Study of superfast quarks using JLab 11 GeV data

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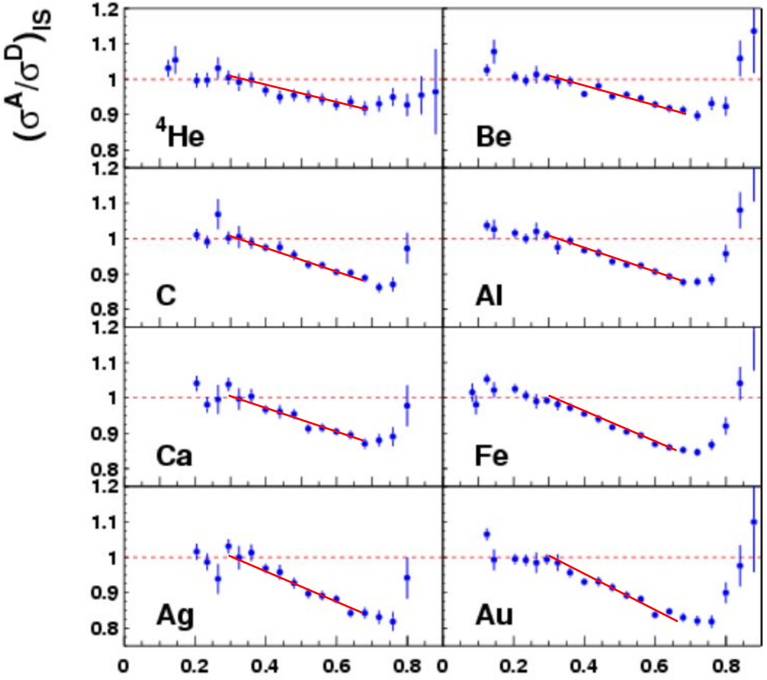
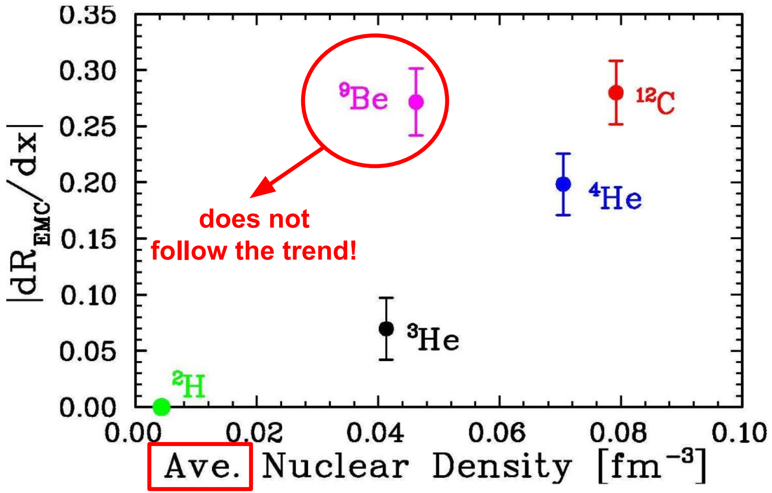
EMC Effect

Strength of the effect highly correlated with A and average nuclear density

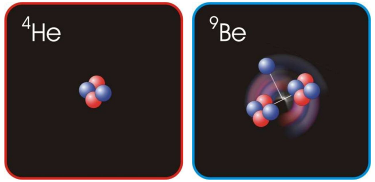
SLAC *J. Gomez, et al., PRD49, 4349 (1994)*



JLab E03-103 RESULTS



J. Seely et al, PRL 103 (2009)



^{9}Be low average density but large 2α + n structure

EMC effect seems to follow **LOCAL DENSITY** rather than average density!

How can we move forward ?

Use study of SRC ($x>1$) to shed light on the EMC effect ($0.3<x<0.7$)

Inclusive DIS sensitive to:

At high x -> Isolate high momentum **nucleons** (SRCs)
At high Q^2 -> Isolate scattering from **quarks**

Can we have access to partonic degrees of freedom at $x>1$? **YES!**

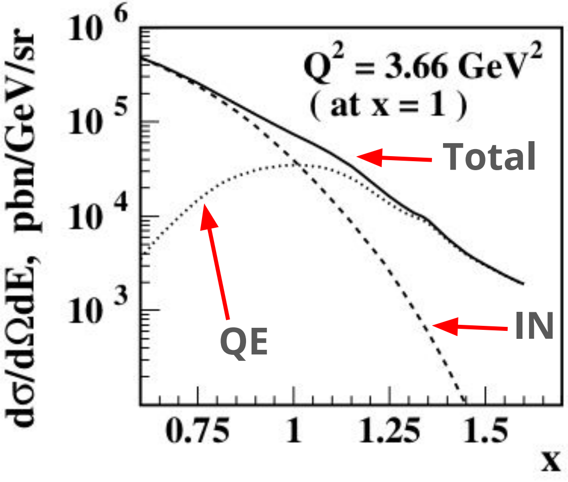
At higher Q^2 inclusive scattering is sensitive to distribution of high momentum **quarks** → SuperFast Quarks (SFQ)

Topic of this talk

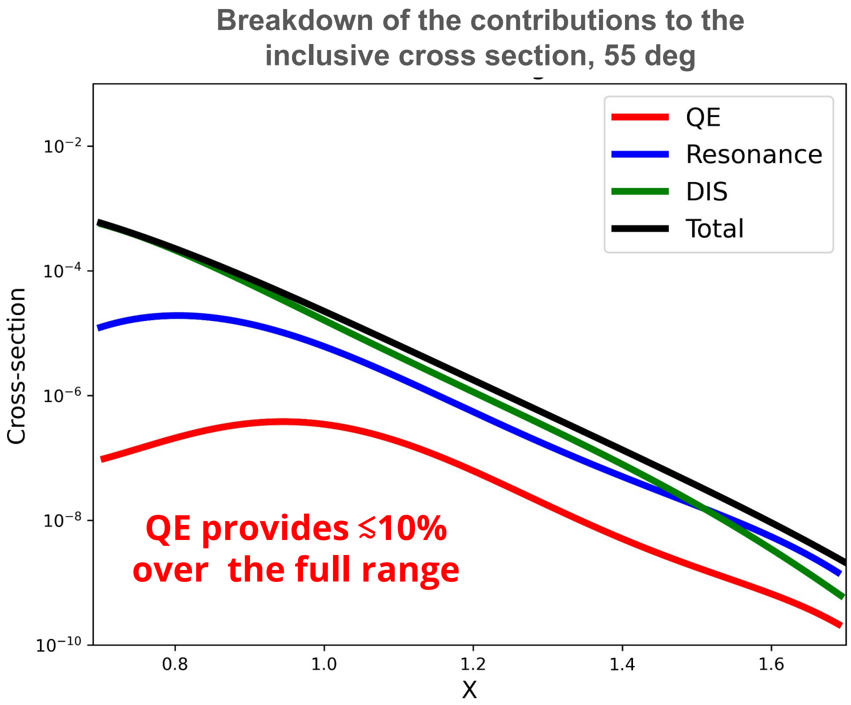
Kinematic requirements to detect SFQ

Q^2 large enough so the DIS tail overwhelm the QE contribution

Low Q^2 -> QE wins



Kinematics at 11 GeV

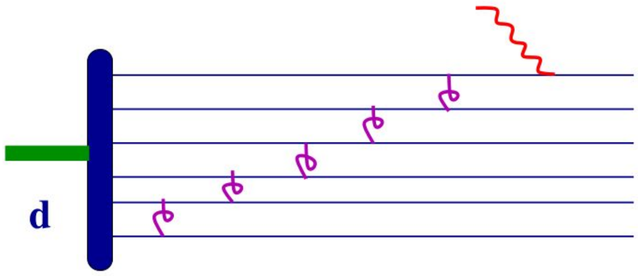


Many Theoretical Models

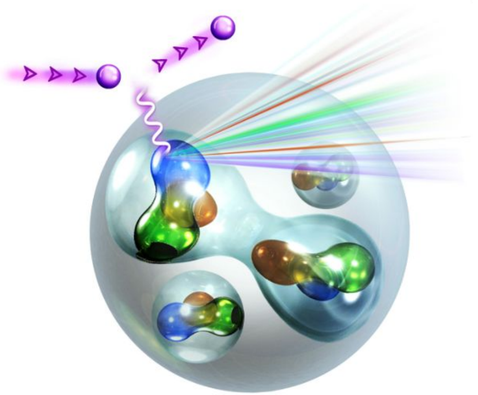
Convolution Model, Six-Quark Model, Hard-Gluon-Exchange Model and many many more ….

One example: **6-quark model:**

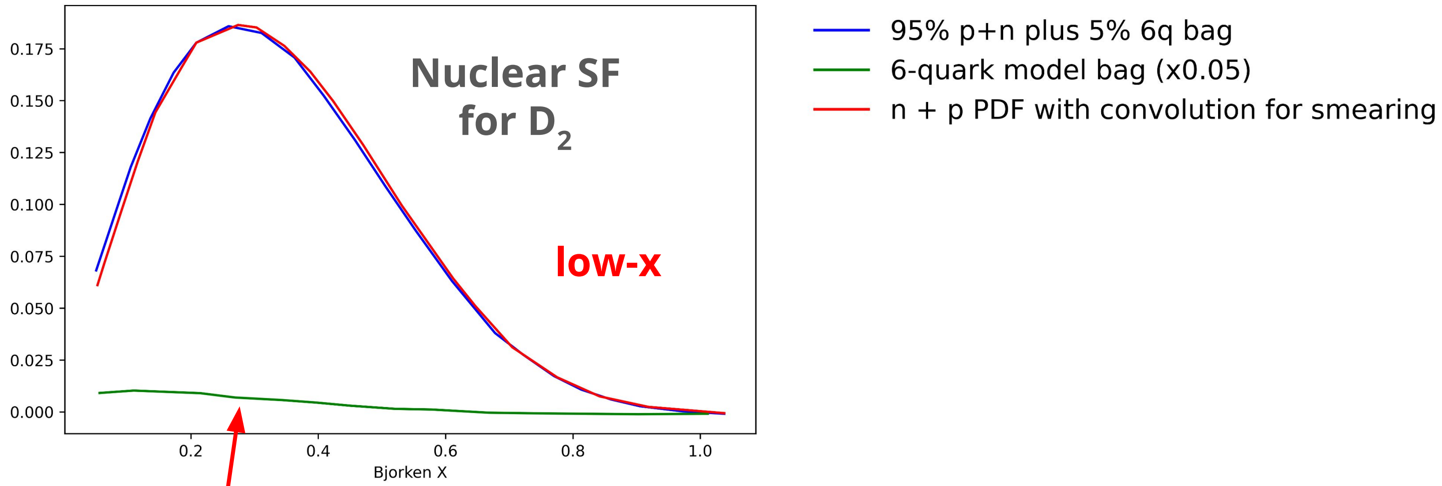
Two nucleon system collapse into 6q state



The really important feature is that we are allowing gluon exchange between the particles



So, quarks degrees of freedom in DIS at x>1



At most 2% effect in the EMC region

We would need extremely high exotic contributions to explain 10-20% suppression

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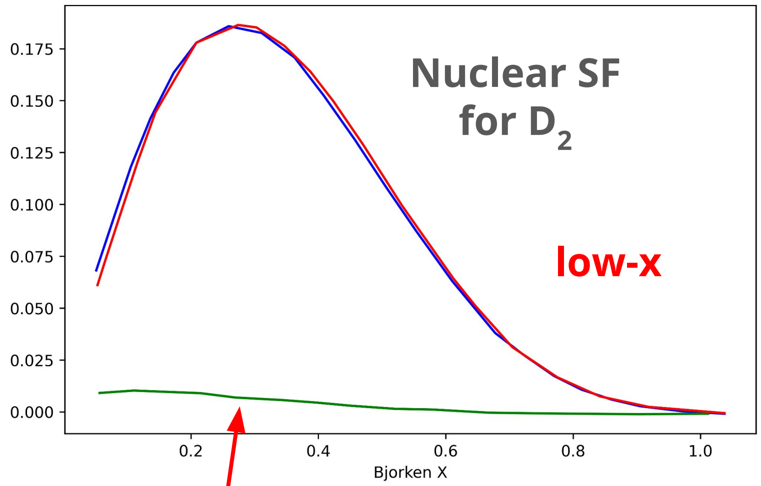

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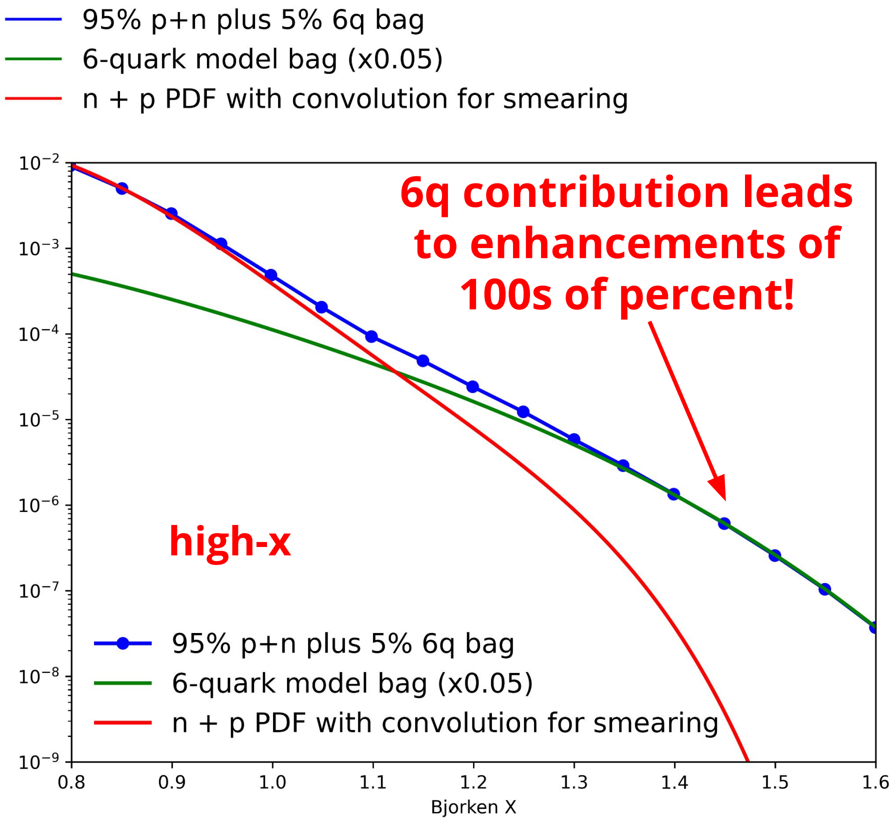
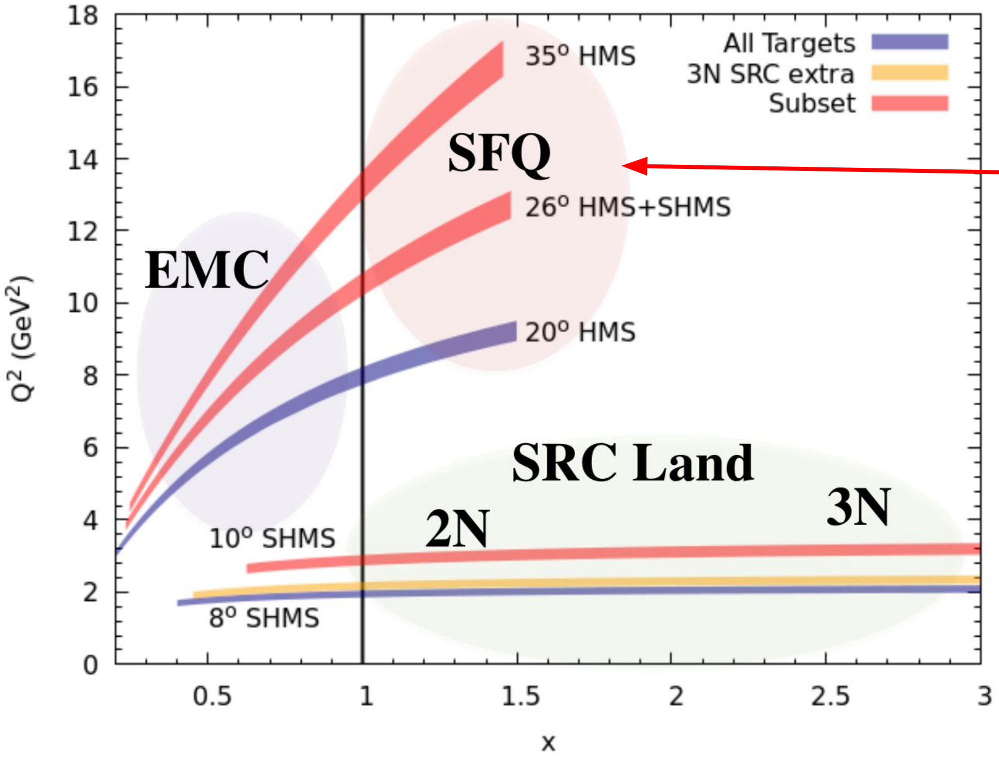
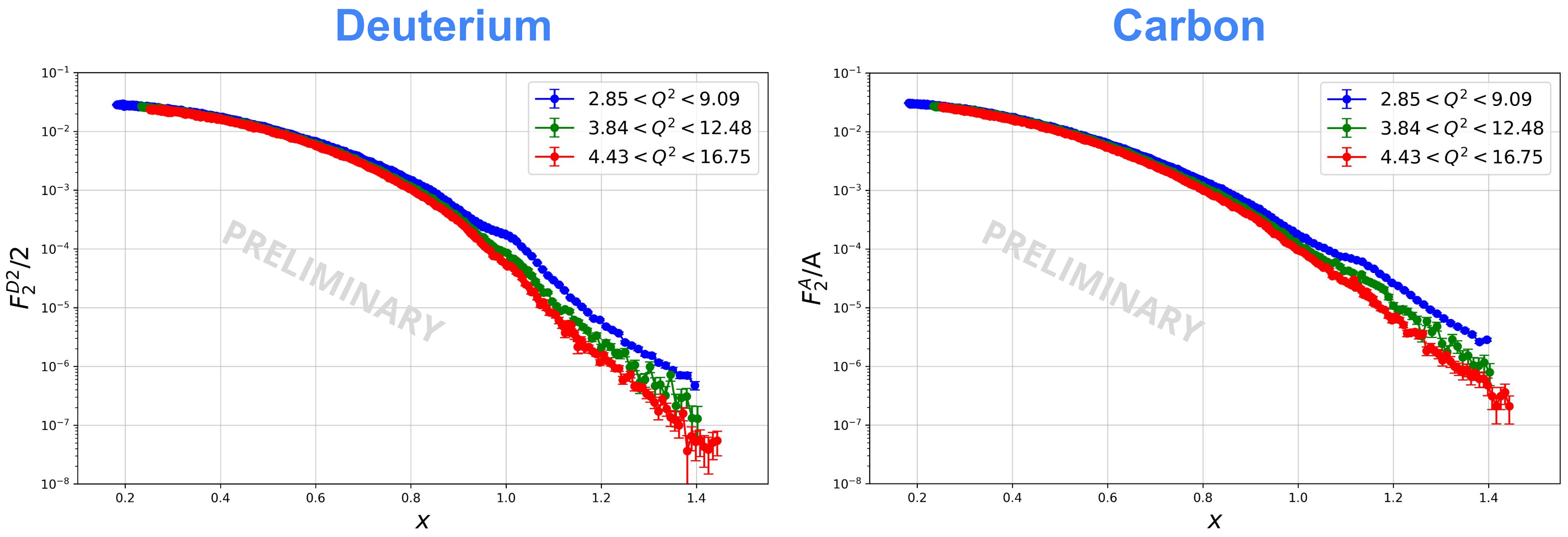


Hall C XEM2 Experiment: E12-06-105

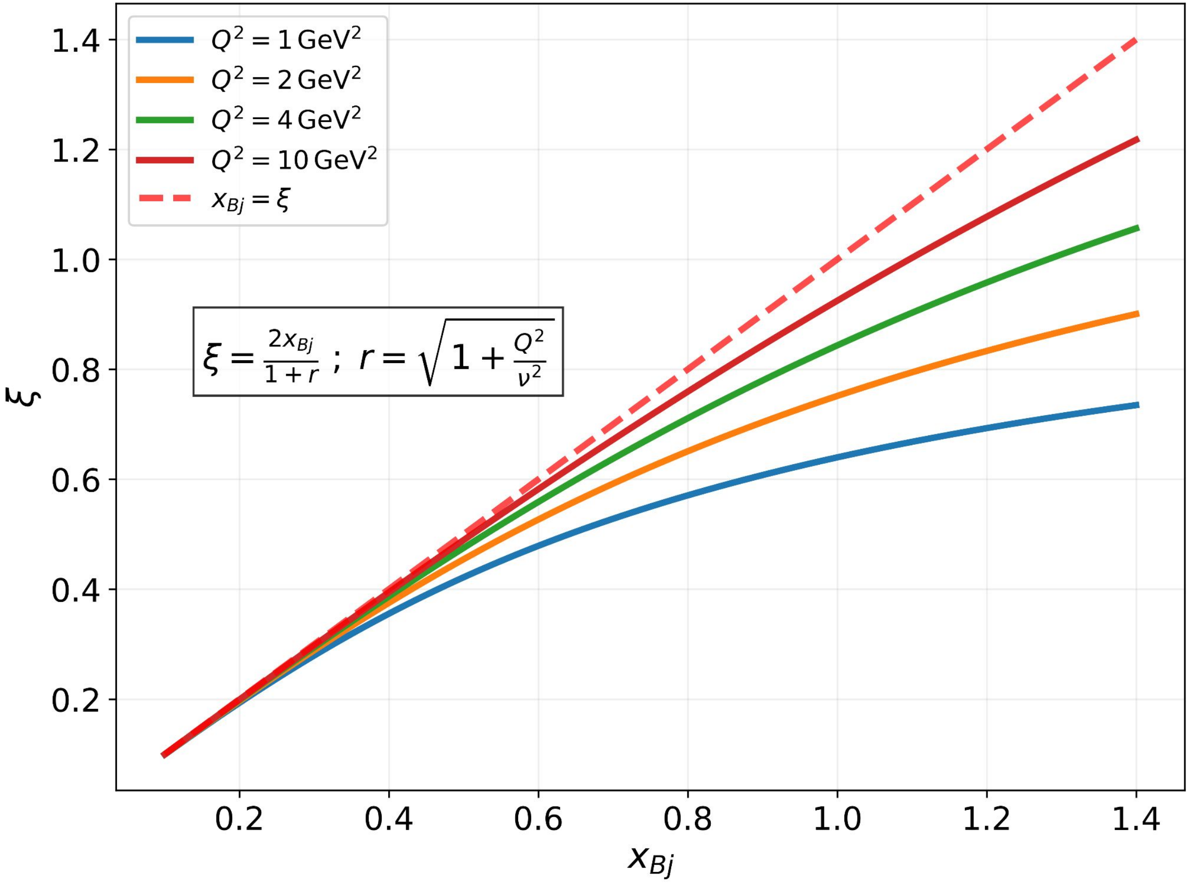


My topic

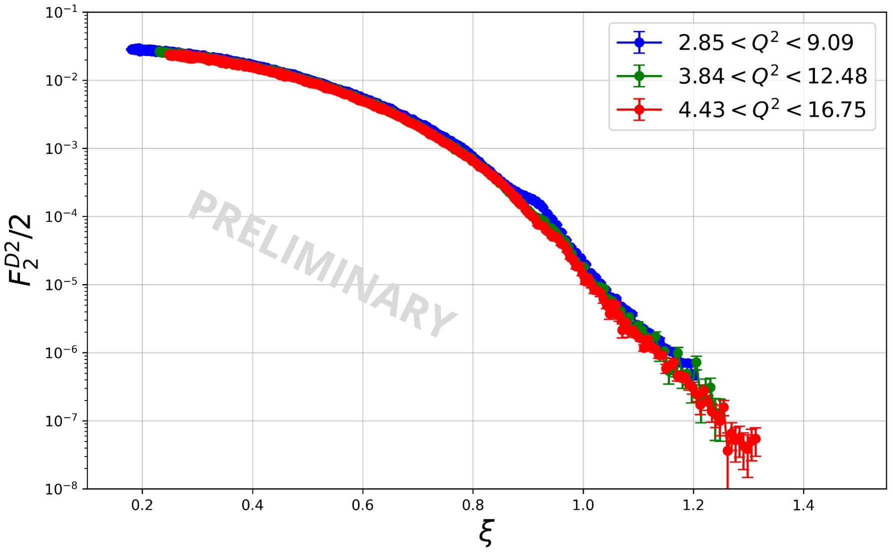
Testing Scaling



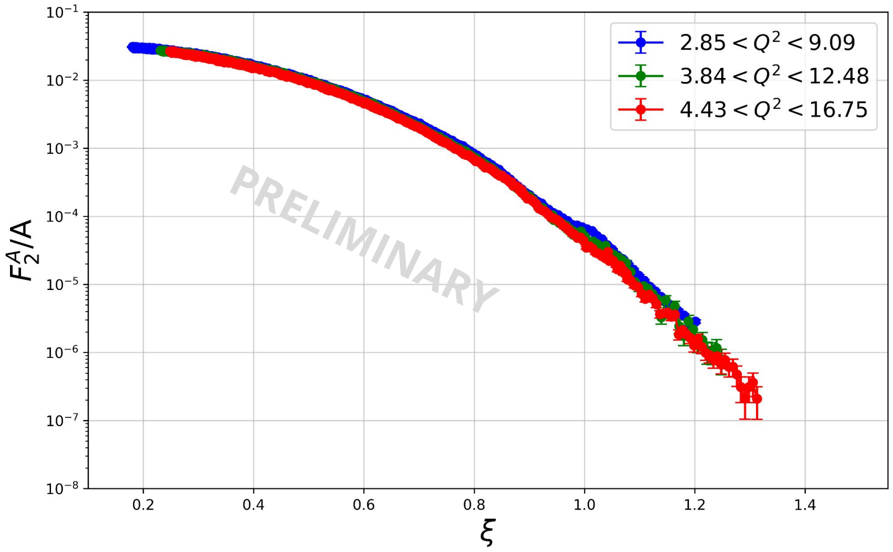
Nachtman Scaling Variable xi



Deuterium



Carbon



Approximate Scaling is observed

Systematic Uncertainties

Table 1: Preliminary systematic uncertainties. The σ columns correspond to cross section uncertainties, while R denotes ratio uncertainties. Normalization (norm) uncertainties are correlated across bins, while point-to-point (p2p) uncertainties are uncorrelated.

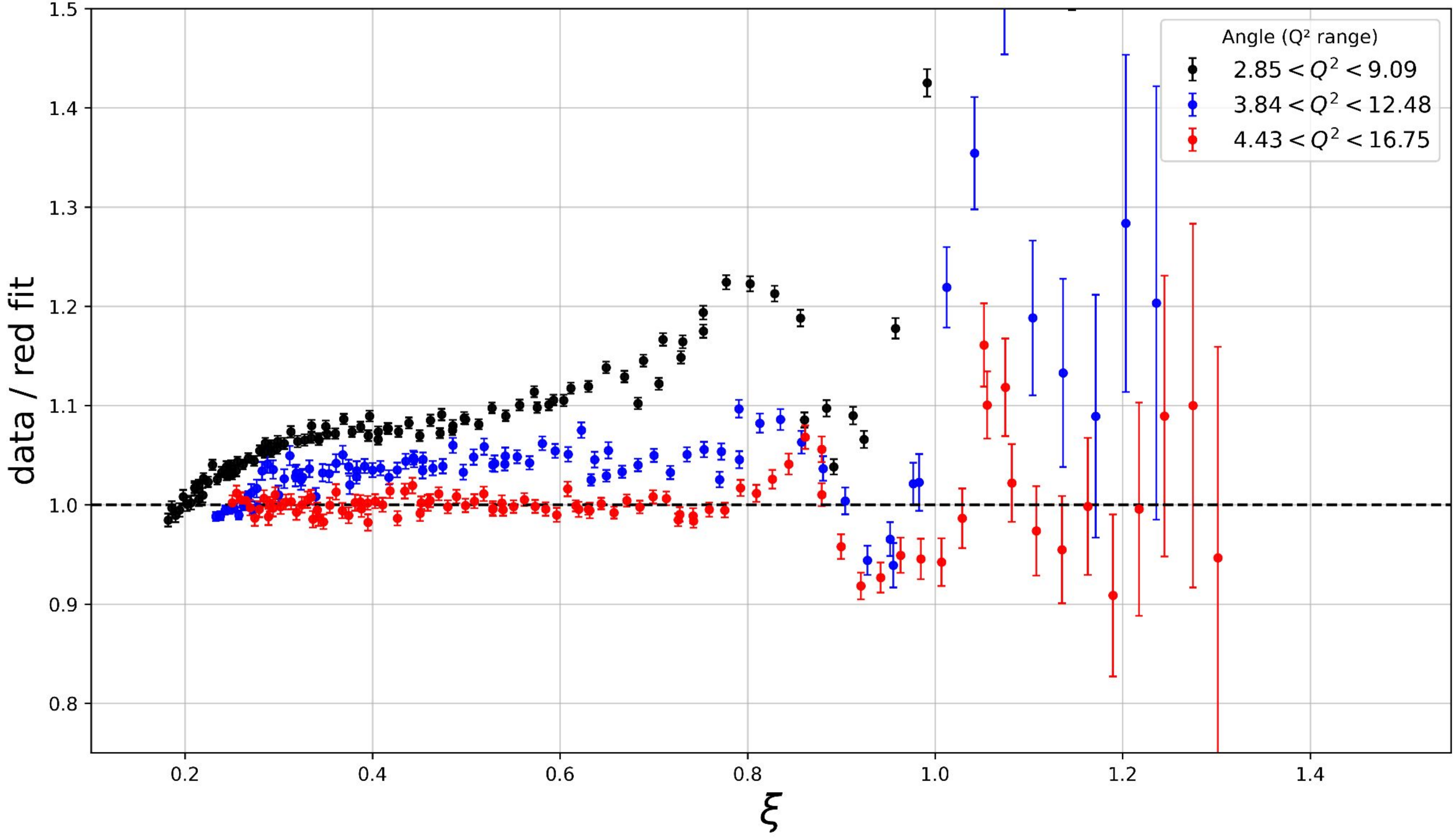
Source	σ_{norm} (%)	σ_{p2p} (%)	R_{norm} (%)	R_{p2p} (%)
Beam Energy	0.30	0.30	0.10	0.14
HMS Momentum	0.60	0.60	0.10	0.22
HMS Angle	1.50	1.50	0.50	0.81
Beam Charge	1.00	0.30	0.30	0.20
Target Boiling (Cryo or L/S)	0.20	0.10	0.20	0.10
Target Boiling (extra for ^{3,4}He)	0.60	0.20	0.60	0.20
Trigger Efficiency	0.40	0.30	0.00	0.00
Tracking Efficiency	0.70	0.20	0.30	0.10
PID Efficiency	0.10	0.10	0.00	0.10
Dead Time	0.10	0.10	0.10	0.10
Acceptance (Solid)	1.00	0.40	0.00	0.00
Acceptance (Extra cryo or L/S)	1.00	0.20	0.30	0.20
Bin Centering (L/S for ratio)	0.20	0.10	0.20	0.10
Endcap Subtraction	1.00	0.50	1.00	0.50
CSB	0.50	0.50	0.25	0.25
Pion Contamination	0.20	0.20	0.20	0.20
Radiative Correction	1.10	0.50	0.50	0.55
Total	**3.05**	**2.00**	**1.53**	**1.24**

Some of the XEM2 members

Thank you!

BACKUP

Quantifying Scaling



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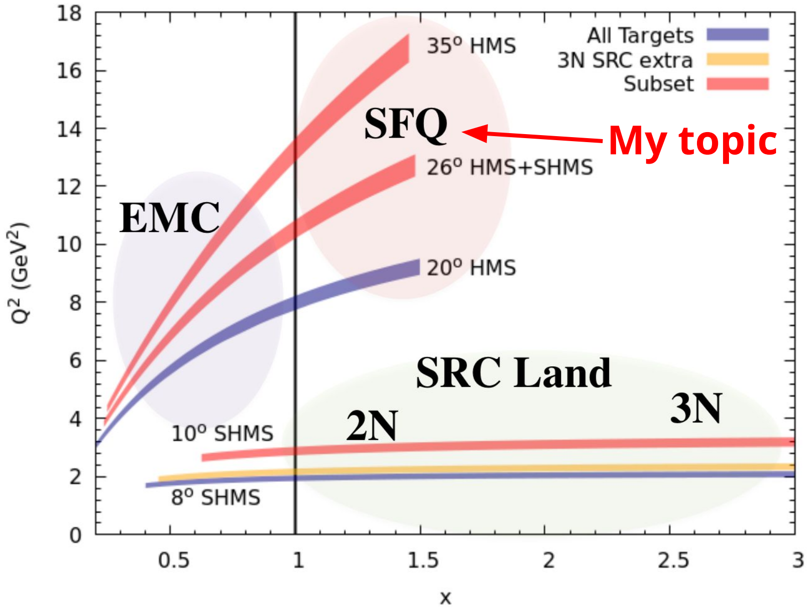
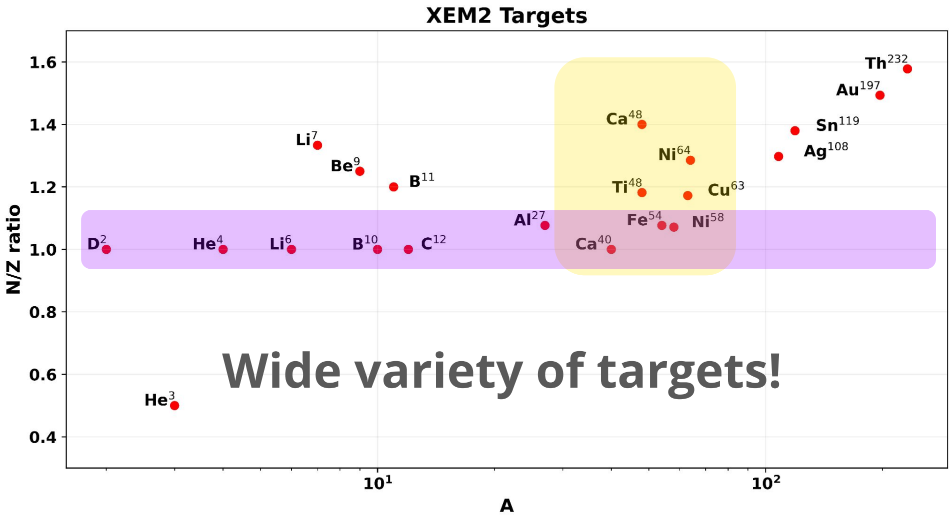
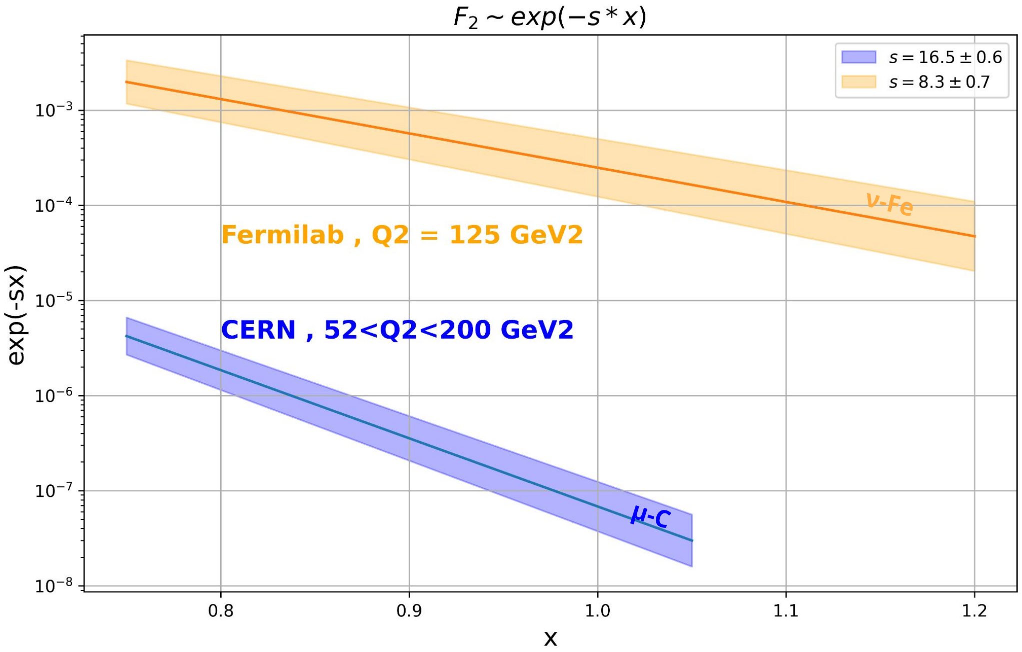




What does the distribution of SFQ look like?

Exponential fall off

Inconclusive attempts in the past:



Both CERN and Fermilab fit an exponential to F_2 and extract the 'slope' of the fall off

Problems:
Fermilab has poor resolution in x
CERN has low statistics (upper limit only goes up to x=1.05)

JLab results closer to CERN , but there are many problems still, we need higher Q^2 to have a cleaner sample