

# First look at EMC data from the XEM2 Experiment

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ECT\* Workshop

Short-Distance Nuclear Structure and PDFs

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UNIVERSITY  
of VIRGINIA



Jefferson Lab

# Overview

## Jefferson Lab and Hall C

- CEBAF
- HMS

## XEM2 (EMC)

- Motivation

## XEM2 '18 Results

- EMC Ratios
- EMC v. Density

## XEM2 '22 Online Results

- Uncertainty Projections
- Preliminary EMC Ratios

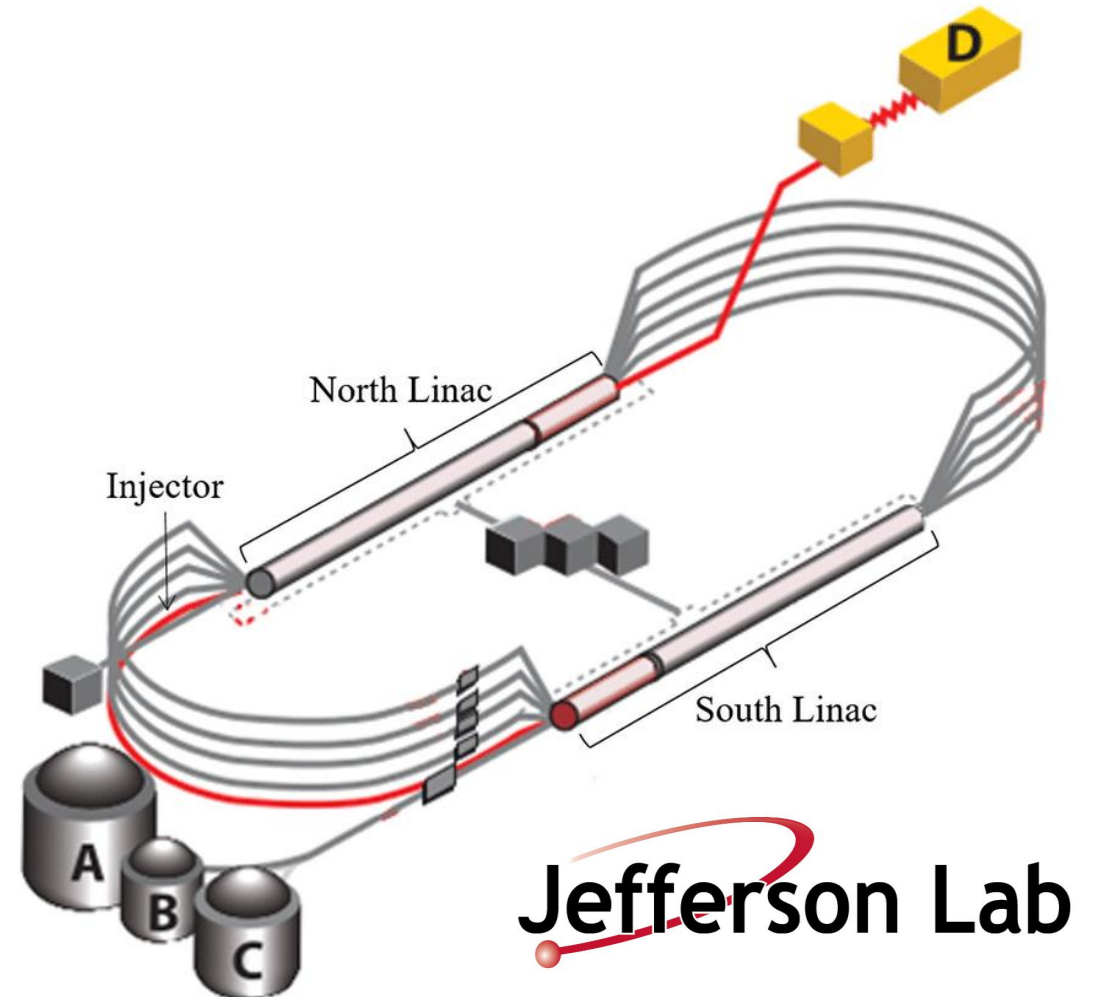
## Summary



# CEBAF

Jefferson Lab is home to the Continuous Electron Beam Accelerator Facility (CEBAF) which produces a **high luminosity, medium energy** electron beam.

- An electron beam typically of 100's of  $\mu\text{A}$  enters the accelerator track from the Injector.
- The beam can then circle the track, passing through North and South Linacs up to six times to reach energies of nearly 12 GeV.
- The beam is then sent into the four 'halls' for use in experiments.
- In Hall C, the electron beam interacts with a target and scattered particles are detected.



# HMS

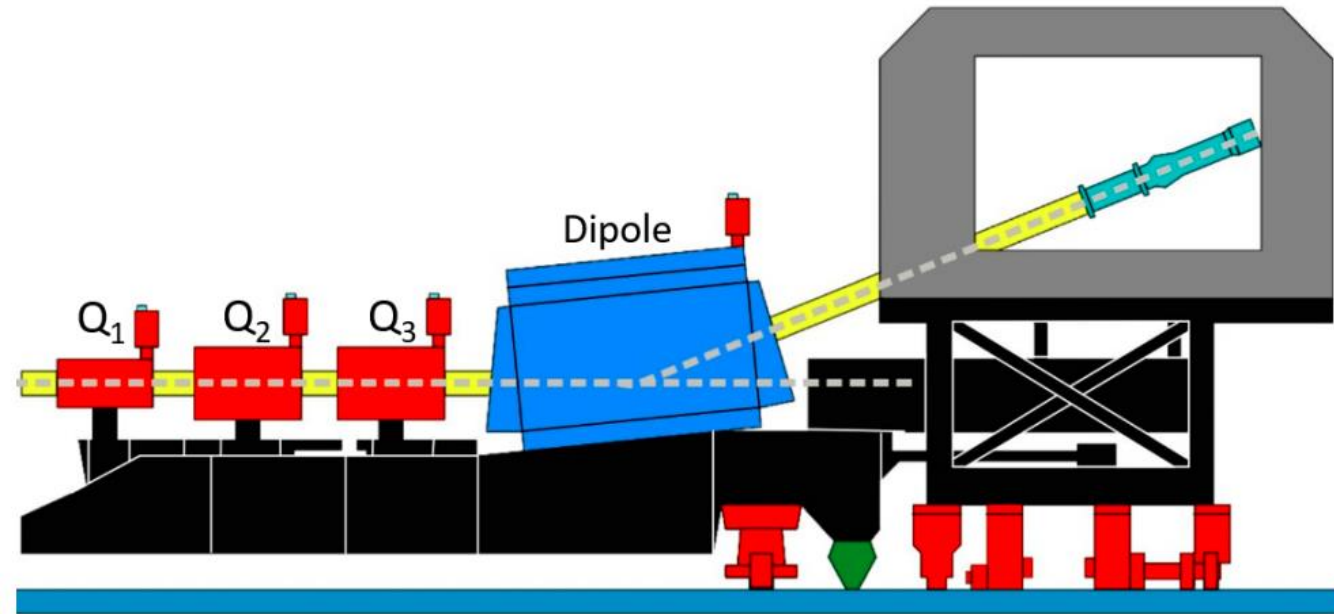
Hall C is home to the High Momentum Spectrometer (HMS).

Three quadrupoles followed by a dipole focus and direct particles of a selected momentum into the detector stack.

The HMS is a **small acceptance spectrometer**:

- Momentum Acceptance:  $\pm 8\%$
- Angular Acceptance:  $\pm 32$  by  $\pm 85$  mrad

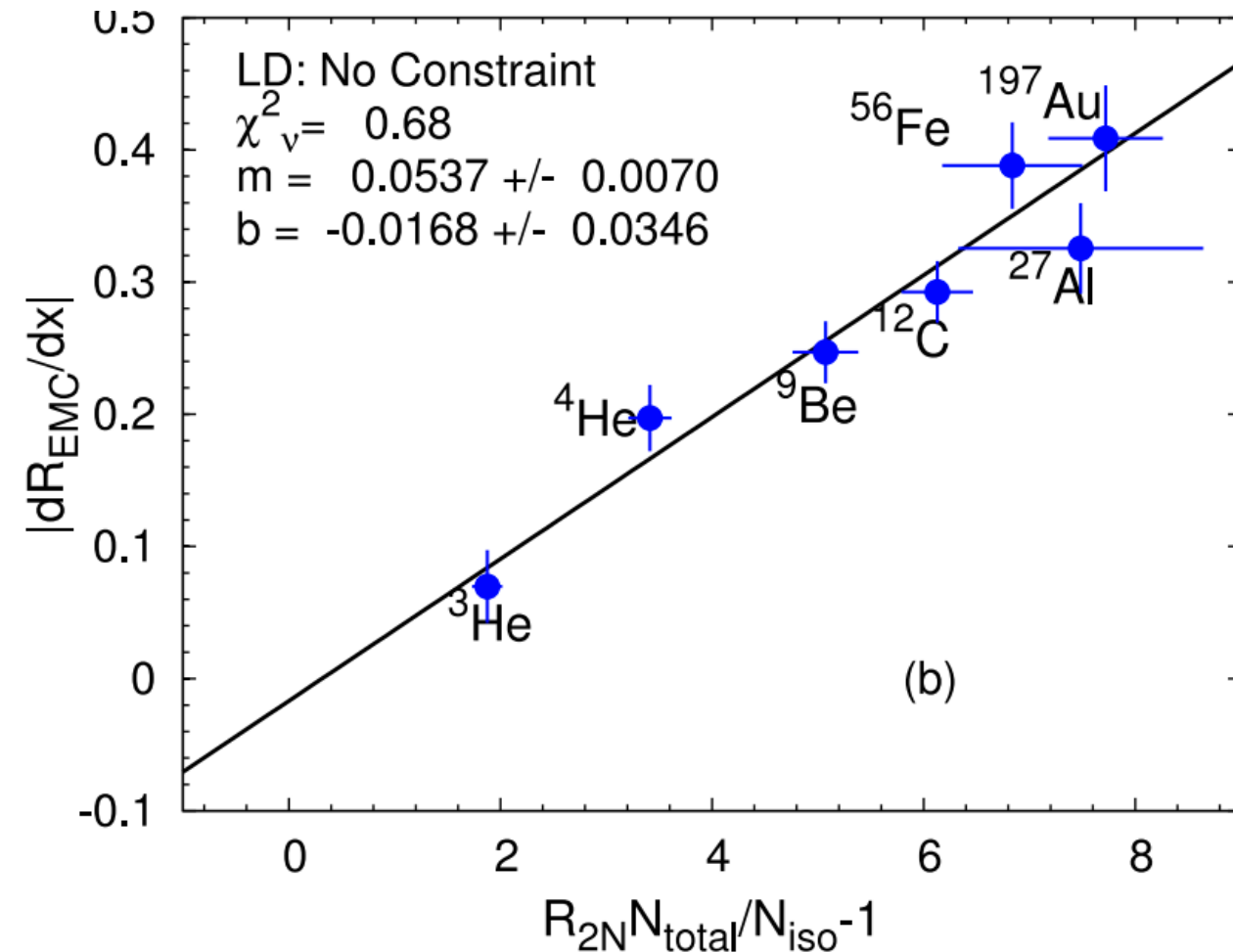
Coupled with the high luminosity beam from CEBAF, this allows the HMS to provide **high precision inclusive measurements of a small region of phase space**.



# XEM2 (EMC) Motivation

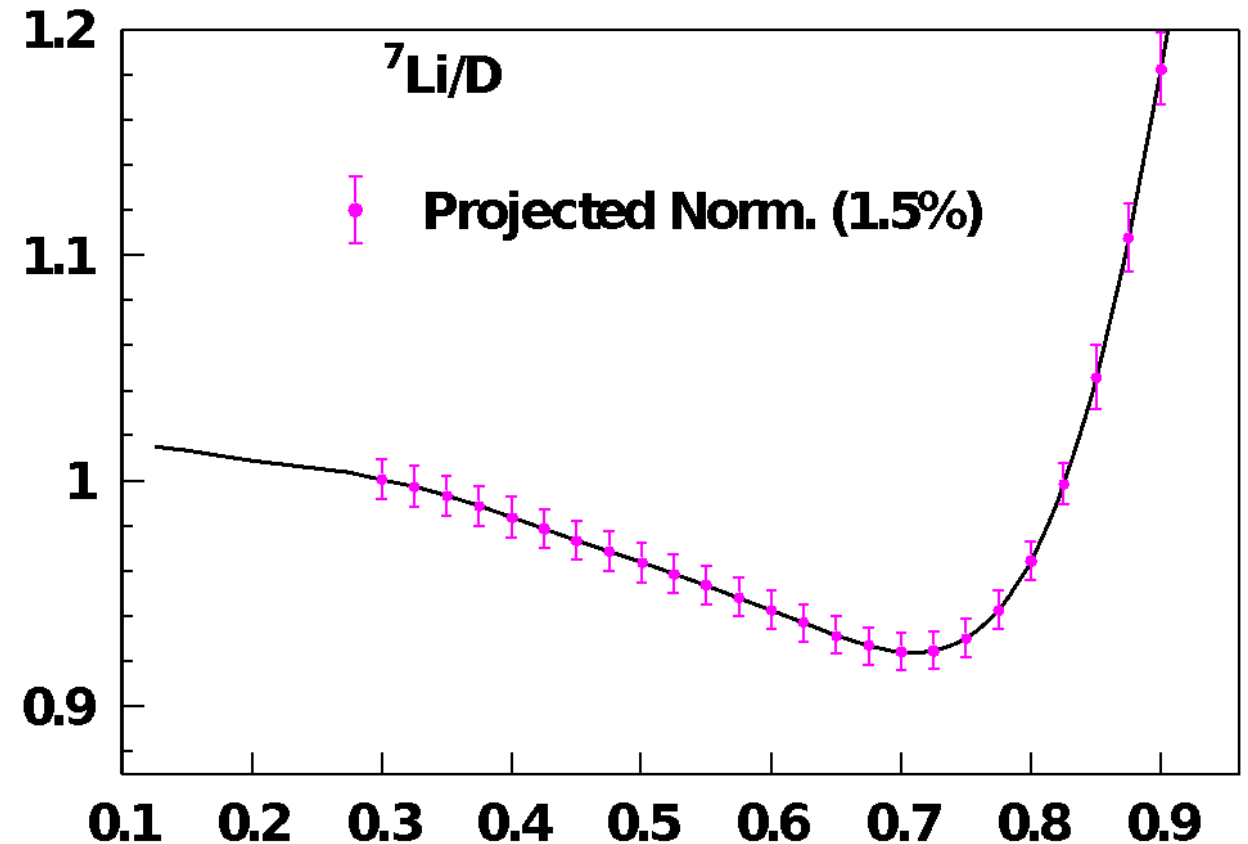
- **Exploring EMC-SRC Connection**

- Running in parallel with the XEM2 SRC experiment allows for direct comparison between the two phenomena for a large number of nuclei.



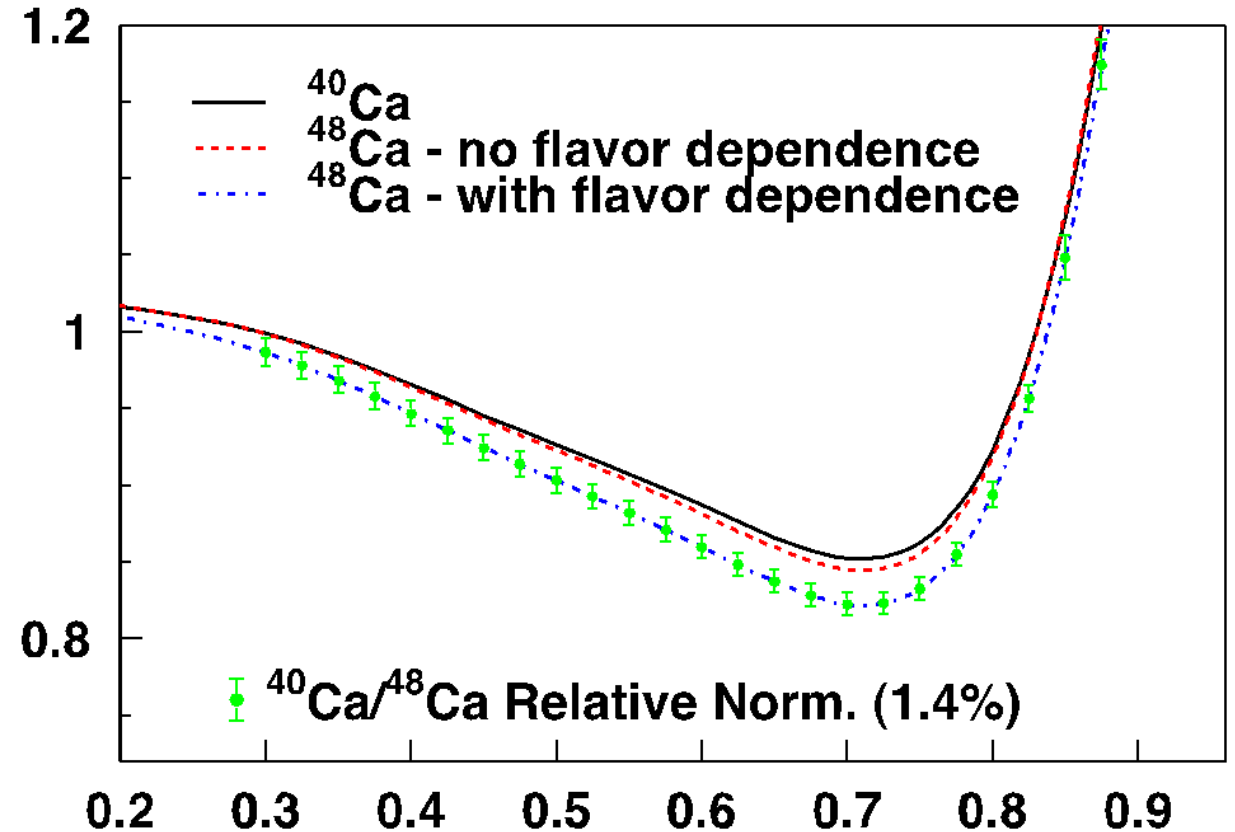
# XEM2 (EMC) Motivation

- **Exploring EMC-SRC Connection**
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- **Mapping out EMC Effect in Light Nuclei**
  - Light (few-body) nuclei are amenable to theoretical comparisons
  - Light nuclei provide an ideal environment to probe short range structure



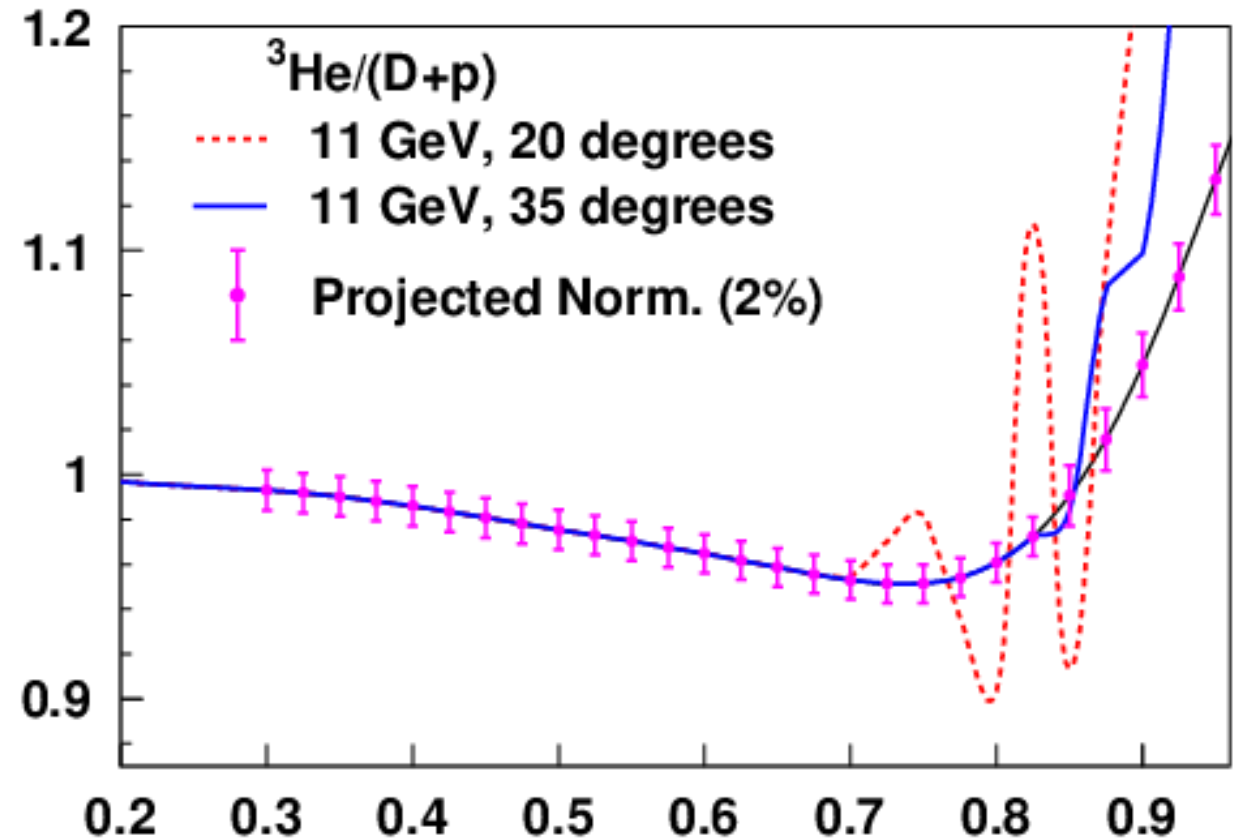
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  - Ca40, Ca48, and Ti are well suited to tease out any flavor dependence of the EMC Effect.



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- **And more...**



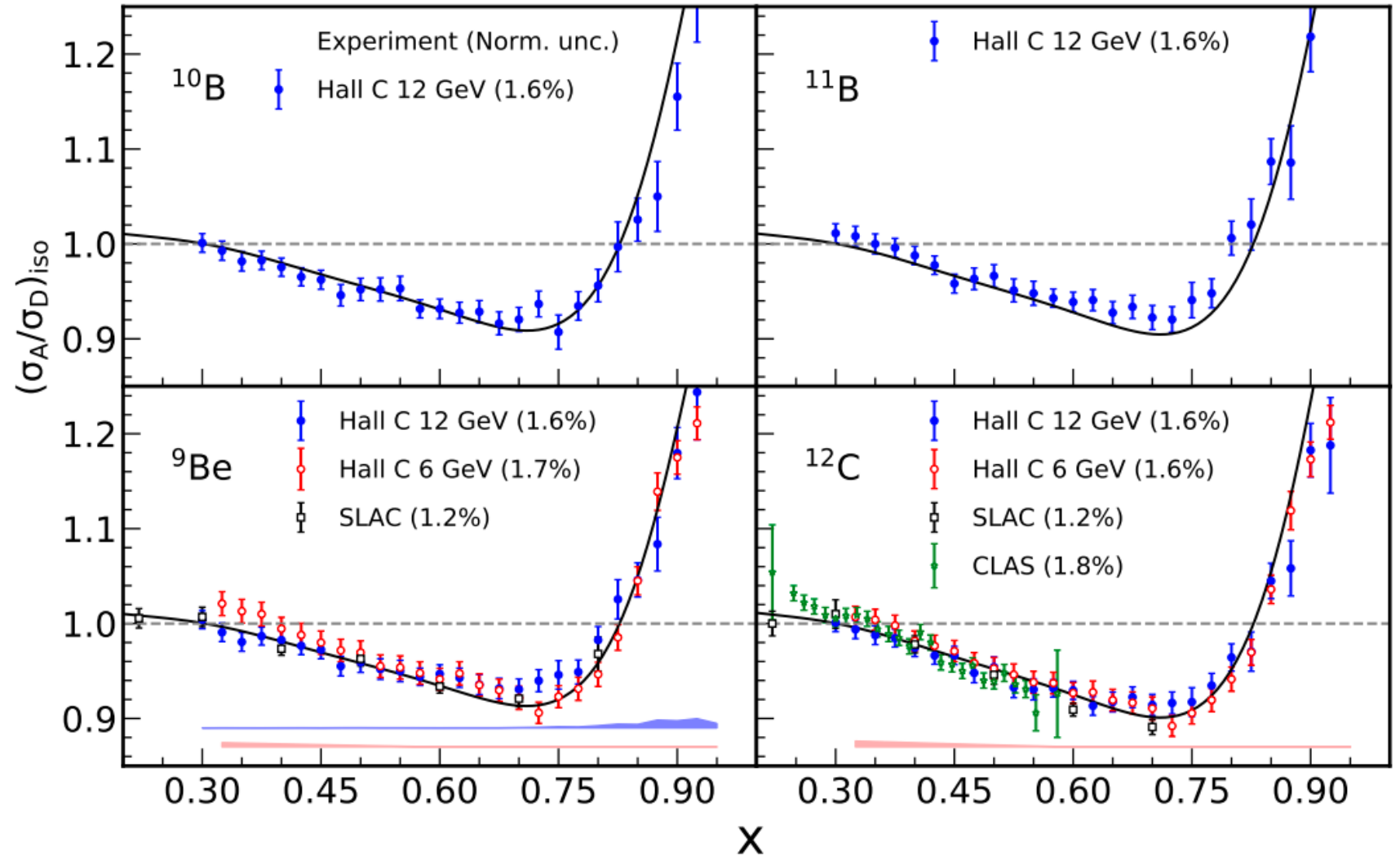


# XEM2 '18 EMC Ratios

Reasonable agreement with previous measurements of Be9 and C12.

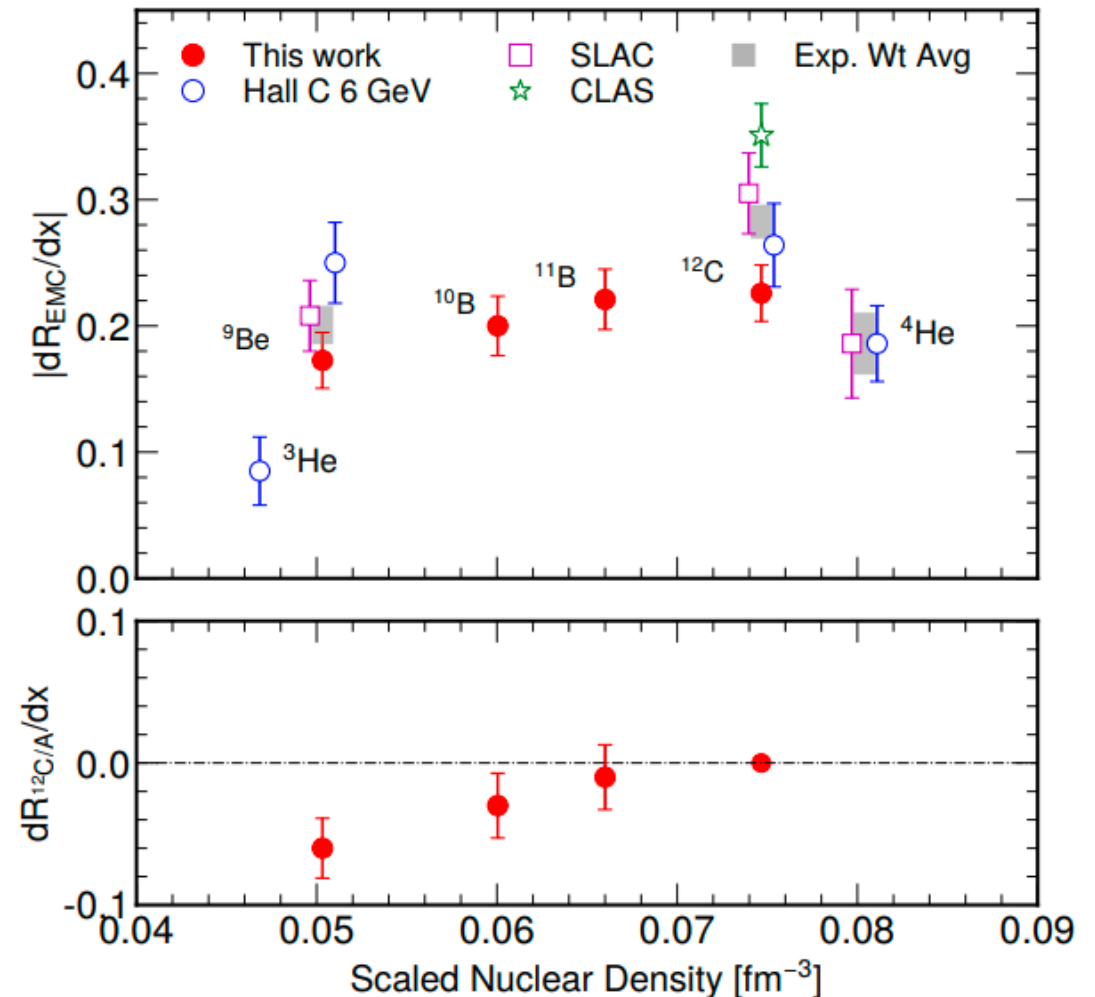
First measurements of the EMC Effect in B10 and B11.

\*Publication currently going through peer review process.



# XEM2 '18 EMC v. Density

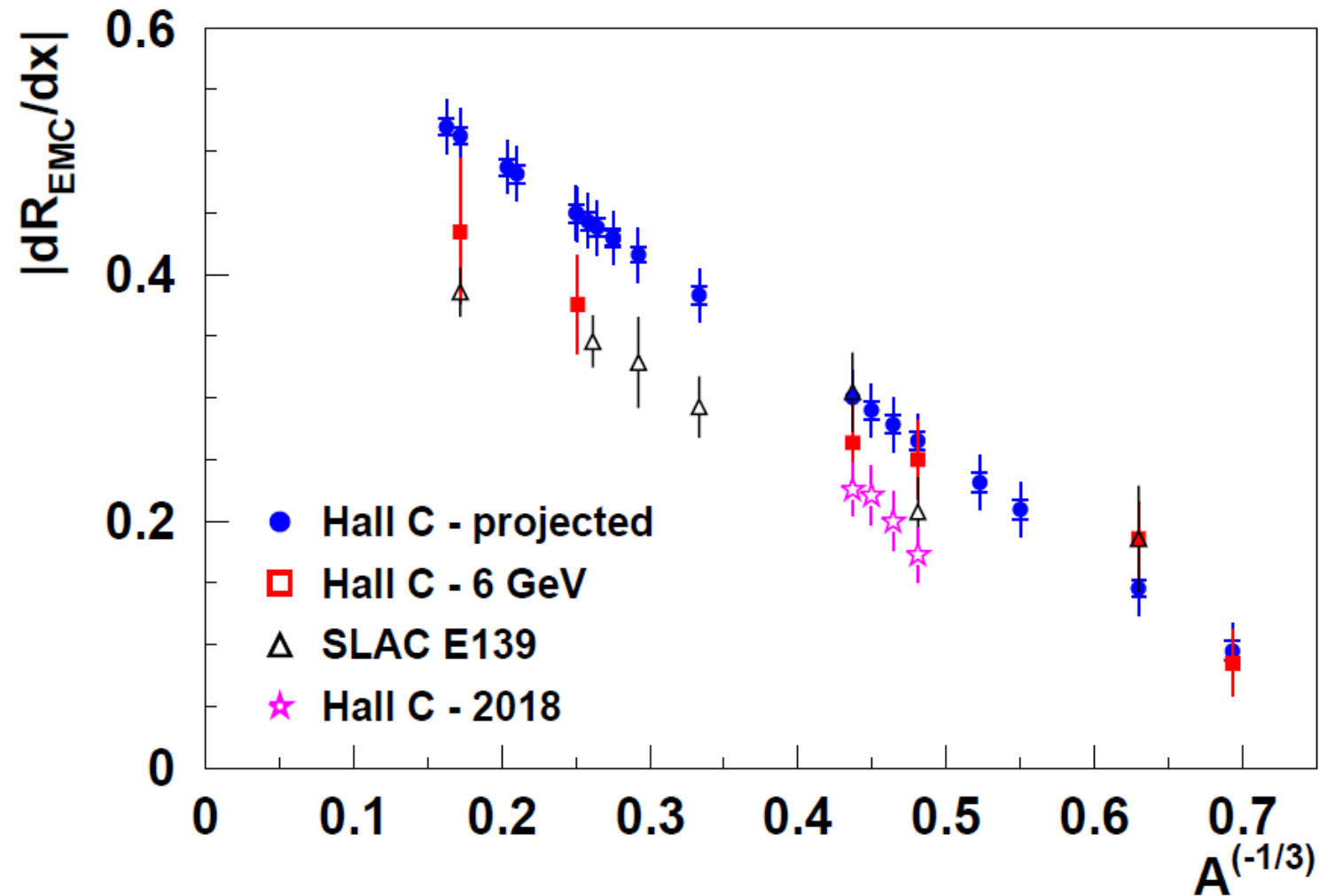
*“The size of the EMC effect for the boron isotopes is similar to that for  $^4\text{He}$ ,  $^9\text{Be}$ , and  $^{12}\text{C}$ , reinforcing the hypothesis that the EMC effect is driven by local, rather than average nuclear density.”*



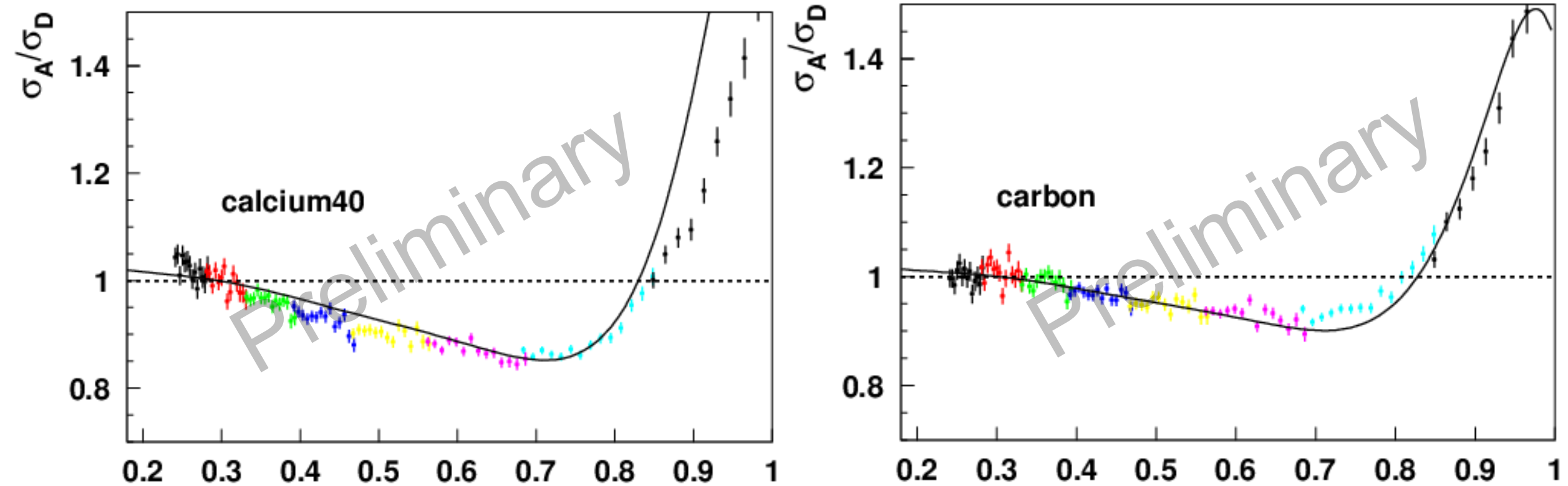
# XEM2 '22 Online Uncertainty Projections

Competitive statistical precision achieved for all measured targets.

Error bars shown use 2018 systematic uncertainties – almost certainly an overestimate of the systematic uncertainties that will be achieved for the 2022 data.



# XEM2 '22 Online EMC Ratios



# Summary

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- XEM2 experiment collected inclusive scattering data for the EMC Effect and SRCs for a large number of nuclei, allowing us to study:
  - EMC-SRC Relation
  - Isospin Dependence
  - Light Nuclei
- Results from '18 Boron data taking supports the hypothesis that the EMC Effect is driven by local nuclear density.
- Online results from '22 data taking show that target statistics were met and data looks OK so far.
- Aiming to show preliminary offline results from the '22 EMC data at DNP this October – Stay Tuned!