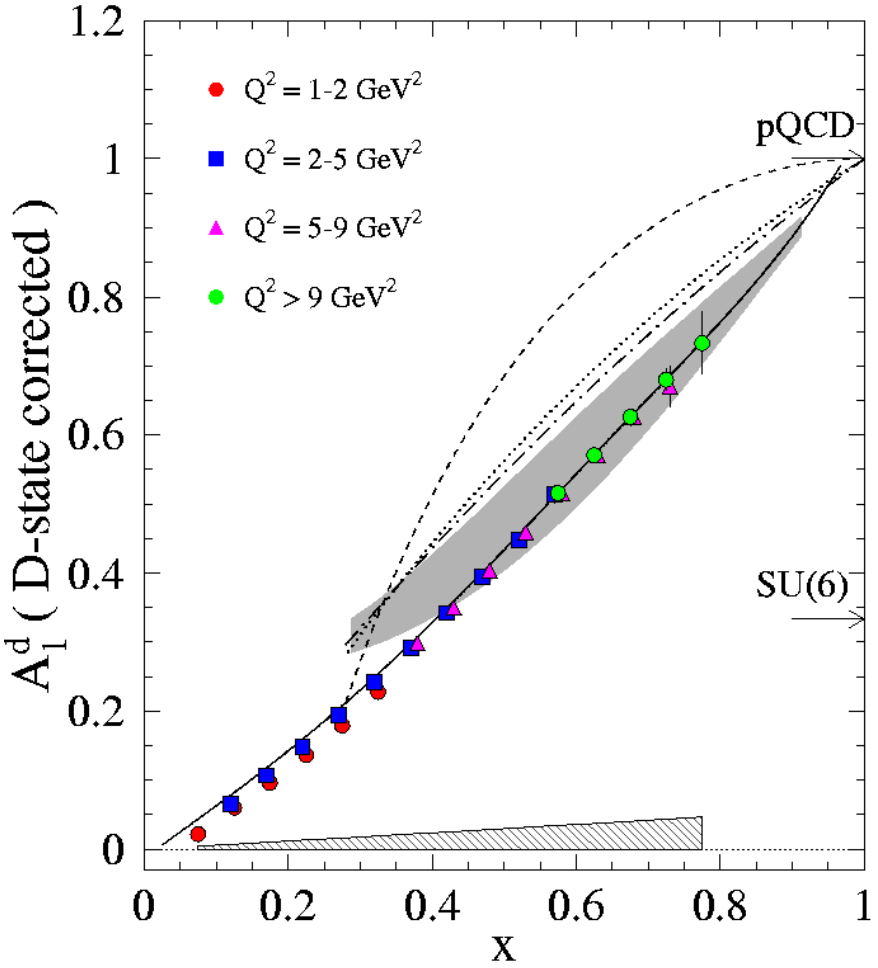
Kinematic Coverage (DIS)



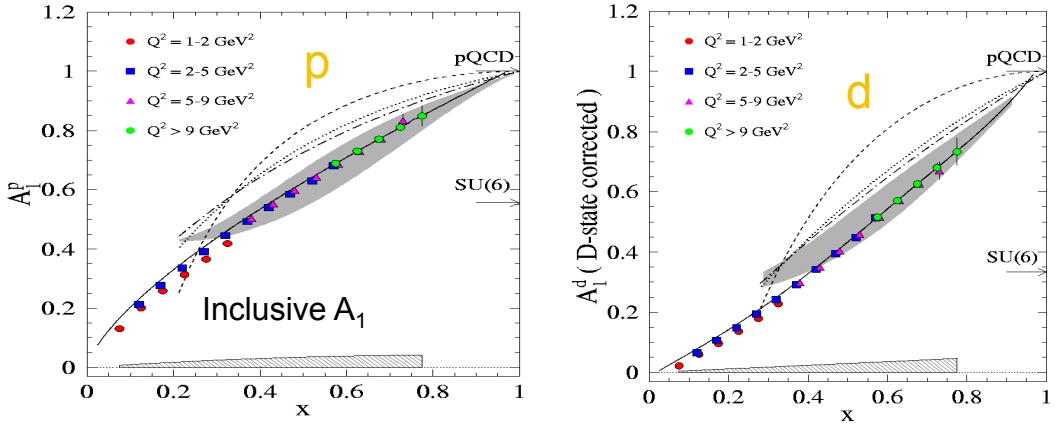
PREDICTED DATA FROM CLAS12

Proton $W > 2$; $Q^2 > 1$ Deuteron

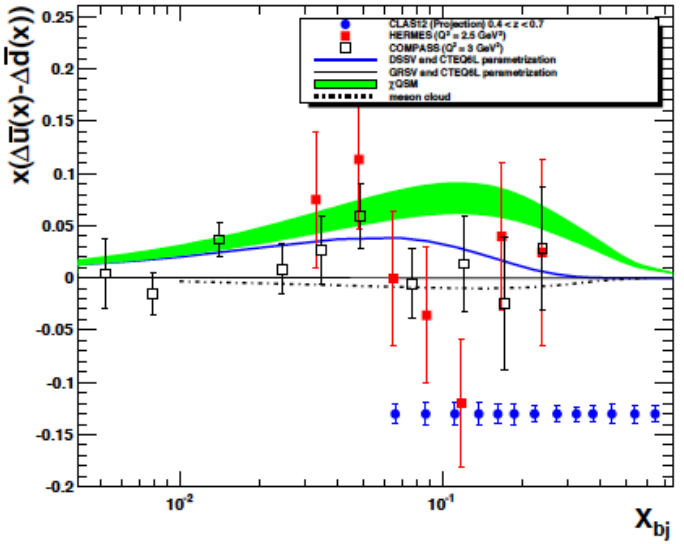


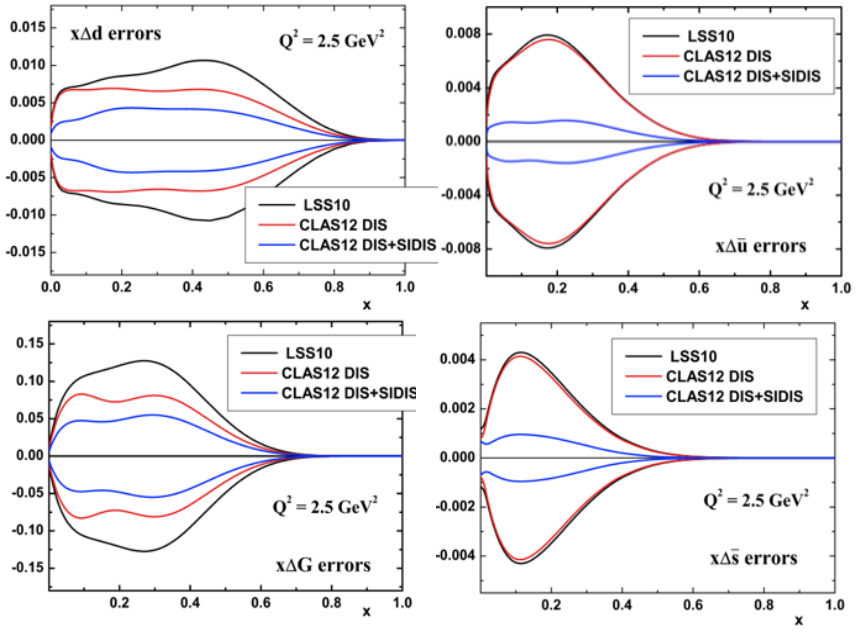


INCLUSIVE + TAGGED SSF – HALL B

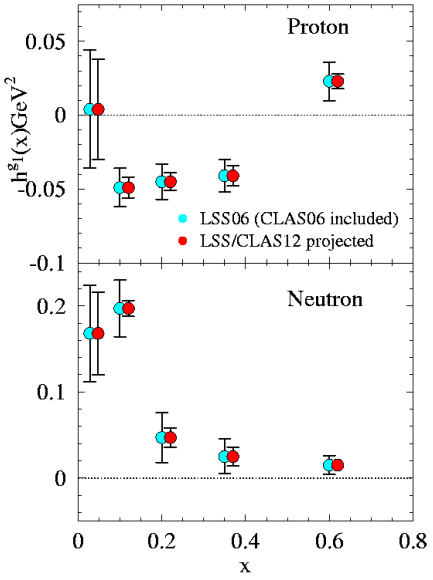


SIDIS A_1

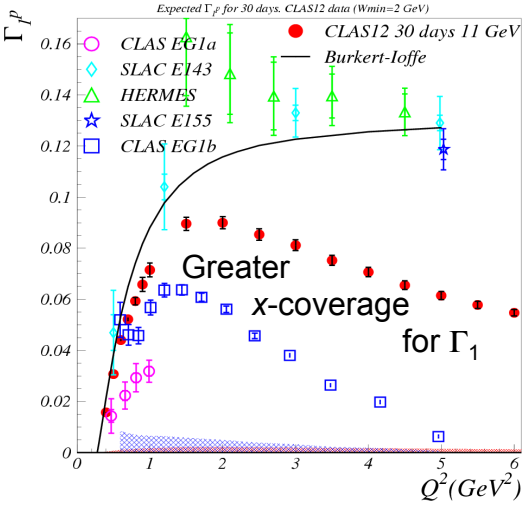




Improved PDFs from NLO analyses

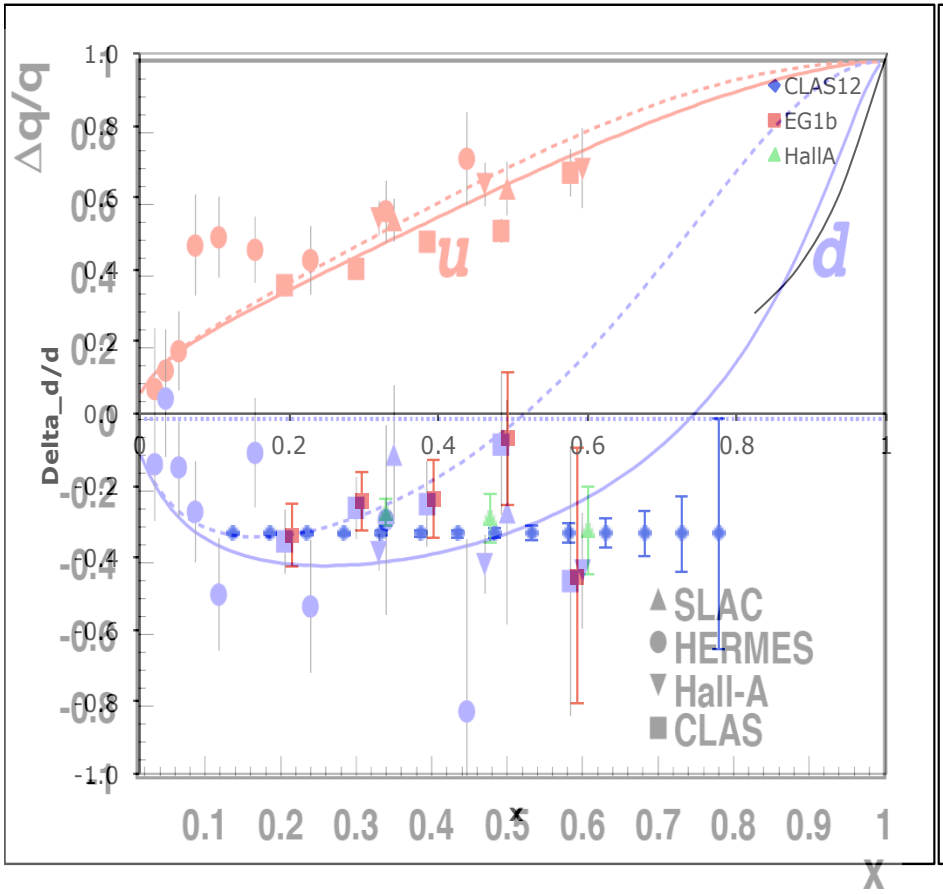


Better determination of Higher Twist vs. *x*

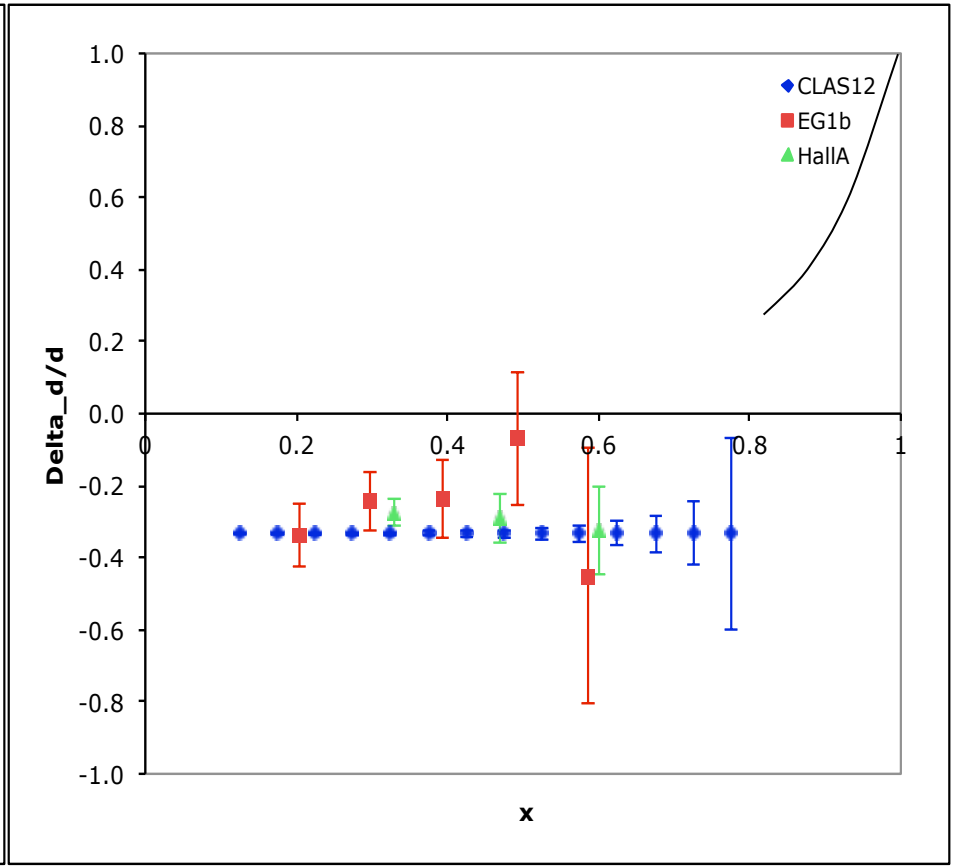


Improved coverage to evaluate moments

DELTA-D / D



50 days on ND3



100 days on ND3

JAM COLLABORATION

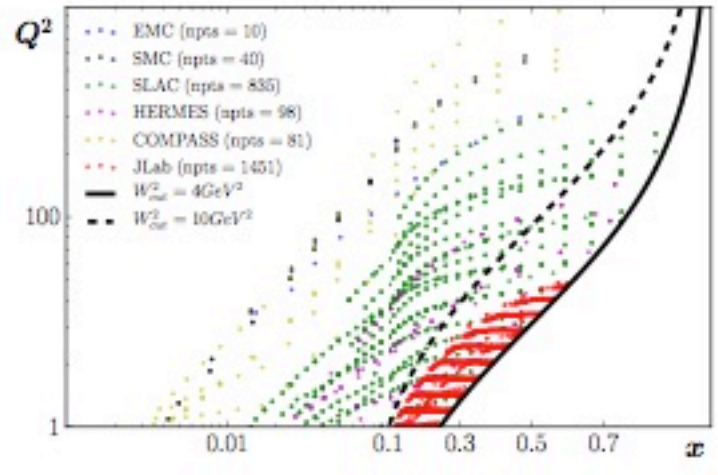
Jefferson Lab Angular Momentum Collaboration

Nobuo Sato W. Melnitchouk, S. E. Kuhn, J. J. Ethier, A. Accardi

Global Analysis

Data

- ✓ Polarized DIS $\rightarrow \Delta u, \Delta d$
- Polarized SIDIS: $\rightarrow \Delta\bar{d}, \Delta\bar{u}, \Delta s$
- Inclusive Jets/π^0 : $\rightarrow \Delta g$
- W production $\rightarrow \Delta\bar{d}, \Delta\bar{u}$



Theory

- ✓ Target mass corrections
- ✓ Twist-3 and twist-4 contributions in polarized structure functions
- ✓ Nuclear corrections for ^{3}He and deuteron targets
- Threshold resummation $\rightarrow (\alpha_S^m \log(1-x)^n)$

Tools

- ✓ Numerical codes developed within python framework
- ✓ Development of DGLAP evolution equations in Mellin space
- ✓ Fast calculation of observables $\rightarrow$ Mellin space techniques

+ iterative MC method

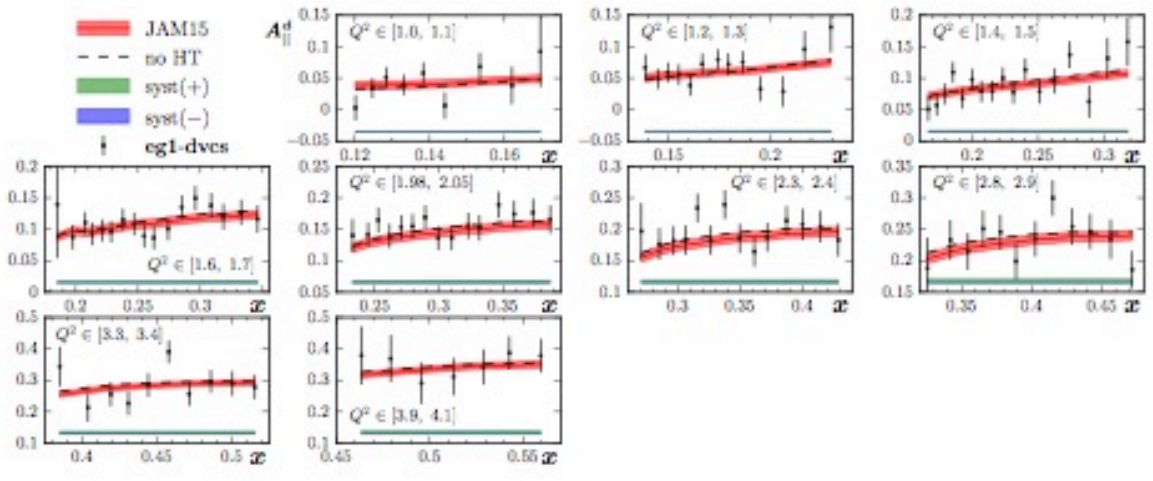


FIG. 12: Deuteron longitudinal polarization asymmetries $A_\parallel^d$ from the eg1-dvcs [15] experiment at Jefferson Lab's Hall B. The curves and legends are as in Fig. 8.

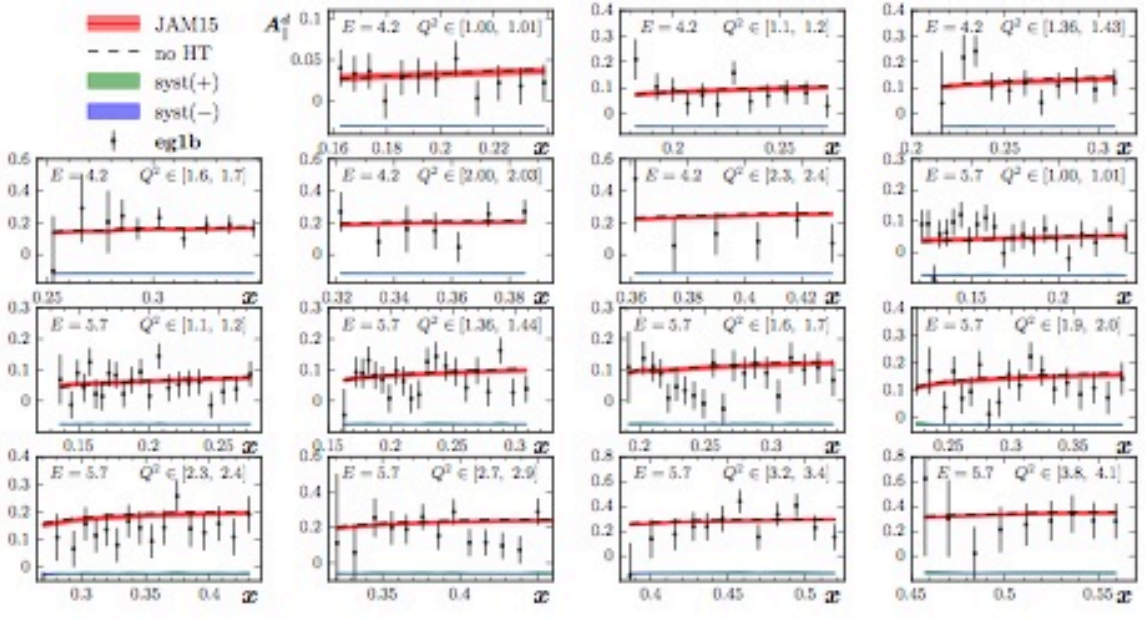
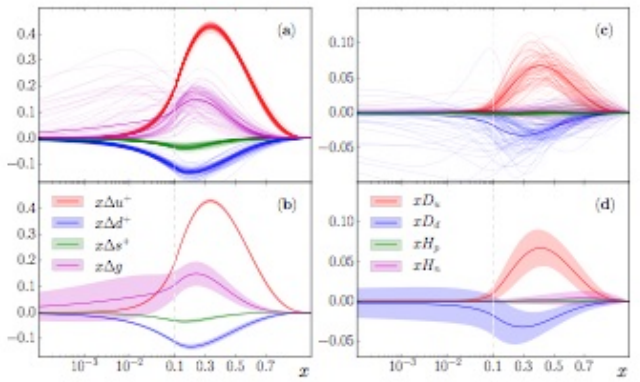
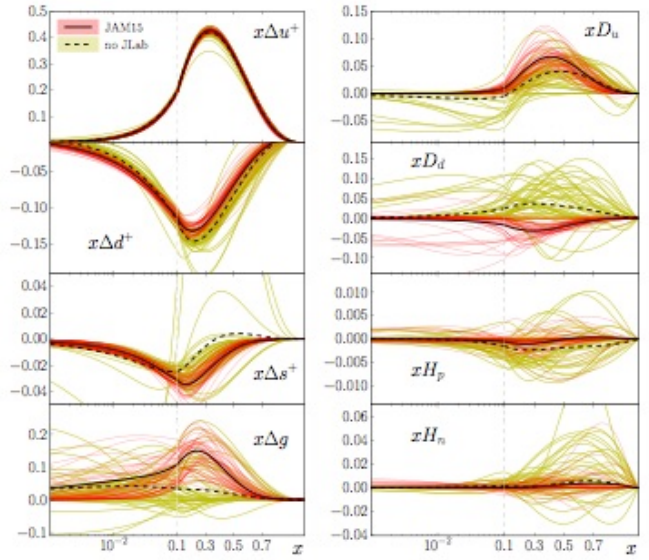


FIG. 13: Deuteron longitudinal polarization asymmetries $A_\parallel^d$ from the eg1b [16] experiment at Jefferson Lab. The curves and legends are as in Fig. 8.

Results



Impact of JLab data



FUTURE W/ JAM

Add SIDIS and pp

Will evaluate impact of 11 GeV data with 50 and with 100 days of deuterium in CLAS12

→ expect significant improvement of ΔG, Δs, Δd and ΔΣ

- hopefully first results by end of March, to include in separate mini-proposal for run group (C++?)

Production of Kaons in SIDIS

- What happens when we remove the strange PDF in the theory calculation?