Preliminary Results from the 12 GeV EMC Effect Experiment in Hall C of Jefferson Lab

Cameron Cotton

DIS2024

April 10, 2024

This work is supported by U.S. Department of Energy under Award numbers DE-SC0014434 and DE-SC0014664 (SCGSR)

Outline

- The EMC Effect
- Experiment Overview
- Experiment Goals
- Preliminary Results

The EMC Effect

Prediction (Pre-1983)

$$F_2^A(x) = ZF_2^p(x) + NF_2^n(x)$$

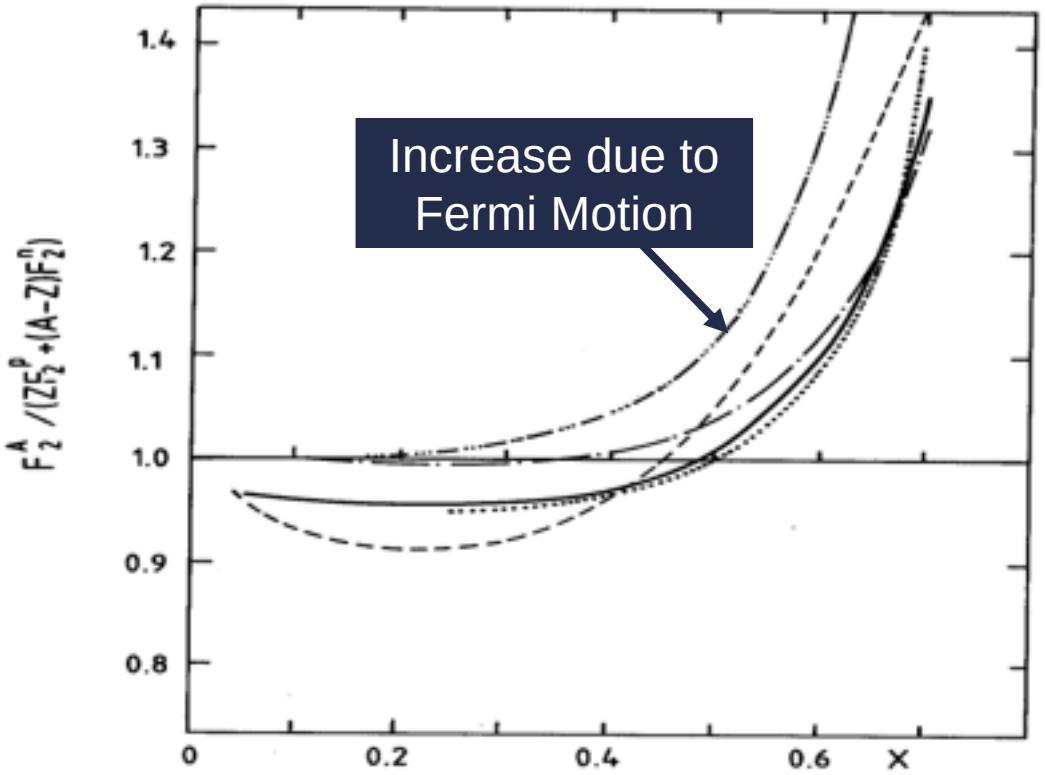
Experiment

J. Aubert et al., Phys. Lett. B123, 275 (1983)
V. Guzey et al., Phys. Rev. C86 045201 (2012)

The EMC Effect

Prediction (Pre-1983)

$$F_2^A(x) = ZF_2^p(x) + NF_2^n(x)$$



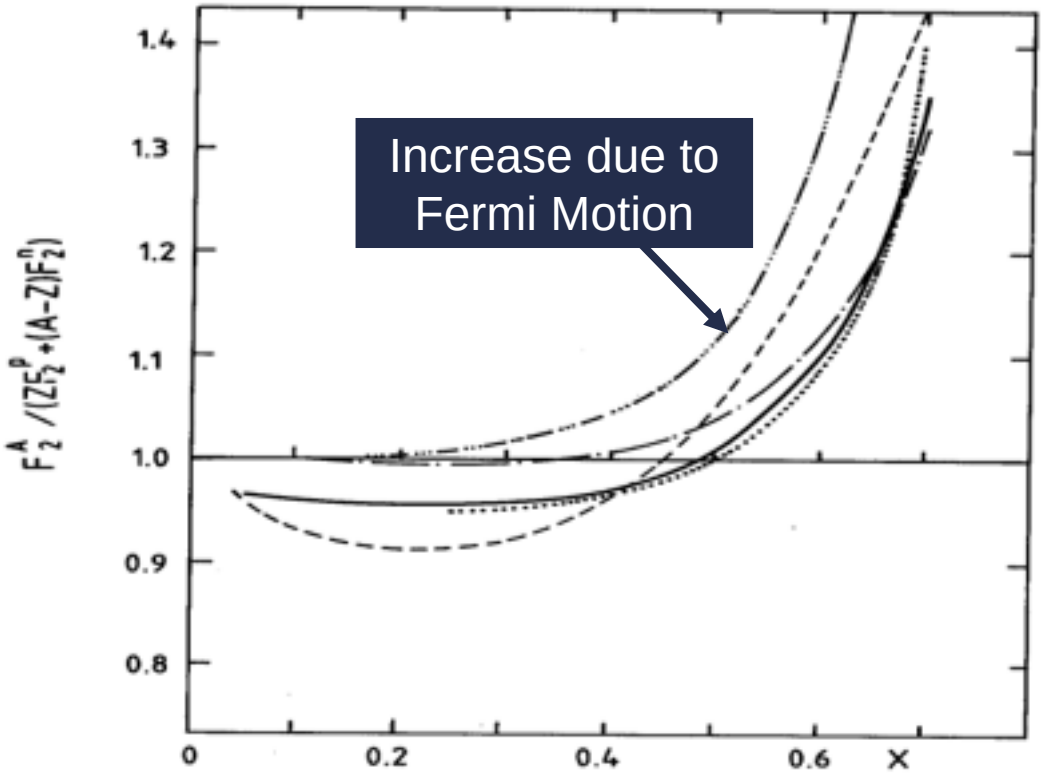
Experiment

J. Aubert et al., Phys. Lett. B123, 275 (1983)
V. Guzey et al., Phys. Rev. C86 045201 (2012)

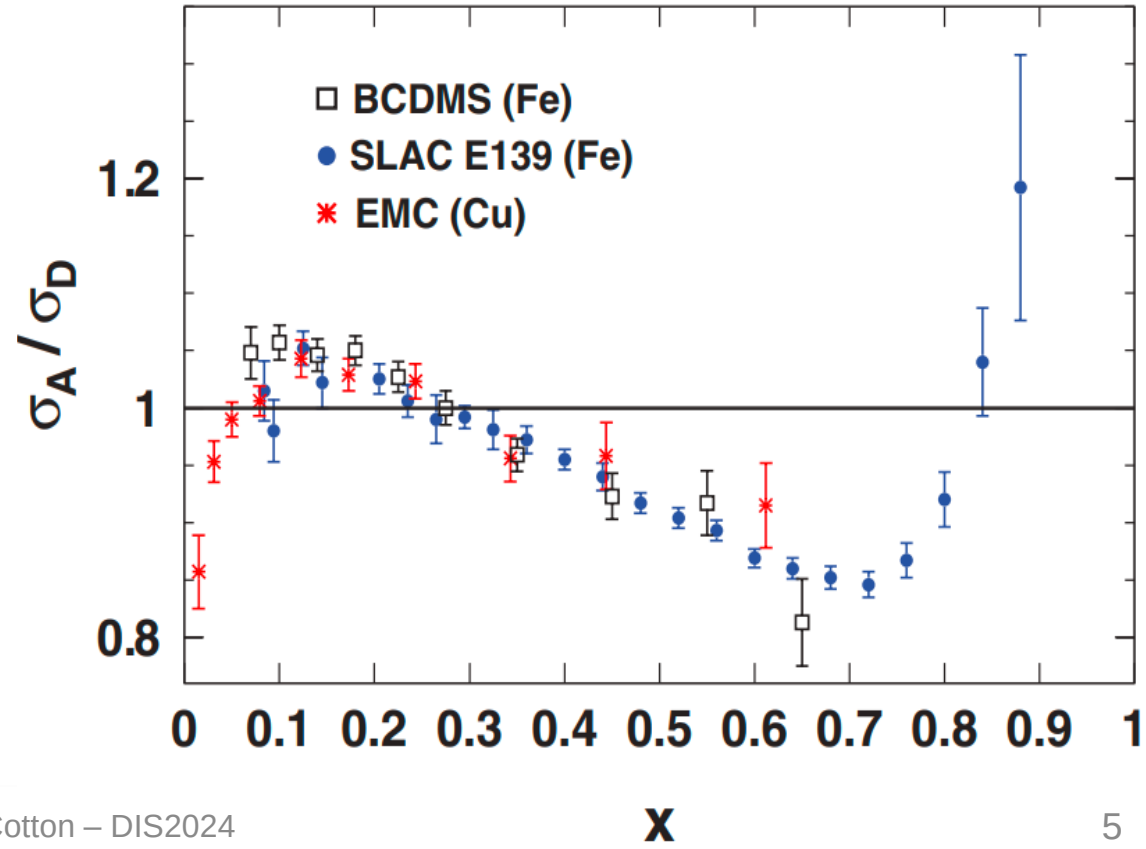
The EMC Effect

Prediction (Pre-1983)

$$F_2^A(x) = ZF_2^p(x) + NF_2^n(x)$$



Experiment

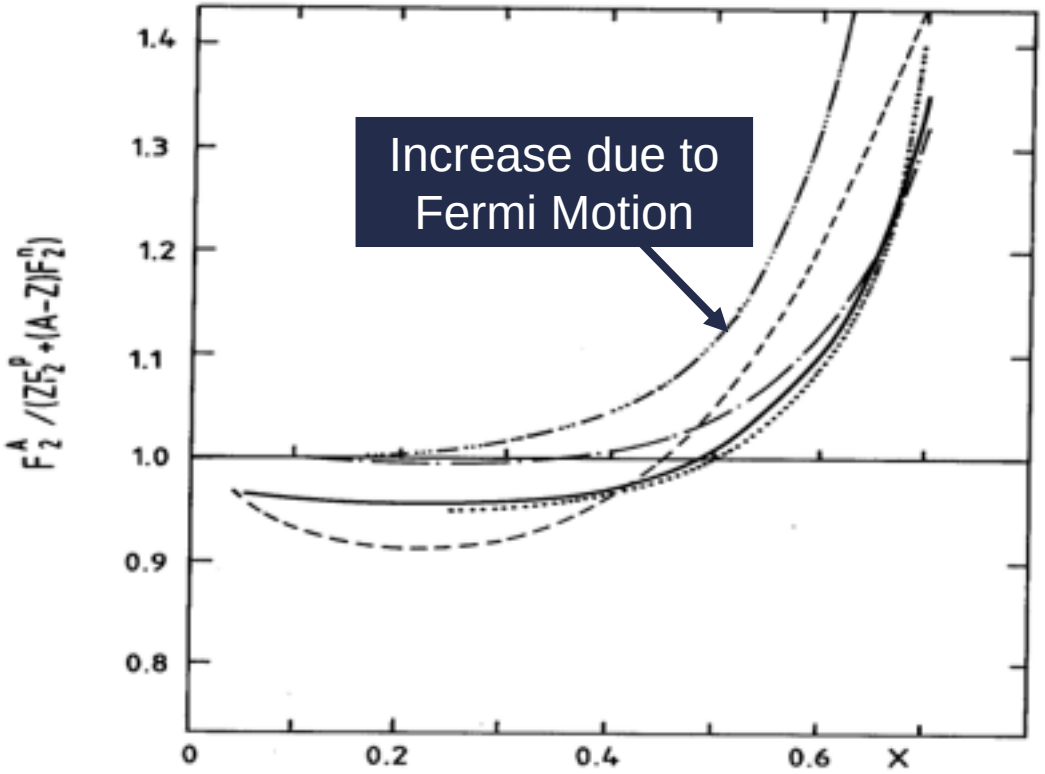


J. Aubert et al., Phys. Lett. B123, 275 (1983)
V. Guzey et al., Phys. Rev. C86 045201 (2012)

The EMC Effect

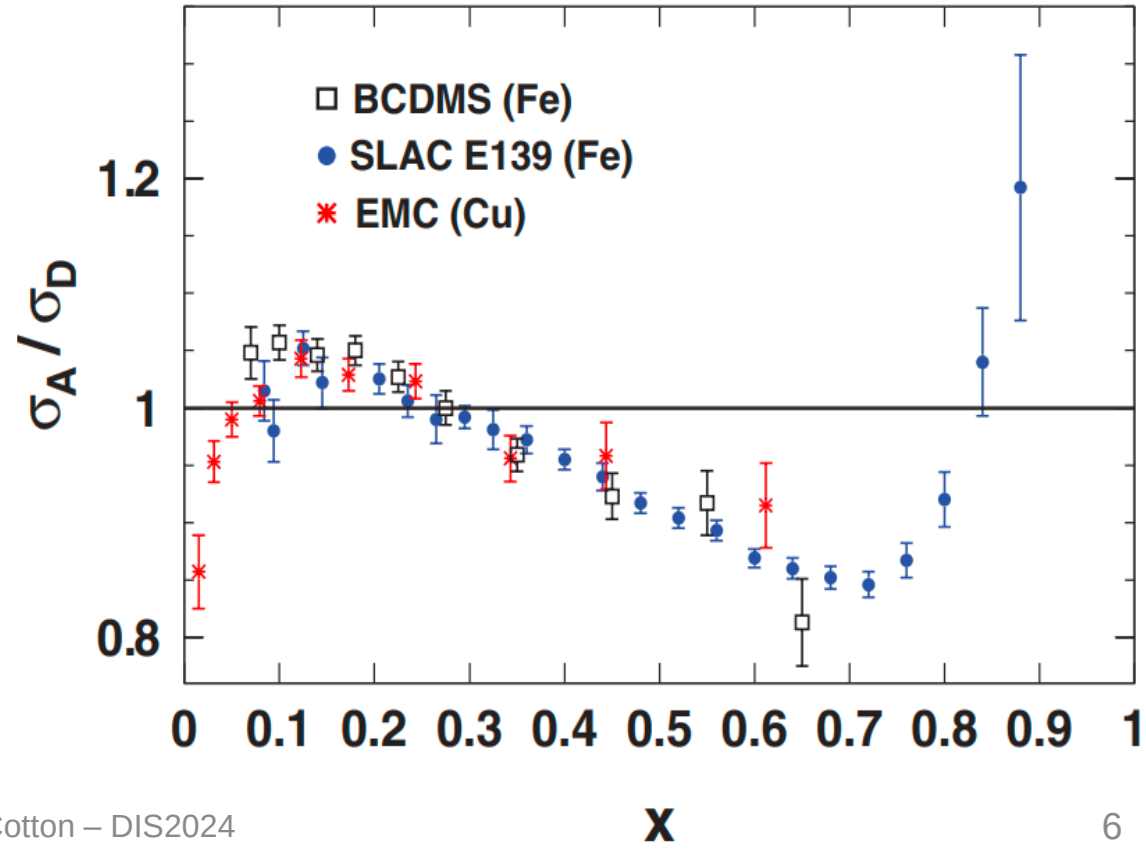
Prediction (Pre-1983)

$$F_2^A(x) = ZF_2^p(x) + NF_2^n(x)$$



Experiment

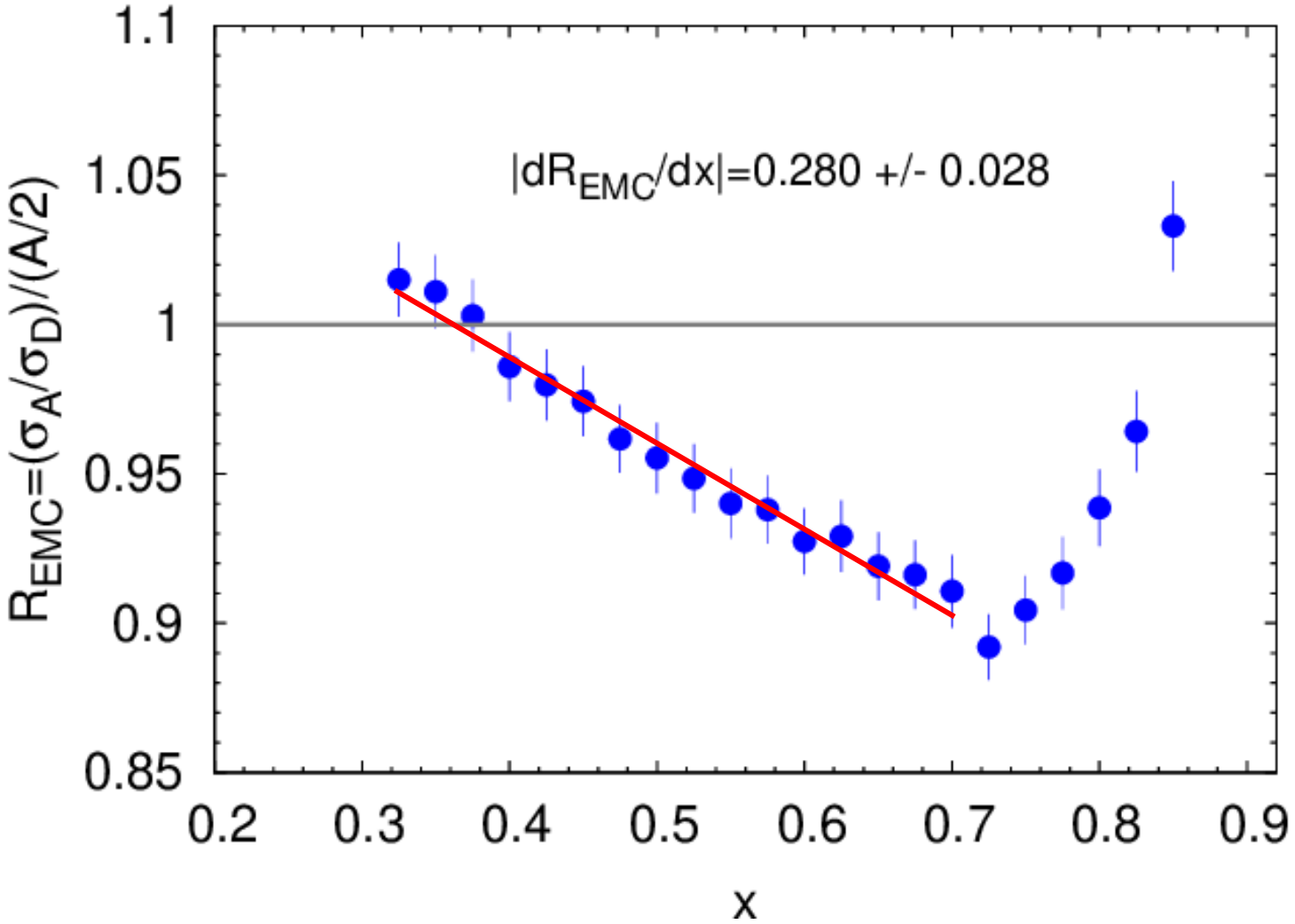
Quark distributions are modified in nuclei?



J. Aubert et al., Phys. Lett. B123, 275 (1983)
V. Guzey et al., Phys. Rev. C86 045201 (2012)

The EMC Effect

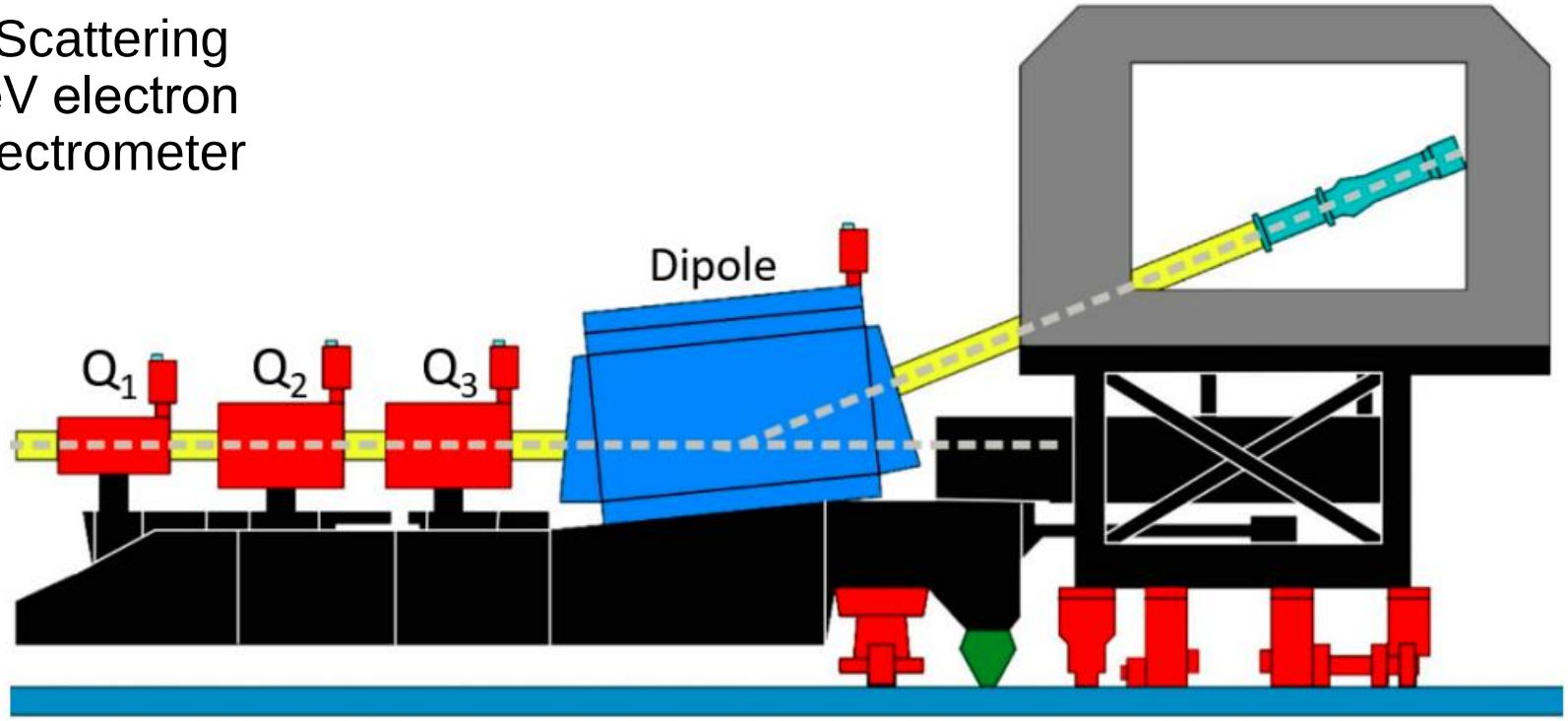
- The “size” of the EMC Effect can be compared between different nuclei by taking the slope of the per-nucleon cross section ratio in the range: $\boldsymbol{0.30 < x < 0.70}$



J. Arrington et al., Phys. Rev. C **86**, 065204 (2012).

E12-10-008 Overview

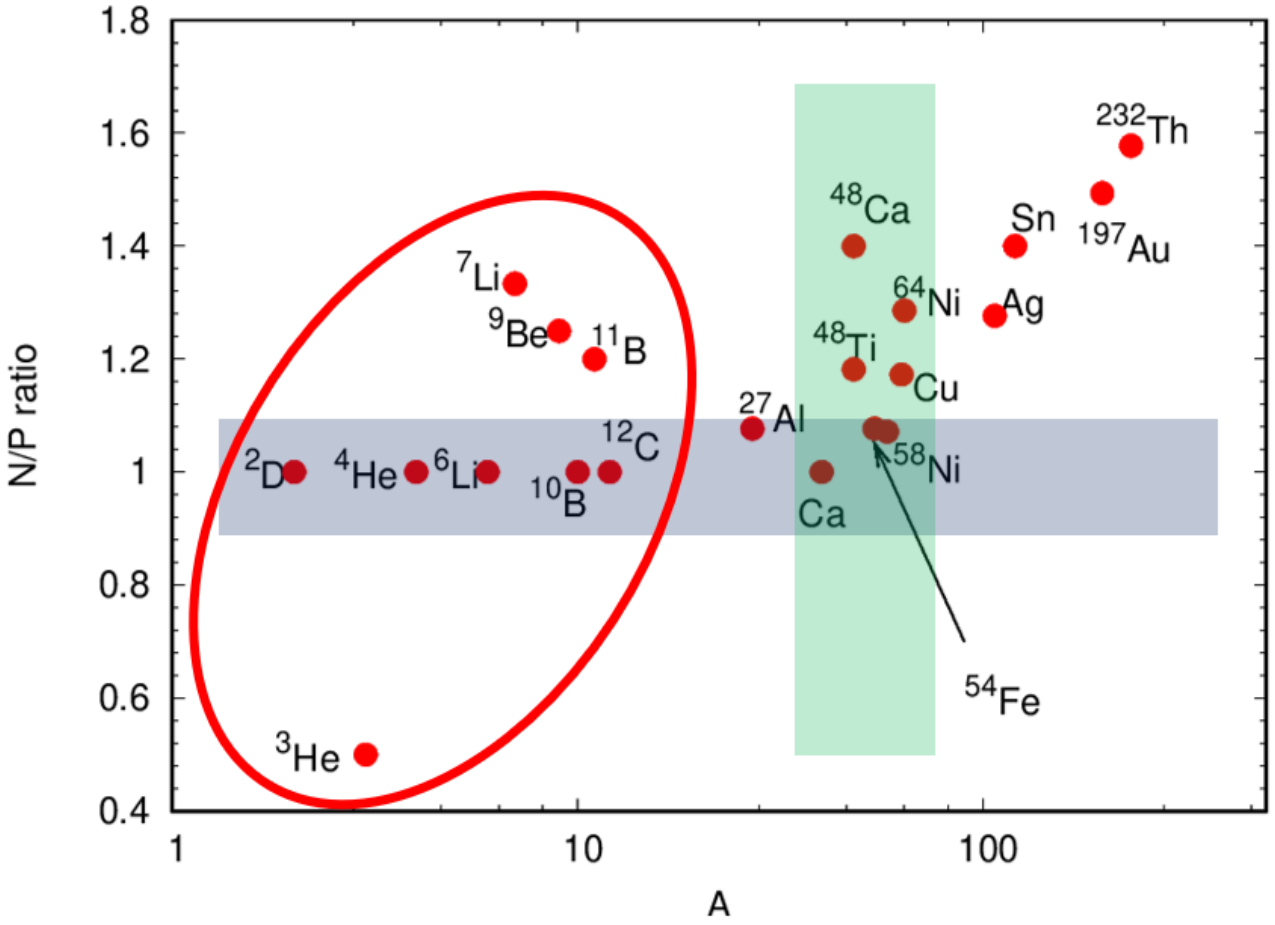
- Ran in Hall C of Jefferson Lab from Fall 2022 through Spring 2023.
- Collected inclusive Deep Inelastic Scattering (DIS) data using CEBAF's 10.6 GeV electron beam and the High Momentum Spectrometer (HMS).



J. Arrington et al. Phys. Rev. C 104, 065203 (2021)

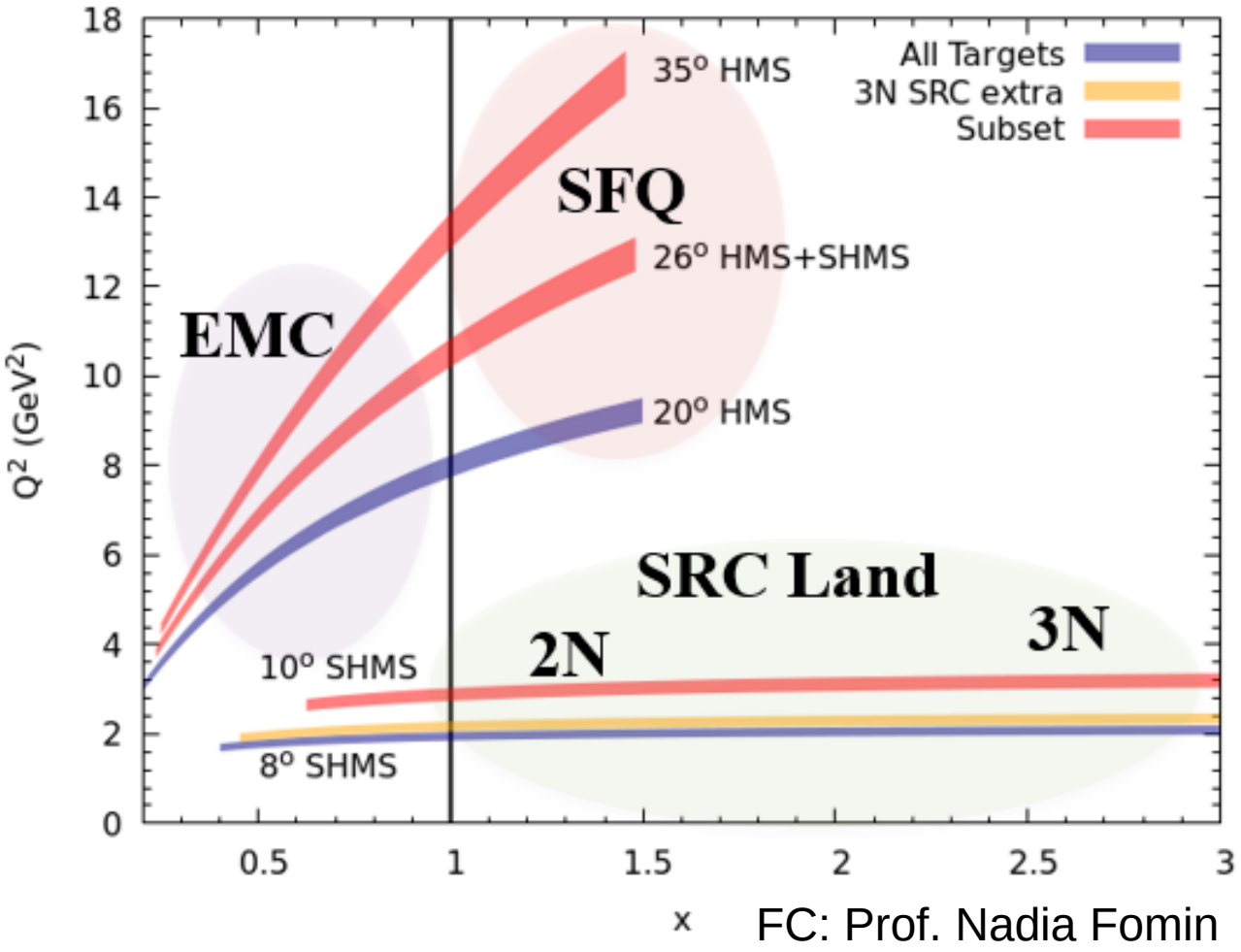
E12-10-008 Overview

- Ran in Hall C of Jefferson Lab from Fall 2022 through Spring 2023.
- Collected inclusive Deep Inelastic Scattering (DIS) data using CEBAF's 10.6 GeV electron beam and the High Momentum Spectrometer (HMS).
- Large number of targets to study the EMC Effect across a diverse range of different nuclear environments.



E12-10-008 Overview

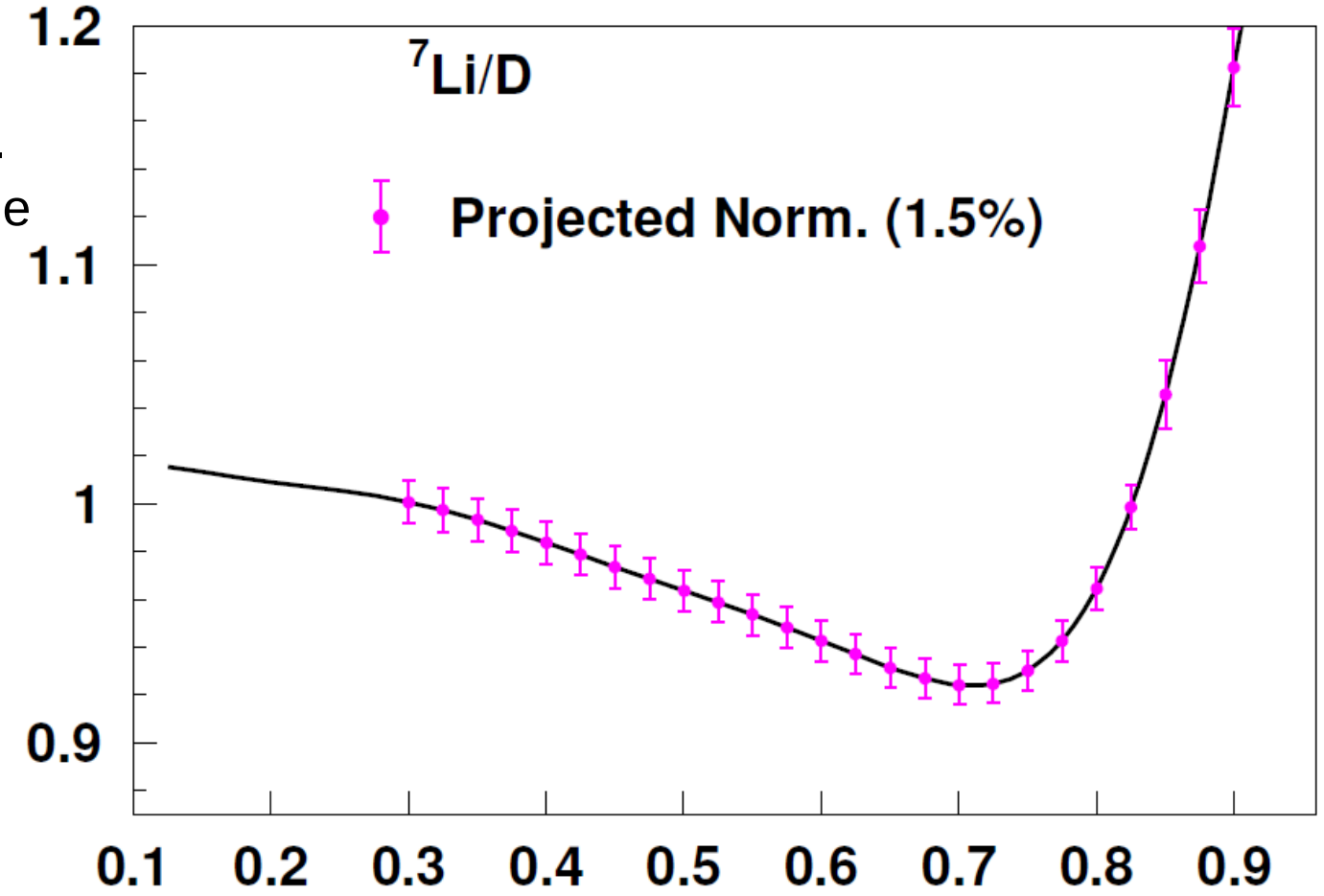
- Ran in Hall C of Jefferson Lab from Fall 2022 through Spring 2023.
- Collected inclusive Deep Inelastic Scattering (DIS) data using CEBAF's 10.6 GeV electron beam and the High Momentum Spectrometer (HMS).
- Large number of targets to study the EMC Effect across a diverse range of different nuclear environments.
- Ran in parallel with an experiment studying SRCs – SRC-EMC Correlation



FC: Prof. Nadia Fomin

Select Experimental Goals

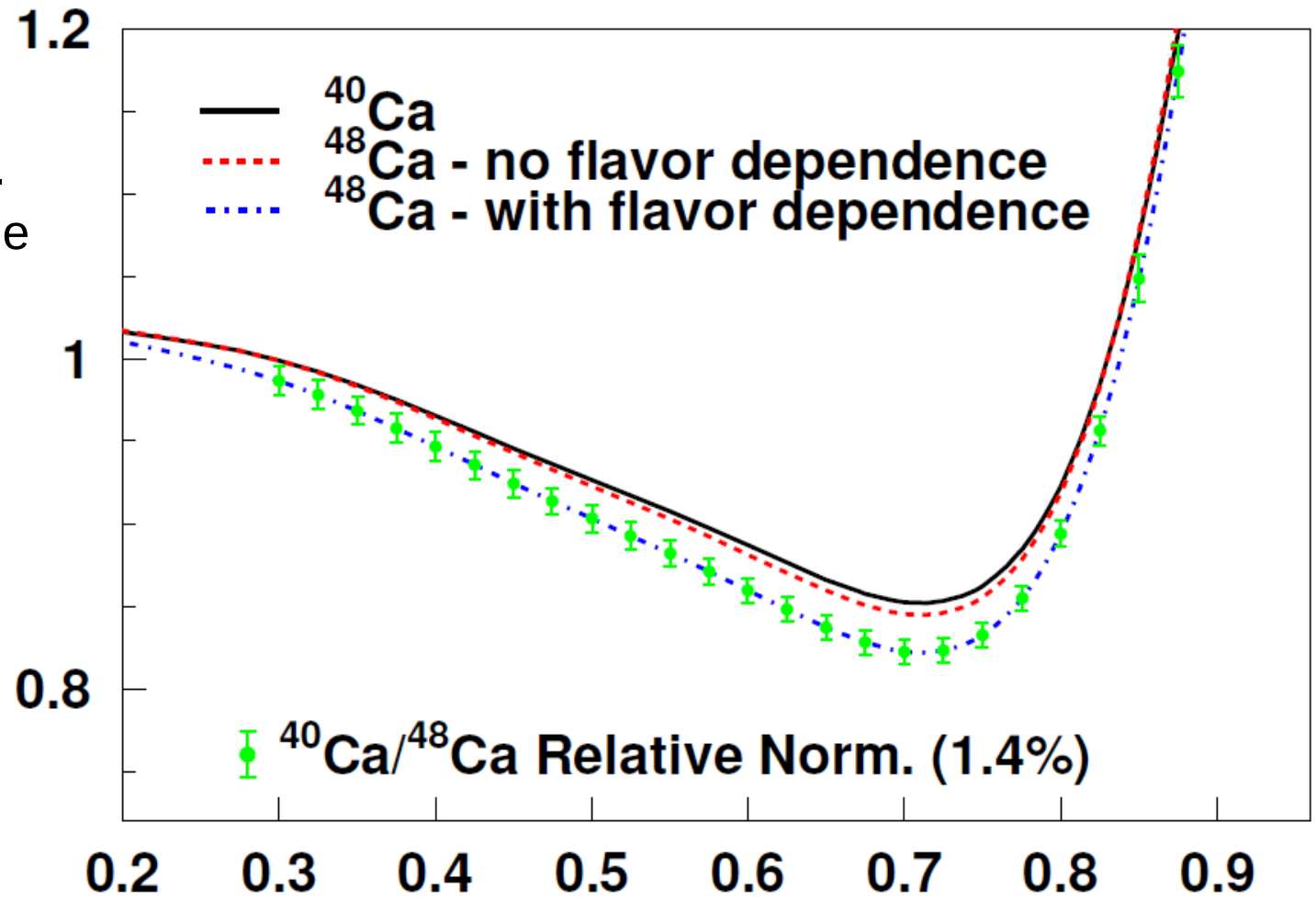
- **EMC Effect in Light Nuclei**
  - Amenable to theoretical comparisons.
  - Ideal environment to probe short range structure.



Select Experimental Goals

- **EMC Effect in Light Nuclei**
  - Amenable to theoretical comparisons.
  - Ideal environment to probe short range structure.

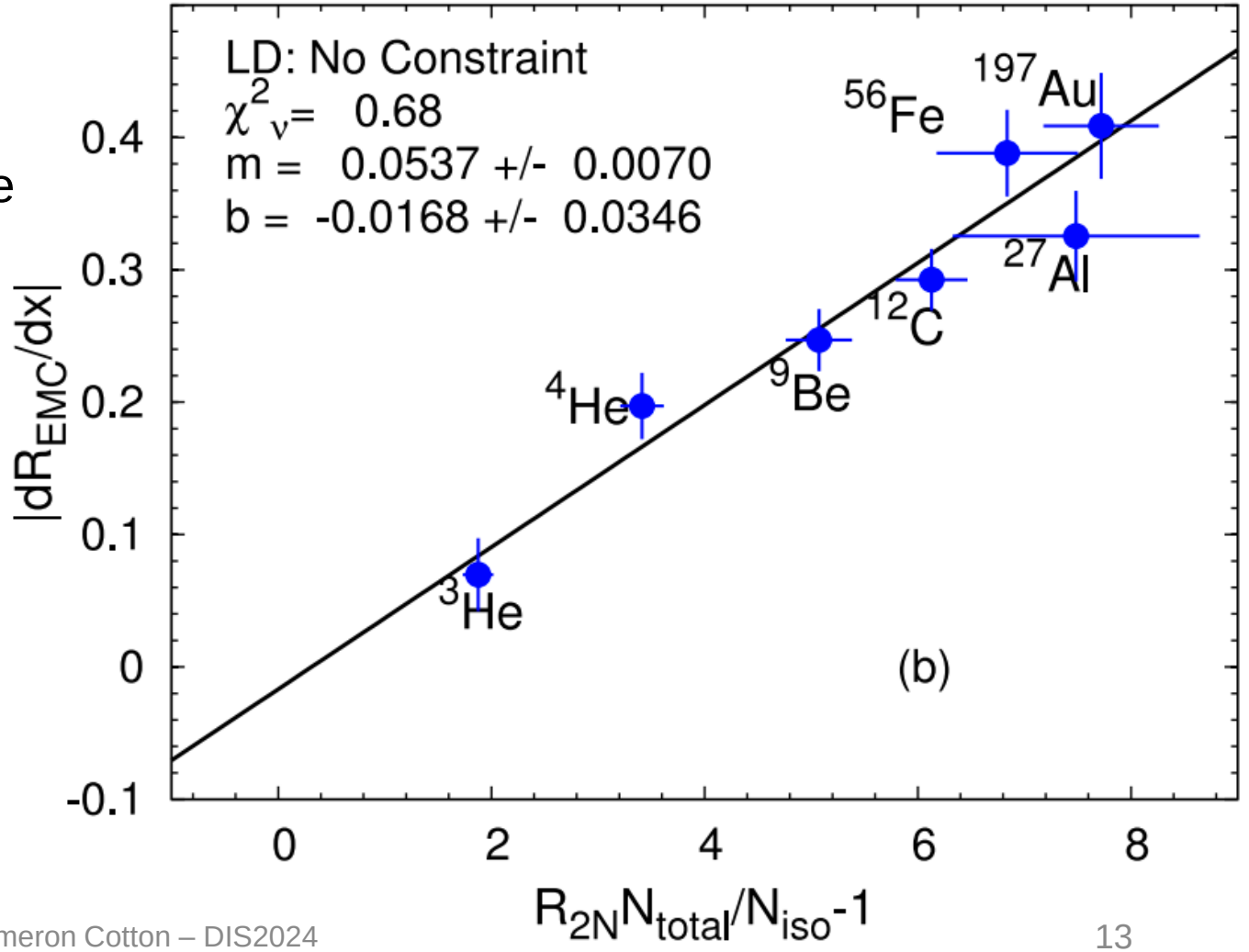
- **Flavor Dependent EMC Effect**
  - Ca40, Ca48, Ni58, Ni64



I. C. Cloet, W. Bentz, and A. W. Thomas, Phys. Lett. B642, 210 (2006).

Select Experimental Goals

- **EMC Effect in Light Nuclei**
  - Amenable to theoretical comparisons.
  - Ideal environment to probe short range structure.
- **Flavor Dependent EMC Effect**
  - Ca40, Ca48, Ni58, Ni64
- **EMC-SRC Connection**
  - Ran in parallel with the XEM2 SRC experiment – direct comparison

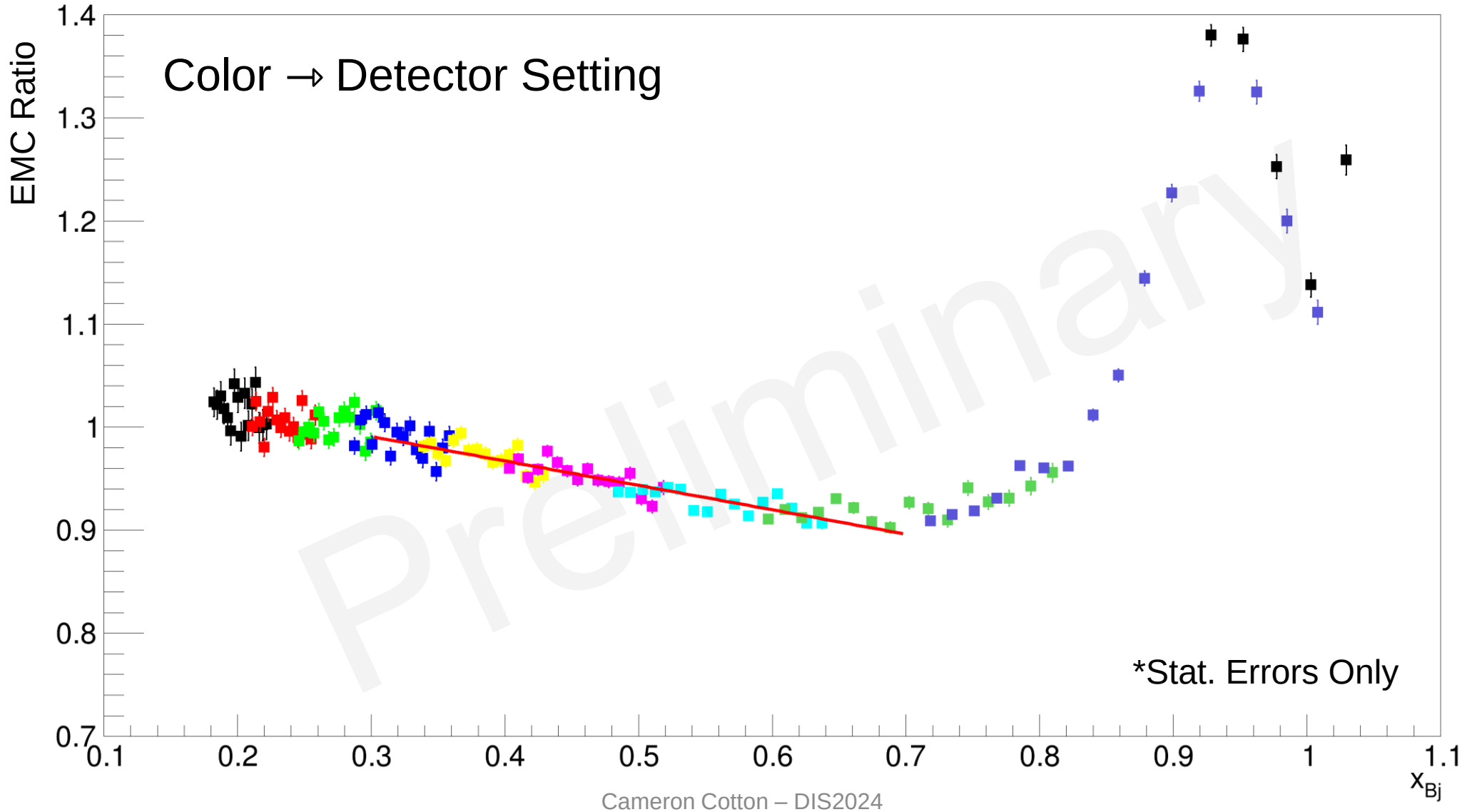


J. Arrington et al., Phys. Rev. C **86**, 065204 (2012).

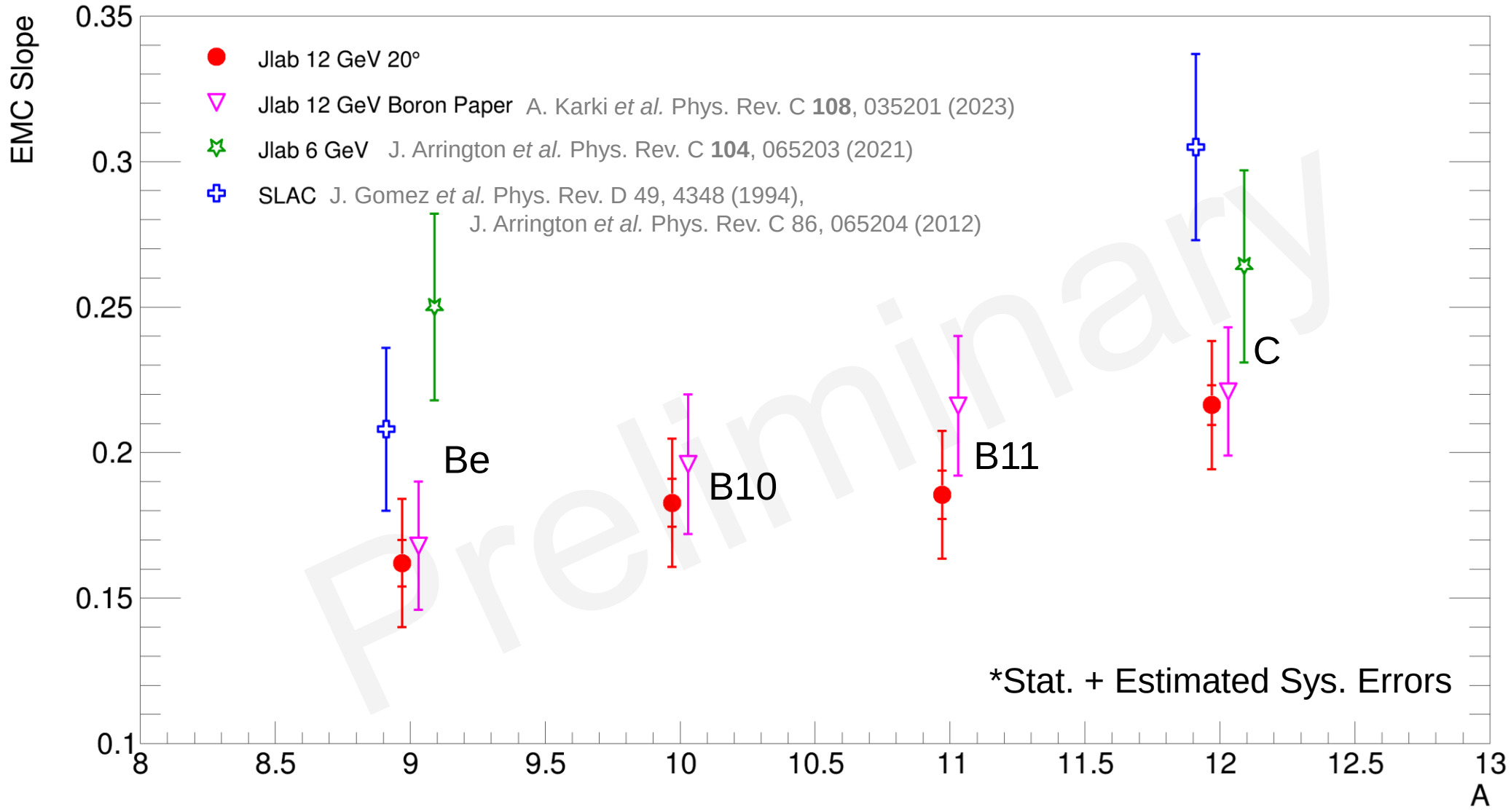
Preliminary Results

- Fine tuning Monte Carlo simulation
- Iterating cross section model
- Selecting F2n/F2p model
- Quantifying systematic errors

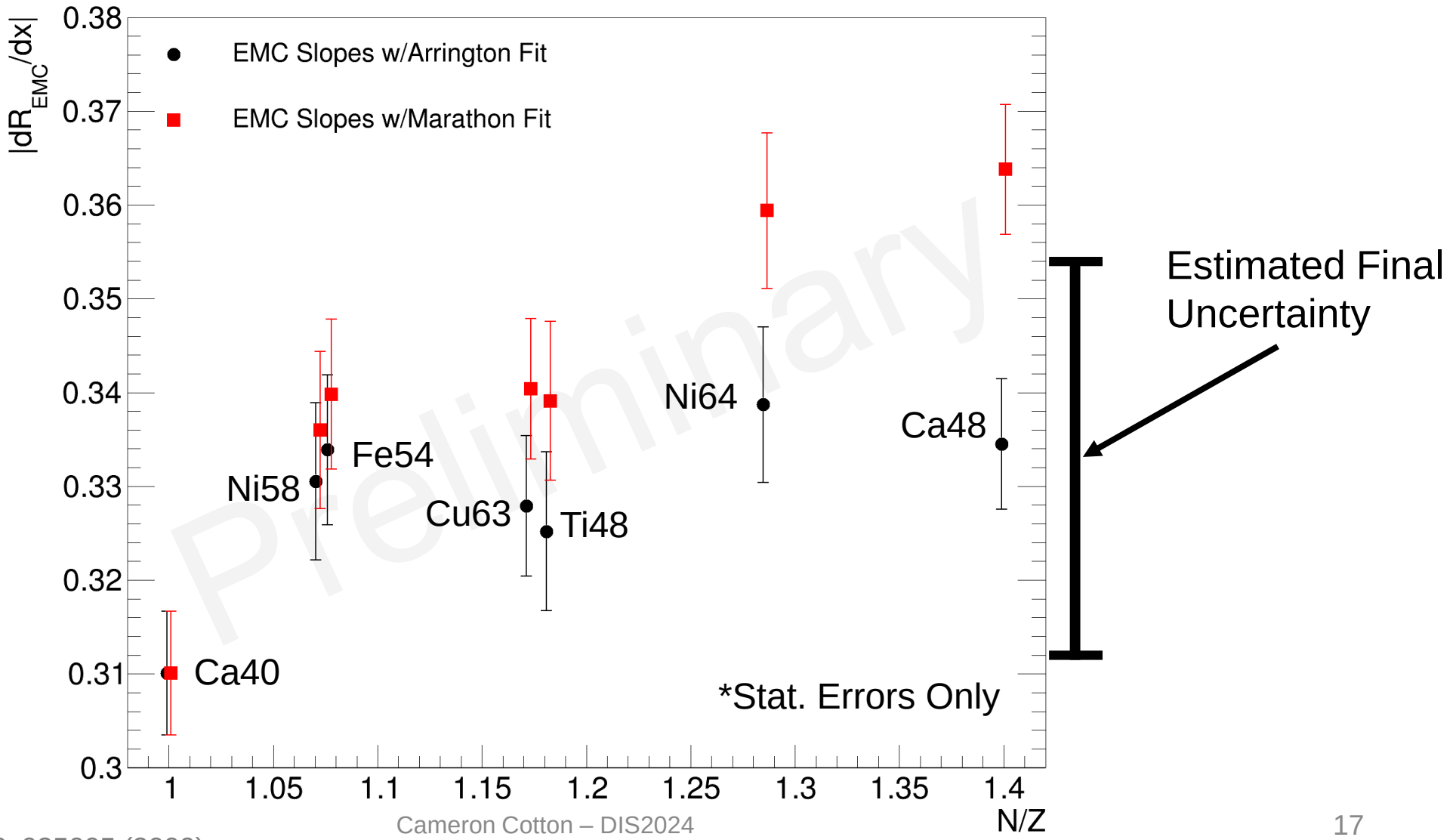
Preliminary Results – Carbon EMC Ratio



Preliminary Results - Be through C

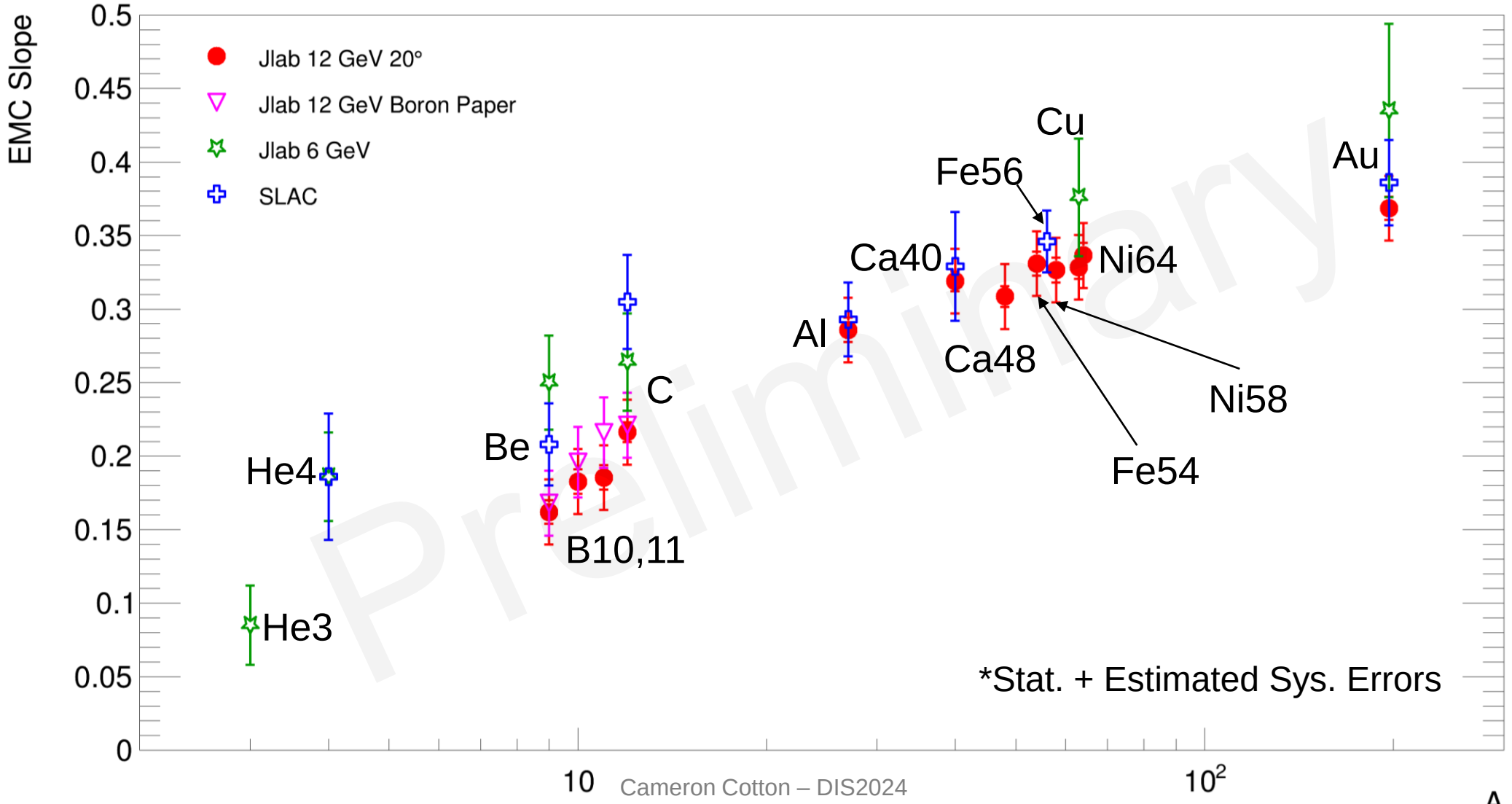


Impact of F_2^n/F_2^p Model



J. Arrington et al., J.83Phys.G36, 025005 (2009)

Preliminary Results



*Preliminary estimated errors; expect final uncertainties to be smaller

Summary

- E12-10-008 completed data collection at Jefferson Lab in Spring 2023.
- Preliminary results appear consistent with measurements of previously studied targets
- Extraction of flavor dependence is very sensitive to F_2^n / F_2^p
- Aiming for first publication this summer!

Questions?