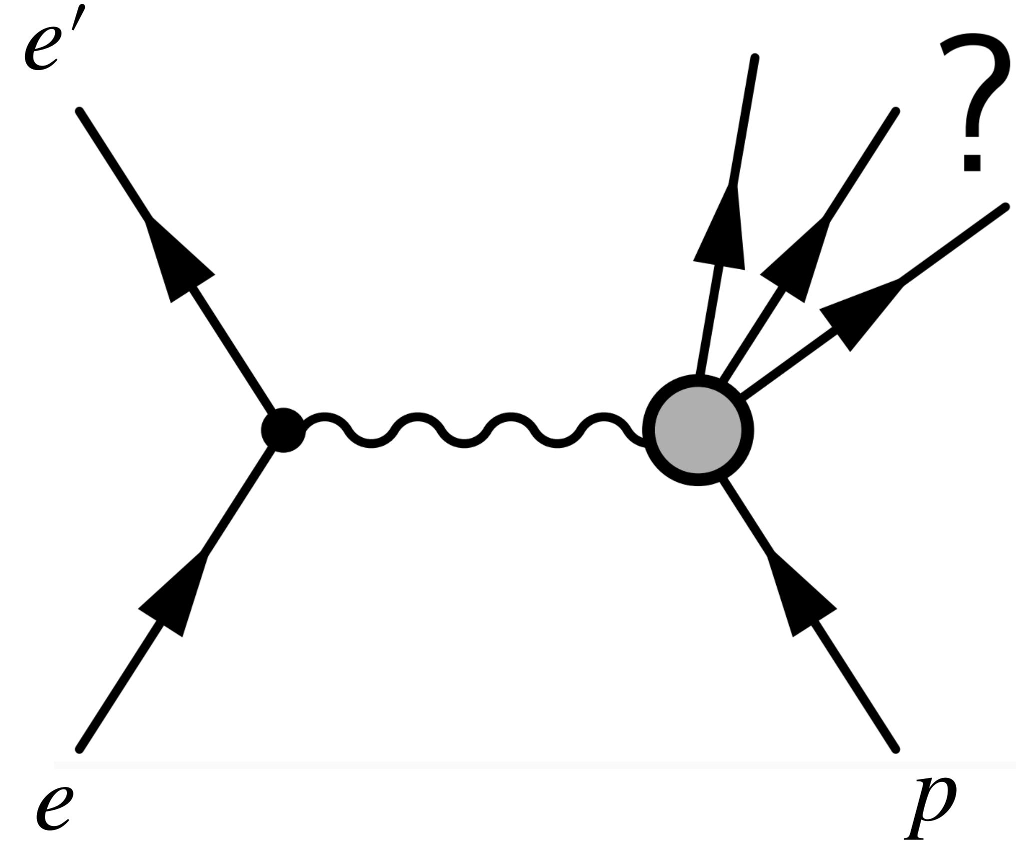
Bound **and** free nucleon structure

Efrain Segarra

Exploring QCD with light nuclei at EIC

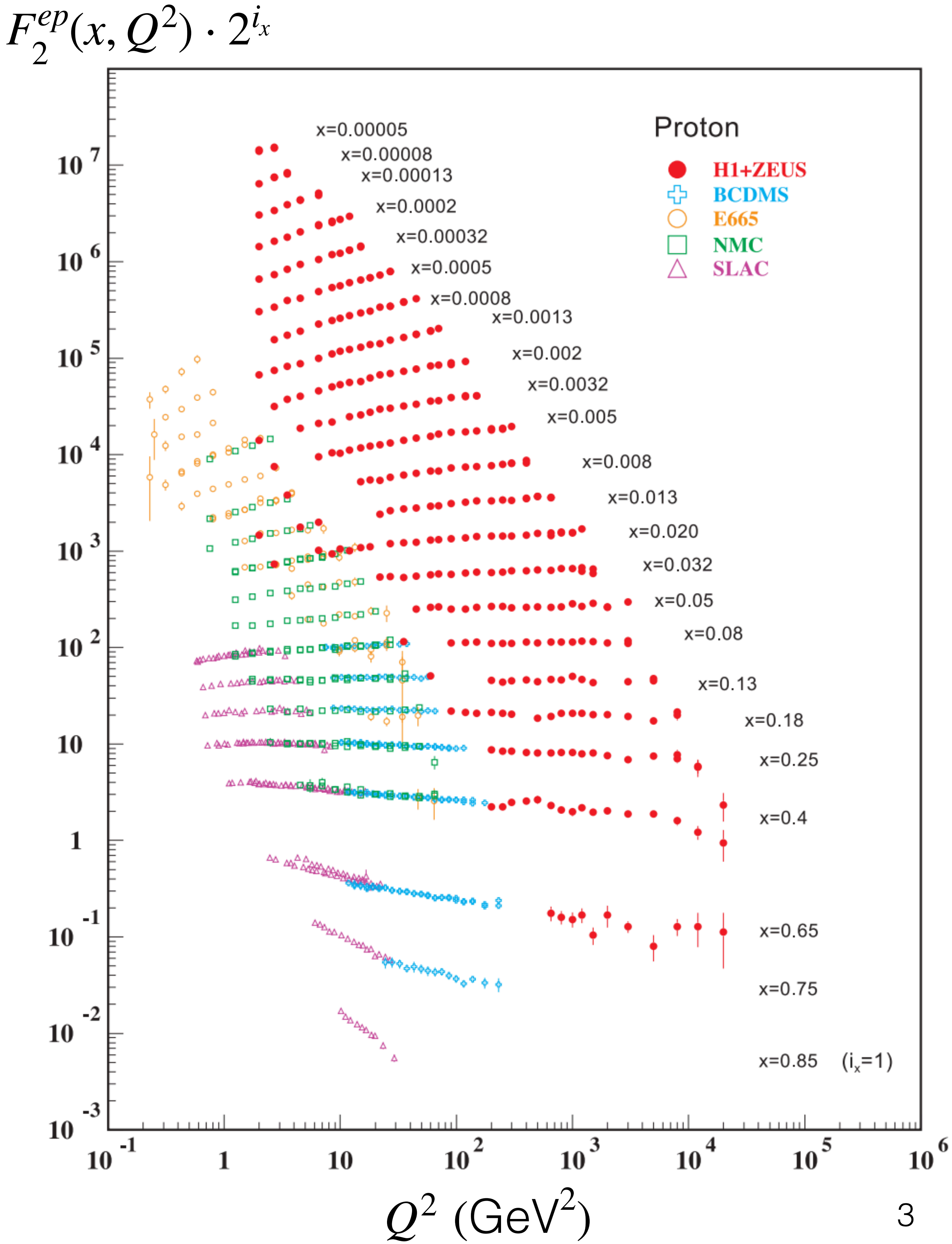
Jan 22, 2020

Structure Functions of a free proton

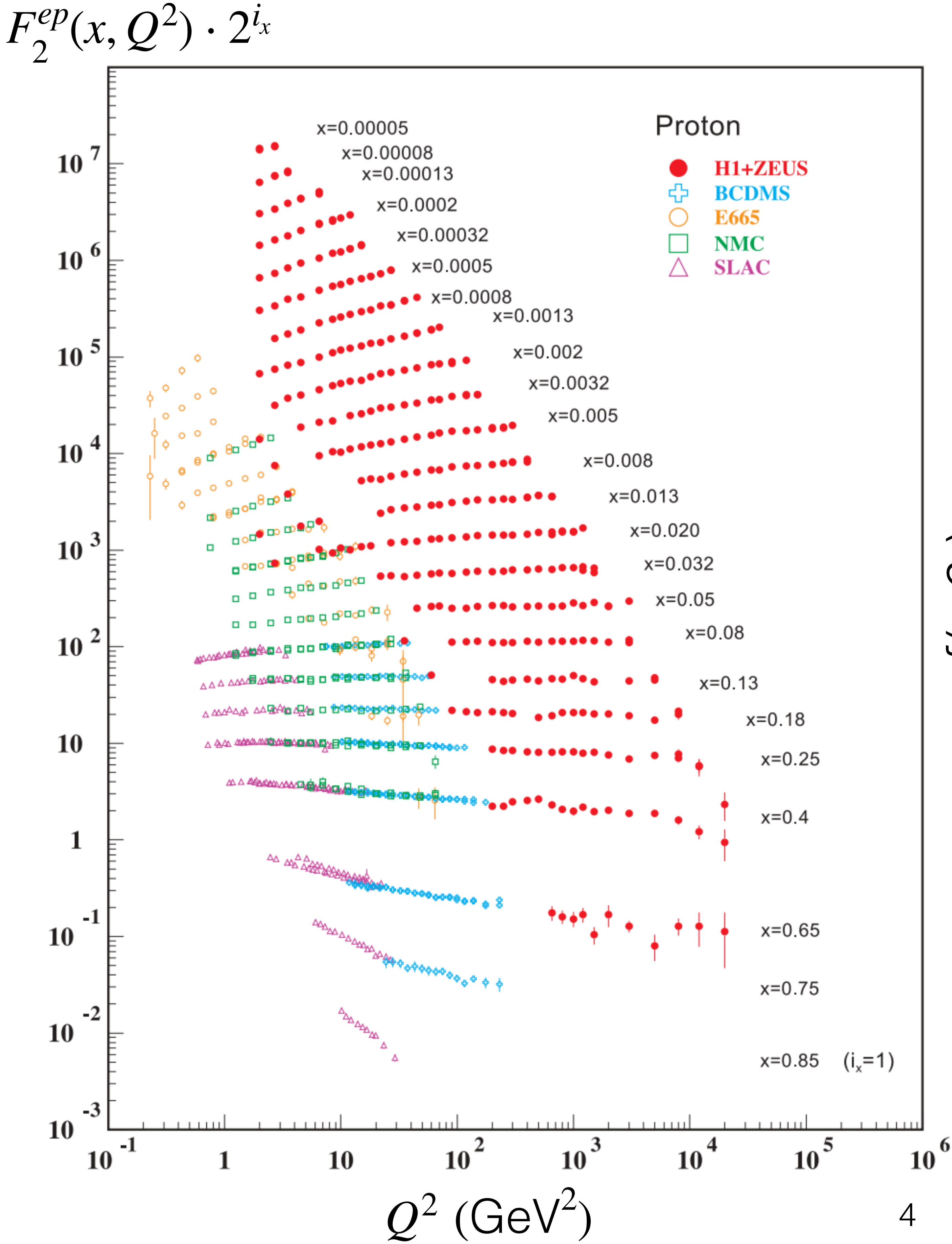


$$\frac{d\sigma}{dx dQ^2} = \frac{4\pi\alpha^2}{Q^4}\left[\left(1 - y - \frac{m_p^2 y^2}{Q^2}\right)\frac{F_2(x,Q^2)}{x} + y^2 F_1(x,Q^2)\right]$$

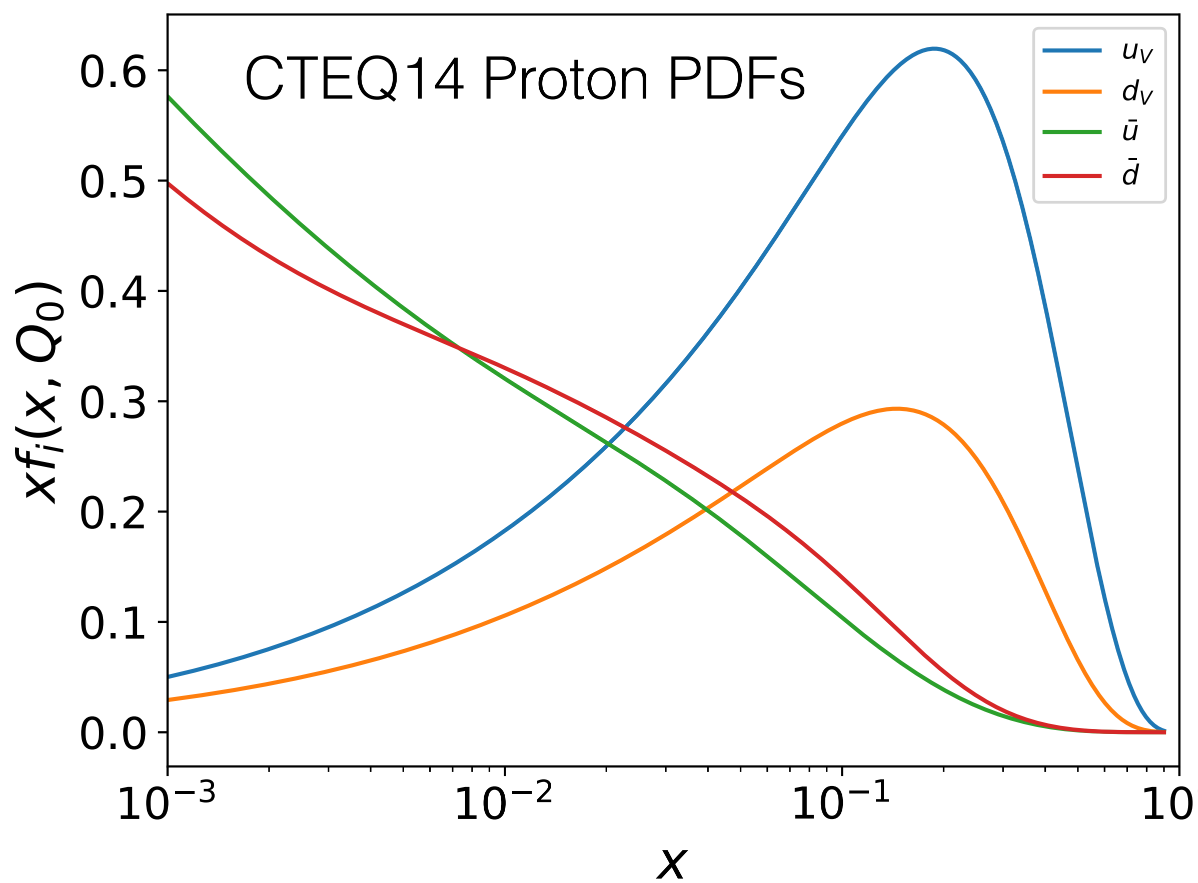
F_2 of free proton



F_2 of free proton



$$F_2 \rightarrow x \sum e_i^2 \left(q_i(x) + \bar{q}_i(x) \right)$$



From measured σ to PDFs

$$\frac{d\sigma}{dx\,dQ^2} \quad \Bigg\} \quad F_2^p\left(x, Q^2\right) \quad \Bigg\} \quad f_i^p\left(x, Q^2\right)$$

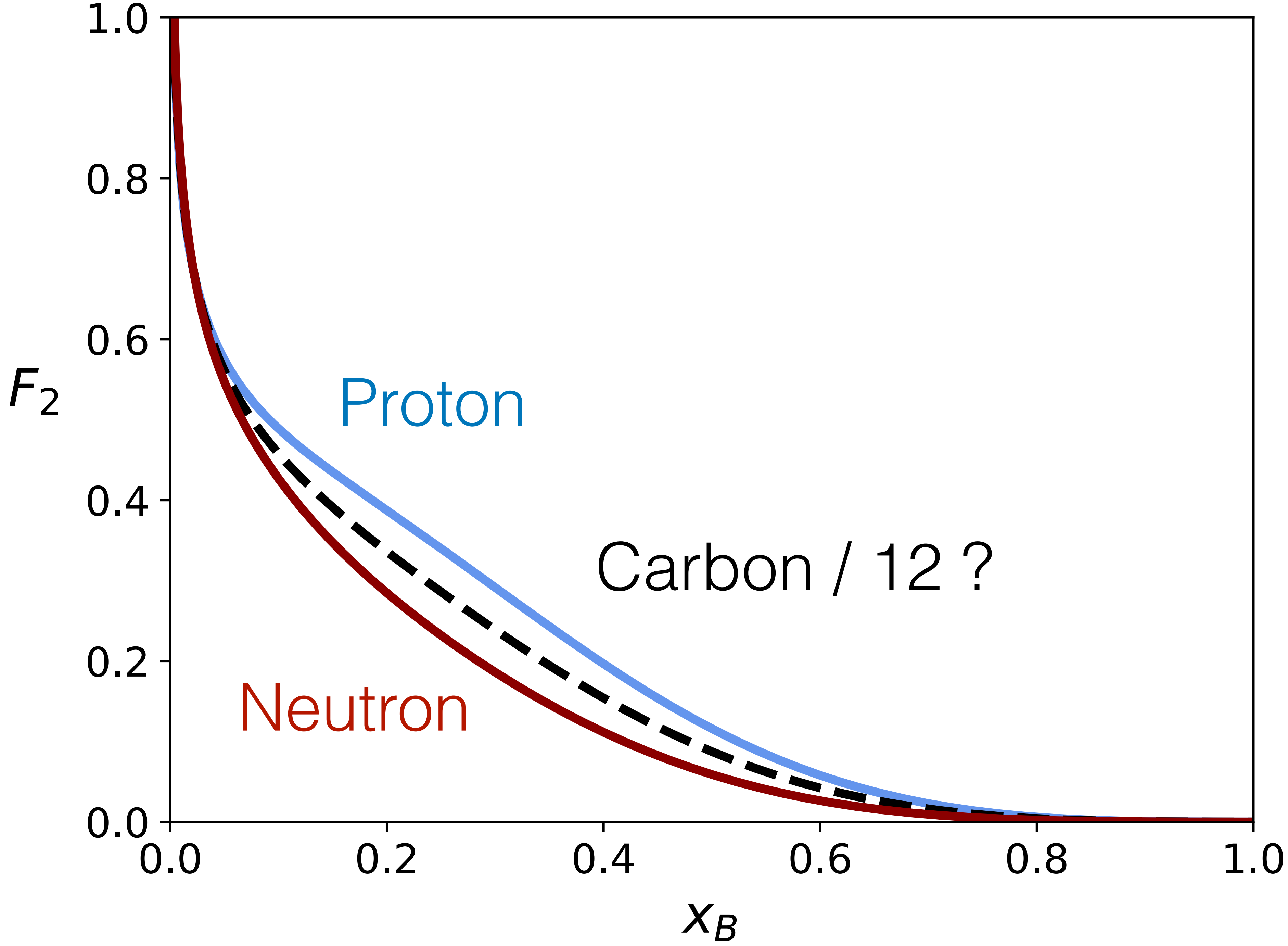
From nuclear DIS to nuclear PDFs

$$\frac{d\sigma^A}{dx dQ^2} \Bigg\} \quad F_2^A\left(x, Q^2\right) \quad \Bigg\} \quad \begin{matrix} F_2^n\left(x, Q^2\right) \\ f_i^A\left(x, Q^2\right) \end{matrix}$$

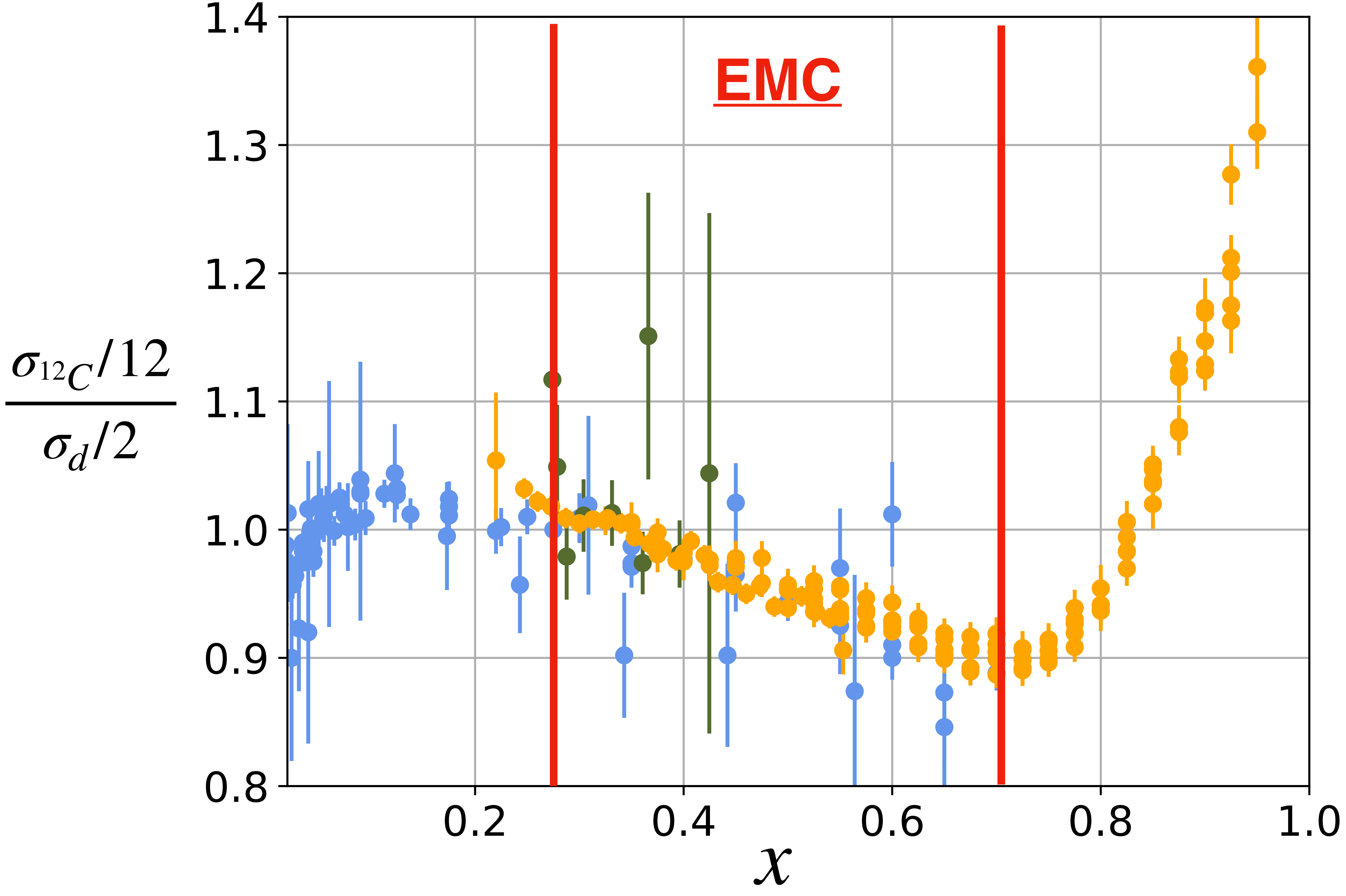
Outline

- Universal modification of SRC nucleons
- Free neutron structure & A=3
- Tagged DIS at Jefferson Lab 12 GeV
- Nuclear PDFs for the EIC

So what's the deal with bound nucleons?



They are… well, complicated

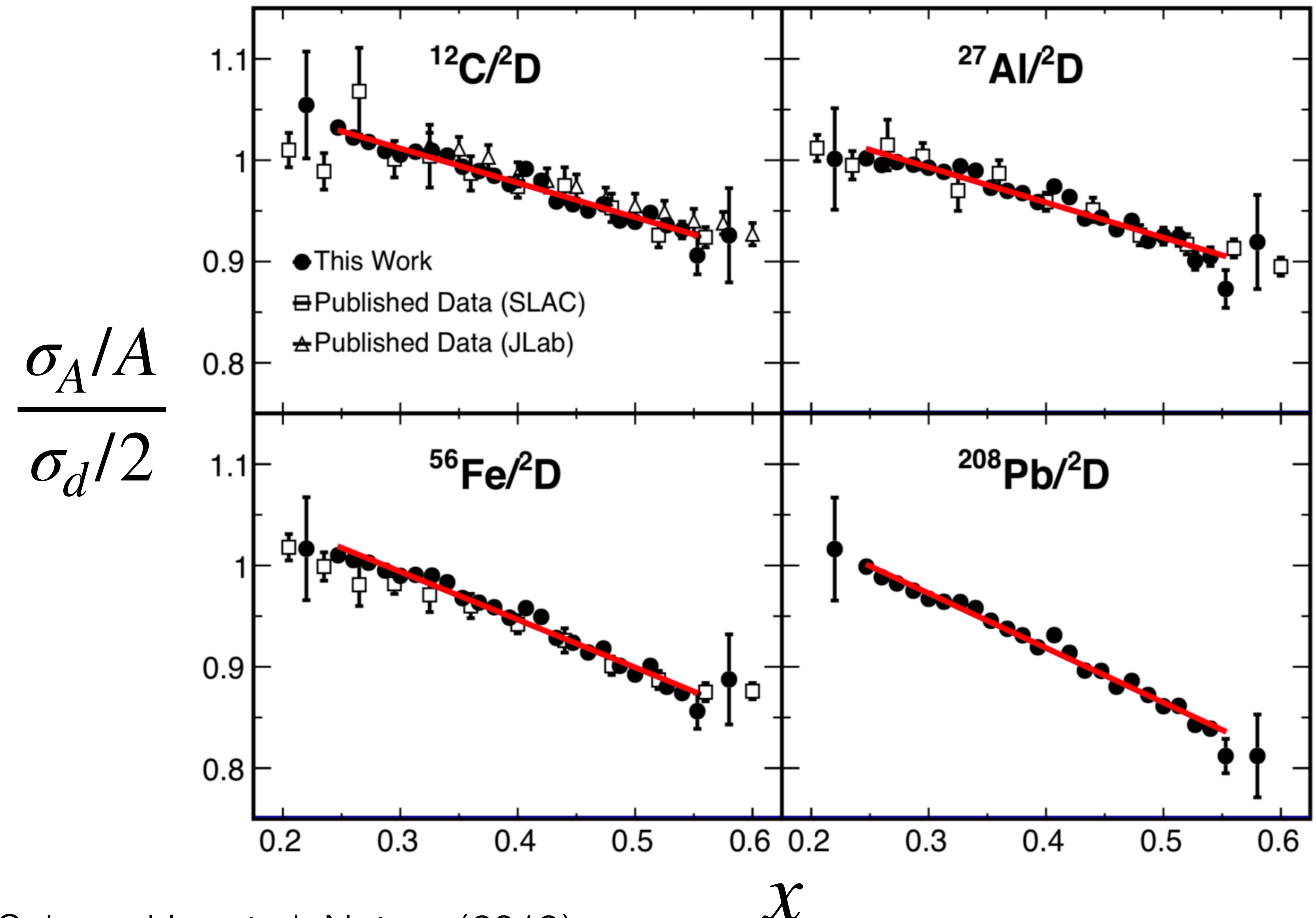


An open question since 90’s

Using insight recently gained on origin on EMC effect, we propose another approach

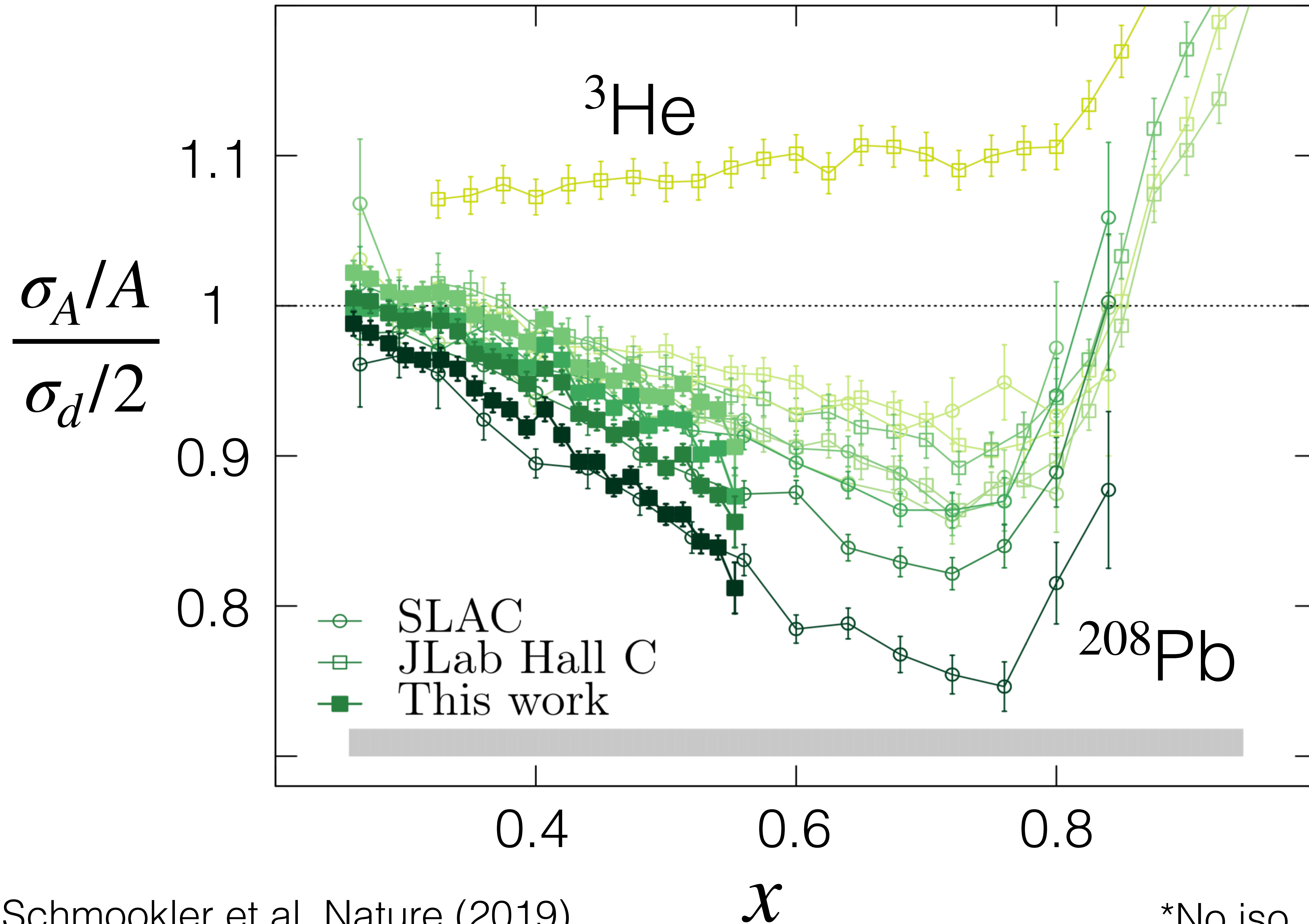
Goal: constrain **high-*x***, low Q^2 free **and** bound nucleon structure **consistently** with **all** nuclear DIS and QE data

Recent high precision (e,e') data



Schmookler et al. Nature (2019)

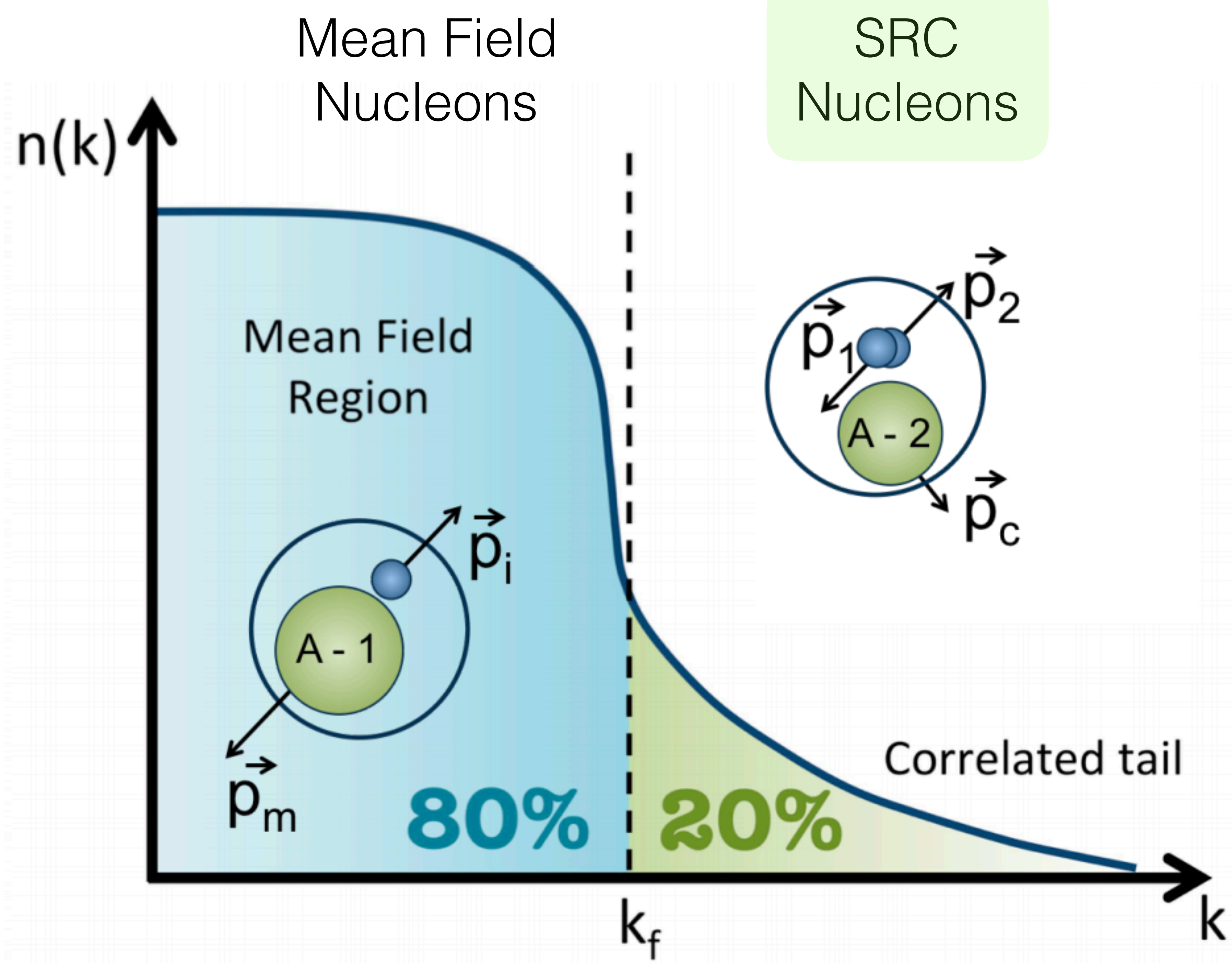
Nuclear EMC effect



Schmookler et al. Nature (2019)

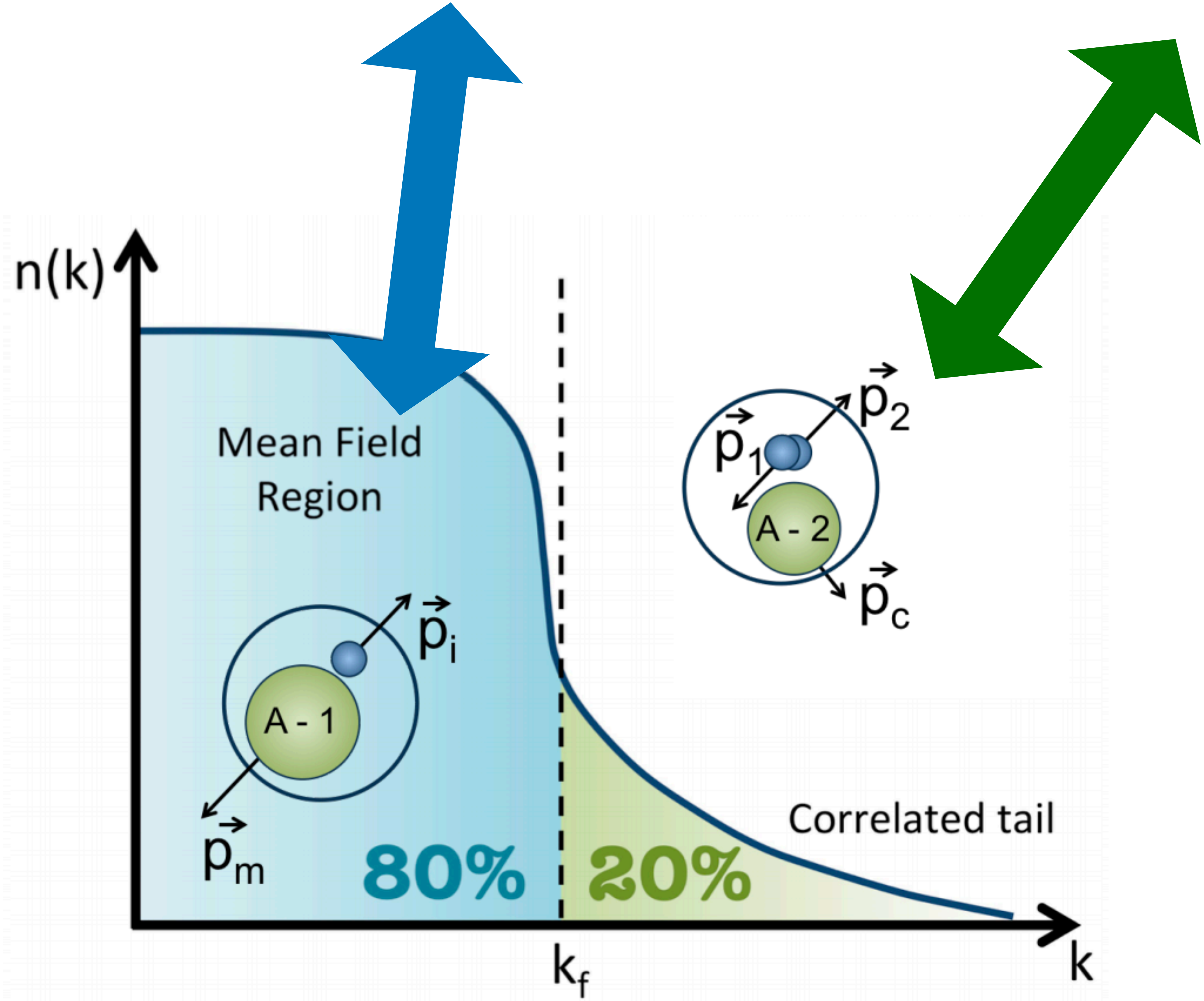
*No iso. corrections

What else do we know about the nucleus?



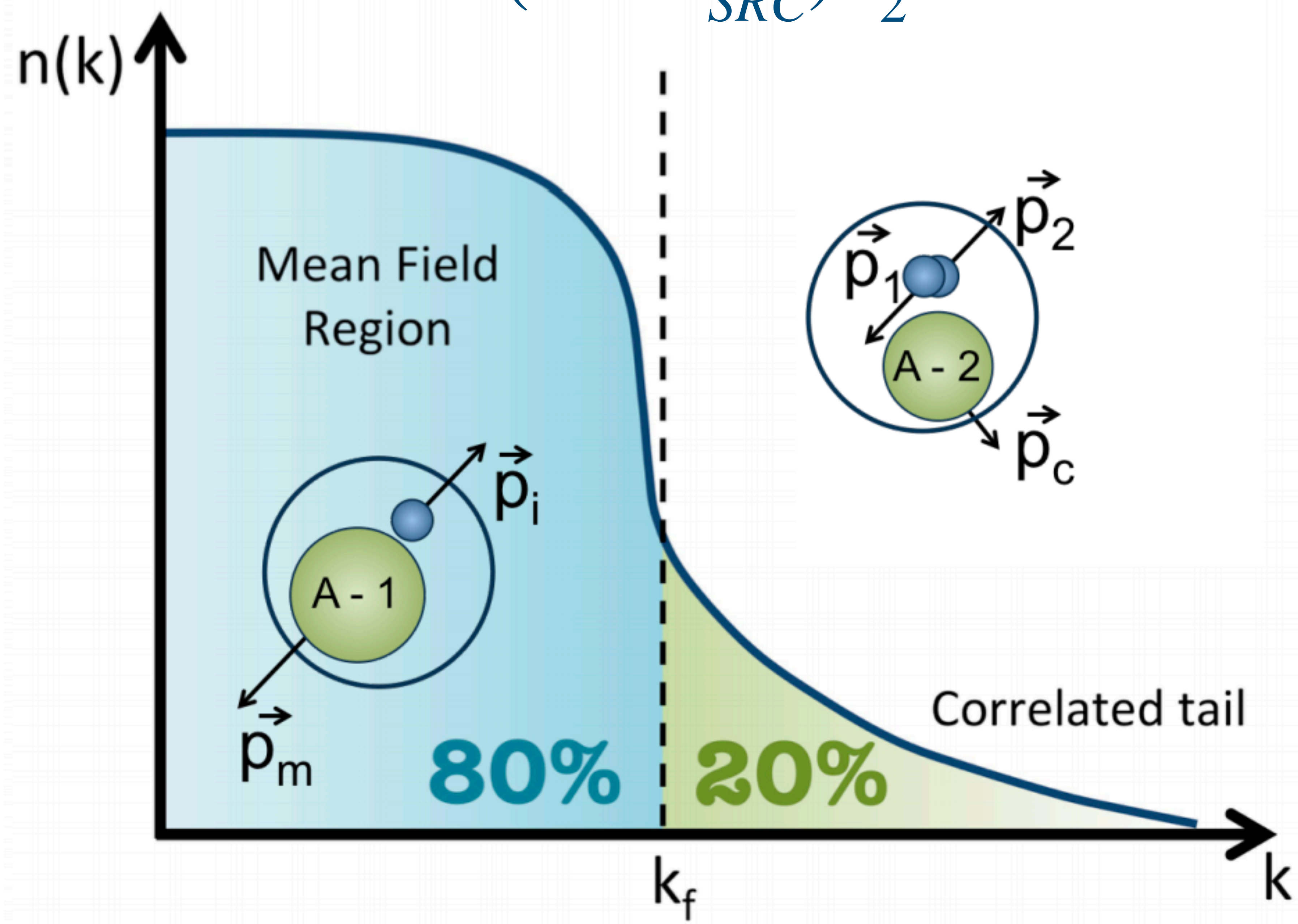
- Relative momentum
- Center-of-mass momentum
- Pair abundance
- Pair type

“Bound” = “Quasi-Free” + “Modified SRC nucleons”



“Bound” = “Quasi-Free” + “Modified SRC nucleons”

$$F_2^A = (Z - n_{SRC}^A)F_2^p + (N - n_{SRC}^A)F_2^n + n_{SRC}^A\left(F_2^{p*} + F_2^{n*}\right)$$



EMC-SRC hypothesis proposes universal modification

$$F_2^A = ZF_2^p + NF_2^n + n_{SRC}^A \underbrace{\left(\Delta F_2^p + \Delta F_2^n\right)}_{\text{Nucleus-independent}}$$

EMC-SRC hypothesis proposes universal modification

$$F_2^A = ZF_2^p + NF_2^n + n_{SRC}^A\left(\Delta F_2^p + \Delta F_2^n\right)$$

$$F_2^d = F_2^p + F_2^n + n_{SRC}^d\left(\Delta F_2^p + \Delta F_2^n\right)$$

$$F_2^A = (Z-N)\,F_2^p + NF_2^d + \left(n_{SRC}^A - Nn_{SRC}^d\right)\left(\Delta F_2^p + \Delta F_2^n\right)$$

Treat **all** bound nucleon structure **consistently** with **all** nuclear DIS and QE data

Extract universal modification using Bayesian inference via Hamiltonian Markov Chain Monte Carlo

$$\frac{F_2^A}{F_2^d} = (Z - N)\frac{F_2^p}{F_2^d} + N + \left(\frac{n_{SRC}^A}{n_{SRC}^d} - N\right)\frac{n_{SRC}^d}{F_2^d}\left(\Delta F_2^p + \Delta F_2^n\right)$$

Universal modification function

E.P. Segarra et al., arXiv: 1908.02223 (2019)

Extract universal modification using Bayesian inference via Hamiltonian Markov Chain Monte Carlo

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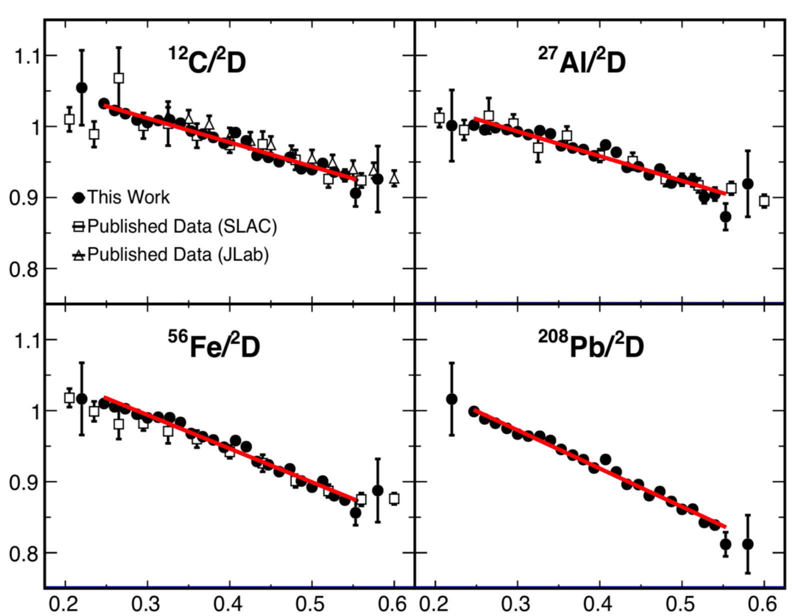
Universal modification function

EMC-DIS Data



$x \in [0.08, 0.95]$ $Q^2 \in [2,15]$ GeV^2

^{3}He, ^{4}He, ^{9}Be, ^{12}C, ^{27}Al, ^{56}Fe, ^{197}Au, ^{208}Pb

E.P. Segarra et al., arXiv: 1908.02223 (2019)

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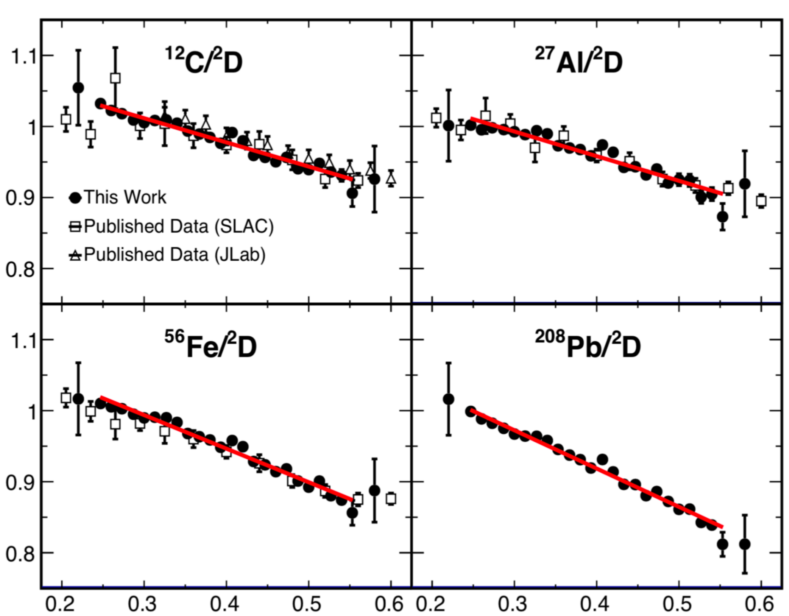
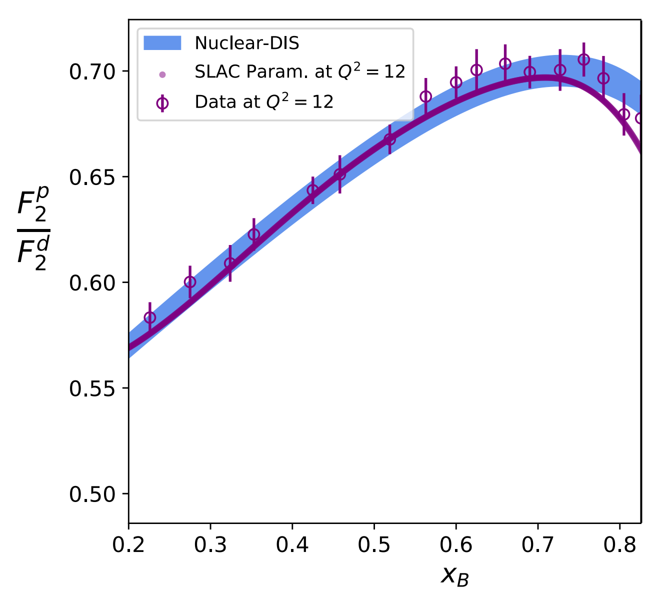
Universal modification function

EMC-DIS Data



F_2^p/F_2^d Data



E.P. Segarra et al., arXiv: 1908.02223 (2019)

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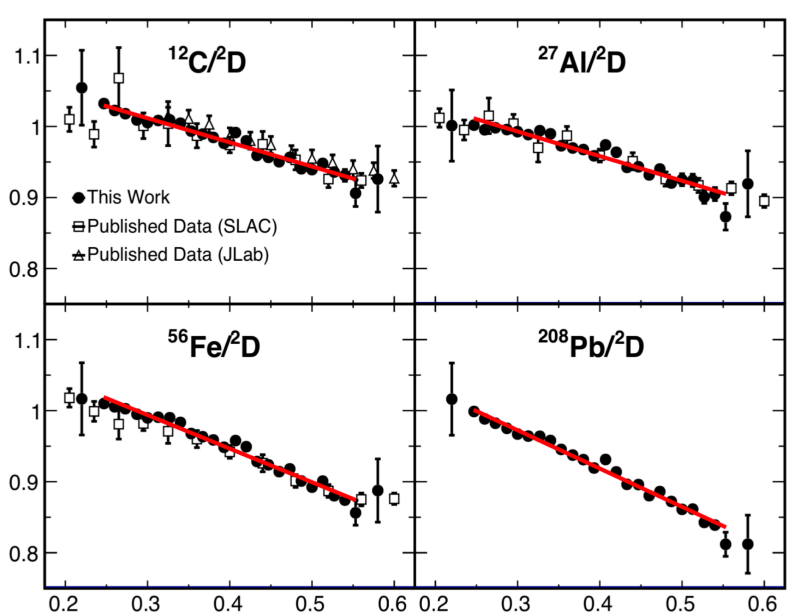
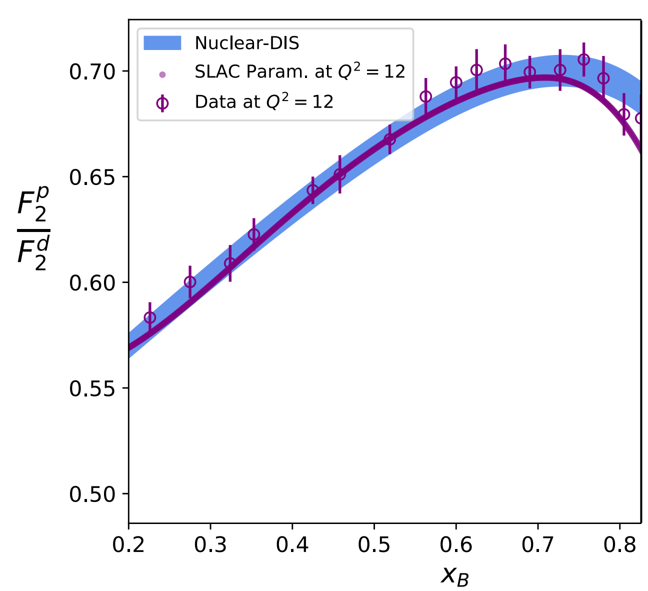
Universal modification function

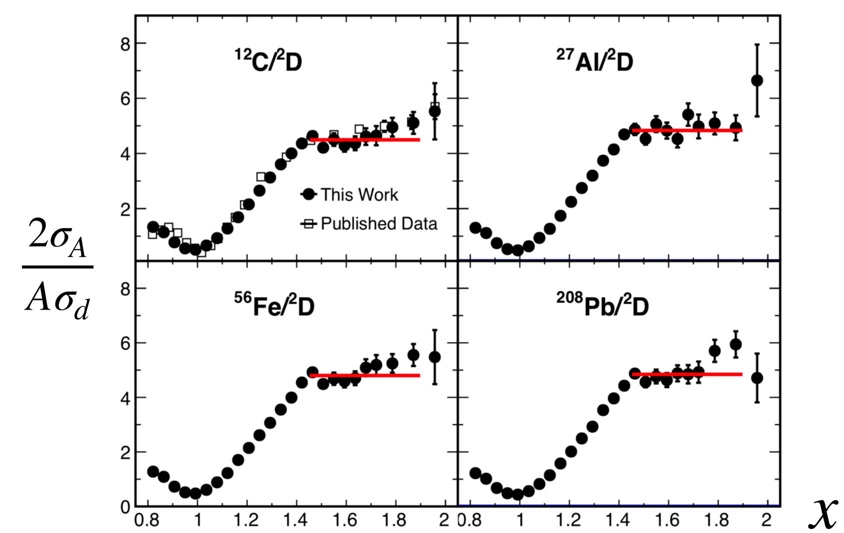
EMC-DIS Data



F_2^p/F_2^d Data



a_2 Pair Abundances



E.P. Segarra et al., arXiv: 1908.02223 (2019)

Extract universal modification using Bayesian inference via Hamiltonian Markov Chain Monte Carlo

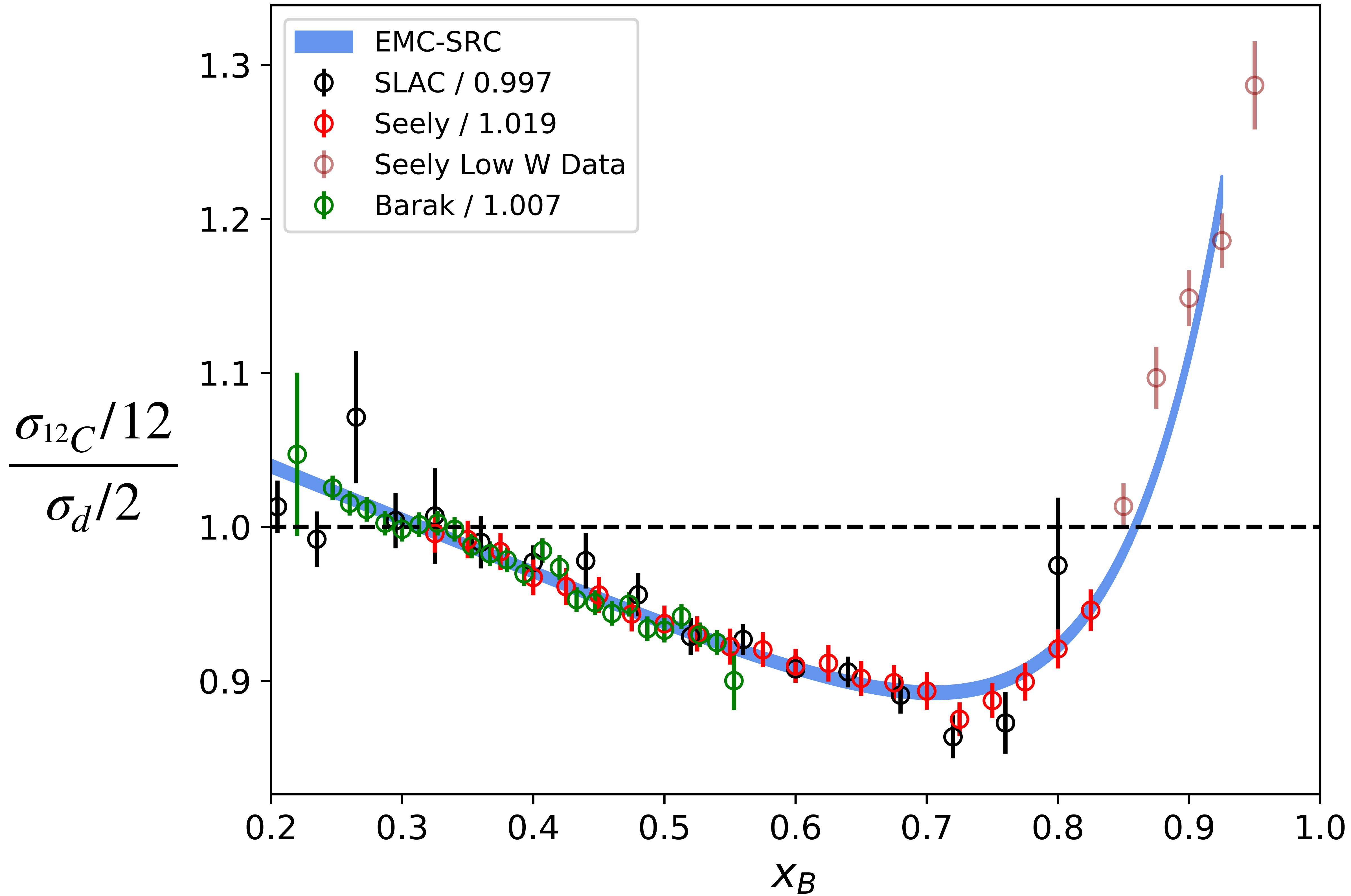
$$\frac{F_2^A}{F_2^d} = (Z-N)\frac{F_2^p}{F_2^d} + N + \left(\frac{n_{SRC}^A}{n_{SRC}^d} - N\right)\frac{n_{SRC}^d}{F_2^d}\left(\Delta F_2^p + \Delta F_2^n\right)$$

Consistent, simultaneous global extraction of 31 model parameters sampled from joint-posterior distribution

$f_{univ}(x)$ $R_{pd}(x)$ $\vec{s}_i$ $\vec{a}_2(A/d)$

E.P. Segarra et al., arXiv: 1908.02223 (2019)

Reproduce the data remarkably well



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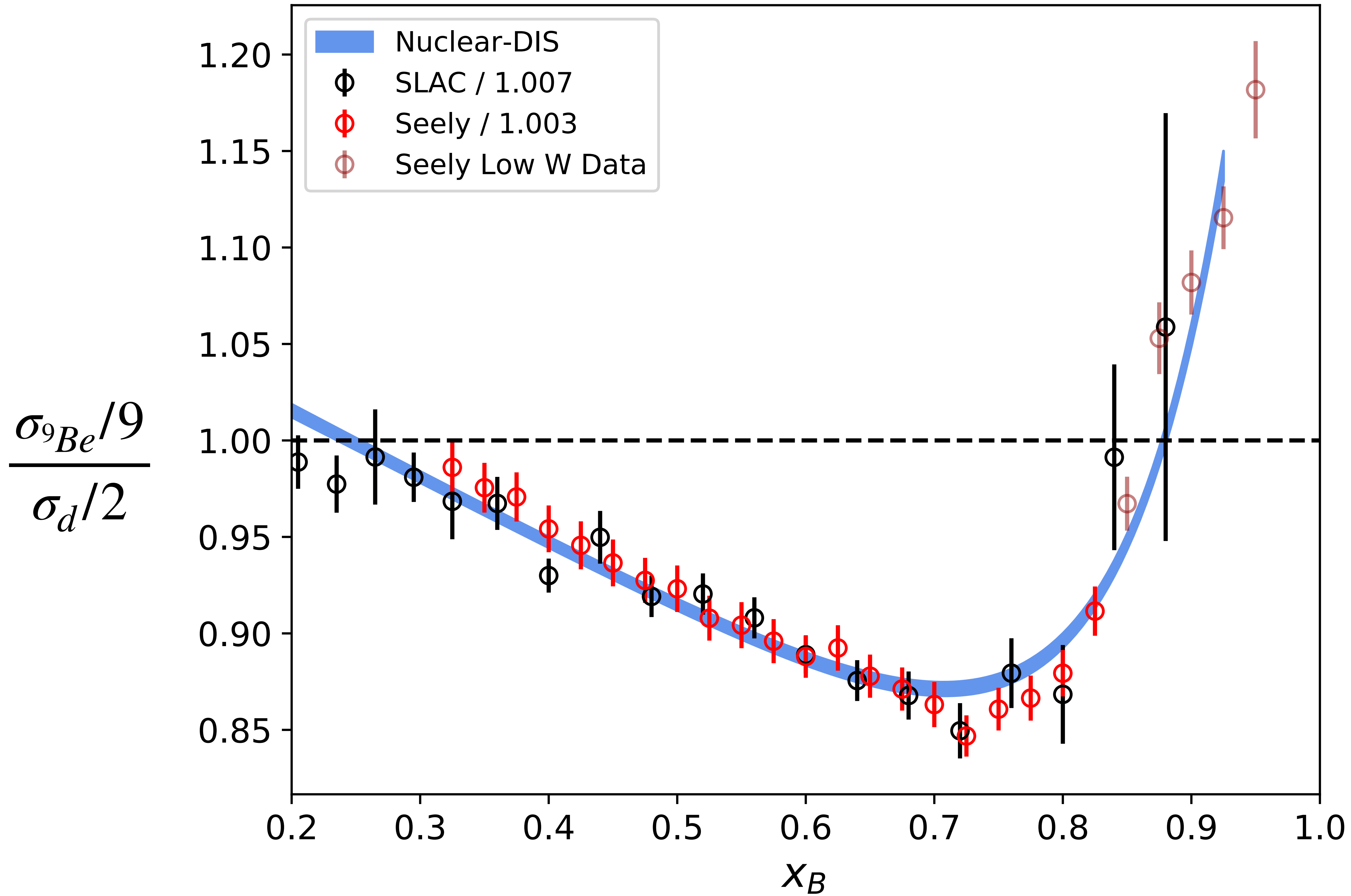

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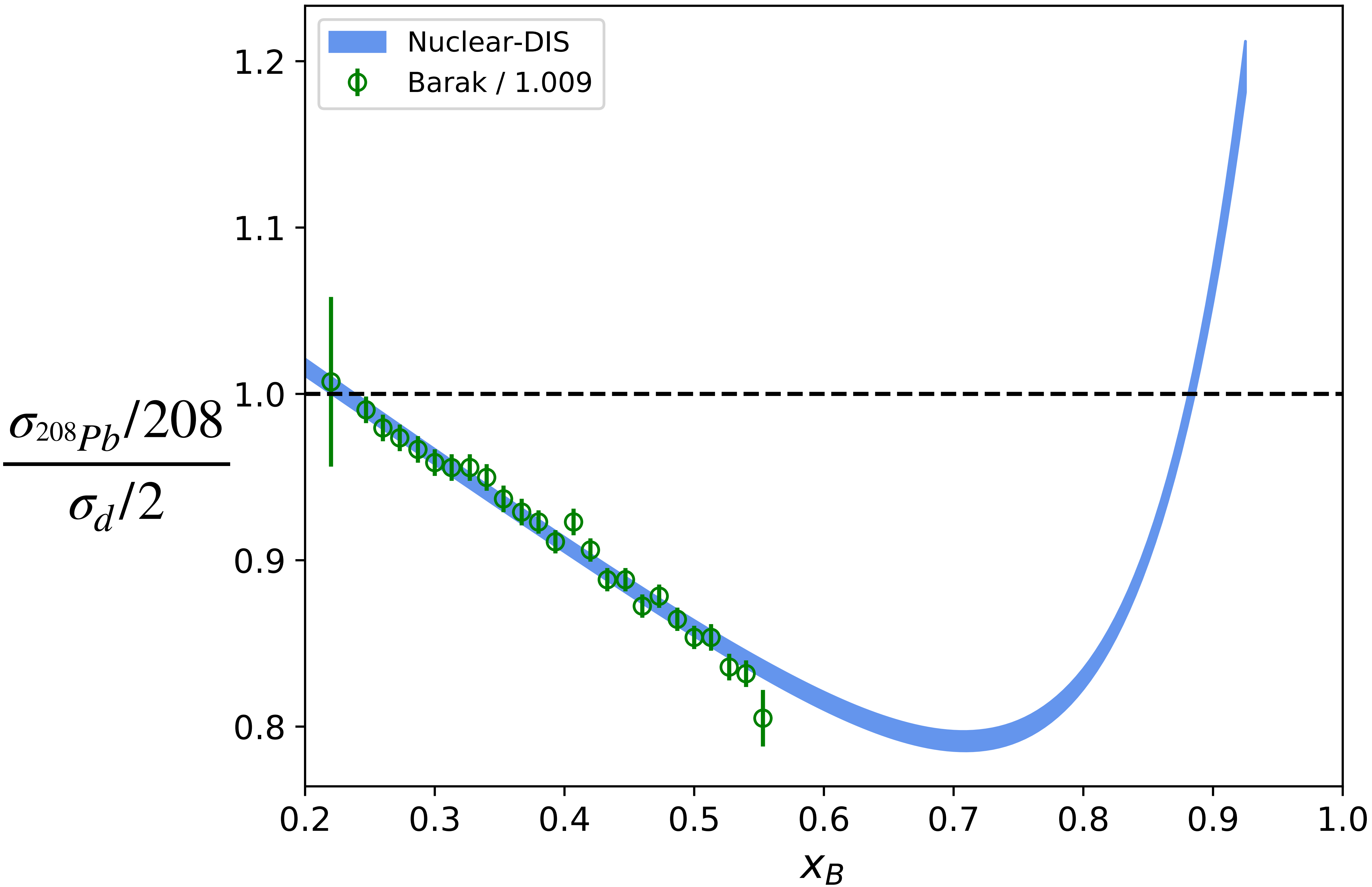
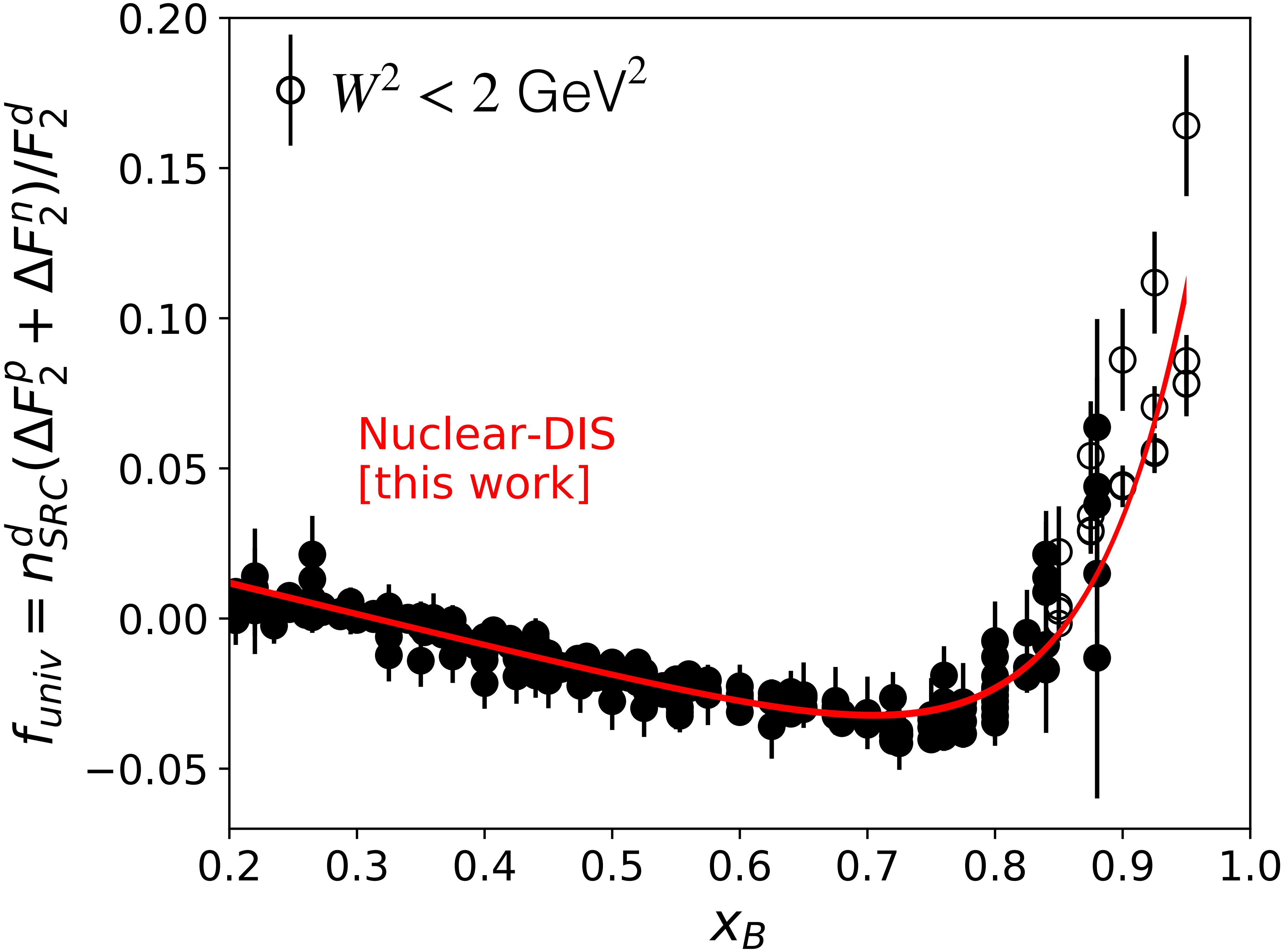


E.P. Segarra et al., arXiv: 1908.02223 (2019)

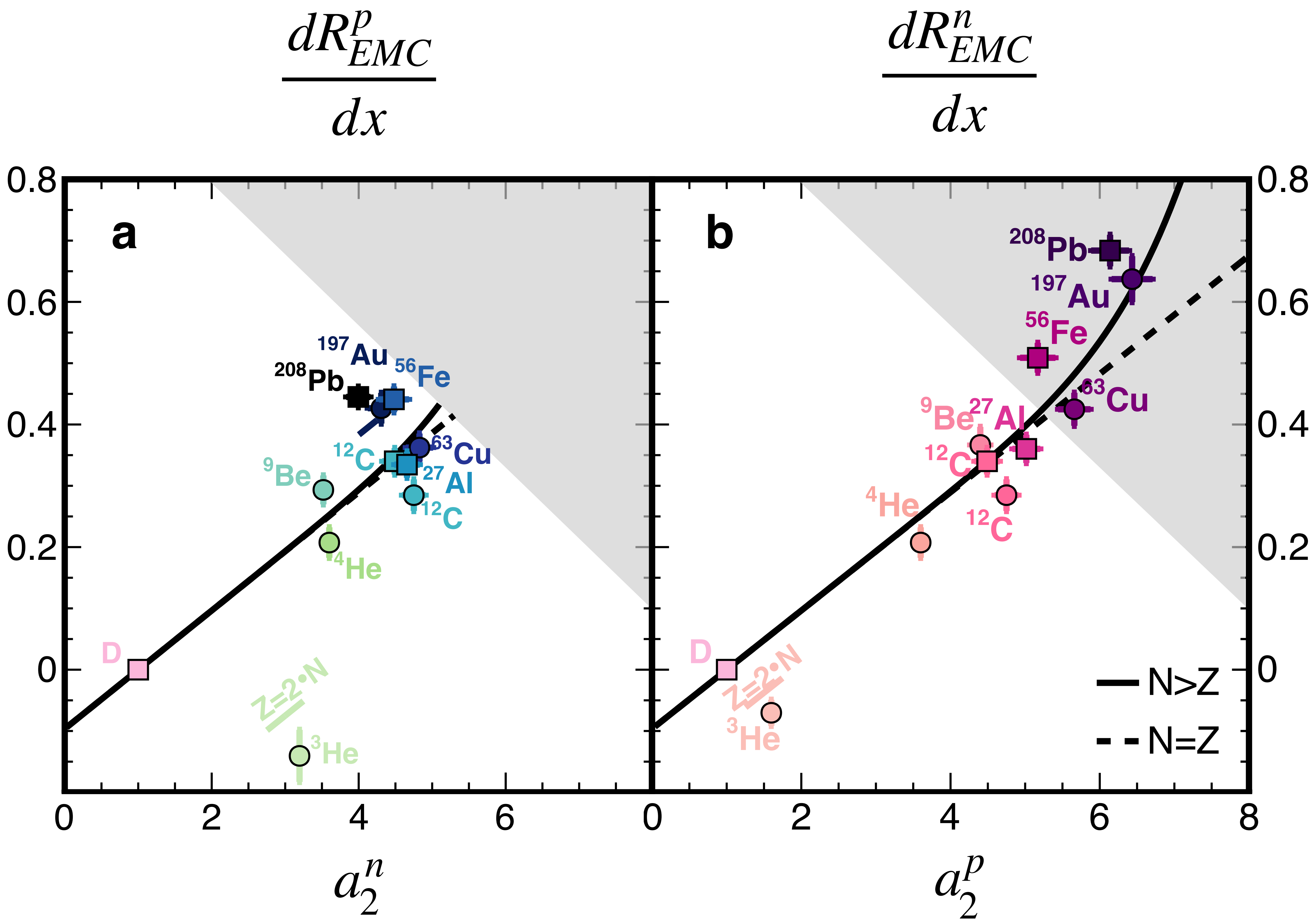
Universal modification function of nuclei



(All 31 model parameters simultaneously extracted from joint posterior)

E.P. Segarra et al., arXiv: 1908.02223 (2019)

How are protons and neutrons modified



Schmookler et al. Nature (2019)

- Universal modification of SRC nucleons
- Free neutron structure & A=3 → **What did we learn so far**
- Tagged DIS at Jefferson Lab 12 GeV
- Nuclear PDFs for the EIC

} **Where do we go from here**

What about neutron structure F_2?

Past approaches to get F_2^n

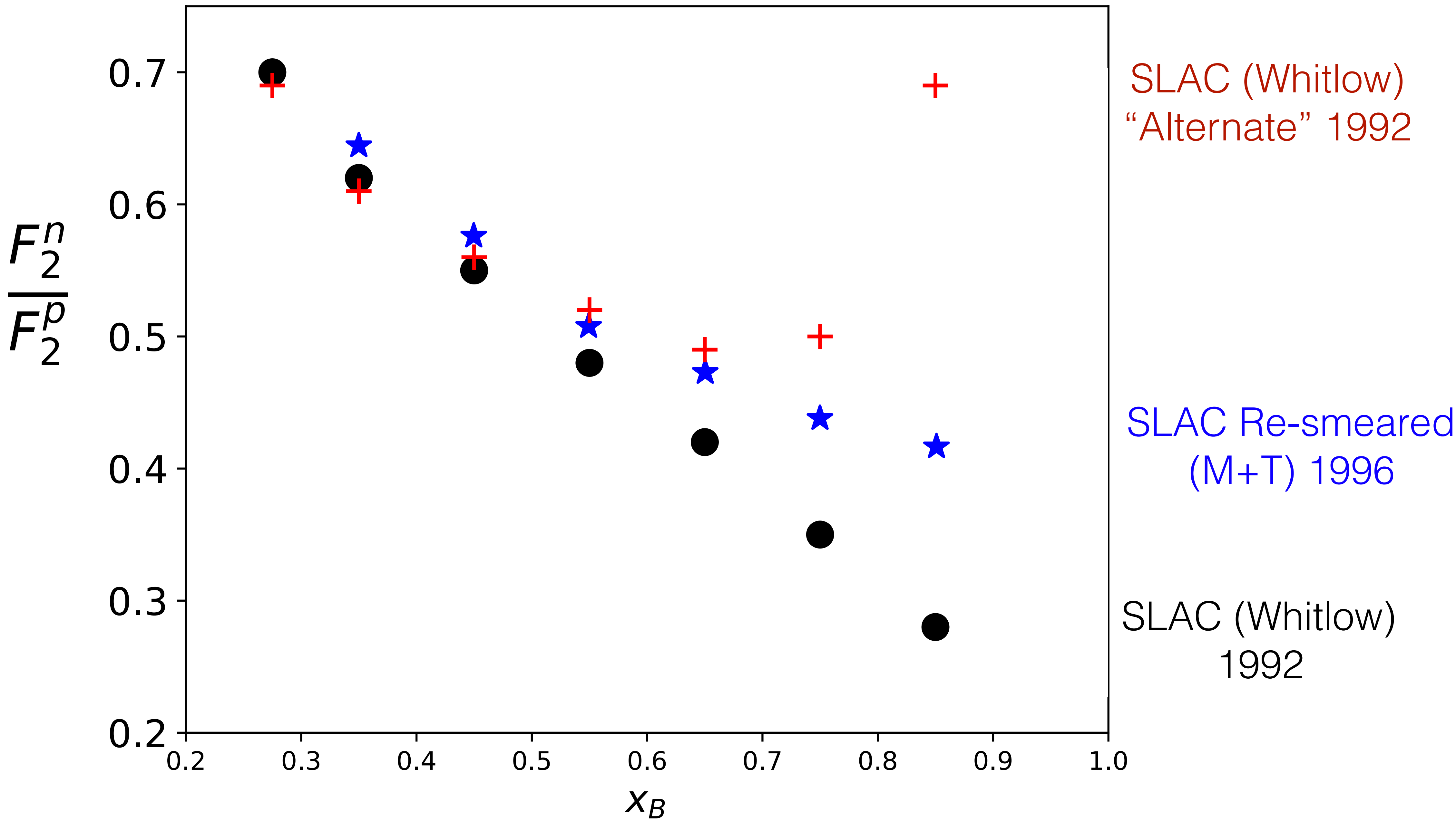
$$F_2^d \approx F_2^p + F_2^n$$

How to treat deuterium to get out neutron?

Smearing, off-shell, etc..

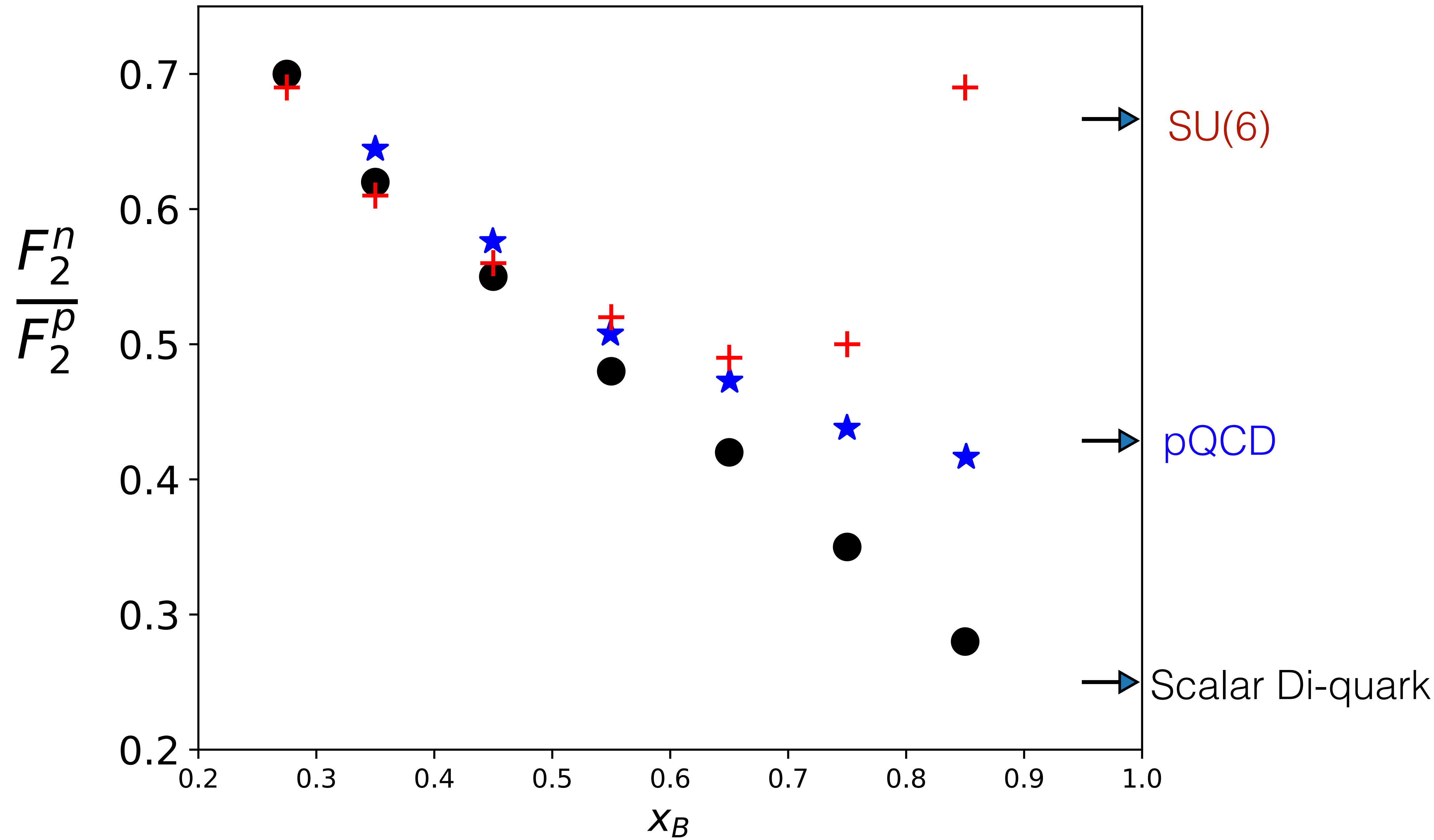
Past approaches to get F_2^n

$$F_2^d \approx F_2^p + F_2^n$$



Large-x informs us on valence structure

$$F_2^d \approx F_2^p + F_2^n$$



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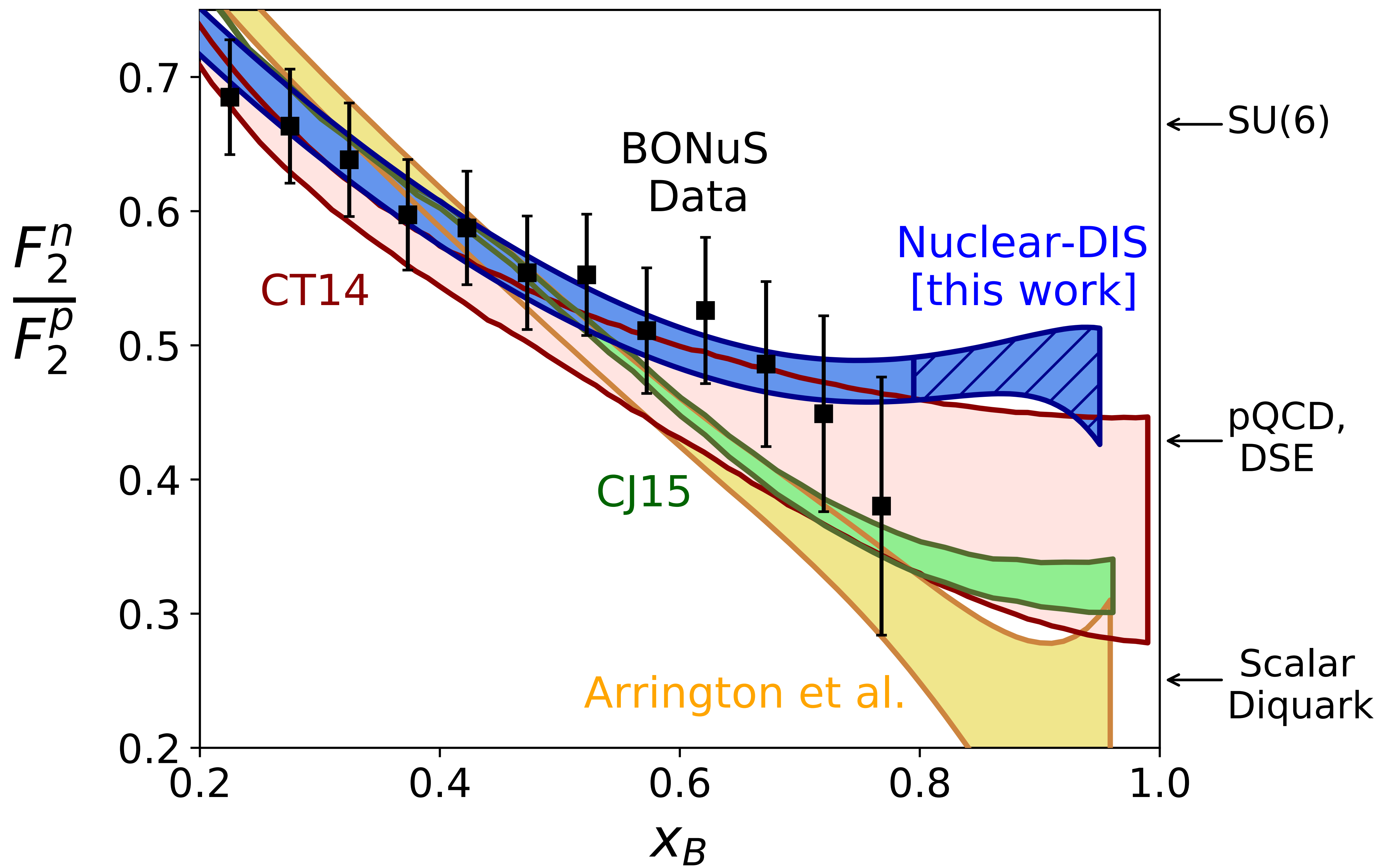
$$F_2^A = (Z - N)\, F_2^p + NF_2^d + \left(n_{SRC}^A - N n_{SRC}^d \right) \left(\Delta F_2^p + \Delta F_2^n \right)$$

Treat **all** bound nucleon structure **consistently** with **all** nuclear DIS and QE data

Extracting free neutron structure

$$F_2^d = F_2^p + F_2^n + n_{SRC}^d \left(\Delta F_2^p + \Delta F_2^n \right)$$



E.P. Segarra et al., arXiv: 1908.02223 (2019)

Another way to access F_2^n from A=3 nuclei

(MARATHON Experiment, Hall A Jefferson Lab)

$$\frac{F_2^n}{F_2^p} = \frac{2\mathscr{R} - F_2^{^3He}/F_2^{^3H}}{2F_2^{^3He}/F_2^{^3H} - \mathscr{R}}$$

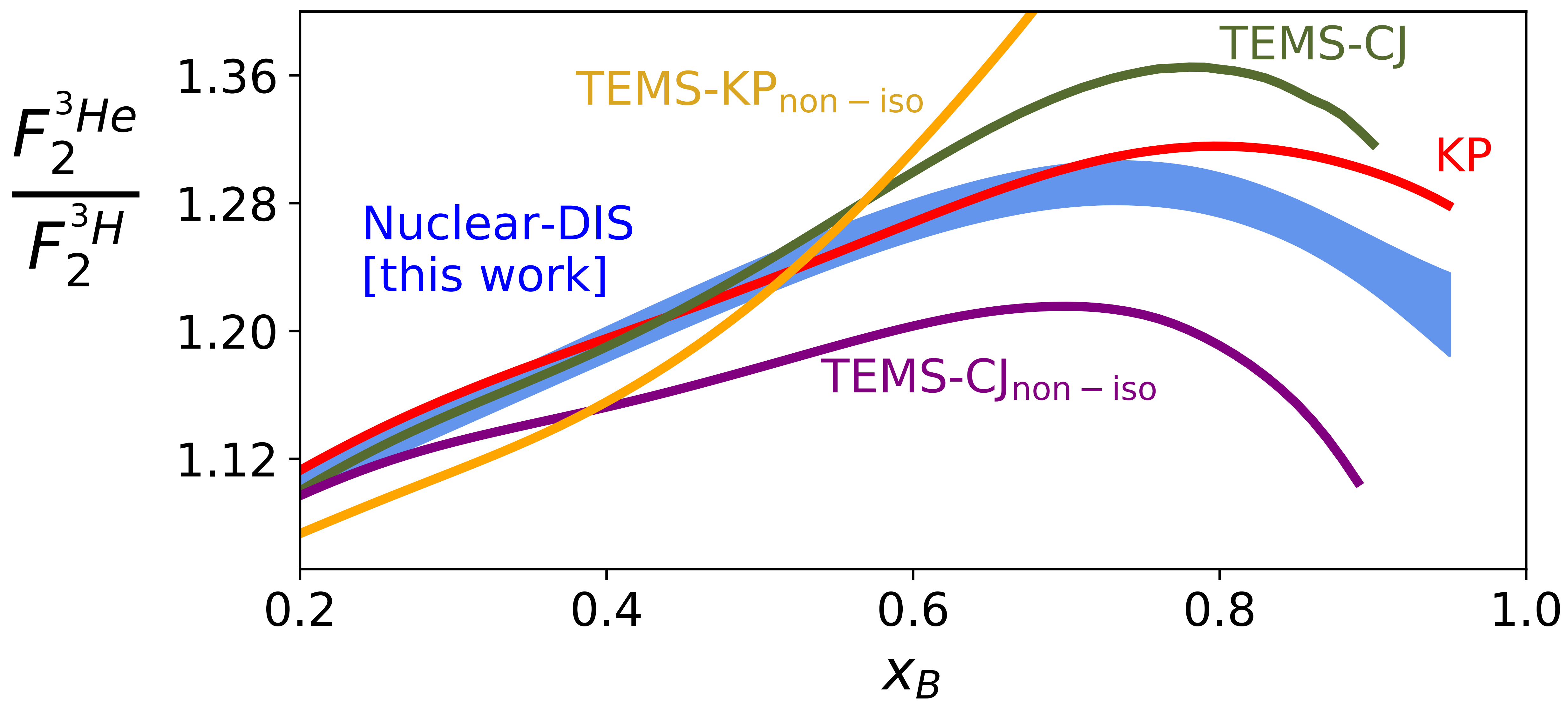
Measured

Theoretical input

$$\mathscr{R} = \frac{F_2^{^3He}}{2F_2^p + F_2^n} \cdot \frac{F_2^p + 2F_2^n}{F_2^{^3H}}$$

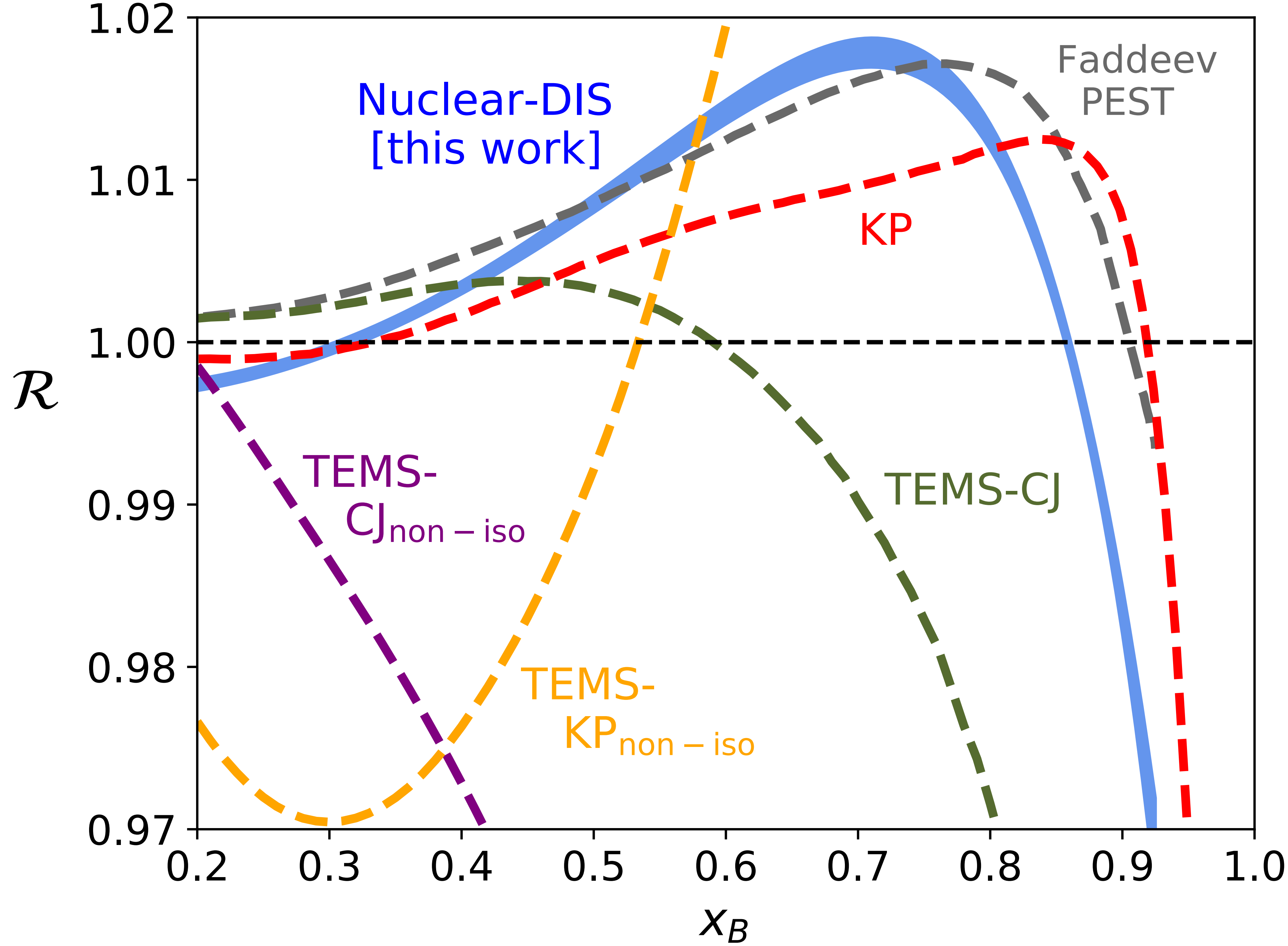
EMC Prediction for A=3

Model discrimination once MARATHON publishes



E.P. Segarra et al., arXiv: 1908.02223 (2019)

Super-ratio theoretical input



E.P. Segarra et al., arXiv: 1908.02223 (2019)

How sensitive is result to theory model?

$$\frac{F_2^n}{F_2^p} = \frac{2\mathscr{R} - F_2^{^3He}/F_2^{^3H}}{2F_2^{^3He}/F_2^{^3H} - \mathscr{R}}$$

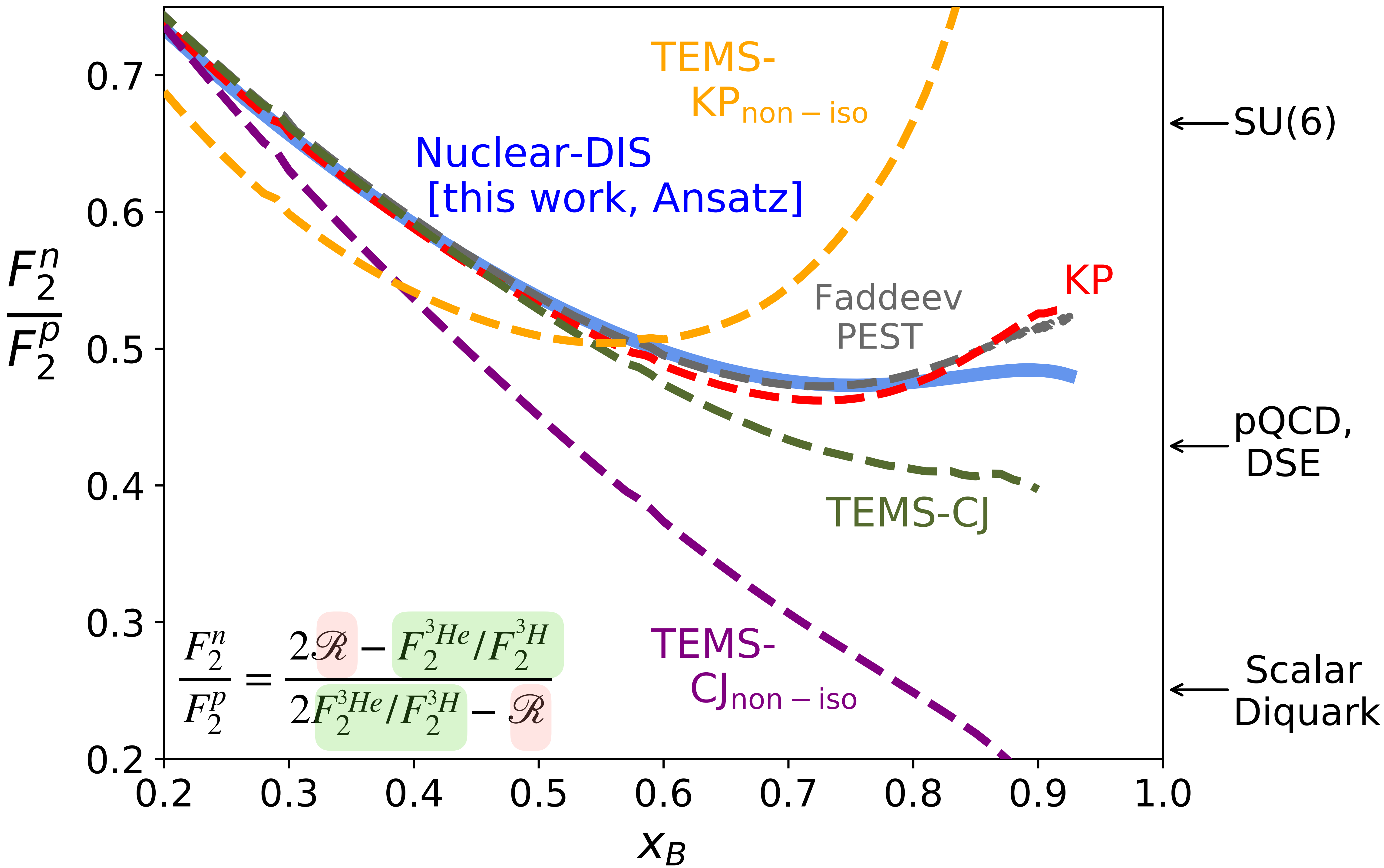
Use our model prediction

Try different theory predictions

$$\mathscr{R} = \frac{F_2^{^3He}}{2F_2^p + F_2^n} \cdot \frac{F_2^p + 2F_2^n}{F_2^{^3H}}$$

E.P. Segarra et al., arXiv: 1908.02223 (2019)

Degeneracy between F_2^n/F_2^p and offshell



E.P. Segarra et al., arXiv: 1908.02223 (2019)

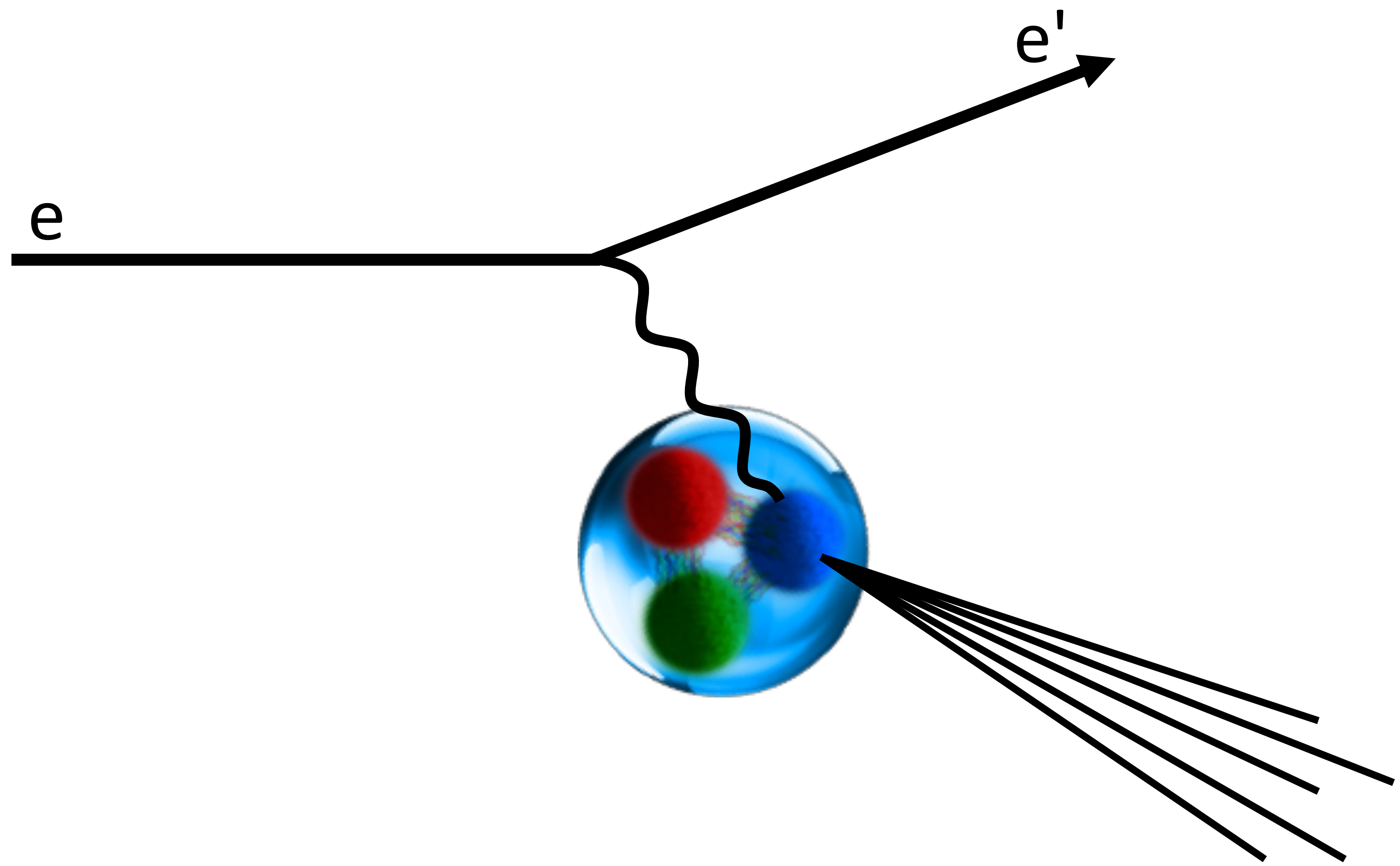
- Universal modification of SRC nucleons
- Free neutron structure & A=3
- Tagged DIS at Jefferson Lab 12 GeV
- Nuclear PDFs for the EIC

} **Where do we go from here**

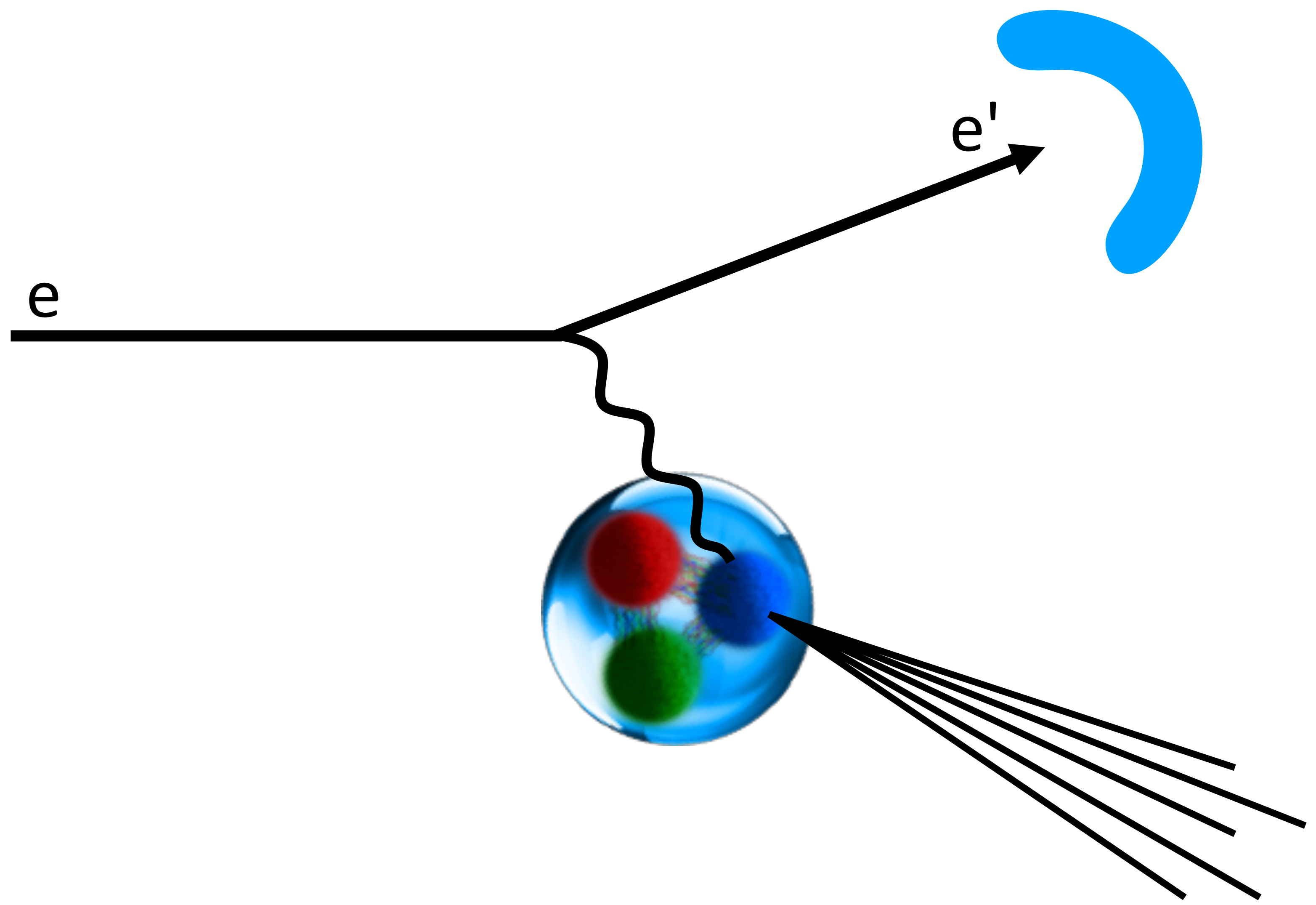
Is modification really driven by nucleons in SRC states?

$$F_2^A = ZF_2^p + NF_2^n + n_{SRC}^A \left(\Delta F_2^p + \Delta F_2^n \right)$$

Inclusive DIS off proton

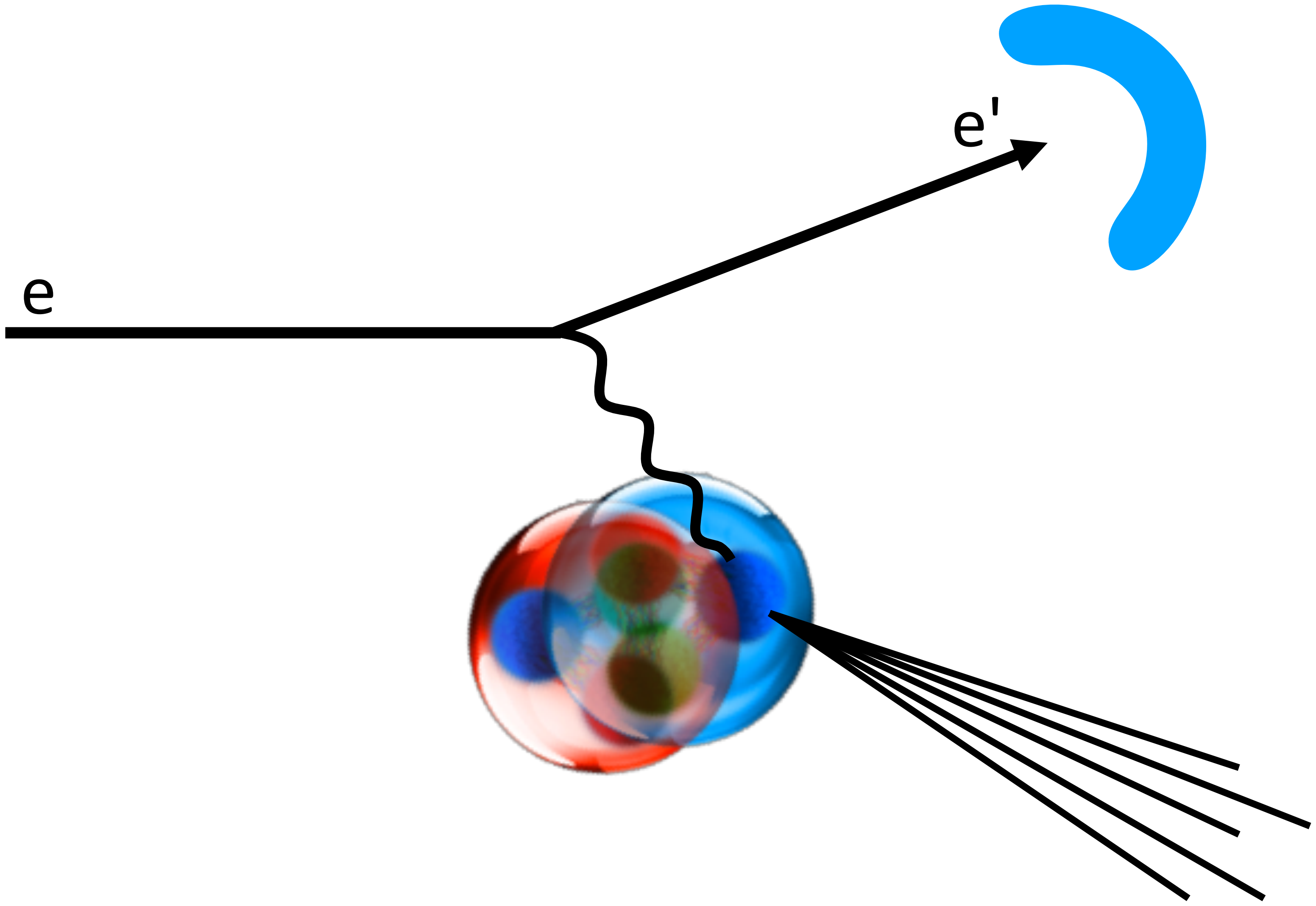


Inclusive DIS off proton



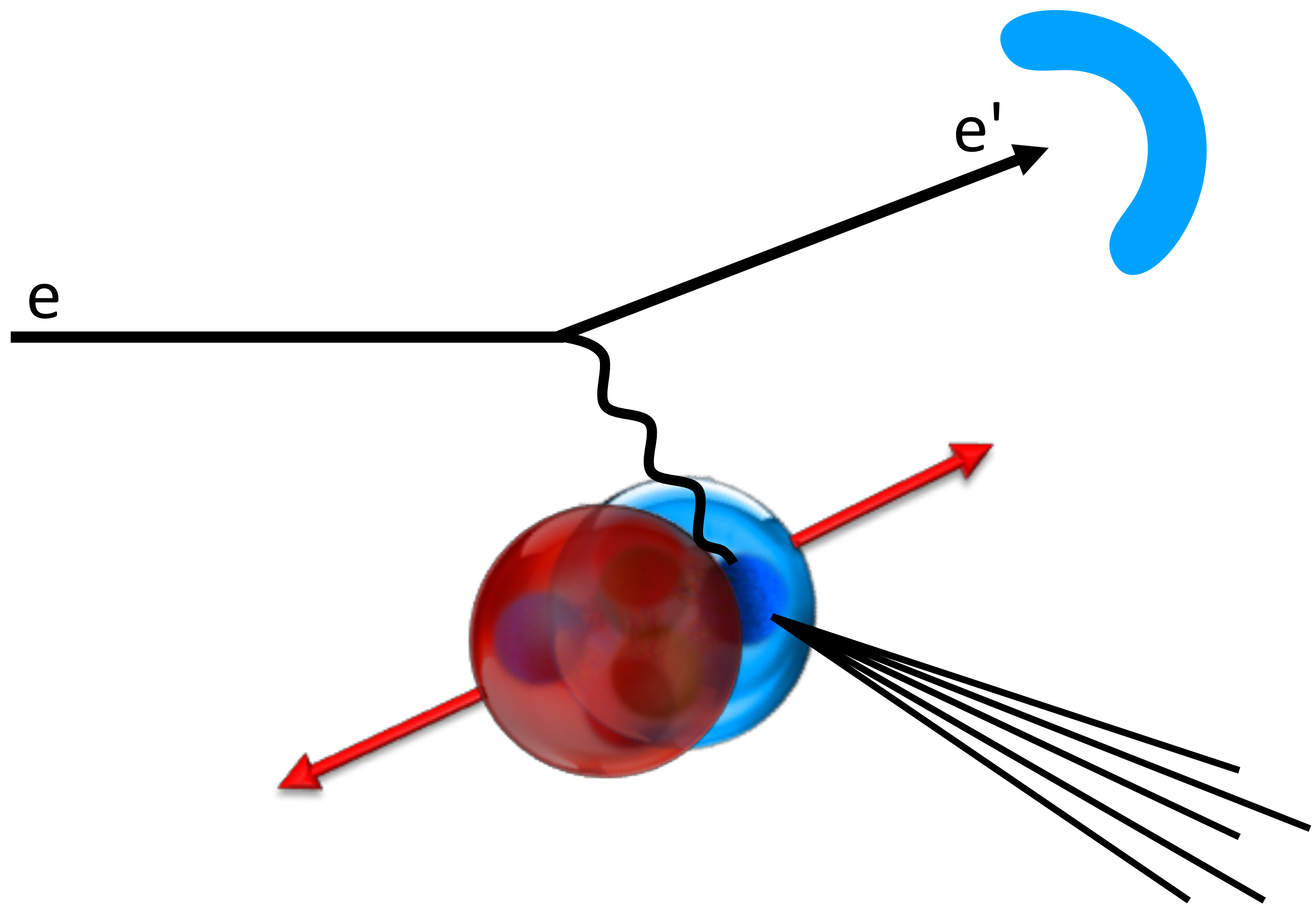
- Partonic d.o.f.

DIS off bound nucleon in deuterium



- Partonic d.o.f.

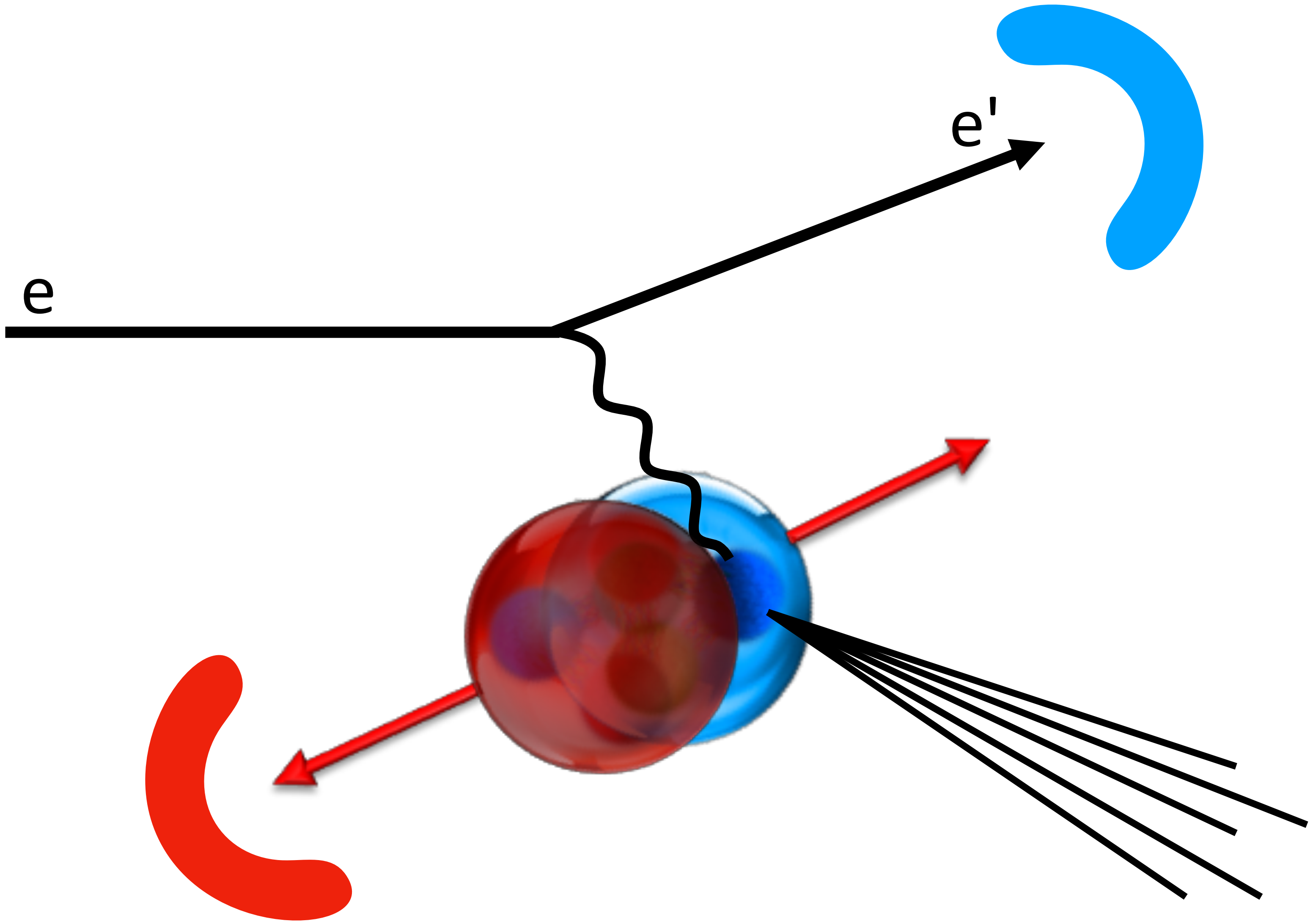
DIS off bound nucleon in deuterium



- Partonic d.o.f.

Can address with spectator-tagging

$$F_2^A = ZF_2^p + NF_2^n + n_{SRC}^A\left(\Delta F_2^p + \Delta F_2^n\right)$$



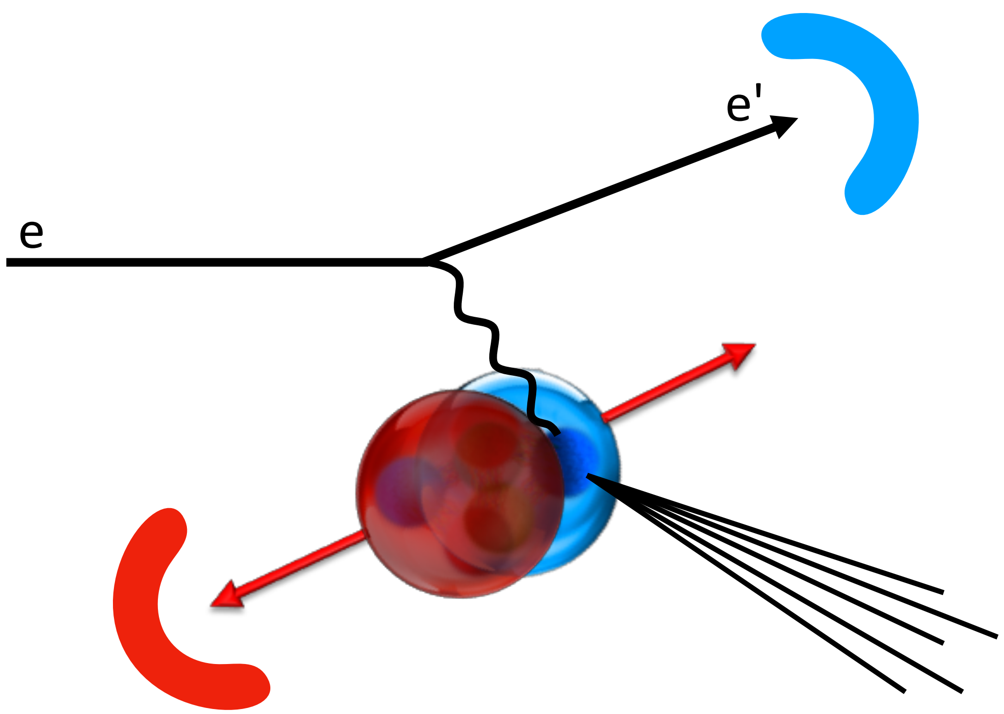
$$W'^2 = (q^\mu + p_D^\mu - p_S^\mu)^2$$

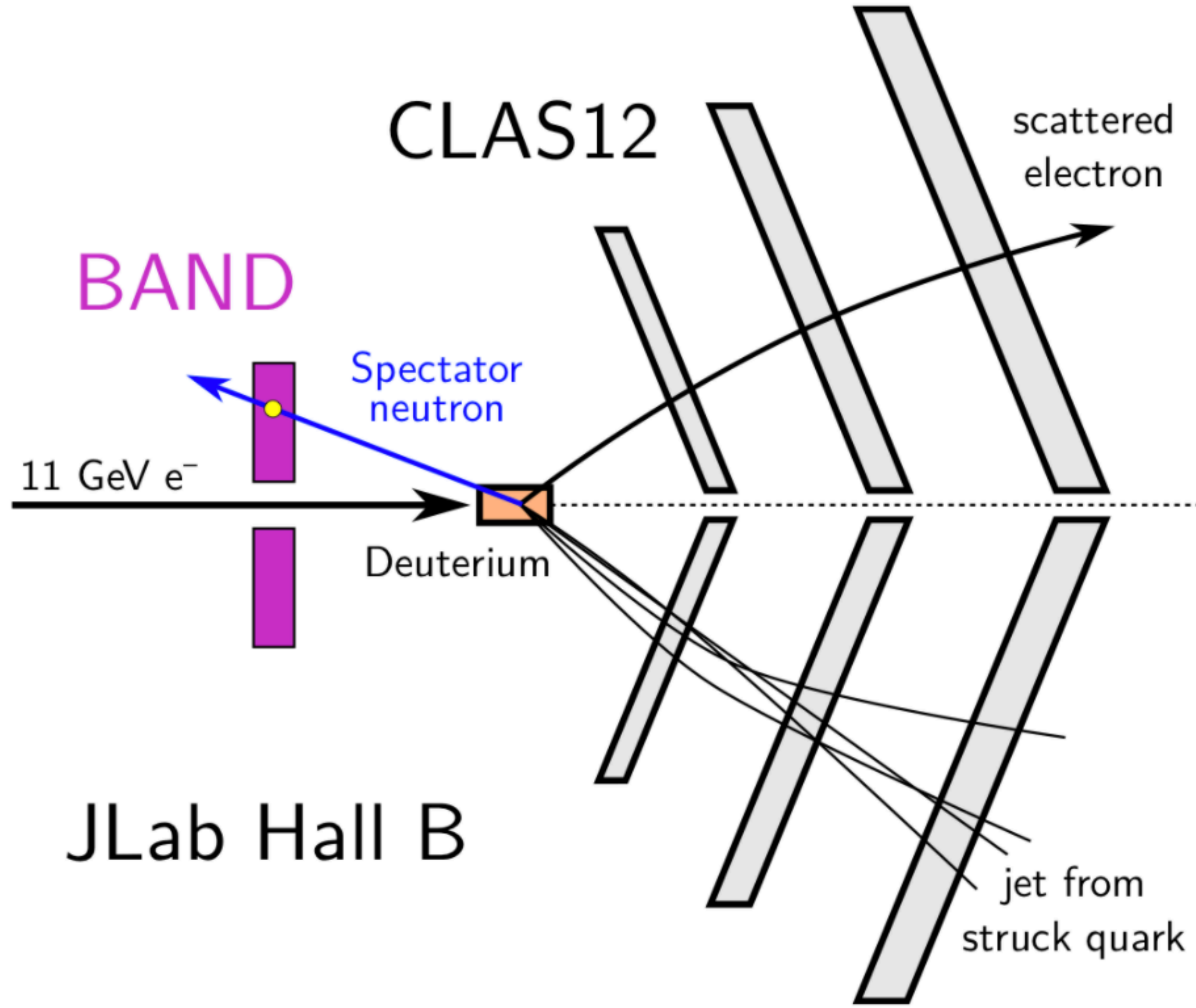
$$x' = \frac{Q^2}{2\left(\nu(m_D - E_n) + \vec{p}_n \cdot \vec{q}\right)}$$

- Partonic d.o.f.
- Nucleonic d.o.f.

BAND Experiment

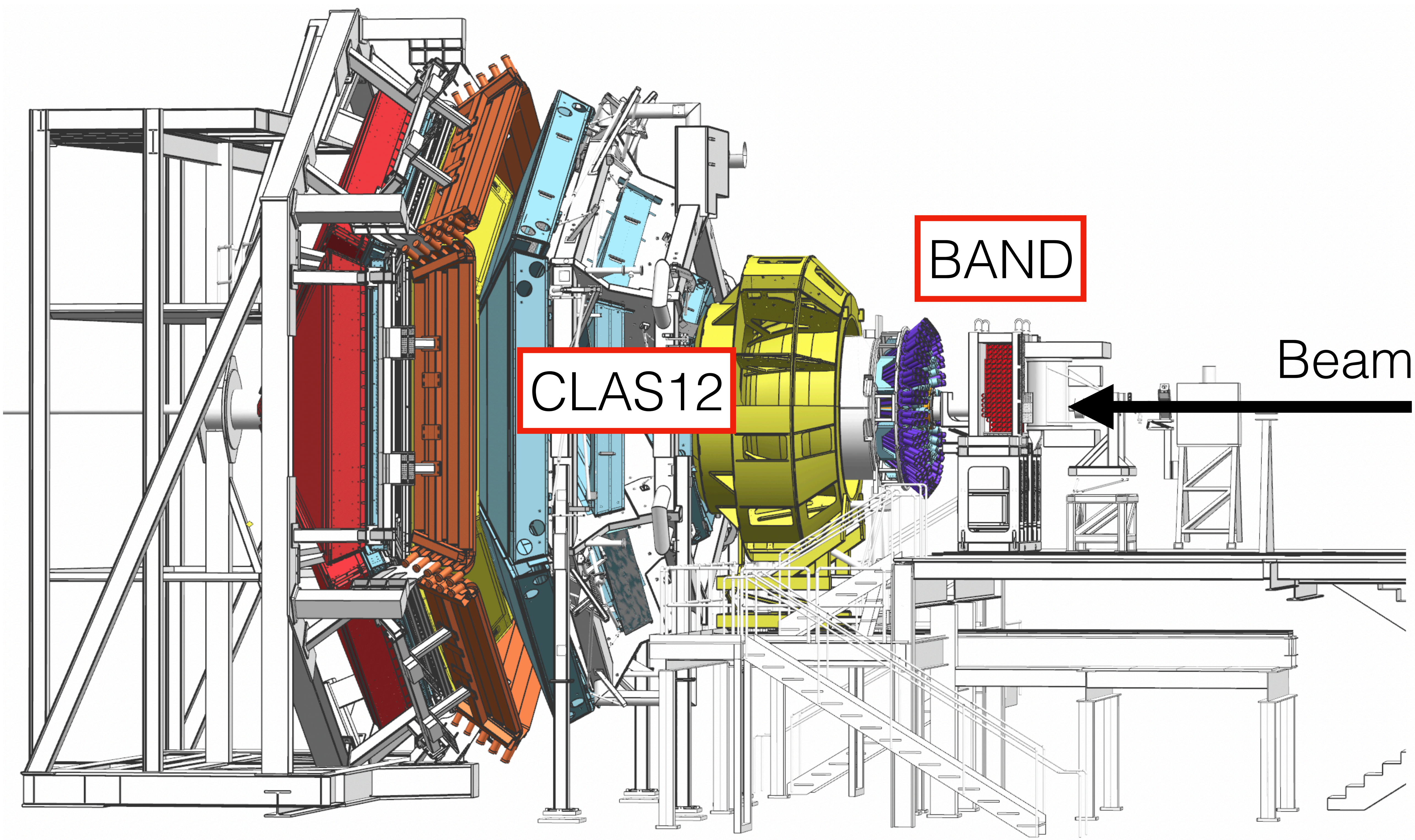
Backward **A**ngle **N**eutron **D**etector
Hall B, Jefferson Lab 12 GeV (RG-B)





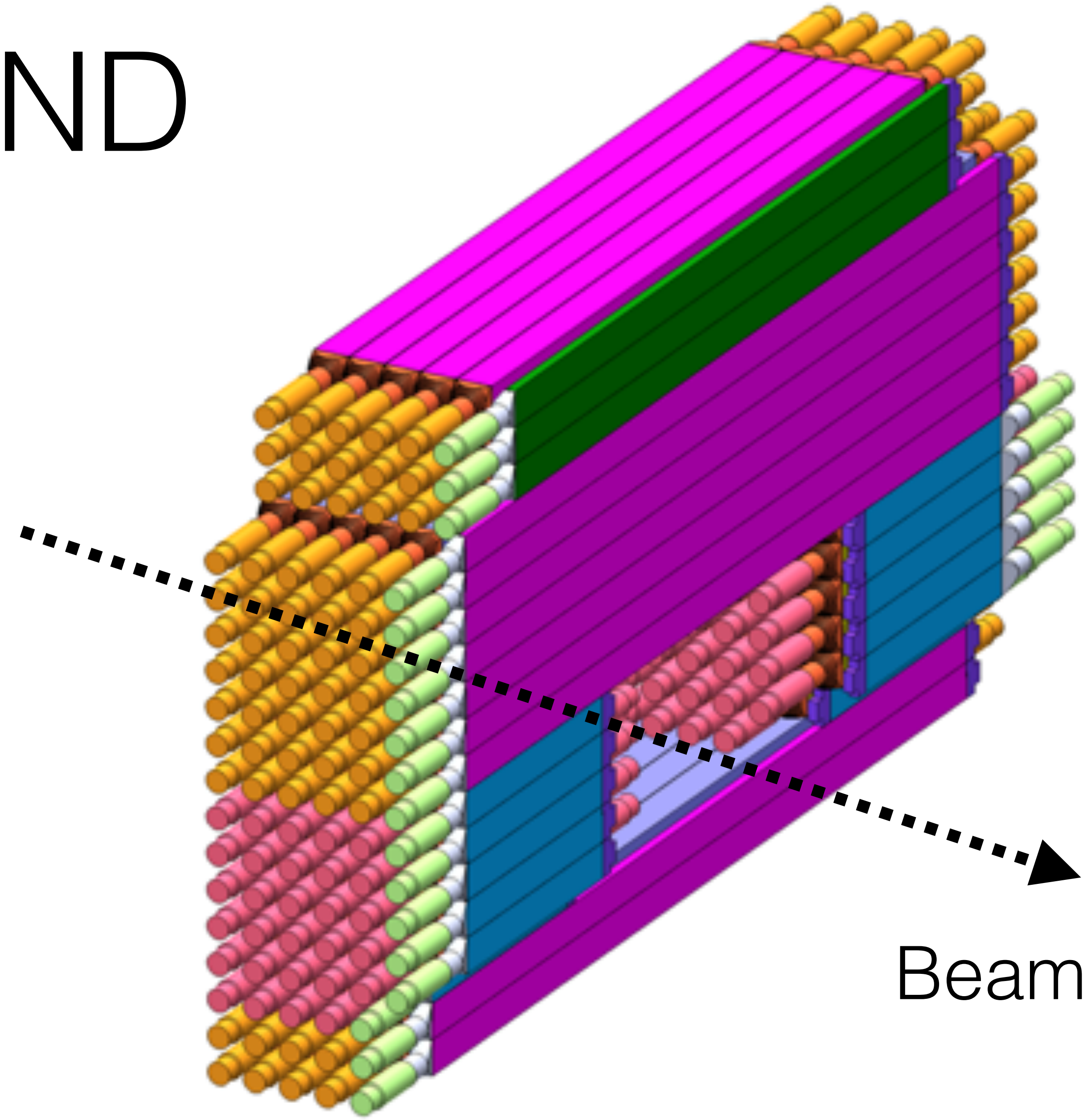
(my thesis work)

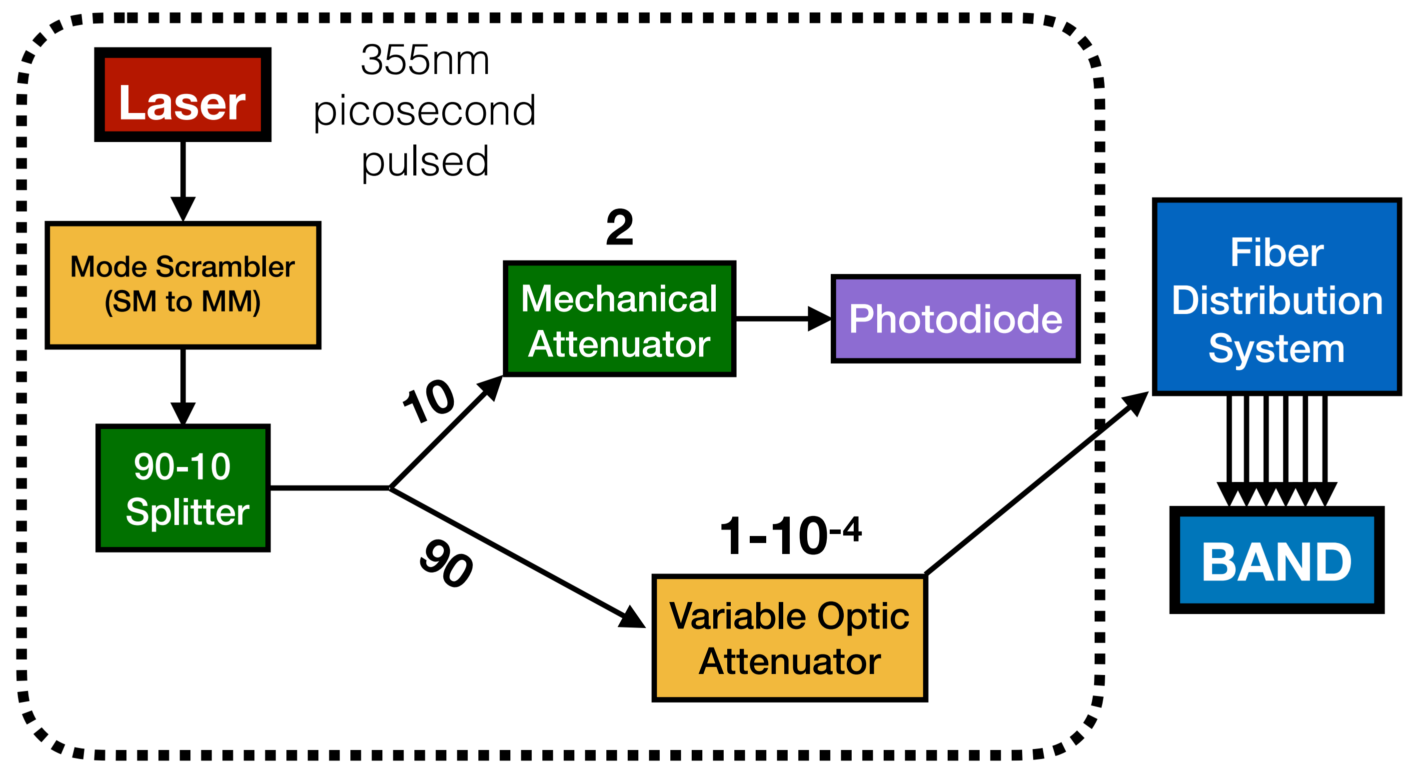
BAND with CLAS12



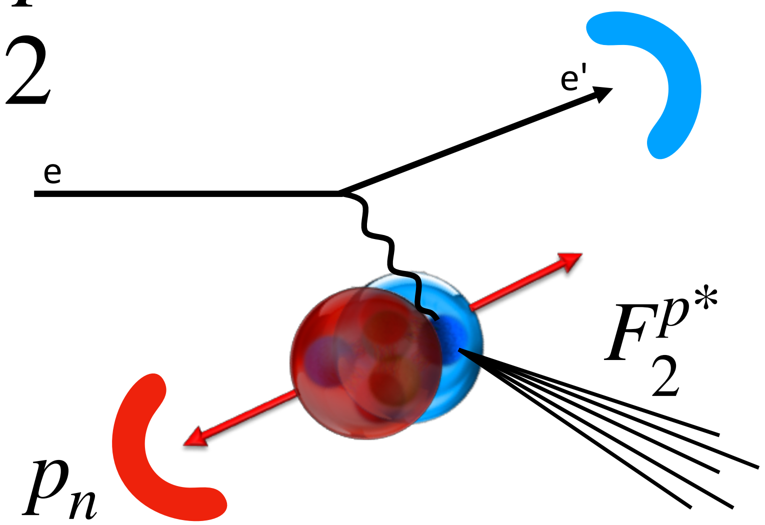
BAND

- 140 scintillator bars
- 5 layers thick (36cm total) with veto layer (2cm thick)
- ToF resolutions < 250 ps
- 3 meters upstream of target, coverage in θ ~ 155-176°
- Design neutron efficiency ~35% and momentum resolution ~1.5%
- Laser system for calibrations

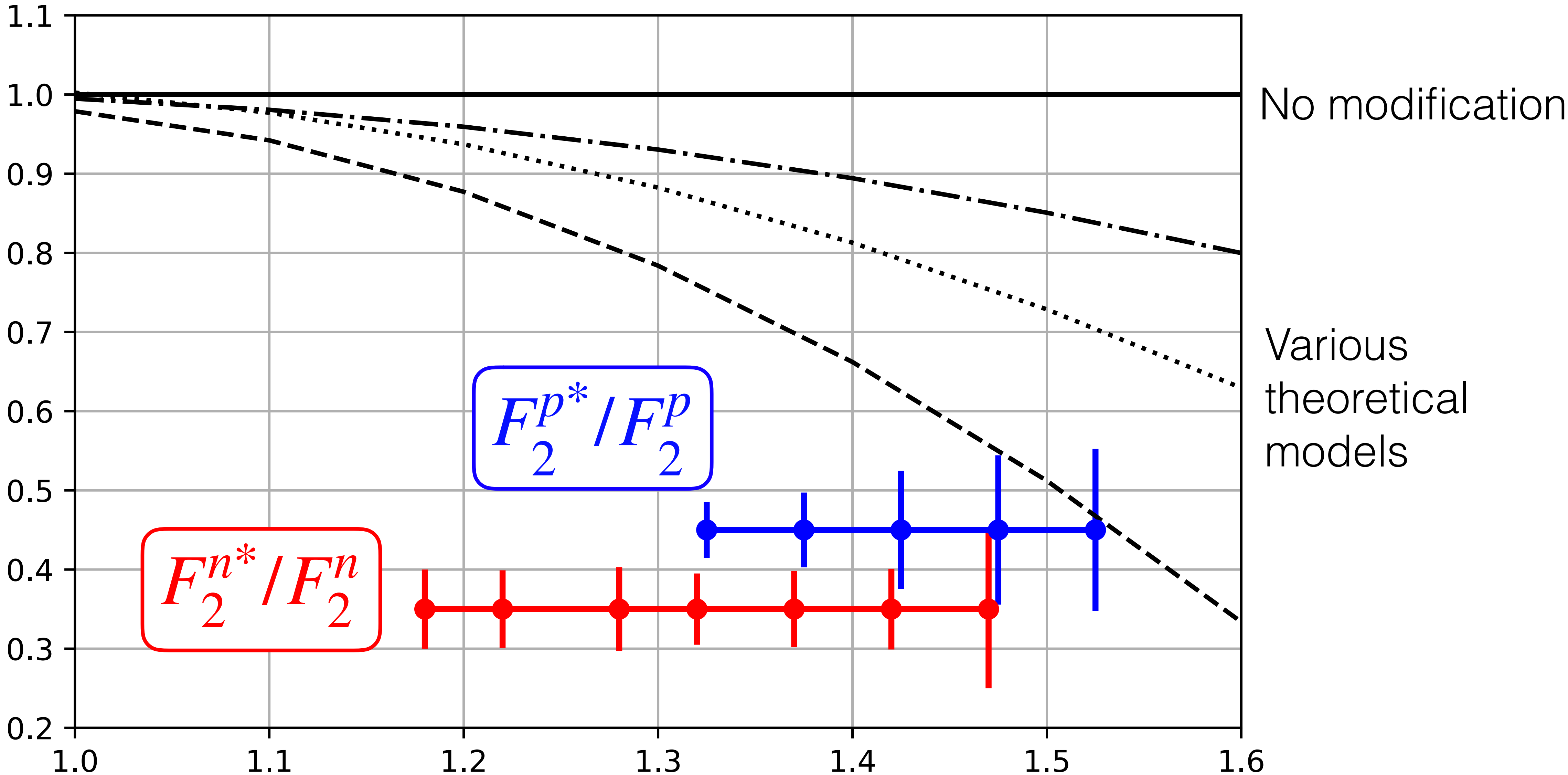




Measure bound F_2^{p*}/F_2^p

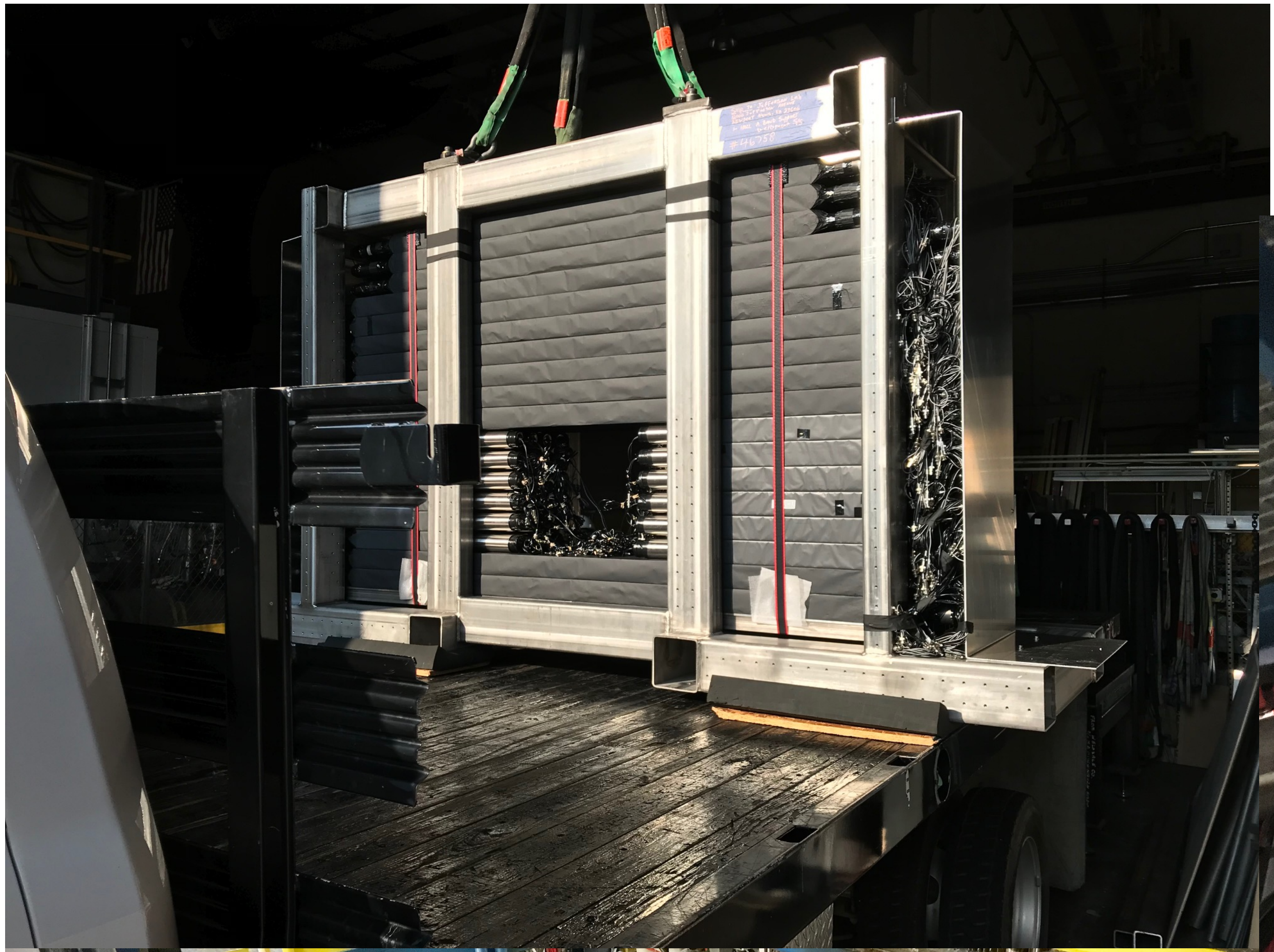


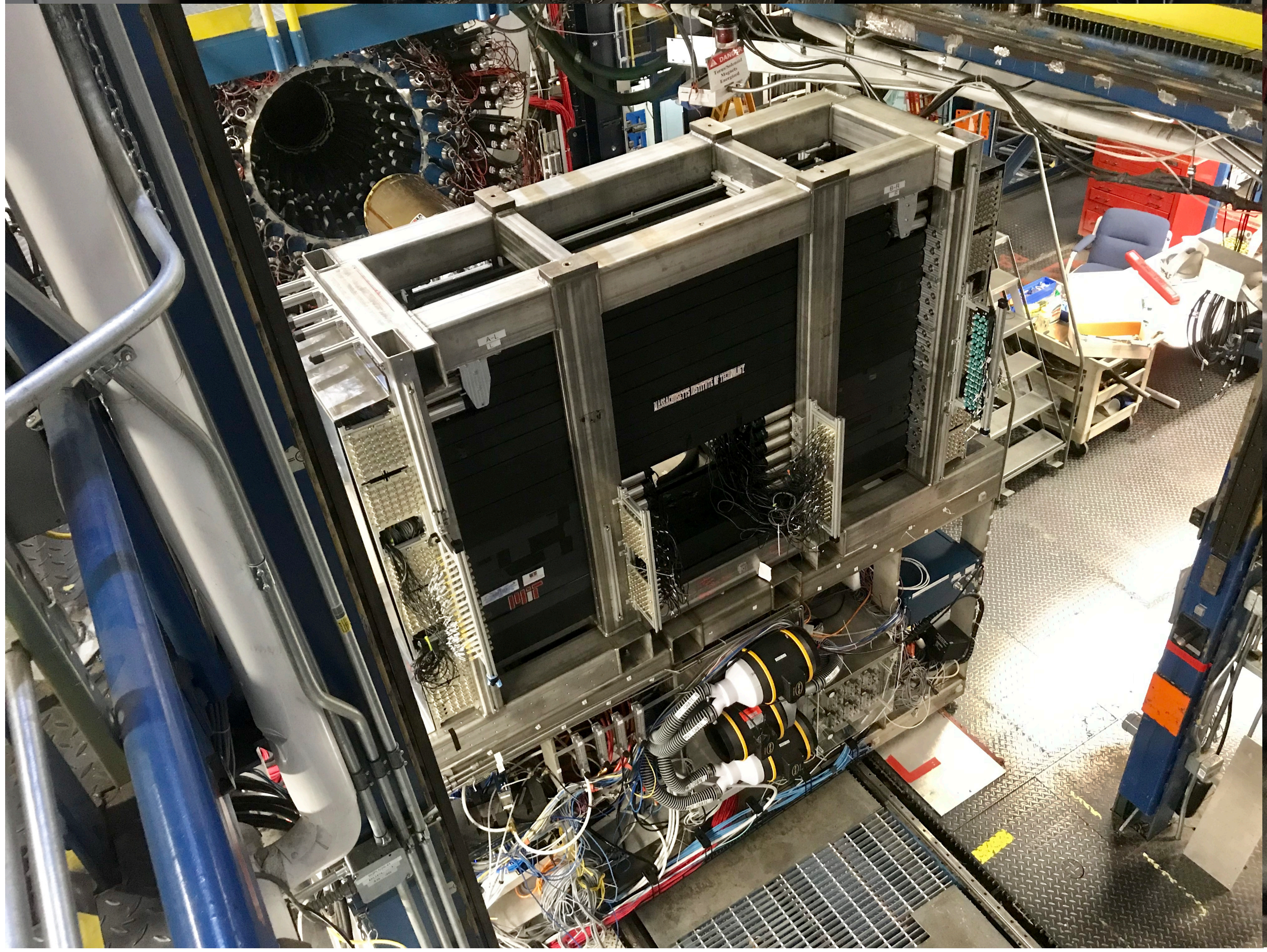
$$\frac{d\sigma^{bound}(Q_2^2, x_2', \theta_{nq}, p_n)}{d\sigma^{bound}(Q_1^2, x_1', \theta_{nq}, p_n)} \Big/ \frac{d\sigma^{free}(Q_2^2, x_2)}{d\sigma^{free}(Q_1^2, x_1)}$$

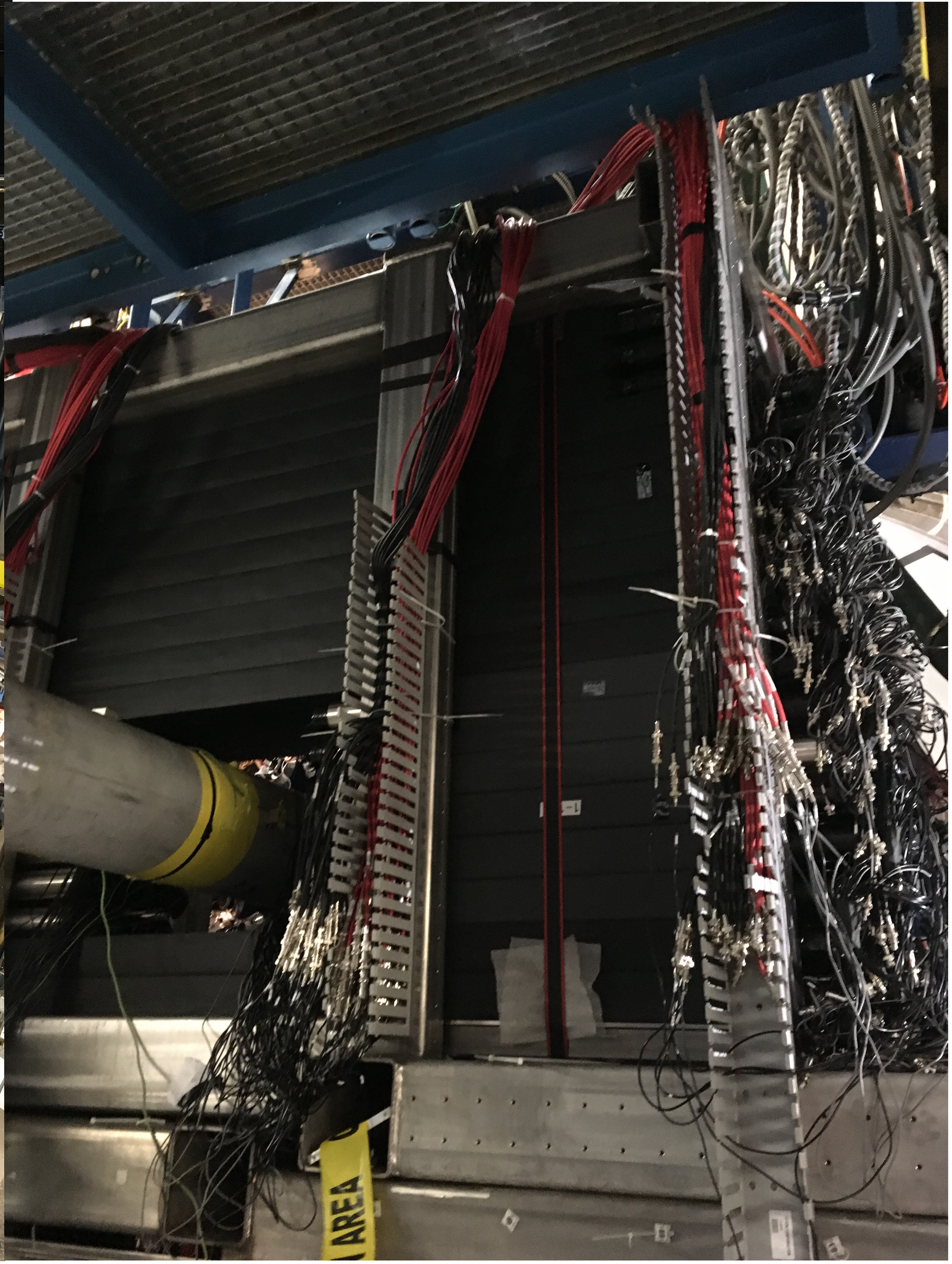


$$\alpha_s = (E_s - p_s^z)/m_s$$

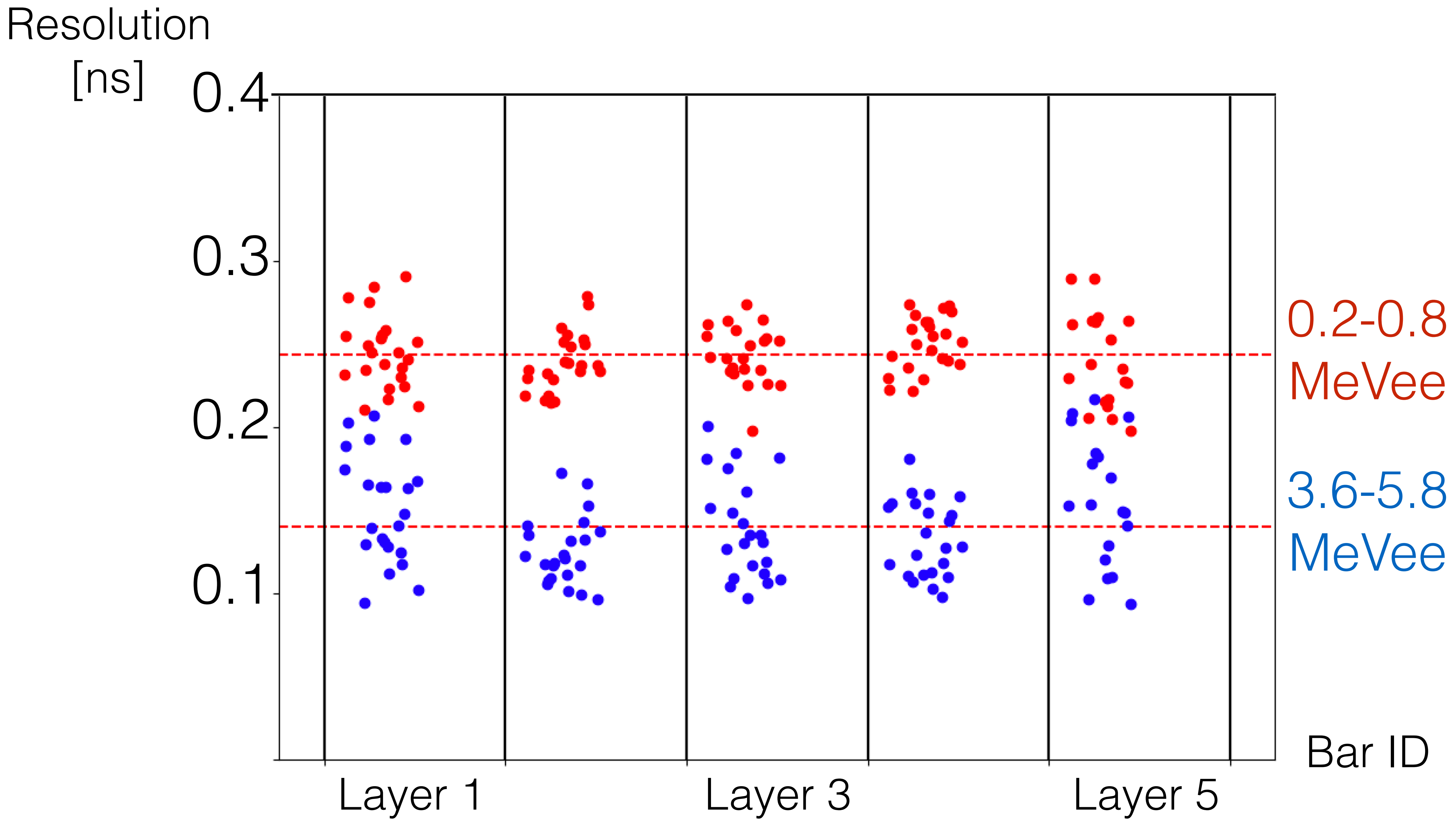
BAND @ CLAS12





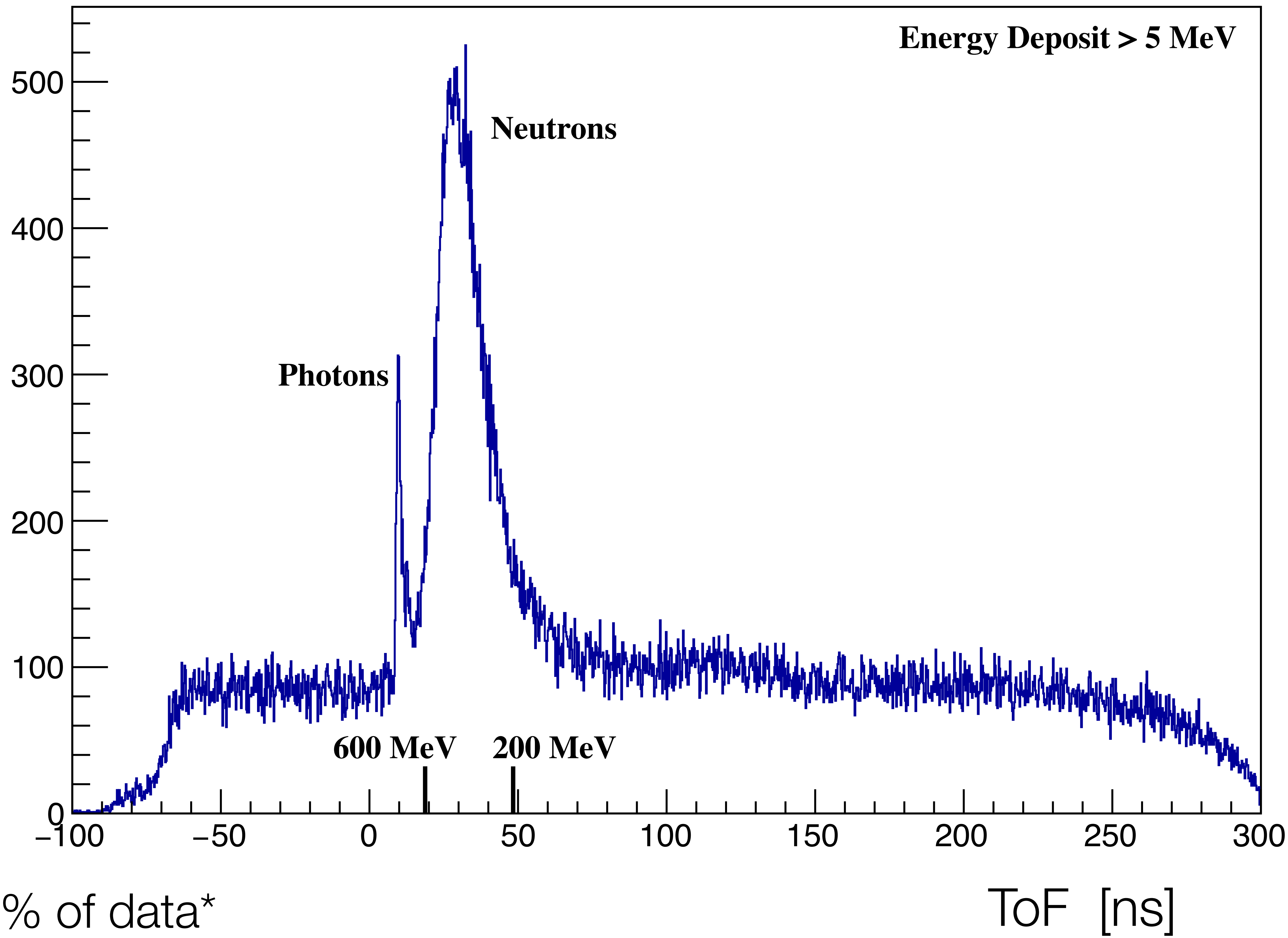


Bar Resolutions



(my thesis work)

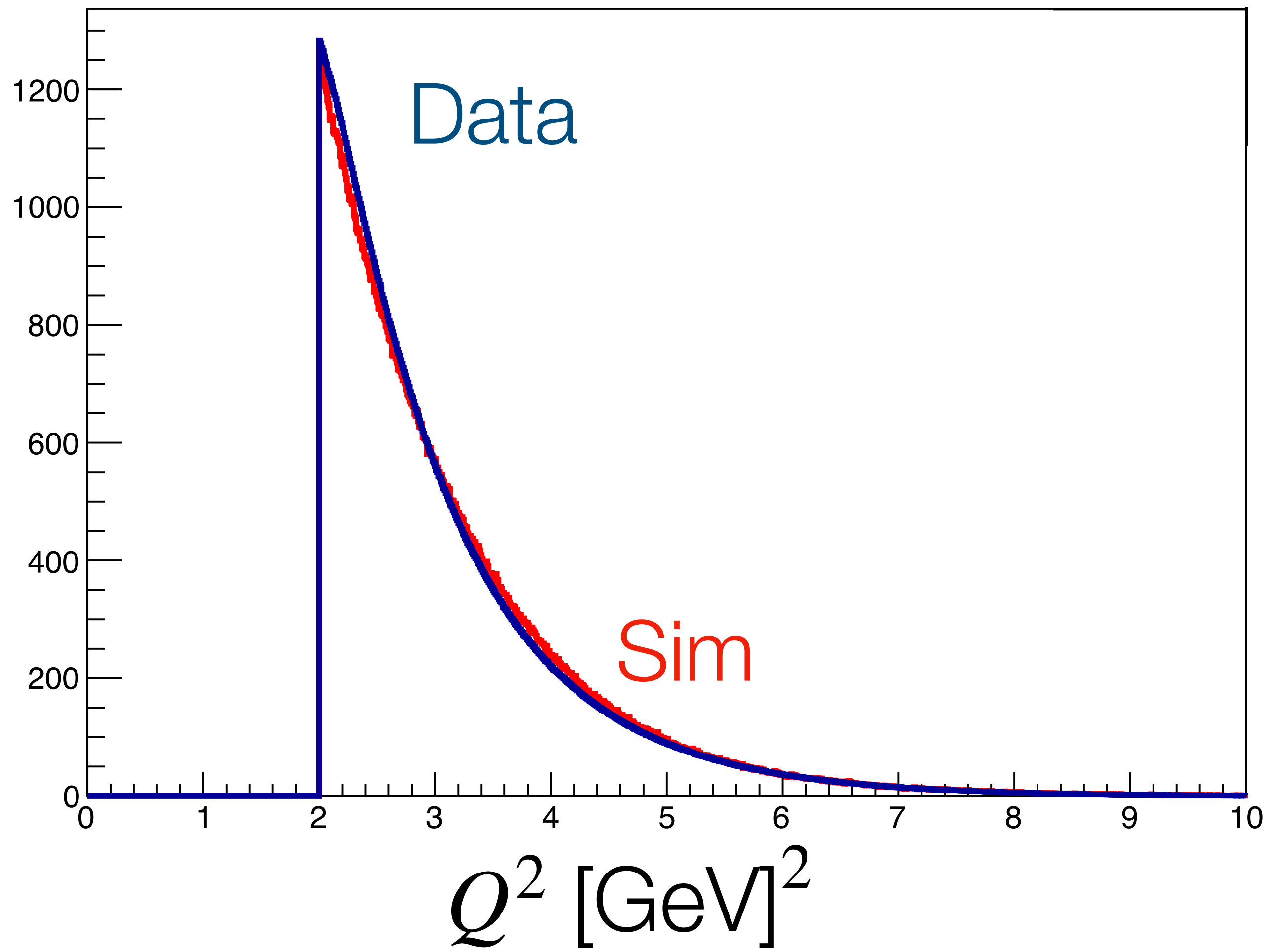
Neutrons in BAND!

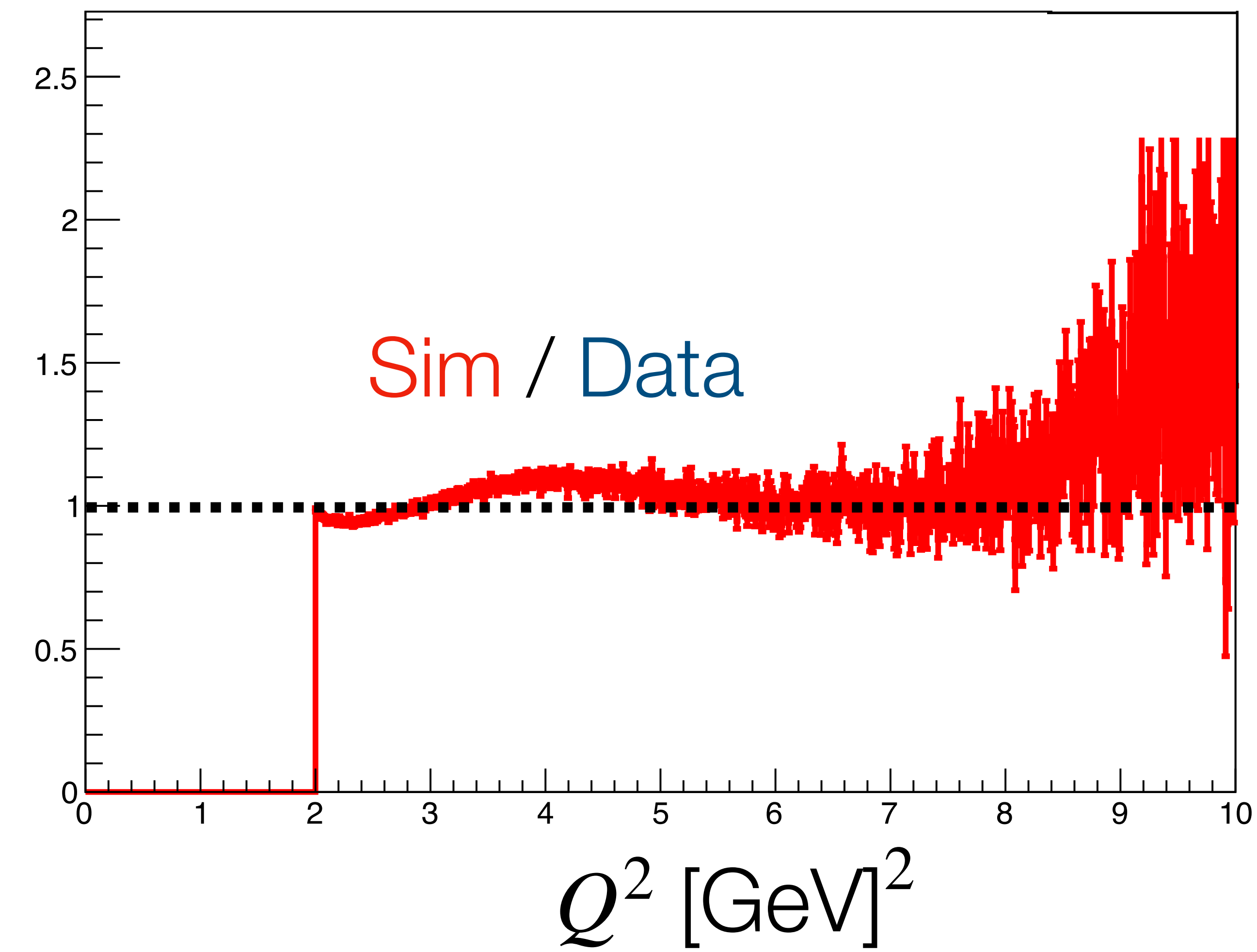


~3.5% of data*
(my thesis work)

Preliminary look at data

Inclusive d(e,e')

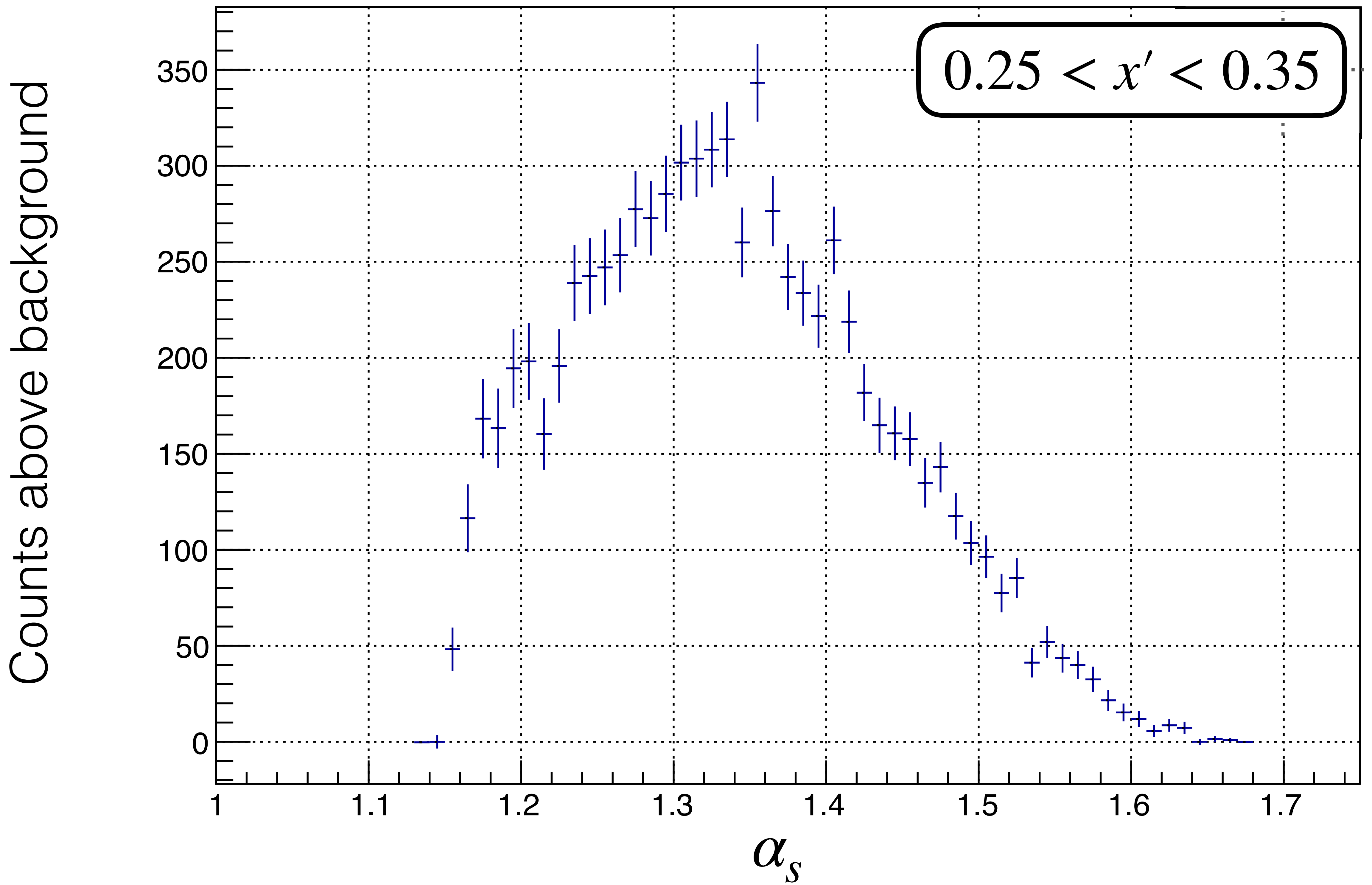




~3.5% of data*
(my thesis work)

Low-x' region should have no modification

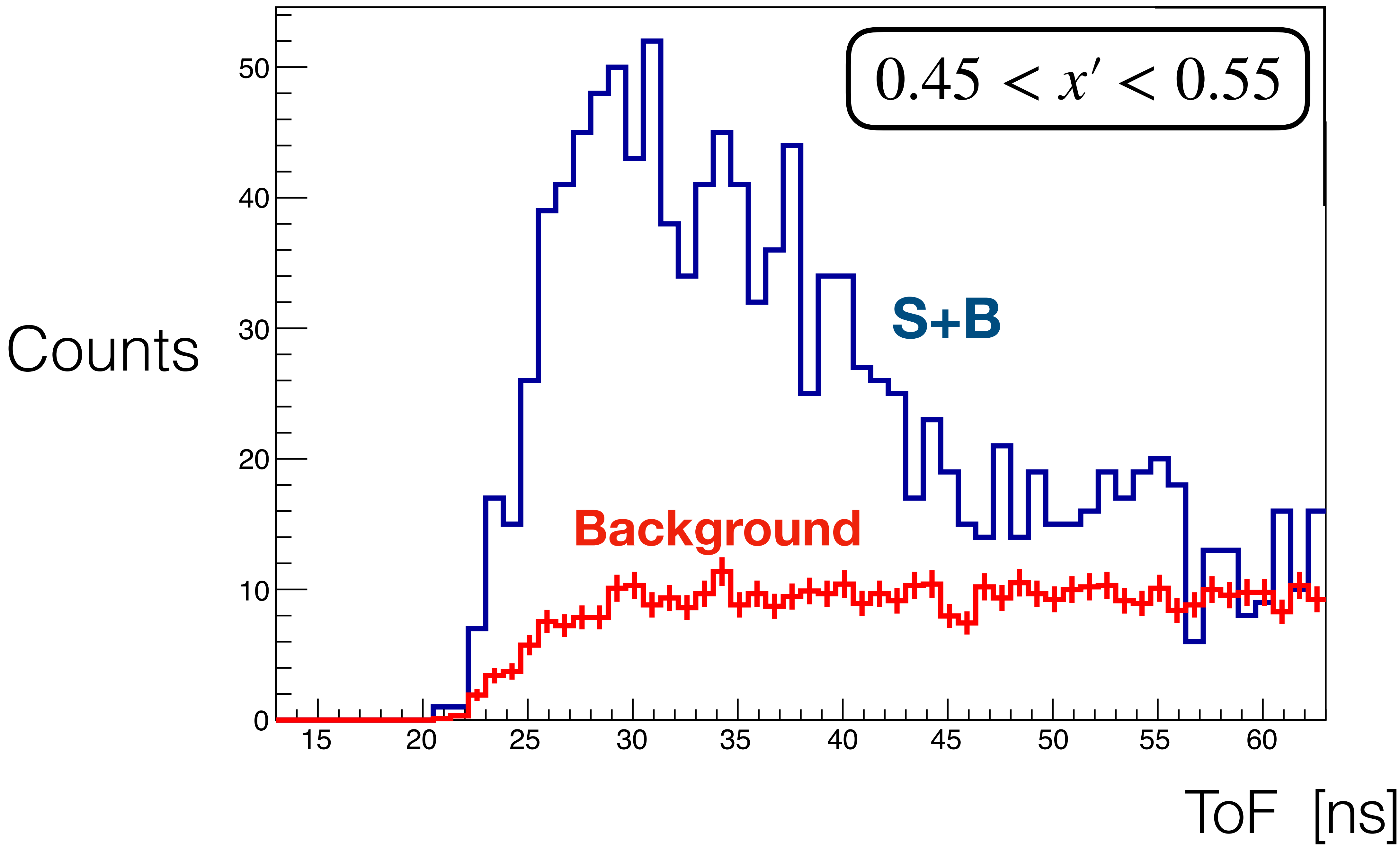
$2 < Q^2 < 10$ $-1 < \cos\theta_{nq} < -0.8$ $W' > 2$



(my thesis work)

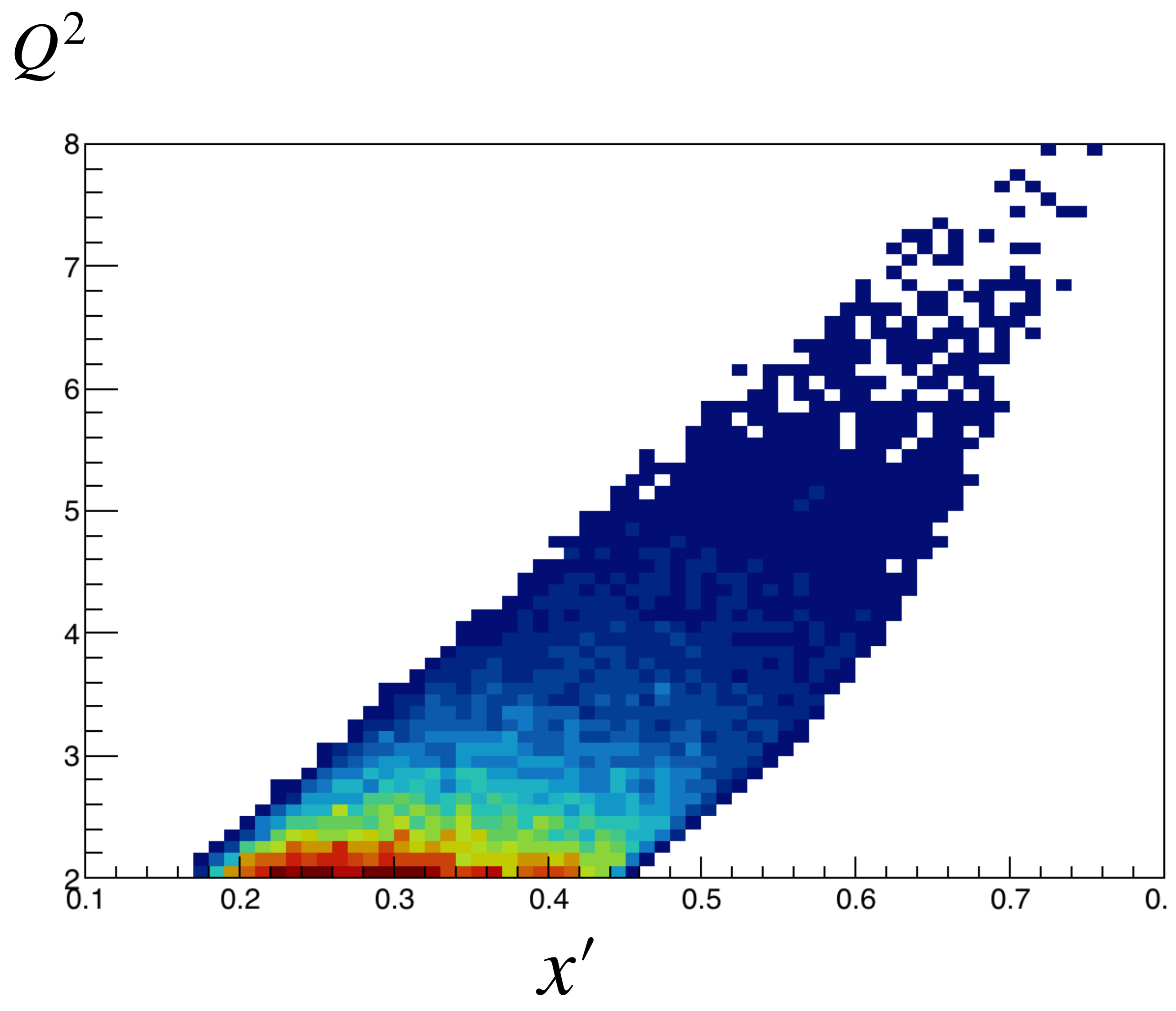
So far, good statistics in hi-x' region

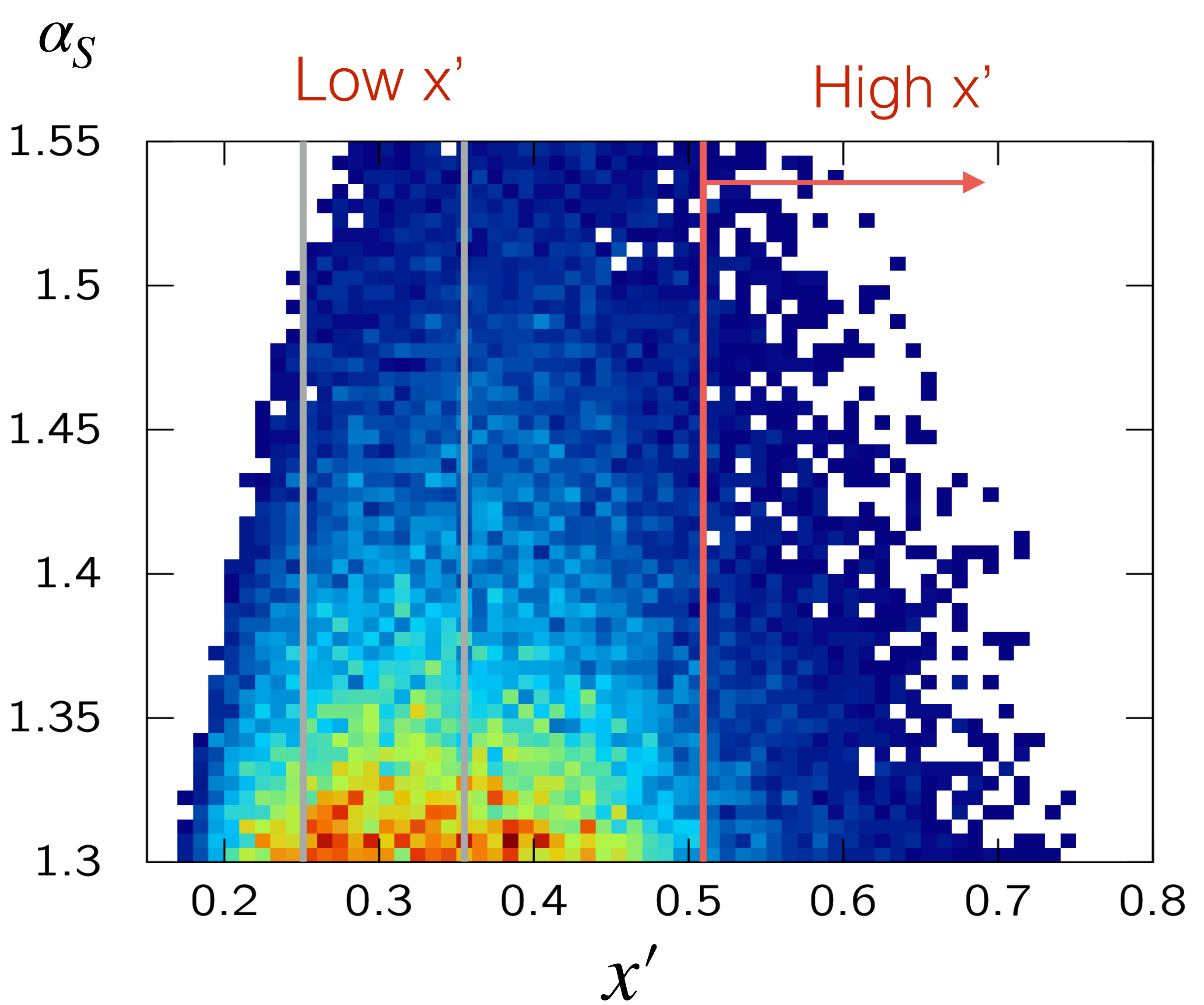
$2 < Q^2 < 10$ $-1 < \cos\theta_{nq} < -0.8$ $W' > 2$



~3.5% of data*
(my thesis work)

Simulated kinematic reach





$Q^2 > 2$ GeV^2
$\cos\theta_{qn} > 110$ deg
$W' > 1.8$ GeV
$p_n > 200$ MeV

- Universal modification of SRC nucleons
- Free neutron structure & A=3
- Tagged DIS at Jefferson Lab 12 GeV
- Nuclear PDFs for the EIC

Where do we go from here

From nuclear DIS to nuclear PDFs

$$\frac{d\sigma^A}{dxdQ^2} \quad \Bigg\} \quad F_2^A\left(x,Q^2\right) \quad \Bigg\} \quad \begin{array}{l} F_2^n\left(x,Q^2\right) \\ f_i^A\left(x,Q^2\right) \end{array}$$

Hi-*x* and nuclear PDFs for EIC

$$f_i^A(x, Q^2)$$

nCTEQ Collaboratioin

(Collaborative work with Fred Olness, Aleksander Kusina, Ingo Schienbein, Thia Keppel, Timothy Hobbs, Karol Kovarik,, and many more)

SMU®

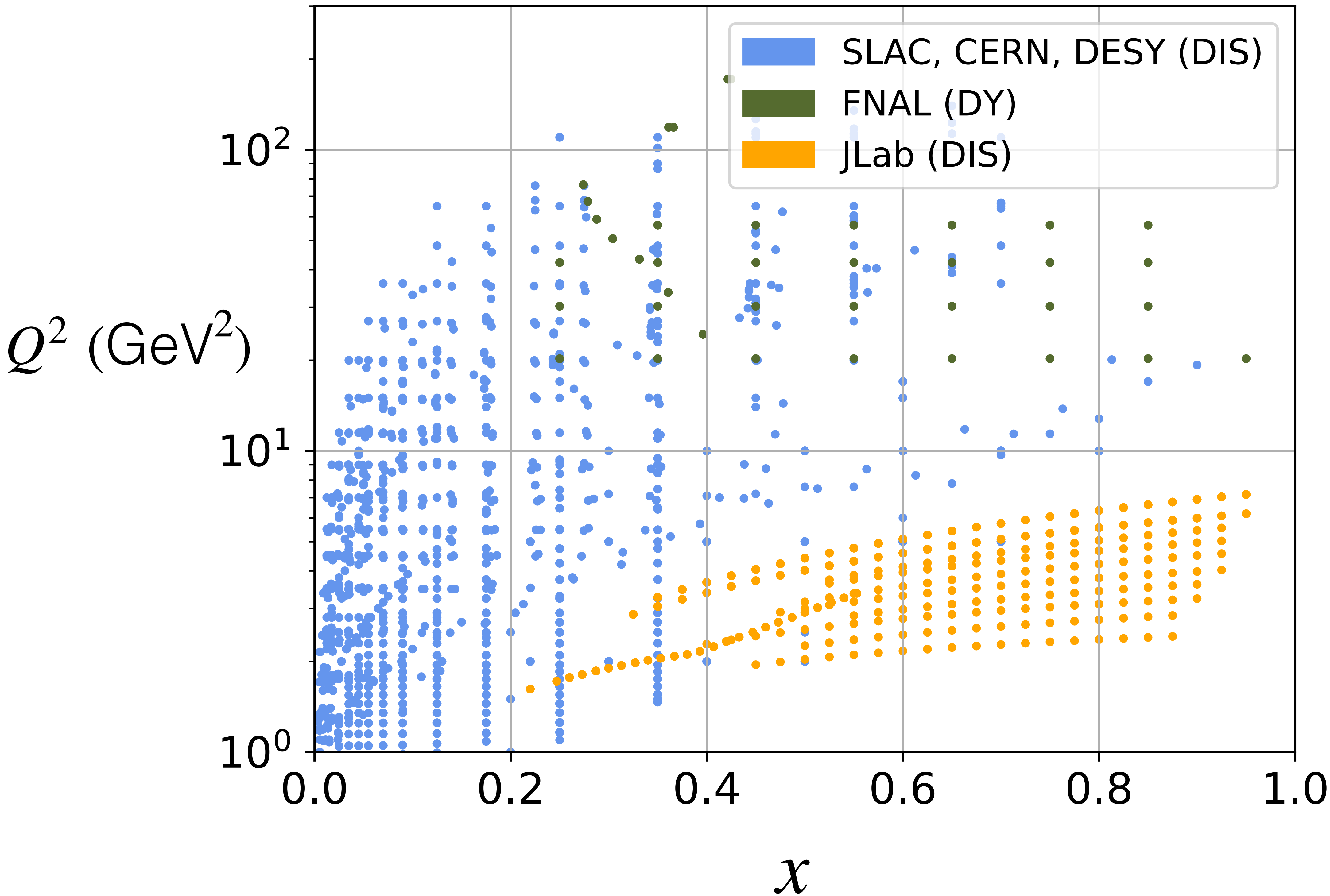
Jefferson Lab

WWU MÜNSTER

Université Joseph Fourier GRENOBLE

How to extract nuclear PDFs?

$$F_2^A(x, Q^2) \sim \sum_i f_i^{(A,Z)}(x, Q^2)$$



Keeping in mind the limitations on constraints

What is measured:

$$F_2^A(x, Q^2) \sim \sum_i f_i^{(A,Z)}(x, Q^2)$$

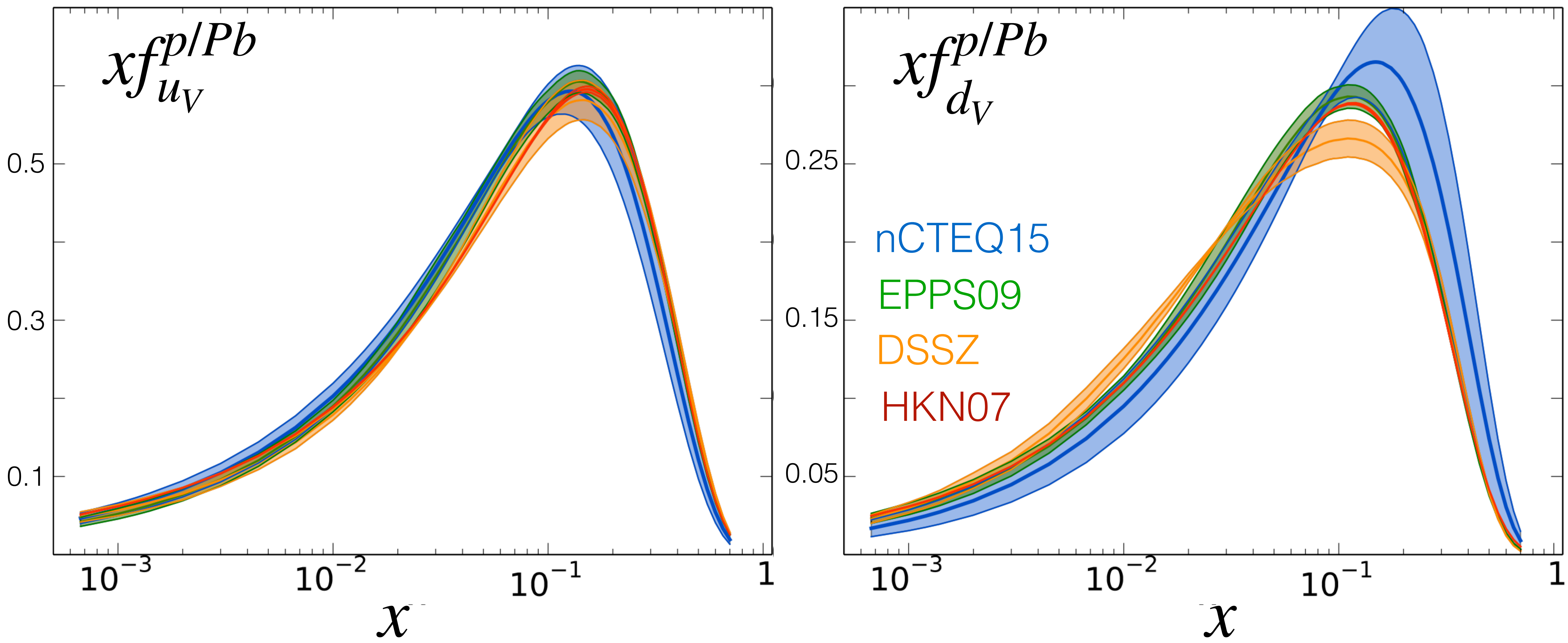
What is constrained:

$$f_i^{(A,Z)}(x, Q) = \frac{Z}{A} f_i^{p/A}(x, Q) + \frac{A-Z}{A} f_i^{n/A}(x, Q)$$

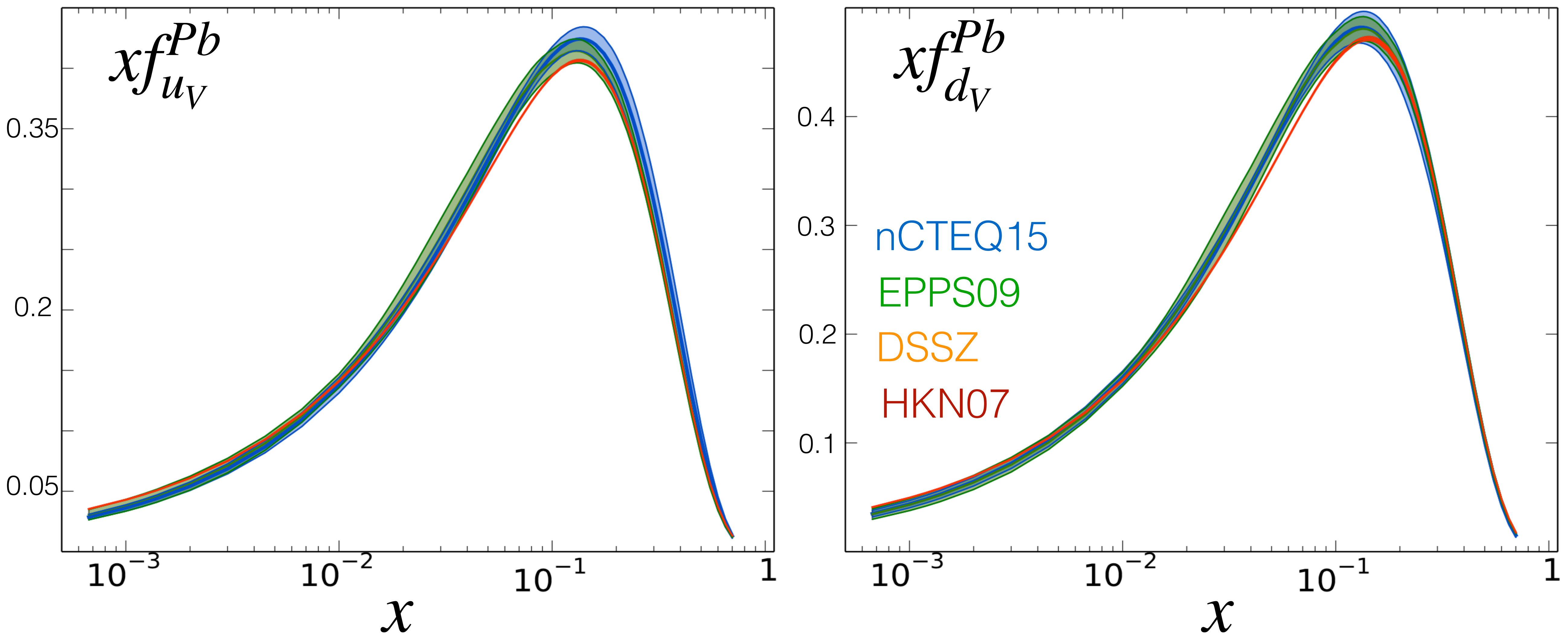
Effective quantities:

$$x f_i^{p/A} \sim x^a (1-x)^b (\ldots)$$

While effective PDFs have some variance between groups



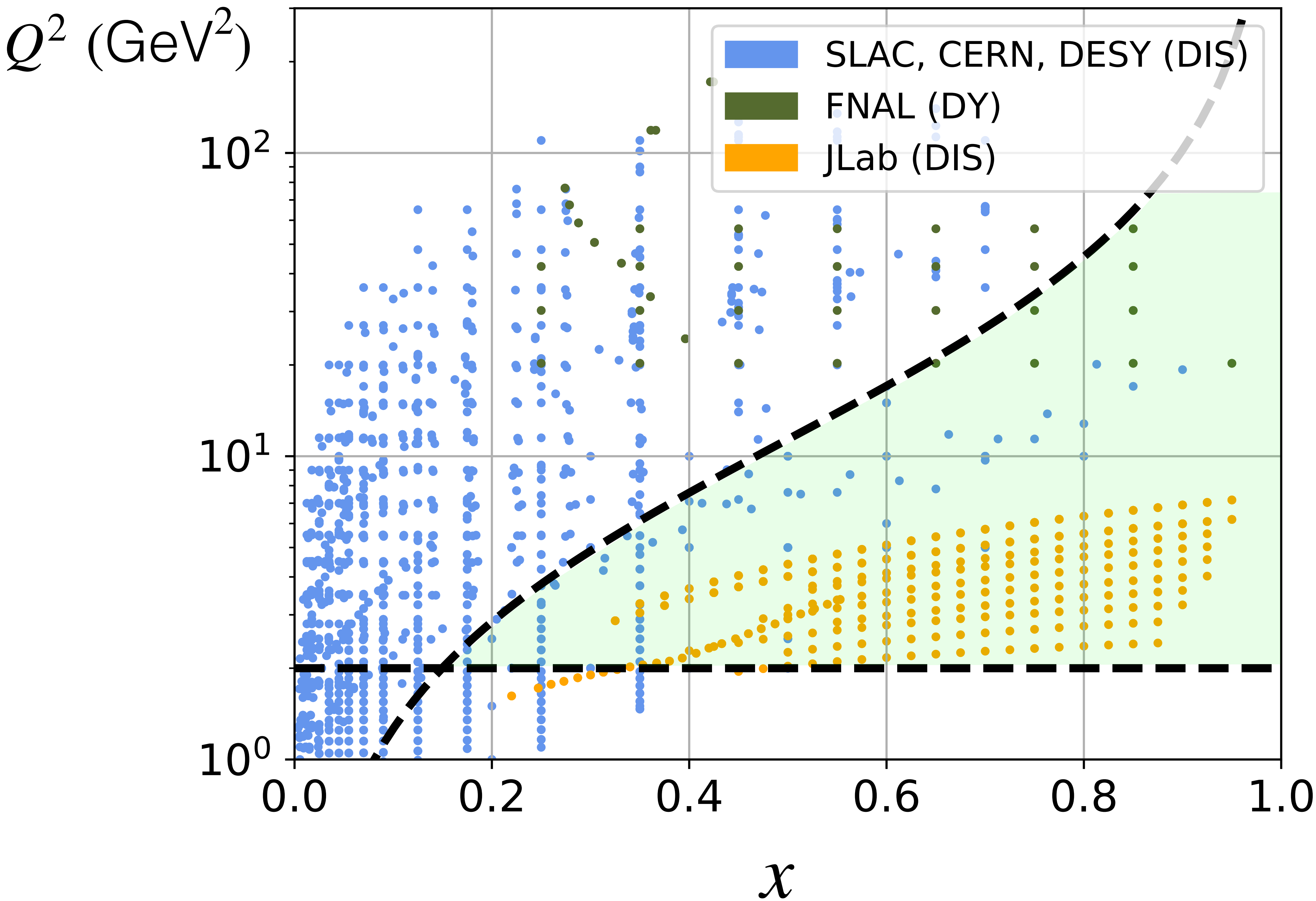
Full Nuclear PDFs are very similar



Majority of data in nCTEQ15 is isoscalar corrected

No sensitivity to difference of u_v,d_v

Moving to valence region

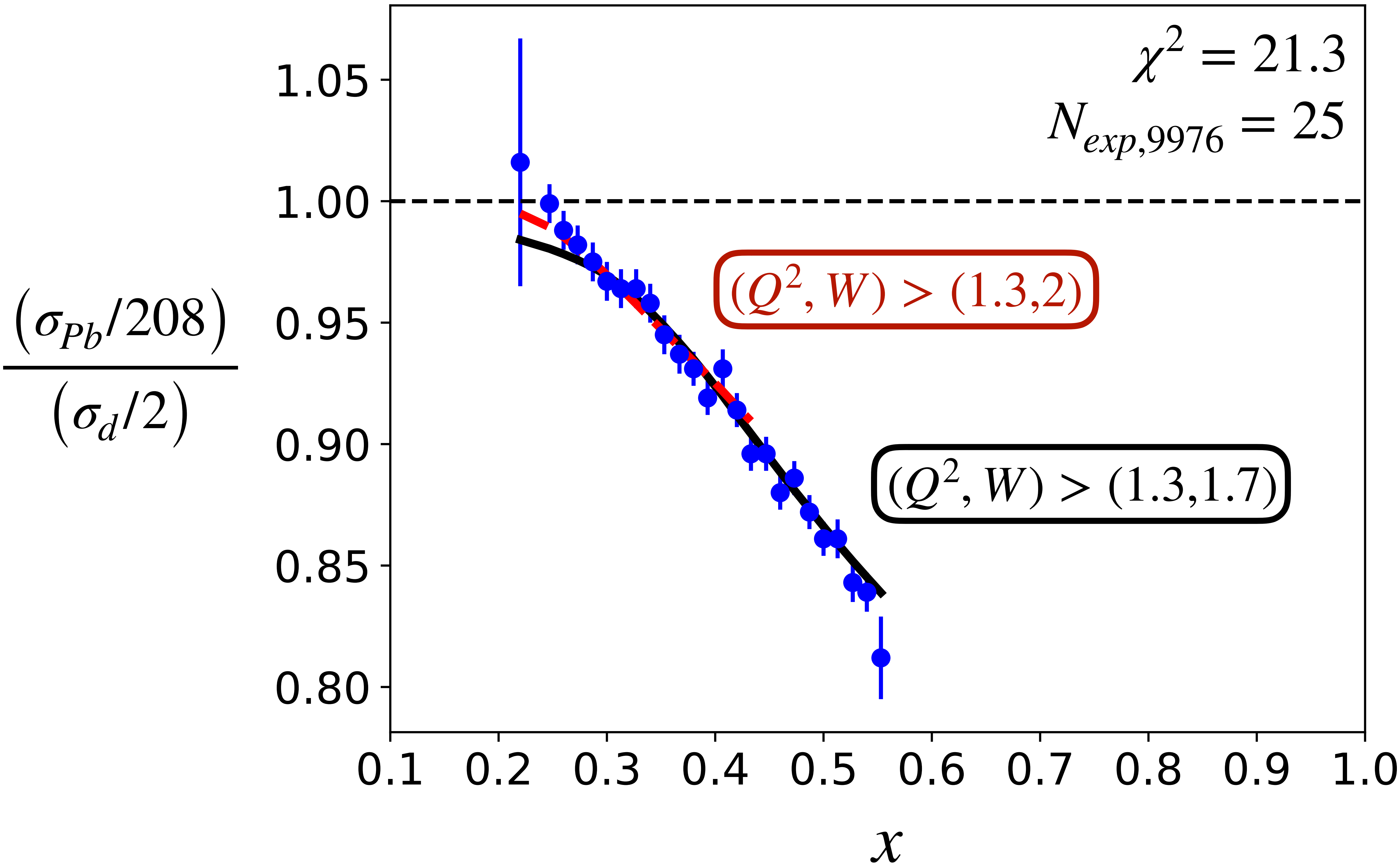


Challenges in valence region

Requires lower (Q^2,W) cuts

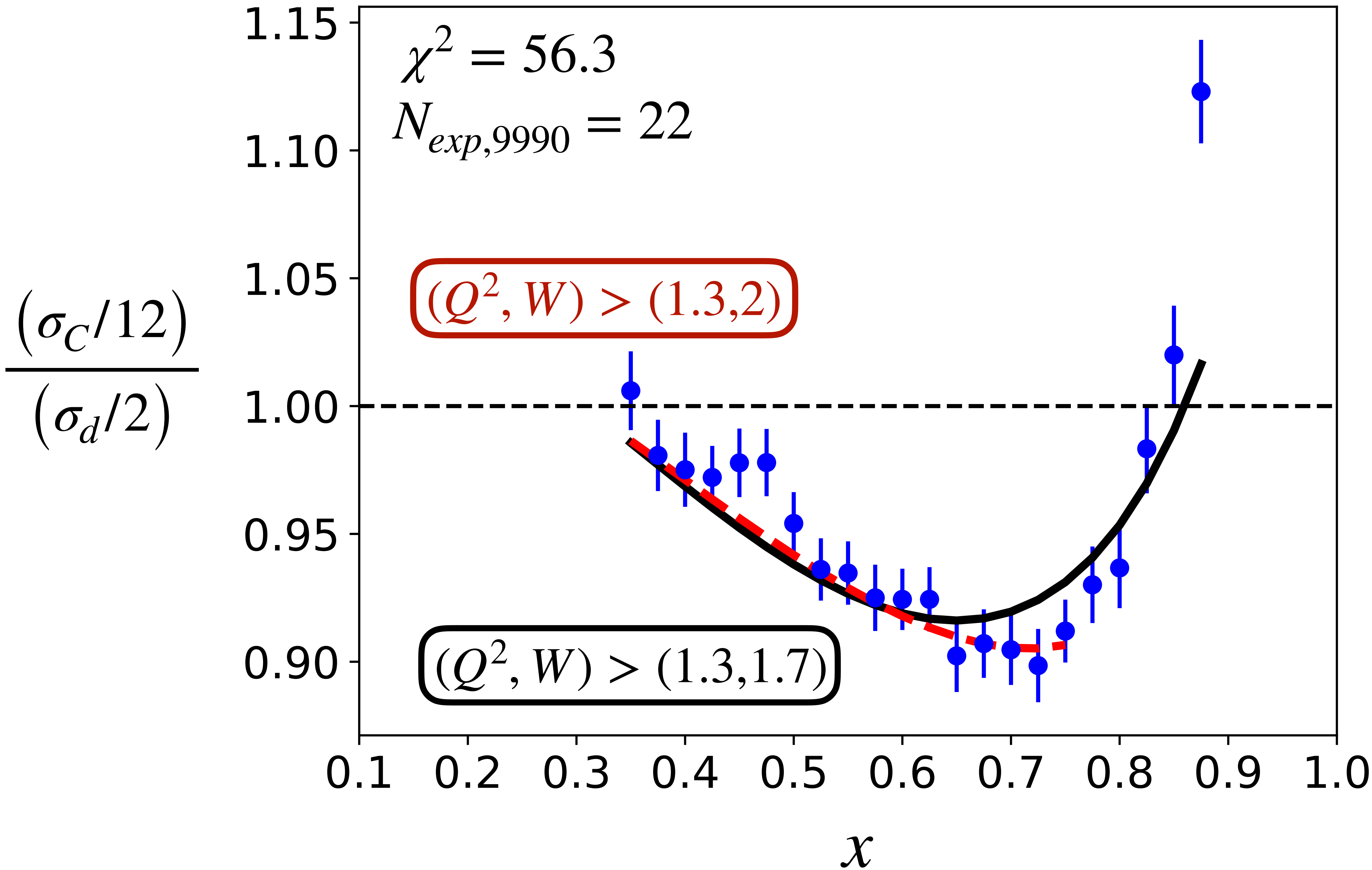
- Describe JLab6 data with nCTEQ15 data consistently
- Target-mass and higher-twist effects
- Flexible x-parameterization
- Assumption of A-dependence
- Deuterium nuclear corrections

x- and A- parameterization



JLab6, Hall B

x- and A- parameterization

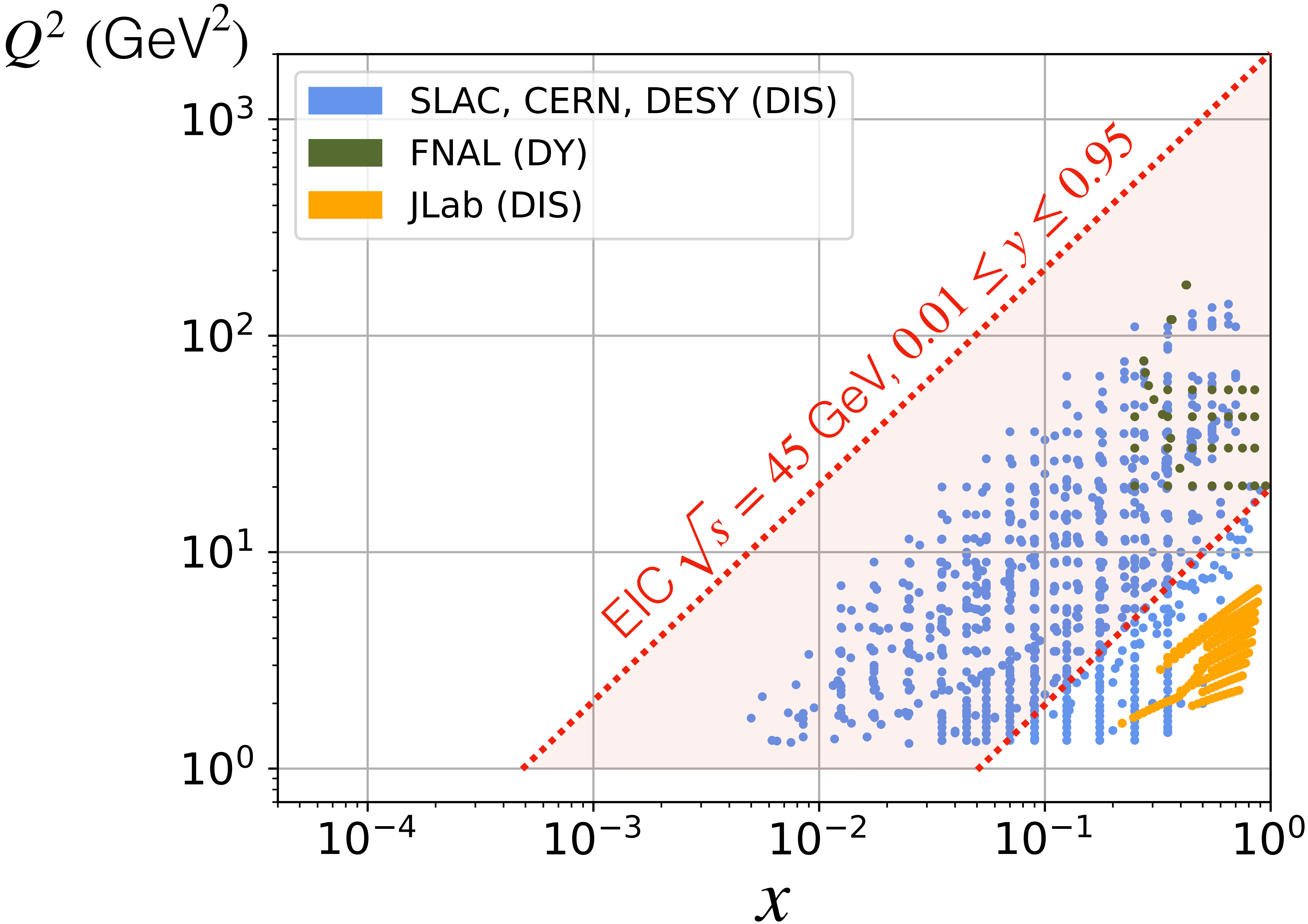


JLab6, Hall C

Stay tuned for nCTEQ 16 (?) PDFs

- Tackle hi-x and low Q^2
- Update parameterization for hi-x and low-A
- Update free proton PDFs
- Address TMC at hi-x and low Q^2
- Understand sensitivity to deuterium nuclear corrections

Addressing valence-region for EIC



Summary

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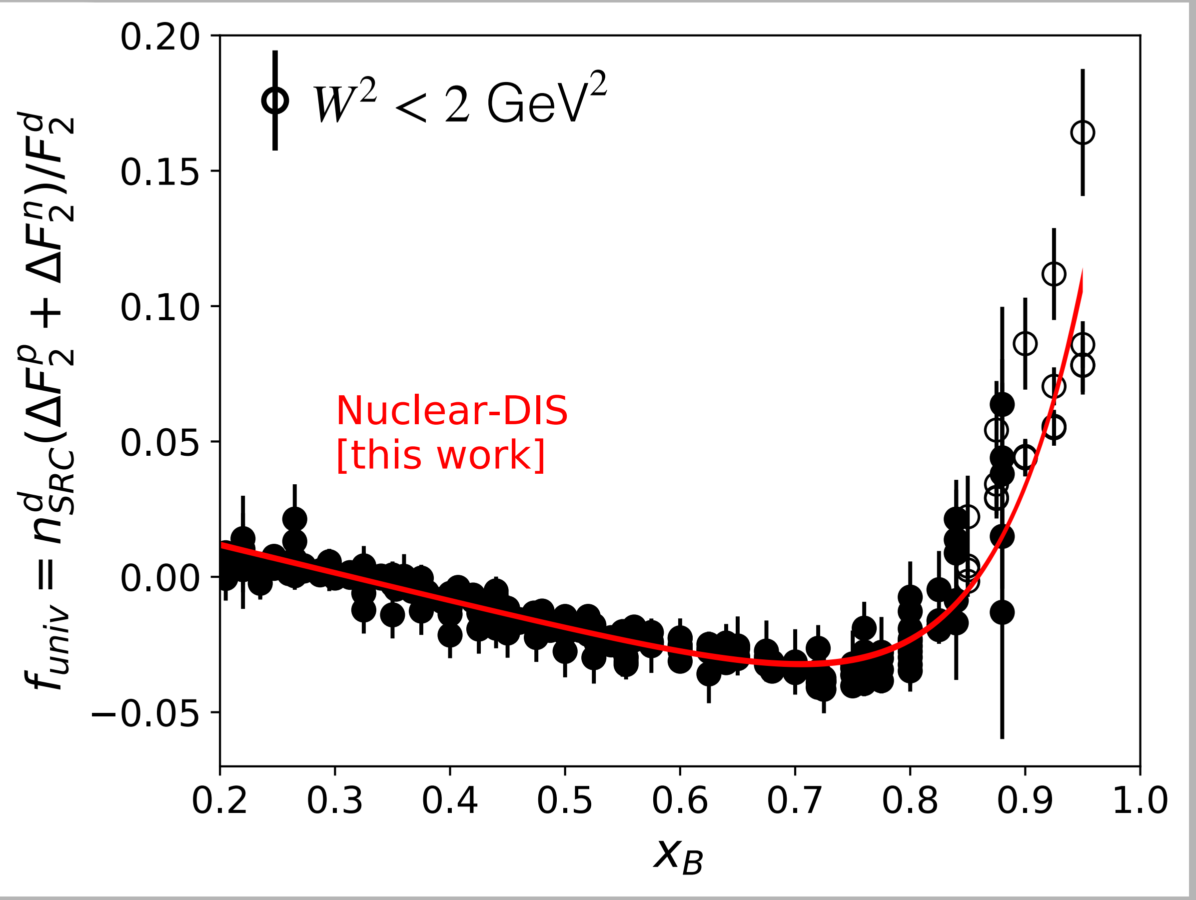

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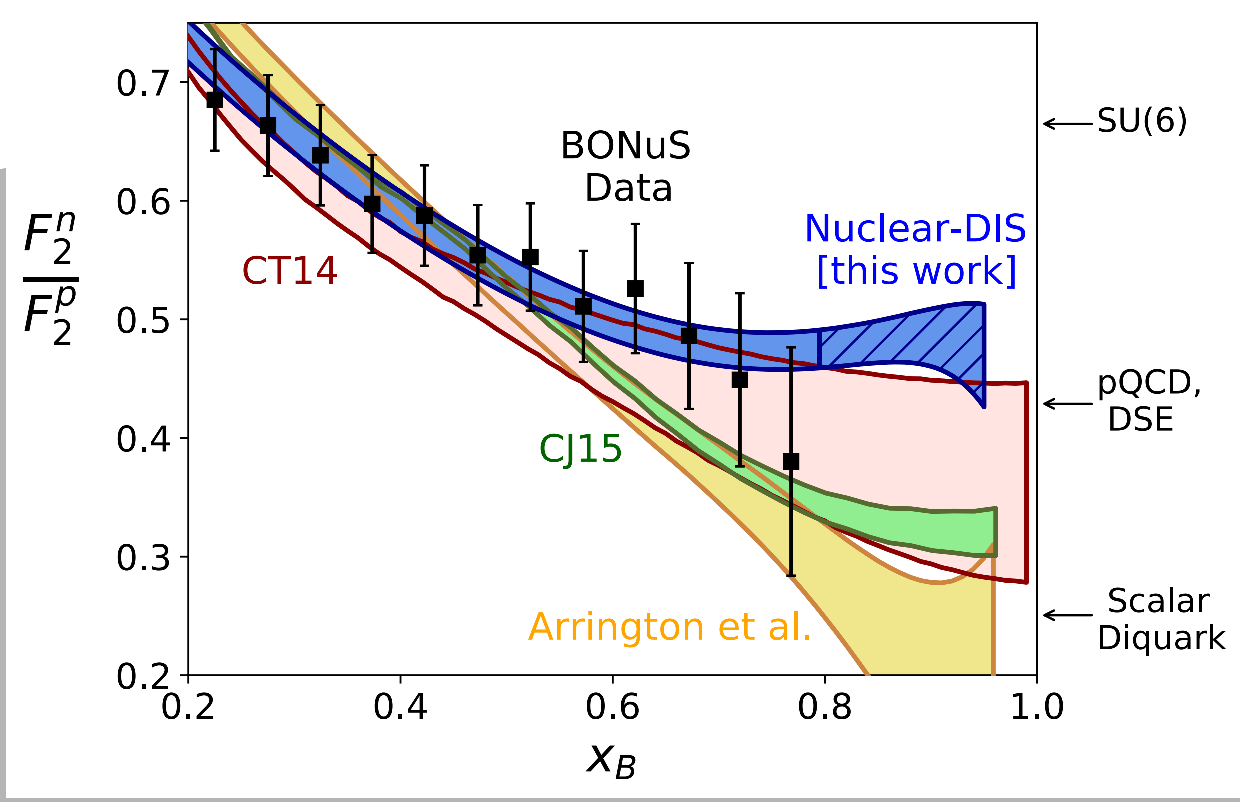

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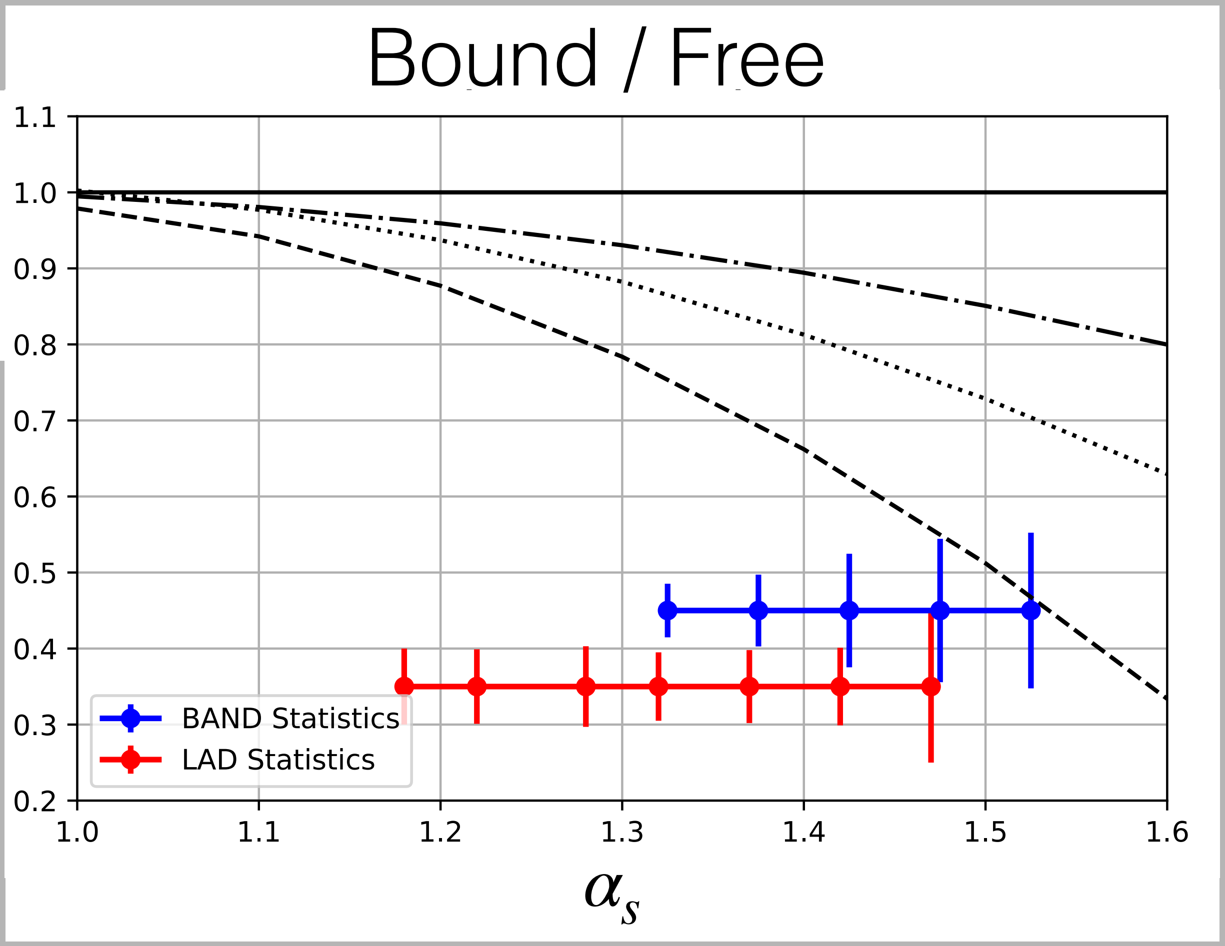

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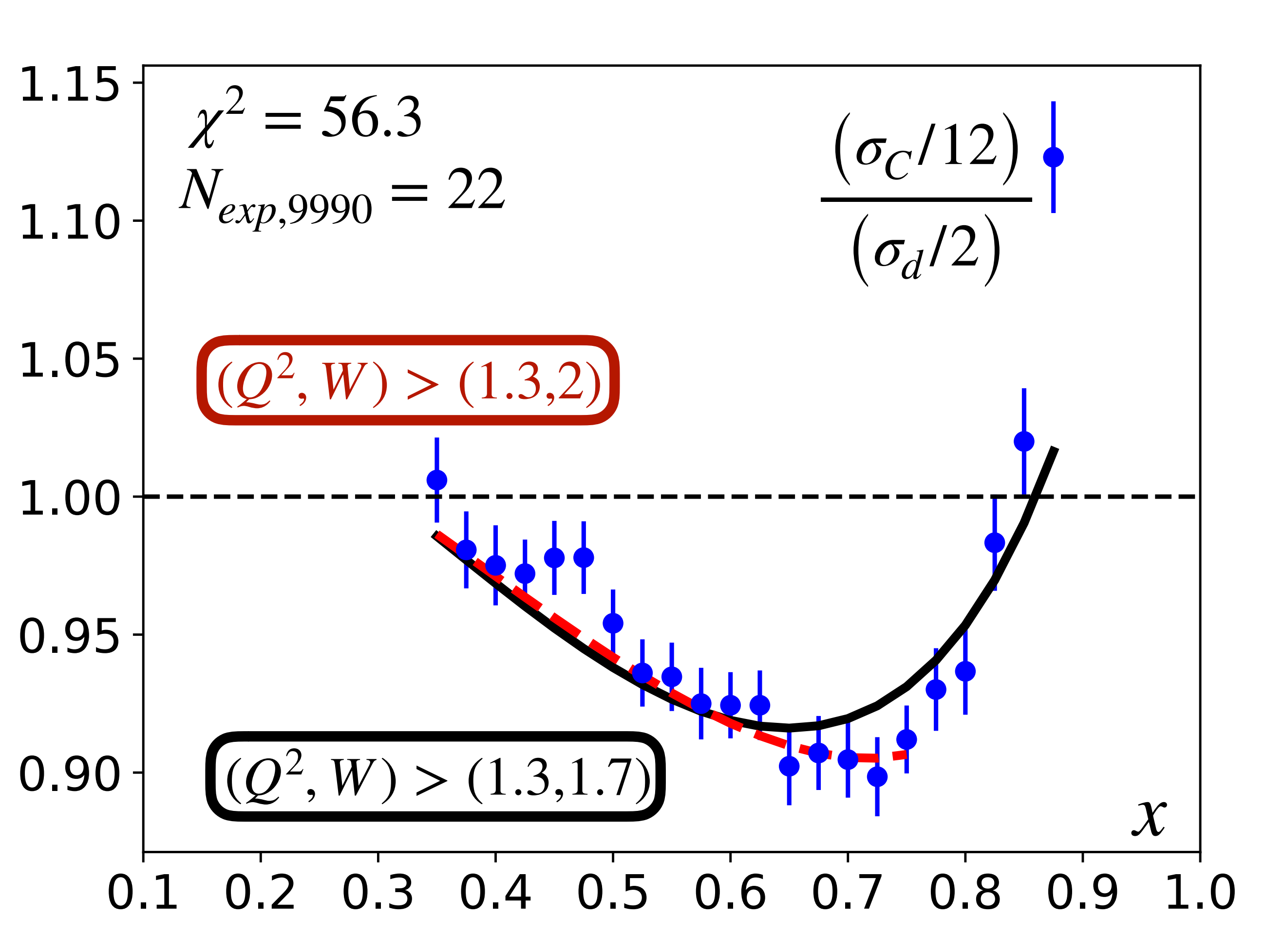


Thanks! Questions?

Efrain Segarra

Exploring QCD with light nuclei at EIC

Jan 22, 2020

Back up

EMC - SRC

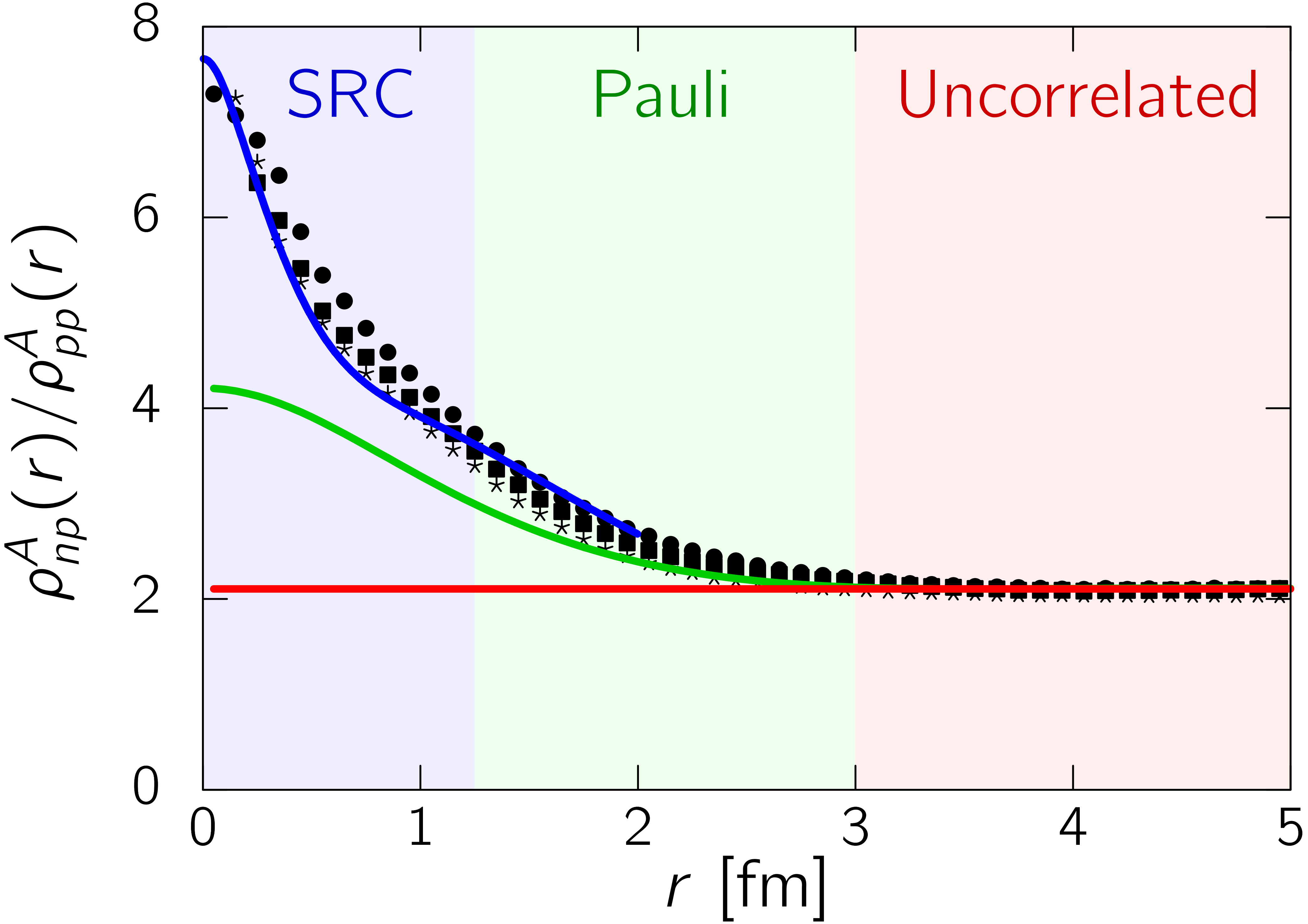
EMC Models across the decades

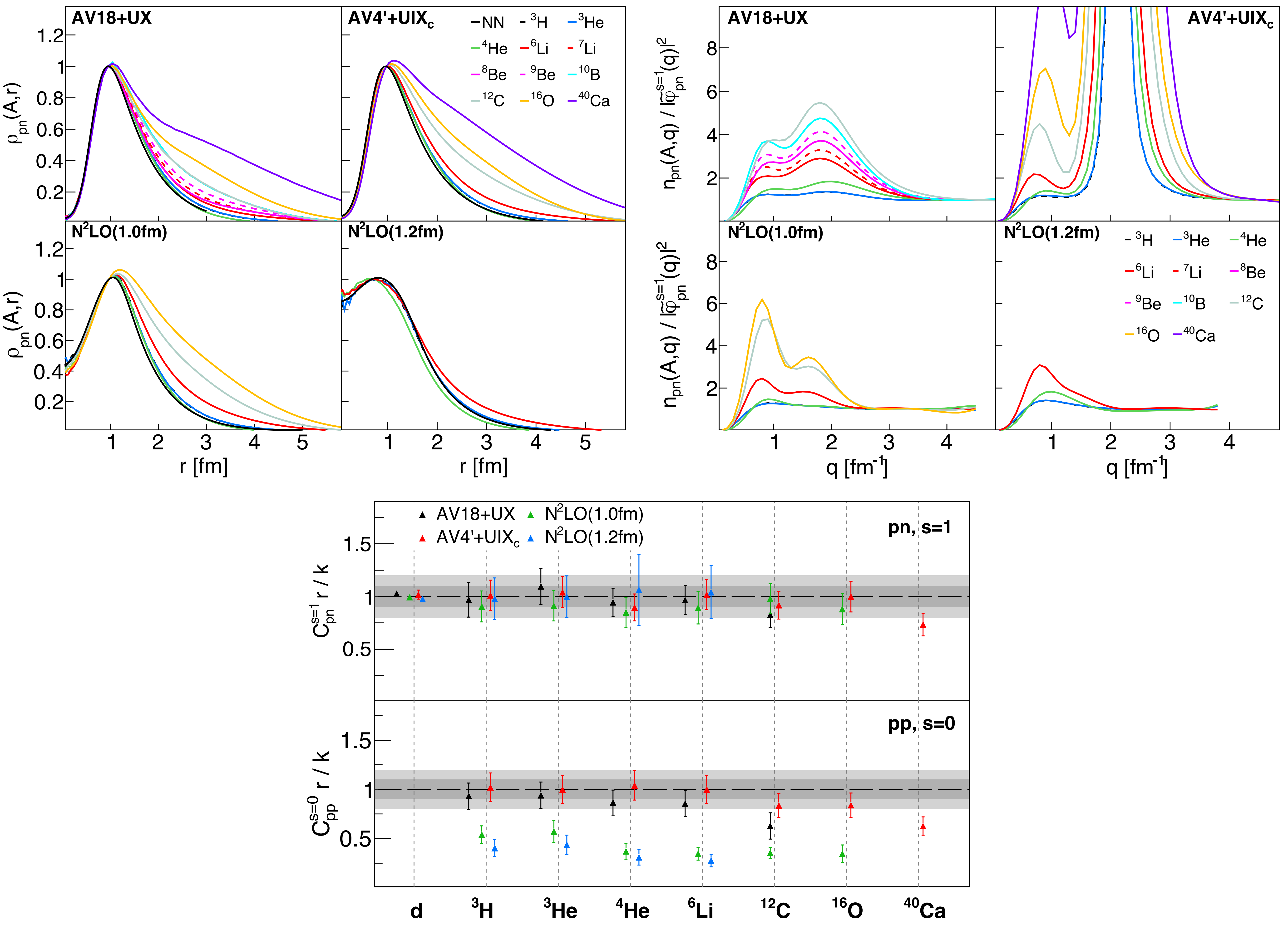
- Proper treatment of ‘known’ nuclear effects
  - Fermi-smearing
  - Nuclear binding

- Bound nucleons are ‘larger’ than free nucleons
  - Larger volume = ‘slower’ quarks
  - Mean-field effect
  - Momentum independent

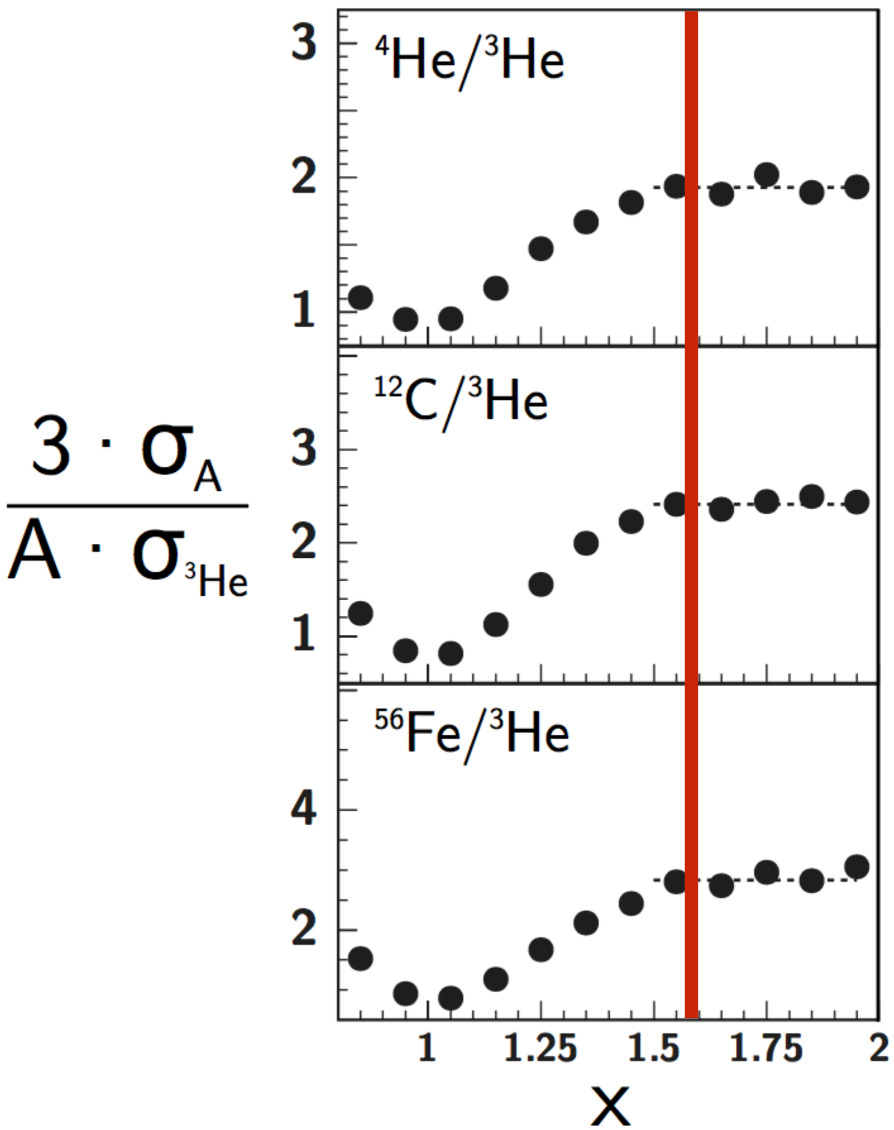
- **Short-range correlations**
  - Beyond mean-field effect
  - Momentum dependent
  - ‘A few nucleons modified a lot’

High virtuality and local density

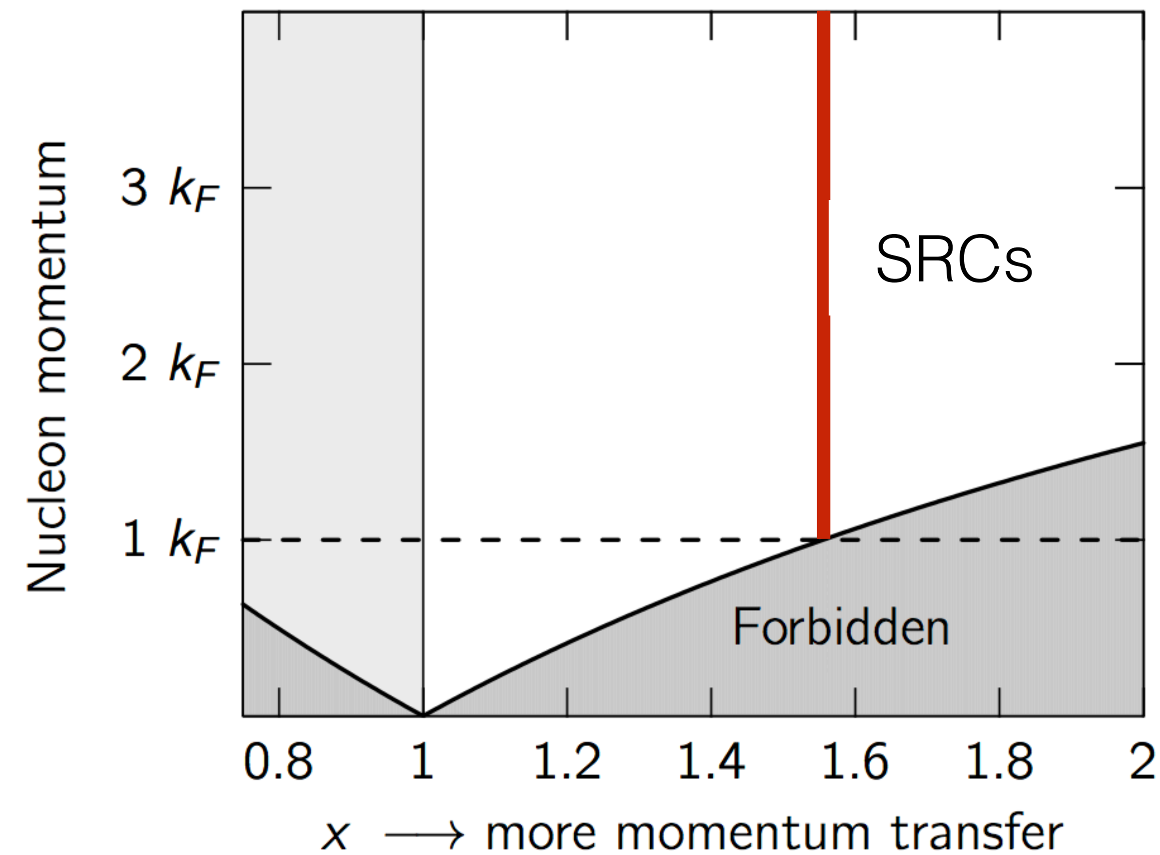



AV18+UX
AV4'+UIX$_c$
N^{2}LO(1.0fm)
N^{2}LO(1.2fm)
NN
^{3}H
^{3}He
^{4}He
^{6}Li
^{7}Li
^{8}Be
^{9}Be
^{10}B
^{12}C
^{16}O
^{40}Ca
$\rho_{pn}(A,r)$
r [fm]
$n_{pn}(A,q) / |\tilde{\varphi}^{s=1}_{pn}(q)|^2$
q [fm^{-1}]
pn, s=1
pp, s=0
$C^{s=1}_{pn}$ r / k
$C^{s=0}_{pp}$ r / k
d
^{3}H
^{3}He
^{4}He
^{6}Li
^{12}C
^{16}O
^{40}Ca

Inclusive a2



K.S. Egiyan et al. PRL 96, 082501(2006)



Scaling constant a_2:

$$\sigma_A = \mathbf{a}_2 \times \frac{A}{2}\sigma_d$$

Bound nucleons in EFT and QCD

<u>1. EFT:</u> $F_2^A(x, Q^2) = F_2^N(x, Q^2) + g_2(A, \Lambda) \cdot f_2(x, Q^2, \Lambda)$

Bound = Free + <u>Factorized Modification</u>

<u>2. QCD:</u> $|N\rangle_{bound} = |N\rangle + (\varepsilon_{bound} - \varepsilon)|N^*\rangle$

Hen, Miller, Piasetzky and Weinstein,
Reviews of Modern Physics (2017).

Chen, Detmold, Lynnm, and
Schwenk, PRL (2018).

Proton Wave-Function in QCD

$$\left|p\uparrow\right\rangle = \frac{1}{\sqrt{2}}\left|u\uparrow(ud)_{S=0}\right\rangle + \frac{1}{\sqrt{18}}\left|u\uparrow(ud)_{S=1}\right\rangle - \frac{1}{3}\left|u\downarrow(ud)_{S=1}\right\rangle - \frac{1}{3}\left|d\uparrow(uu)_{S=1}\right\rangle + \frac{\sqrt{2}}{3}\left|d\downarrow(uu)_{S=1}\right\rangle$$

- SU(6) predict d/u = 0.5
  - ✧ N - Δ mass difference implies SU(6) is broken

Nucleon Model	**F2n / F2p**	**d / u**
SU(6)	2 / 3	0.5

Brodsky et al., Nucl. Phys. B441, 197 (1995)[1]
Melnitchouk and Thomas, Phys. Lett. B377, 11 (1996)

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$$-\frac{1}{3}|d\uparrow(uu)_{S=1}\rangle + \frac{\sqrt{2}}{3}|d\downarrow(uu)_{S=1}\rangle$$

- SU(6) predict d/u = 0.5
  - ✧ N - Δ mass difference implies SU(6) is broken
- Diquark dominance with S_z=0 predict d/u = 0.2

Nucleon Model	F2n / F2p	d / u
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Brodsky et al., Nucl. Phys. B441, 197 (1995)
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- SU(6) predict d/u = 0.5
  - ✧ N - Δ mass difference implies SU(6) is broken
- Diquark dominance with S_z=0 predict d/u = 0.2
- Scalar (S=0) diquark dominance predict d/u = 0

Nucleon Model	F2n / F2p	d / u
SU(6)	2 / 3	0.5
pQCD (S_z=0)	3 / 7	0.2
Scalar Diquark	1 / 4	0

Brodsky et al., Nucl. Phys. B441, 197 (1995)
Melnitchouk and Thomas, Phys. Lett. B377, 11 (1996)

Future experiments

Flavor-tagging of EMC effect

LOI: Next Generation Tritium Experiments in CLAS12

D. Gaskell (Spokesperson),
D.W. Higinbotham (Spokesperson), D. Meekins (Spokesperson)
Thomas Jefferson National Accelerator Facility,
Newport News, Virginia 23606, USA

A. Ashkenazi, A. Denniston, R. Cruz-Torres, O. Hen (Spokesperson)*, D. Nguyen,
A. Papadopoulou, J. Pybus, A. Schmidt, E.P. Segarra
Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

D. Dutta (Spokesperson),
Mississippi State University, Mississippi State, Mississippi 29762, USA

Z. Ye (Spokesperson),
Argonne National Lab, Lemont, IL 60439

F. Hauenstein, M. Khachatryan, and L.B. Weinstein (Spokesperson)
Old Dominion University, Norfolk, Virginia 23529, USA

E. Piasetzky
Tel-Aviv University, Tel Aviv 69978, Israel

S. Sirca (Spokesperson), and M. Mihovilovic (Spokesperson)
University of Ljubljana and Jozef Stefan Institute, 1000 Ljubljana, Slovenia

T. Kolar
Jozef Stefan Institute, 1000 Ljubljana, Slovenia

u_v, d_v
modification
difference

Upcoming Nuclear Targets at CLAS

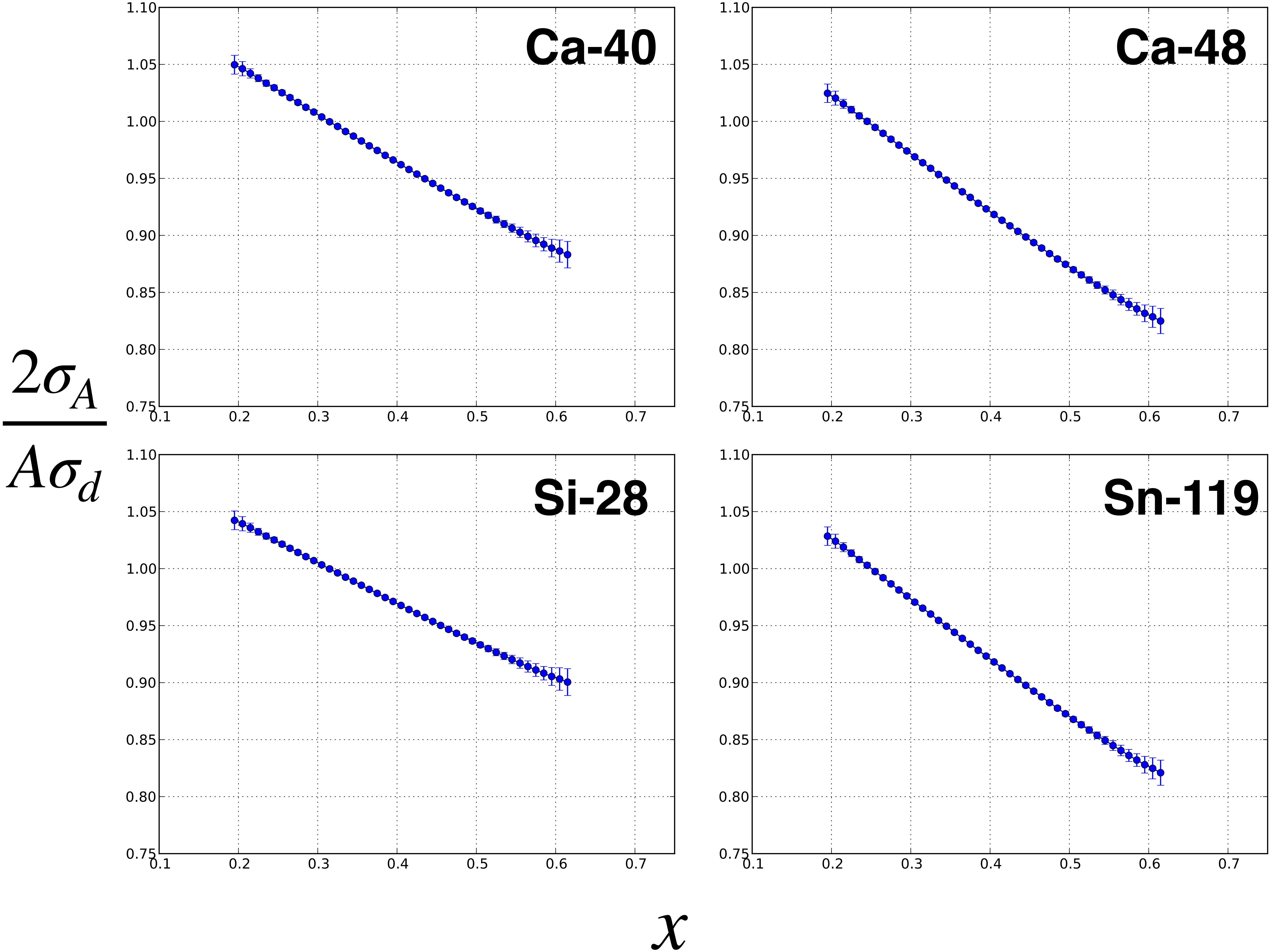
Exclusive Studies of Short Range Correlations in Nuclei using CLAS12
Proposal to Jefferson Lab PAC 46

A. Ashkenazy, R. Cruz Torres, S. Gilad, O. Hen (contact person),
G. Laskaris, A. Papadopoulou, M. Patsyuk, A. Schmidt (co-spokesperson),
B. Schmookler, and E.P. Segarra
Massachusetts Institute of Technology, Cambridge, MA

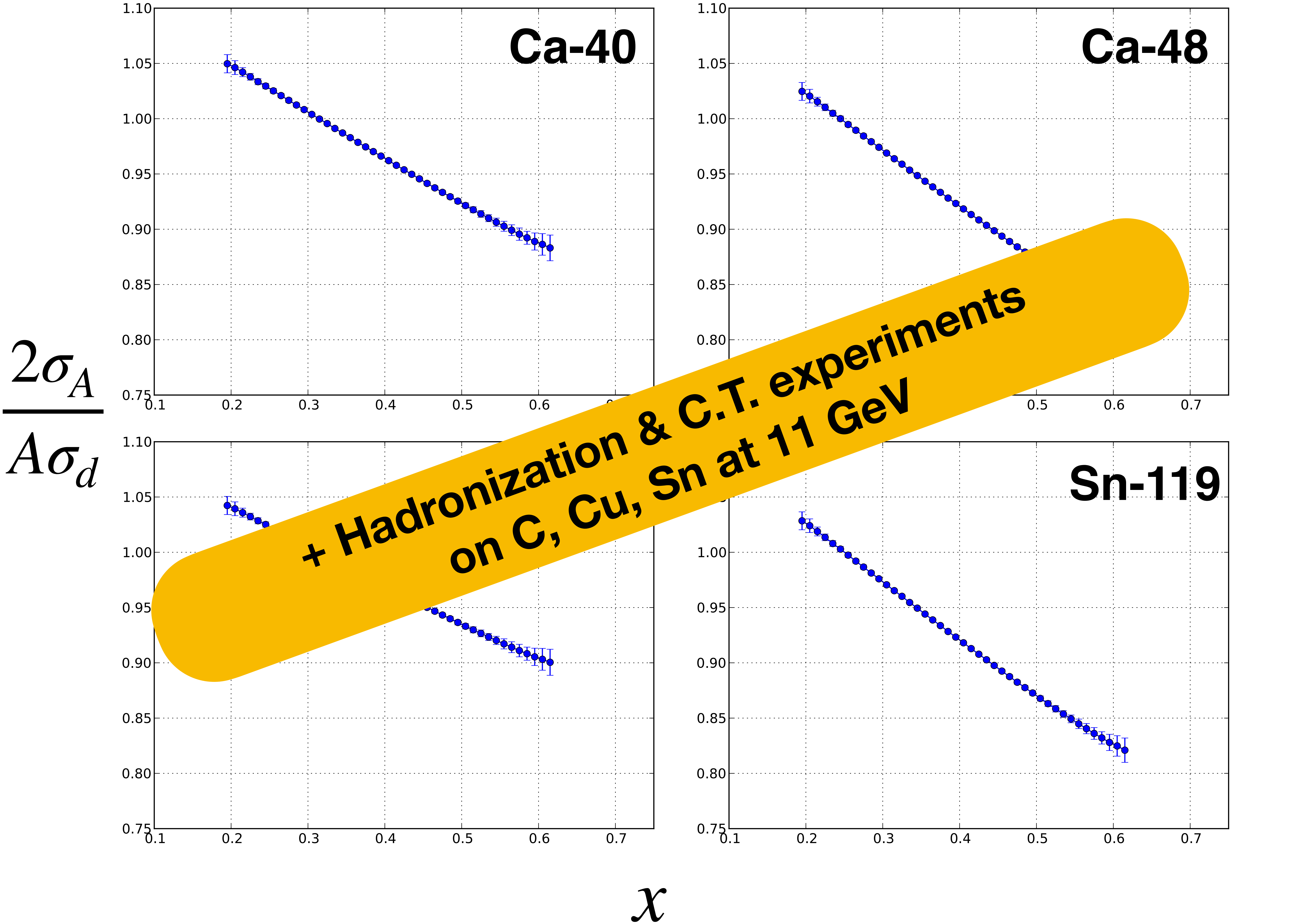
+ many others

d	**He-4**	**C-12**	**Si-27**	**Ar-40**	**Ca-40**	**Ca-48**	**Sn-119**	**Pb-208**

Numerous beam energies; majority of days at 6.6 GeV



Ca-40
Ca-48
Si-28
Sn-119
$\frac{2\sigma_A}{A\sigma_d}$
x
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.1
0.2
0.3
0.4
0.5
0.6
0.7



Ca-40
Ca-48
Sn-119
+ Hadronization & C.T. experiments
on C, Cu, Sn at 11 GeV
$\frac{2\sigma_A}{A\sigma_d}$
x
1.10
1.05
1.00
0.95
0.90
0.85
0.80
0.75
0.1
0.2
0.3
0.4
0.5
0.6
0.7

nPDF

Have to make some sacrifices…

Must parametrize nuclear dependence, combine all nuclear DIS data, and make assumptions

$$xf_i^A(x, Q_0) \sim x^a(\ldots)(1-x)^b$$

Have to make some sacrifices…

Must parametrize nuclear dependence, combine all nuclear DIS data, and make assumptions

$$x f_i^A(x, Q_0) \sim x^a(\ldots)(1-x)^b$$

(nCTEQ15)

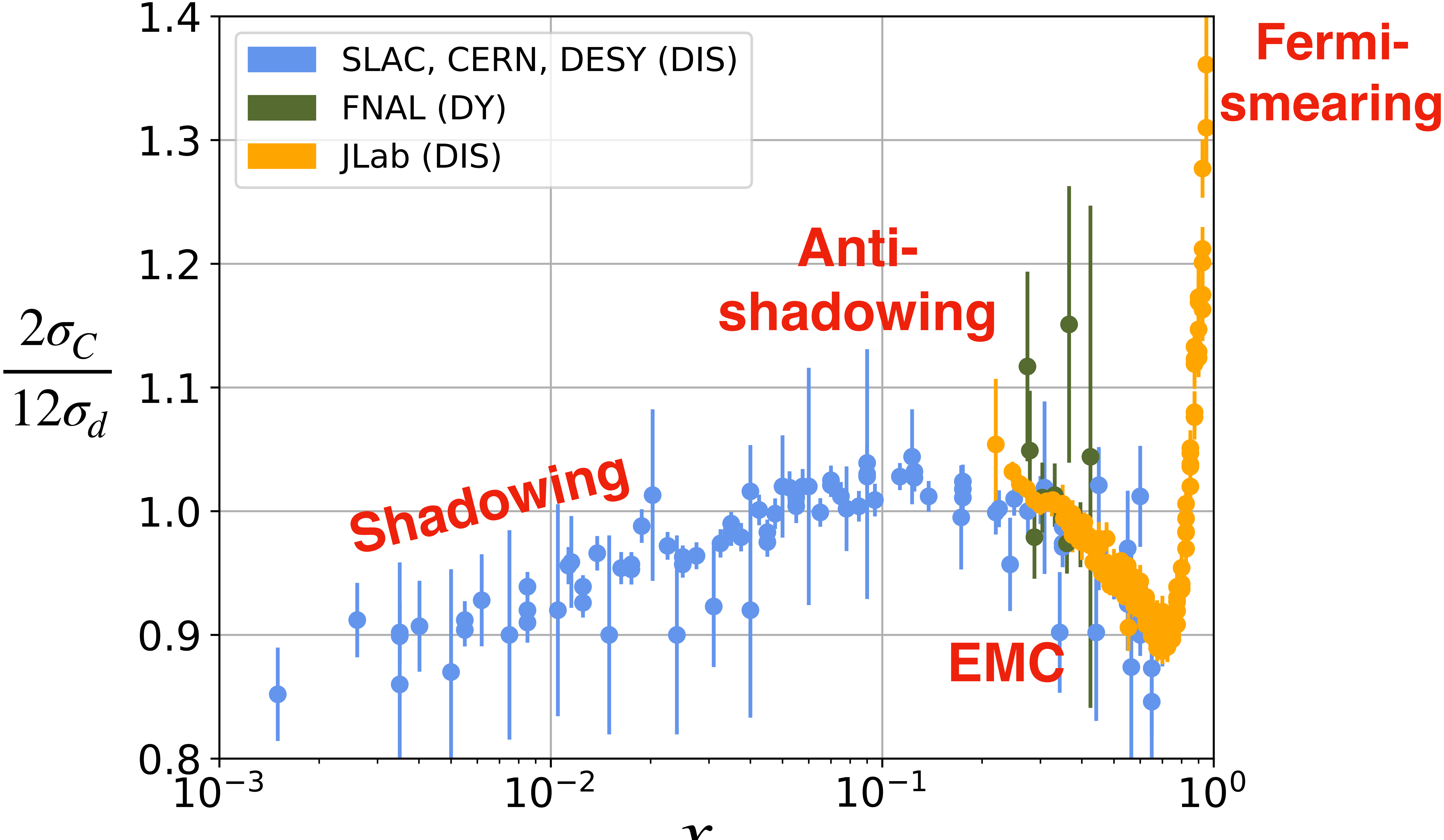
$$a \sim a_1 + a_2(1 - A^{-a_3})$$

(EPPS16)

$$a(A) \sim a(A_{\mathrm{ref}})\left(\frac{A}{A_{\mathrm{ref}}}\right)^{\gamma_a}$$

$$F_2^A(x, Q^2) = \sum_i f_i^{(A,Z)}(x, Q^2) \otimes C_{2,i}(x, Q^2)$$

… and be robust enough to describe the data



nCTEQ15 Framework

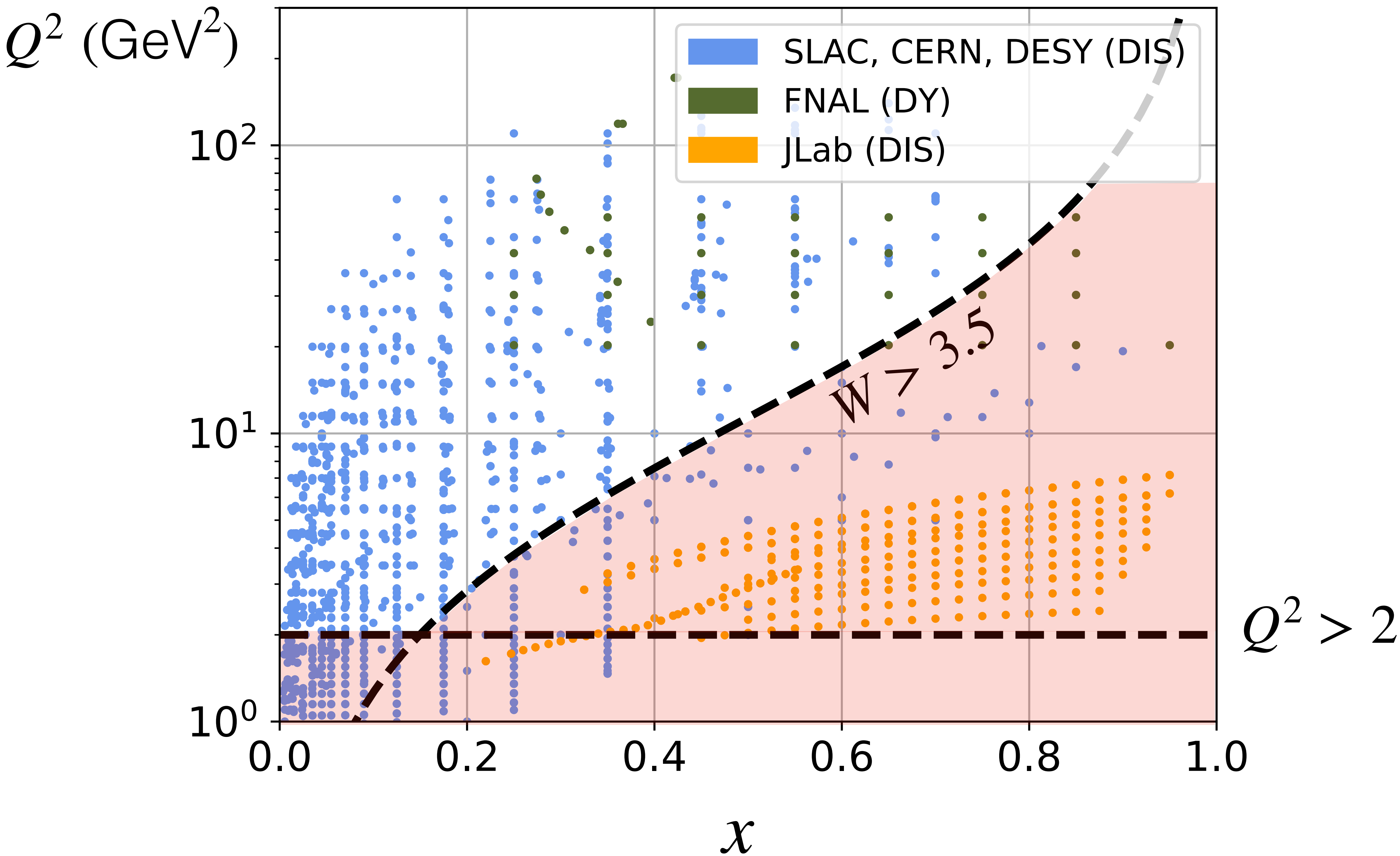
$$xf_i^{p/A} = c_0 x^{c_1} (1-x)^{c_2} e^{c_3 x} \left(1 + e^{c_4} x\right)^{c_5}$$

$$c_k \to c_k(A) = c_{k,0} + c_{k,1} \left(1 - A^{-c_{k,2}}\right)$$

No deuterium nuclear corrections

u_v, d_v fitted independently

Data used in nCTEQ15



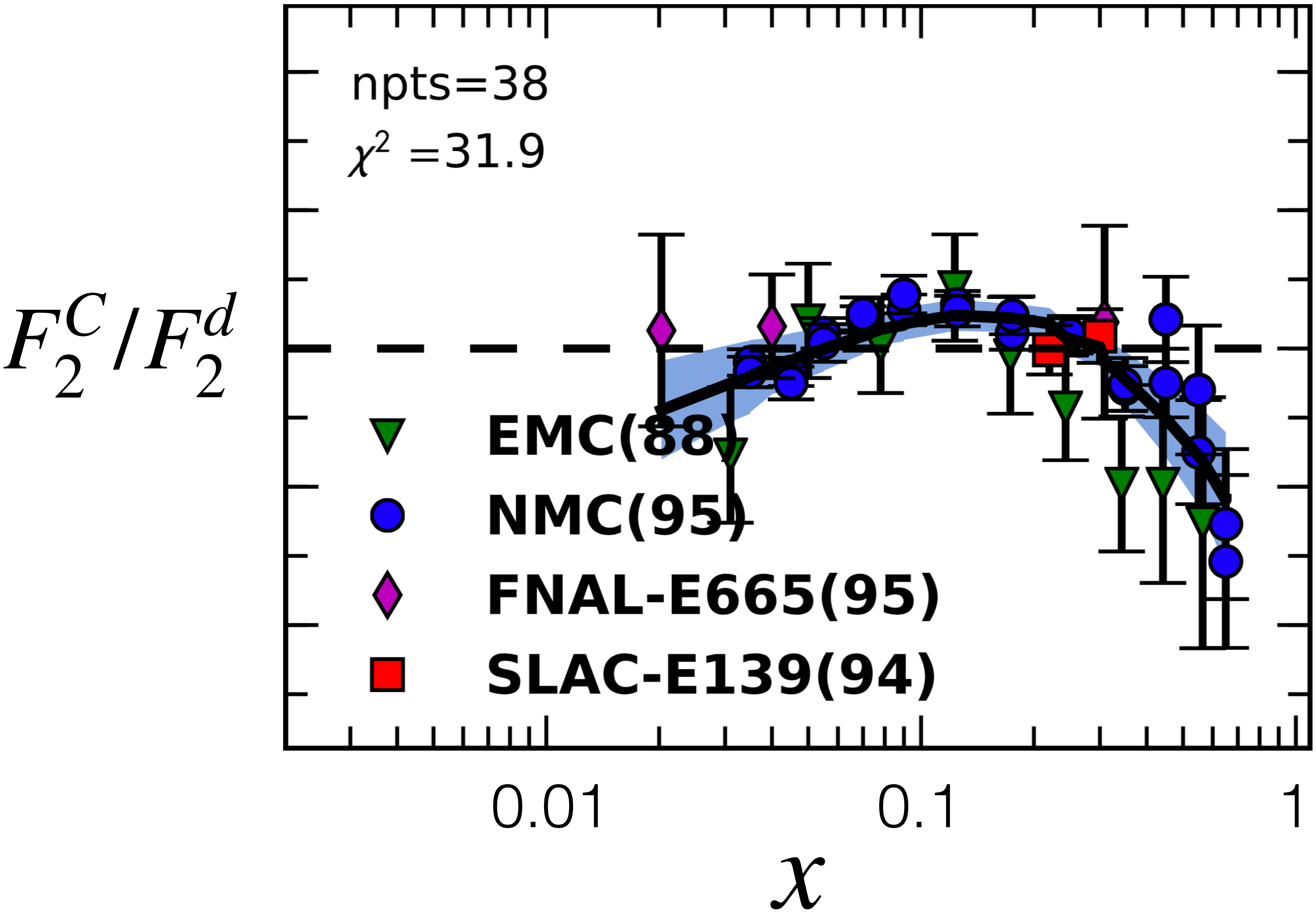
Majority of data in nCTEQ15 is isoscalar corrected

	nNNPDF1.0 EPJC79(2019471	EPPS16 EPJC77(2017)163	nCTEQ15 PRD93(2016)085037	KA15 PRD93(2016)014036	DSSZ12 PRD85(2012)074028	EPS09 JHEP0904(2009)065
lA DIS	✔	✔	✔	✔	✔	✔
DY in p+A	✘	✔	✔	✔	✔	✔
RHIC π d+Au	✘	✔	✔	✘	✔	✔
νA DIS	✘	✔	✘	✘	✔	✘
DY in π+A	✘	✔	✘	✘	✘	✘
LHC p+Pb dijets	✘	✔	✘	✘	✘	✘
LHC p+Pb W,Z	✘	✔	✘	✘	✘	✘

Order in α_s	NNLO	NLO	NLO	NNLO	NLO	NLO
Q-cut in DIS	1.87 GeV	1.3 GeV	**2 GeV**	1 GeV	1 GeV	1.3 GeV
W-cut	3.53 GeV	-	**3.5 GeV**	-	-	-
Data points	451	1811	708	1479	1579	929
Free parameters	Neural Net	20	16	16	25	15
Error tolerance	MC replica	52	35	N.N.	30	50
Proton baseline	NNPDF3.1	CT14NLO	~CTEQ6.1	JR09	MSTW08	CTEQ6.1
Mass scheme	FONLL-B	GM-VFNS	GM-VFNS	ZM-VFNS	GM-VFNS	ZM-VFNS
Flavour sep.	-	val.+sea	valence	-	-	-

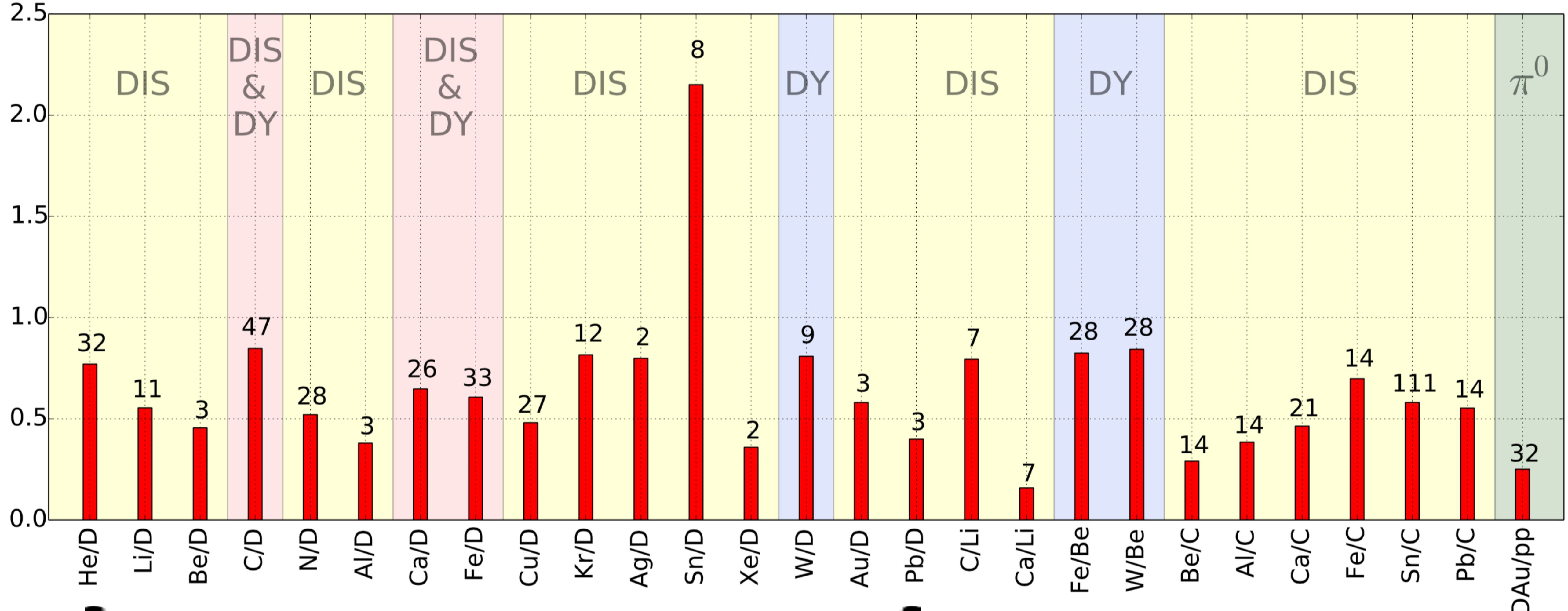
Extraction and assessment of fit

χ^2 minimization on ~ 16 parameters



Assessing quality

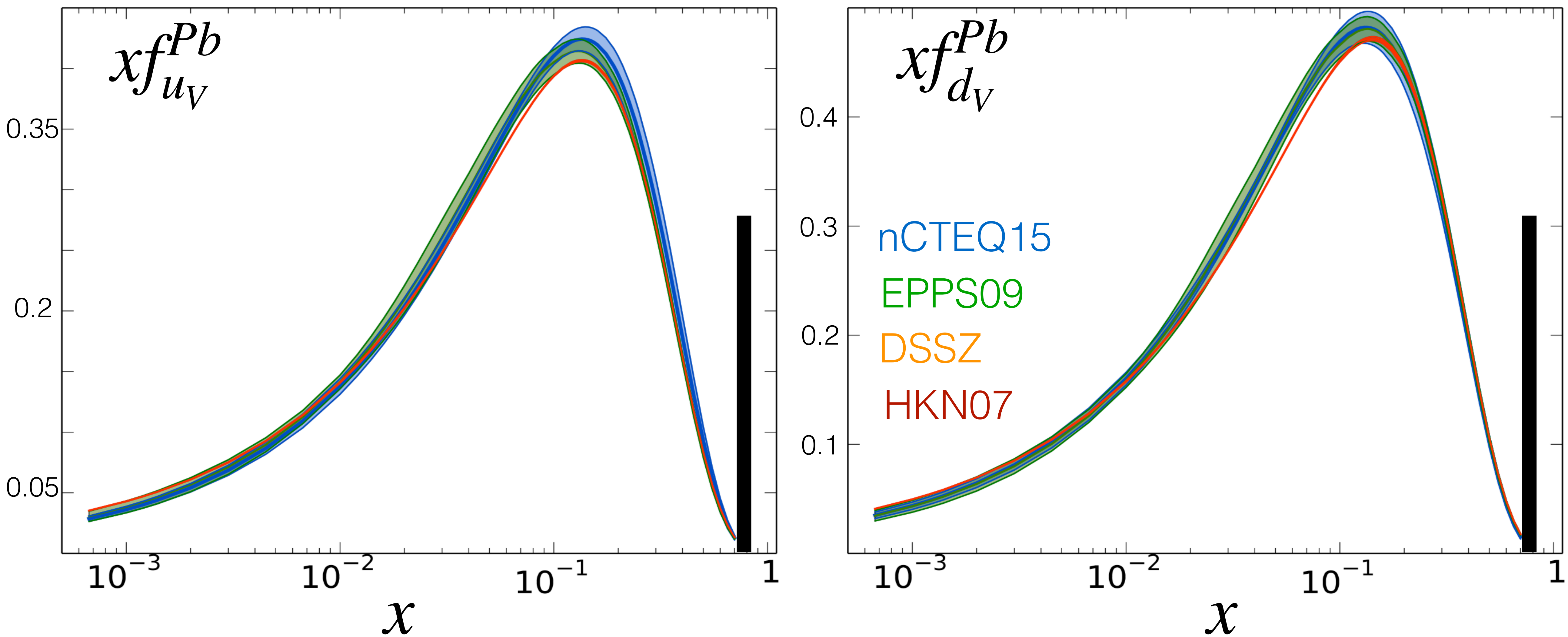
χ^2/N_{data} from resulting minimization



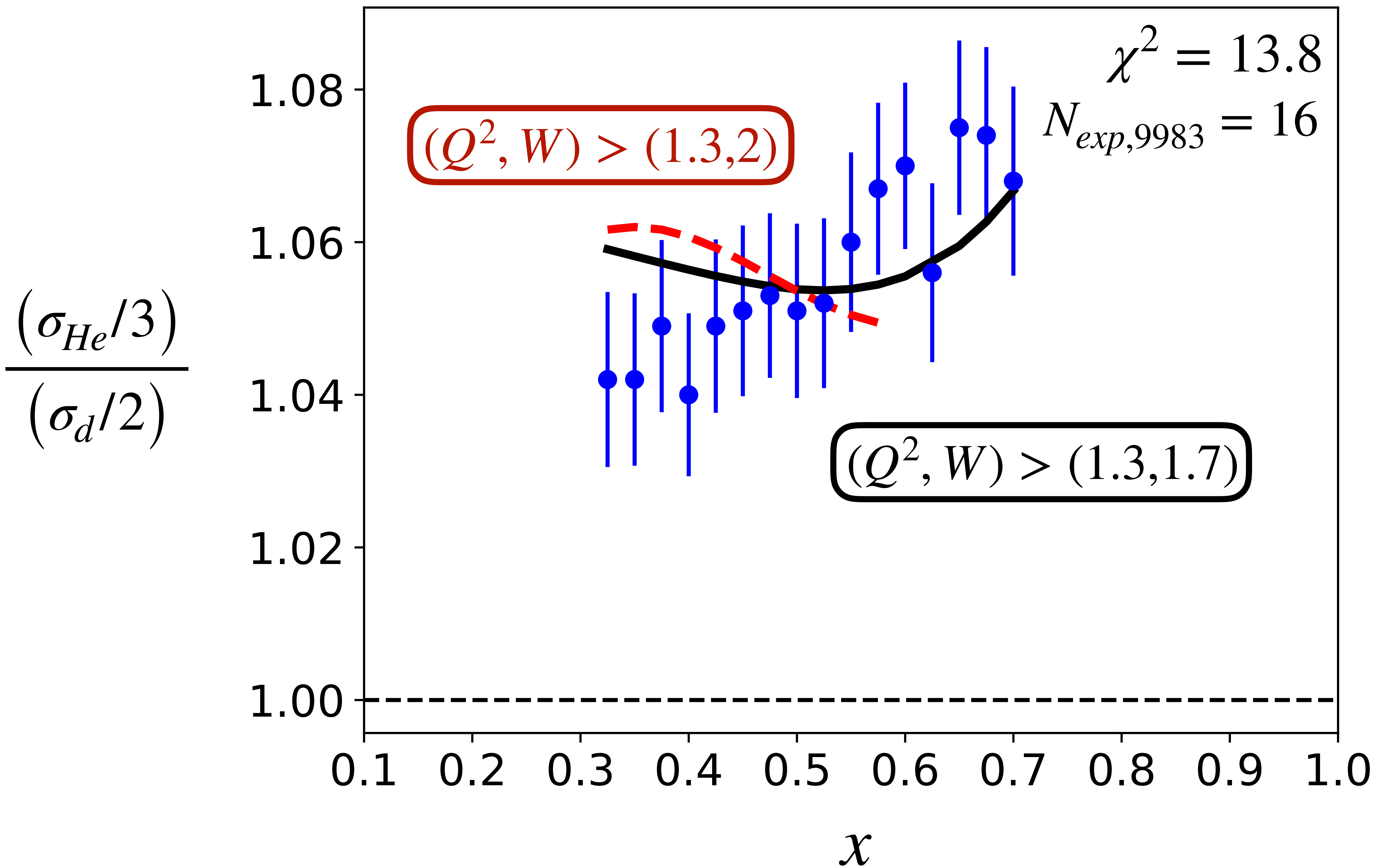
$$\frac{\sigma_A}{\sigma_d}$$

$$\frac{\sigma_{A_1}}{\sigma_{A_2}}$$

Most PDF extractions stop at x=0.6-0.7



x- and A- parameterization



JLab6, Hall C