# Preliminary Results from the 12 GeV EMC Effect Experiment in Jefferson Lab's Hall C

ようこそ！

Cameron Cotton

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Connections Between Nuclear PDFs and Nuclear Structure

11.28.23






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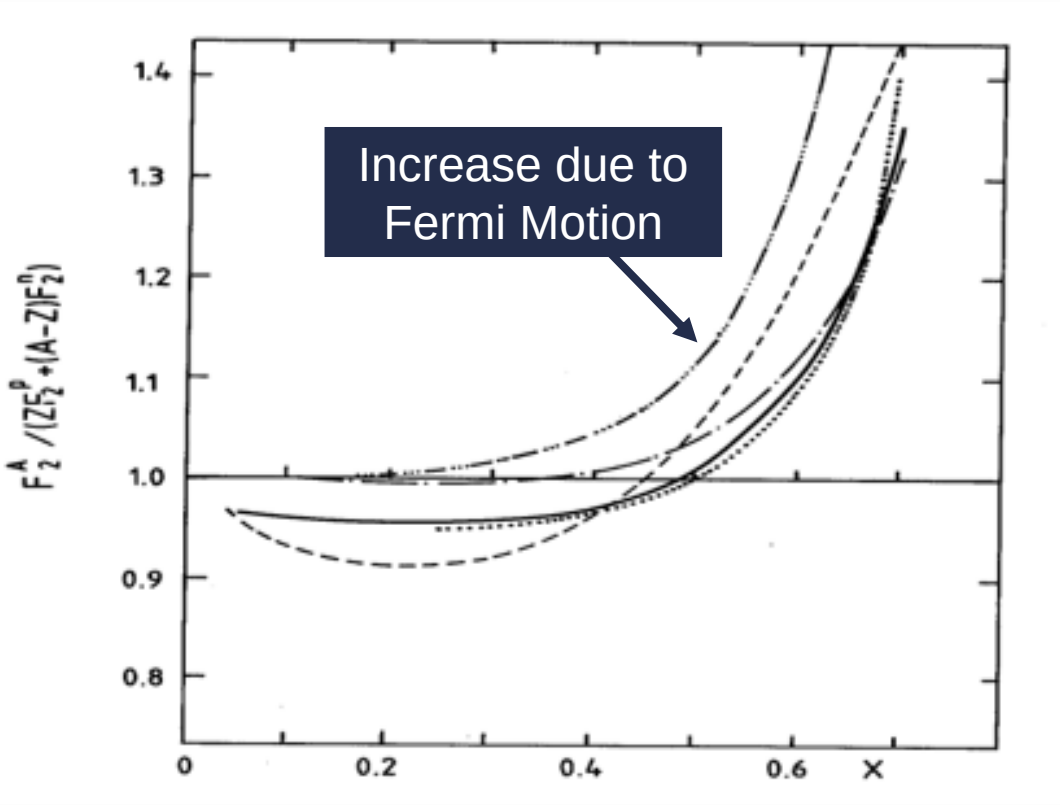
# Outline

- What is the EMC Effect?
- Experimental Overview
- Select Experiment Goals
- Select Preliminary Results
- Summary

# The EMC Effect

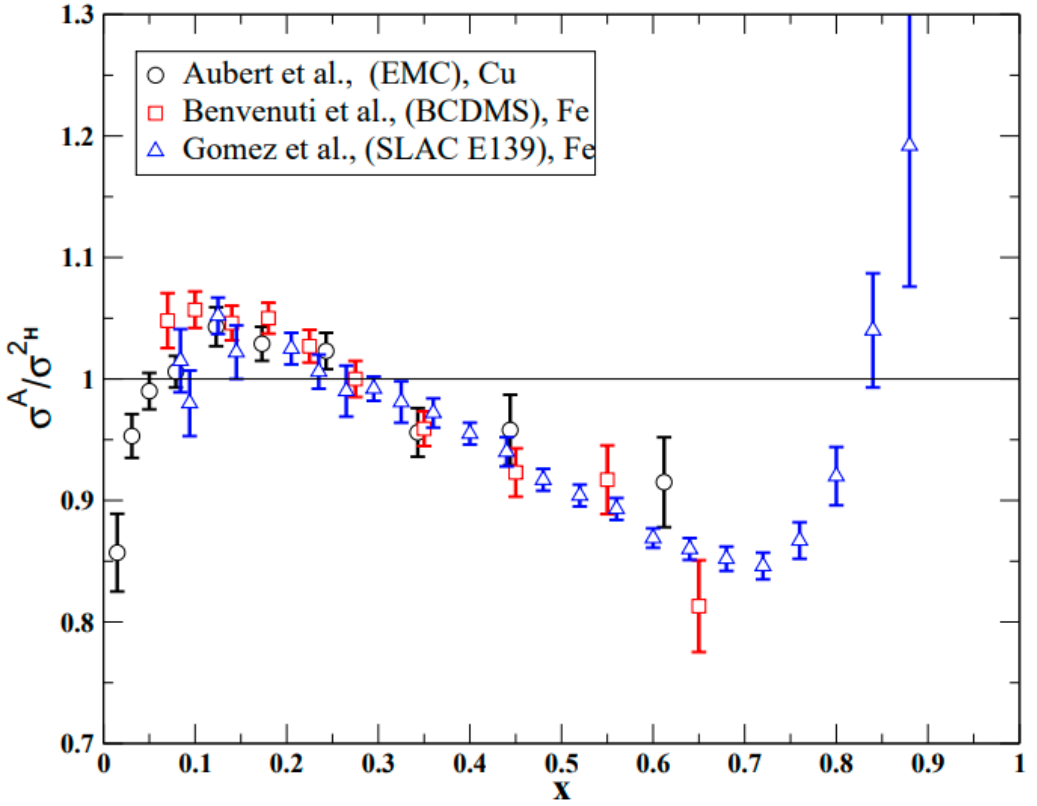
## Prediction (Pre-1983)

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




## Experiment

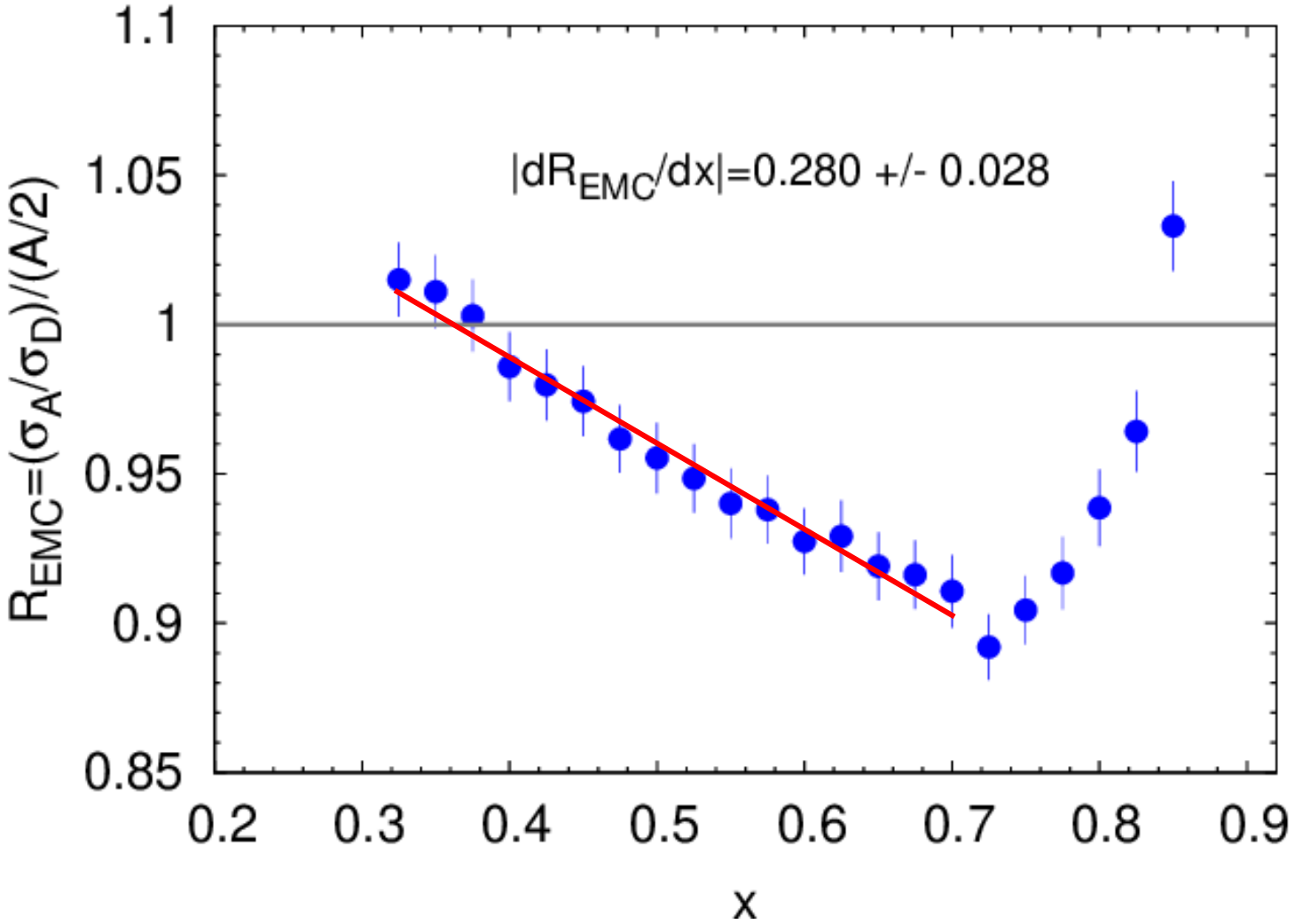
**Quark distributions are modified in nuclei?**




J. Aubert et al., Phys. Lett. B123, 275 (1983)

# The EMC Effect

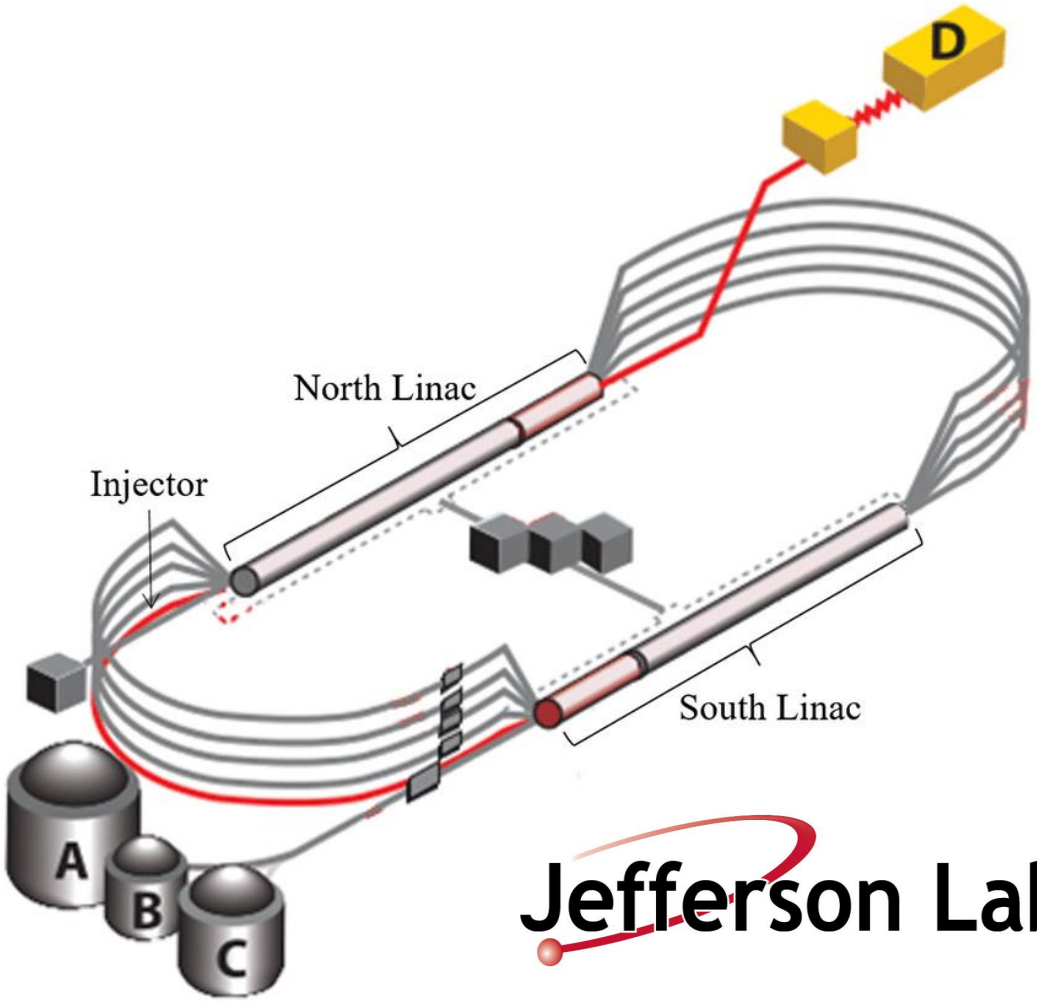
- We can compare the "size" of the EMC Effect in different nuclei by taking the slope of the per-nucleon cross section ratio in the range: $\boldsymbol{0.30 < x < 0.70}$
- We find that the size of the EMC varies between nuclei, generally increasing with A.




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

# Experimental Overview

- Exp. E12-10-008 ran in Hall C of Jefferson Lab from Fall 2022 through Spring 2023.




Jefferson Lab

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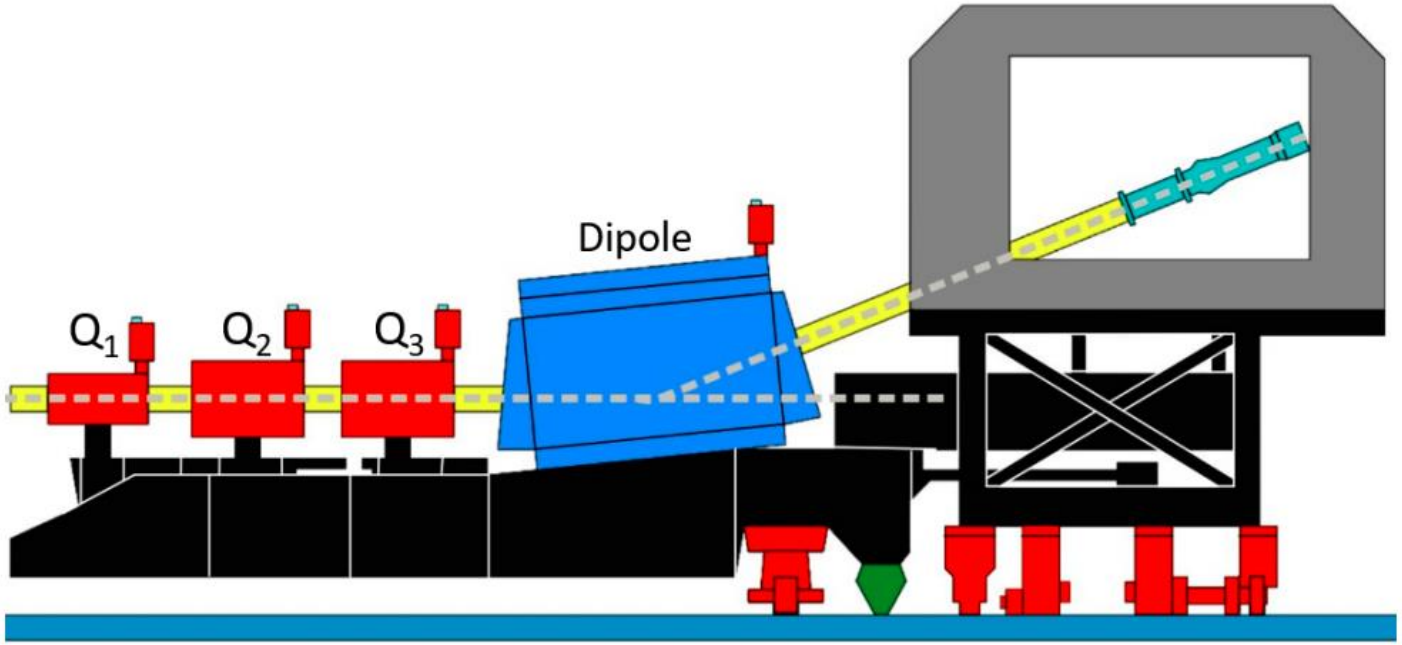
- This experiment collected inclusive Deep Inelastic Scattering (DIS) data utilizing a 10.6 GeV electron beam produced at CEBAF and the High Momentum Spectrometer (HMS) present in Hall C.



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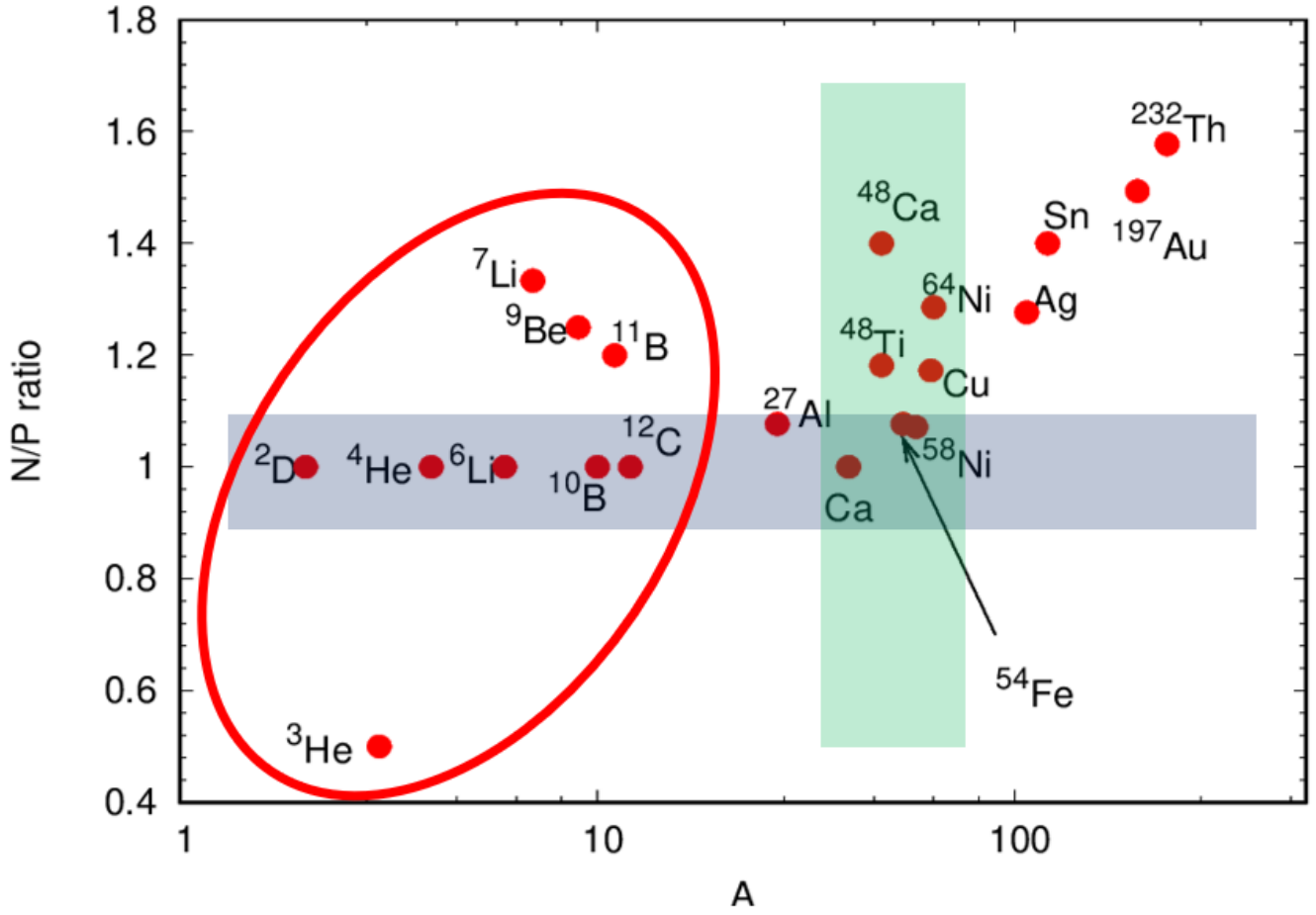
- Data was collected by impinging the 10.6 GeV electron beam on over 20 targets to study the nuclear dependence of the EMC Effect.



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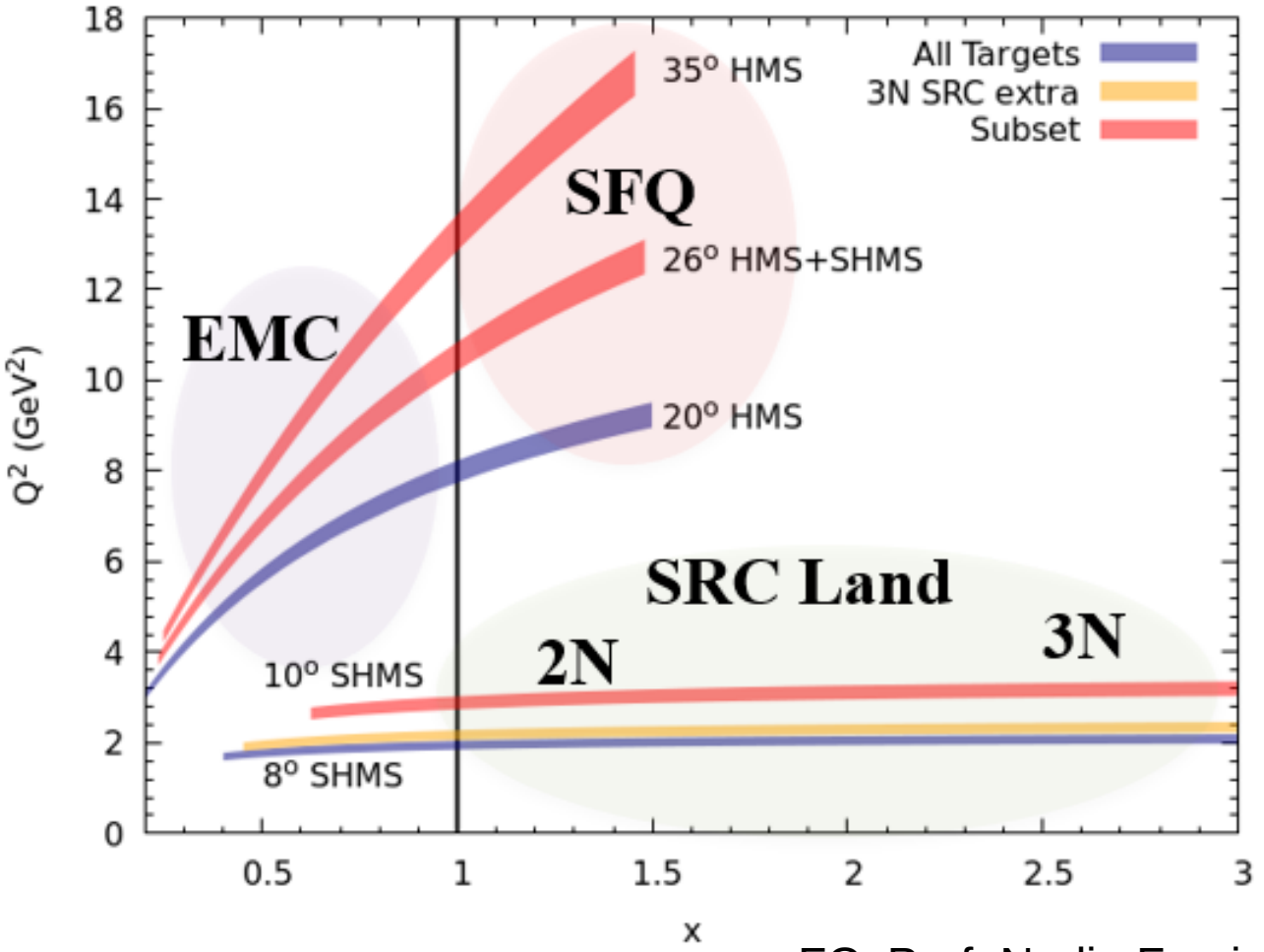
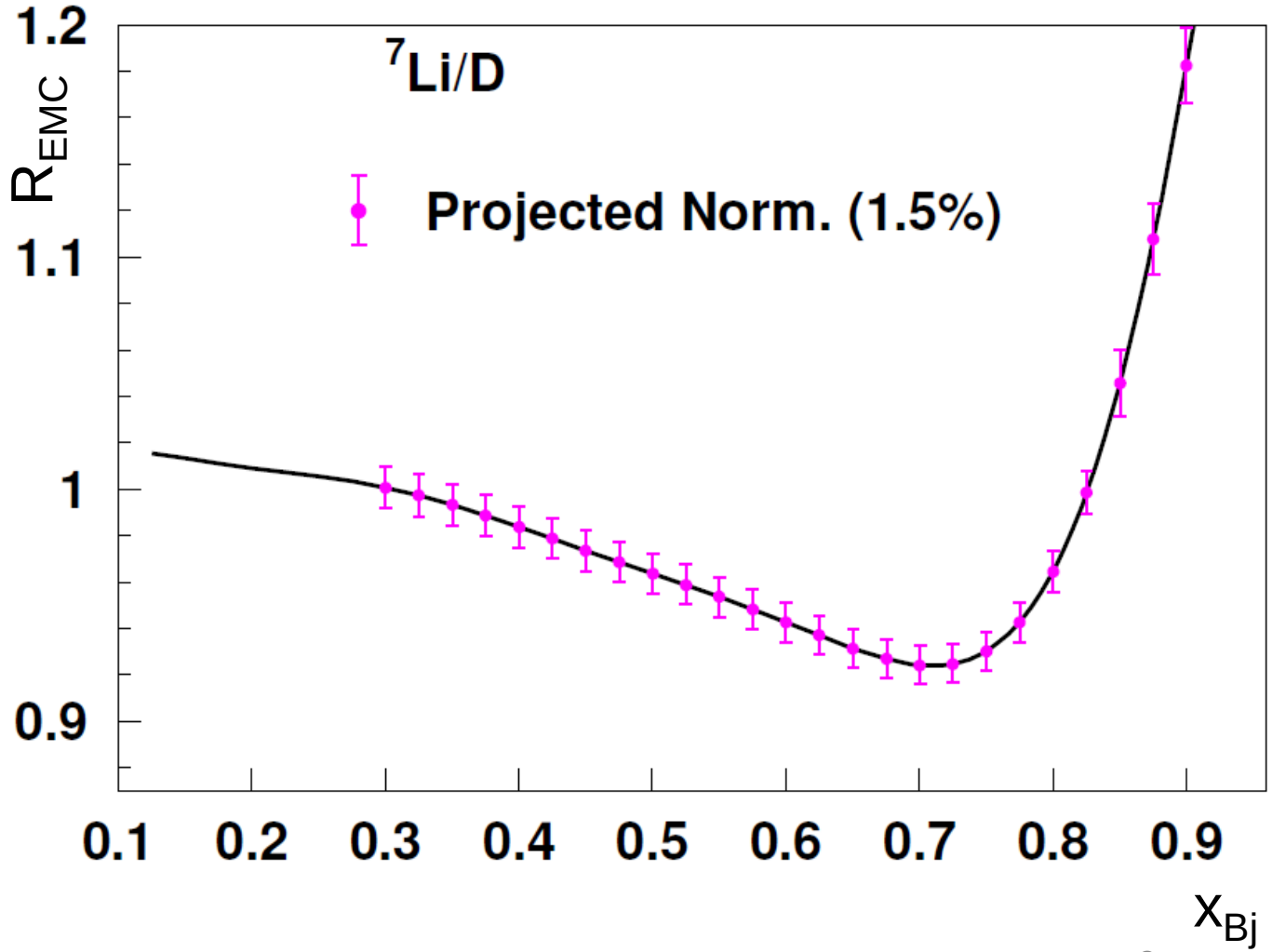
- Kinematic coverage as shown




FC: Prof. Nadia Fomin

# Selected Experiment Goals

- **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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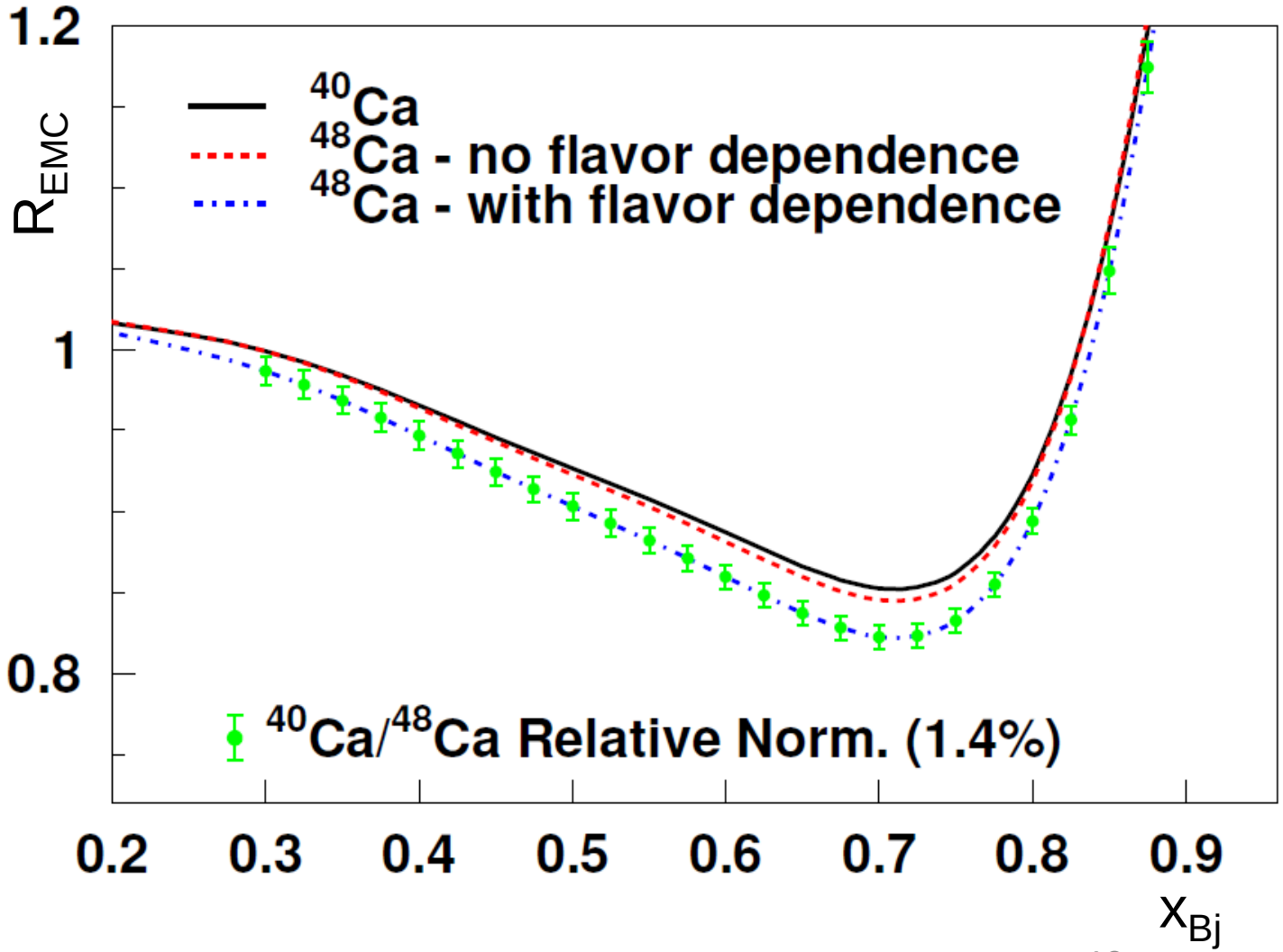
- **Looking for Flavor Dependent EMC Eff.**
  - Ca40, Ca48, and Ti are well suited to tease out any flavor dependence of the EMC Effect.



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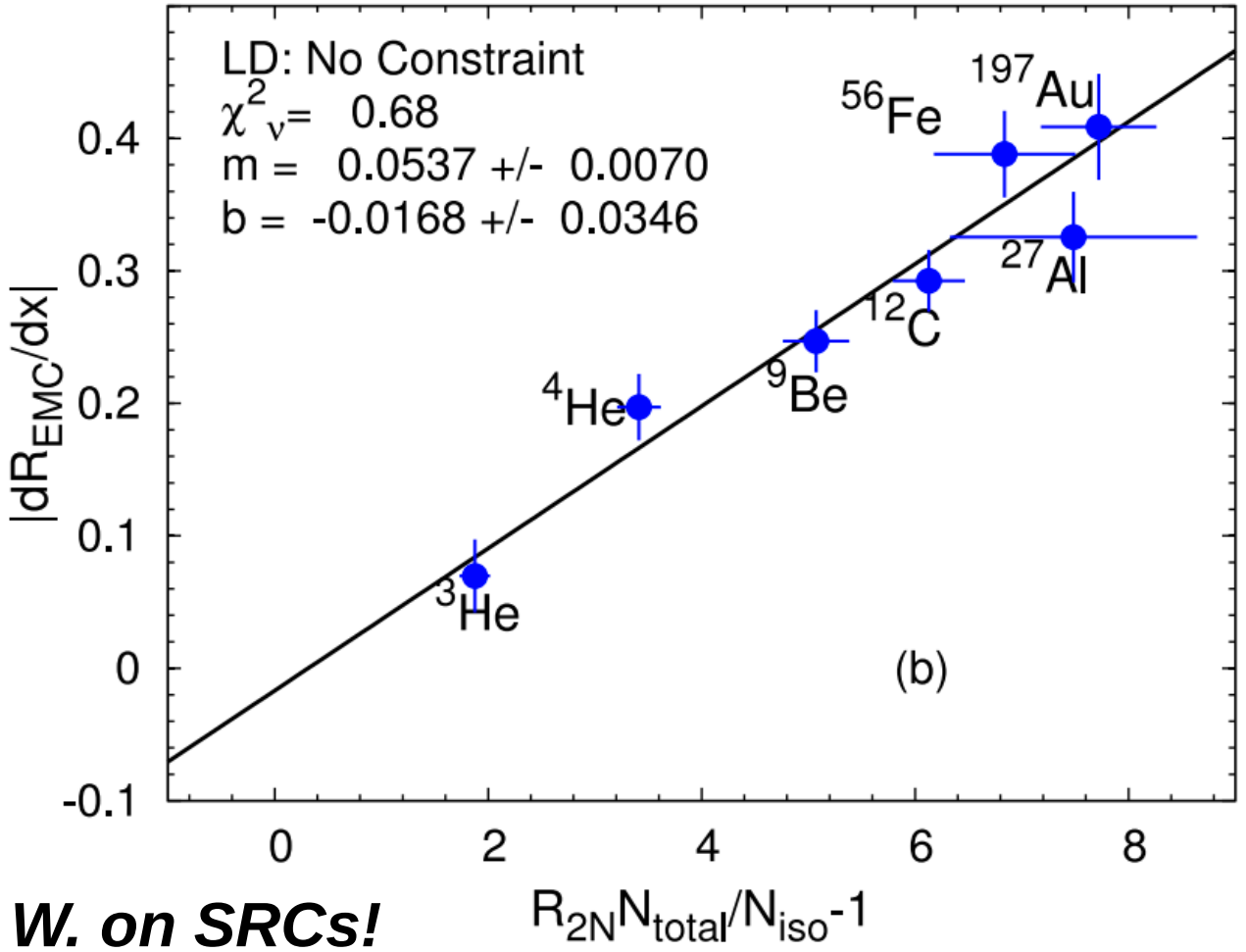
- **Exploring EMC-SRC Connection**
  - Running in parallel with the XEM2 SRC experiment allows for direct comparison between the two phenomena for a large number of nuclei.




***See talk by Zoe W. on SRCs!***

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

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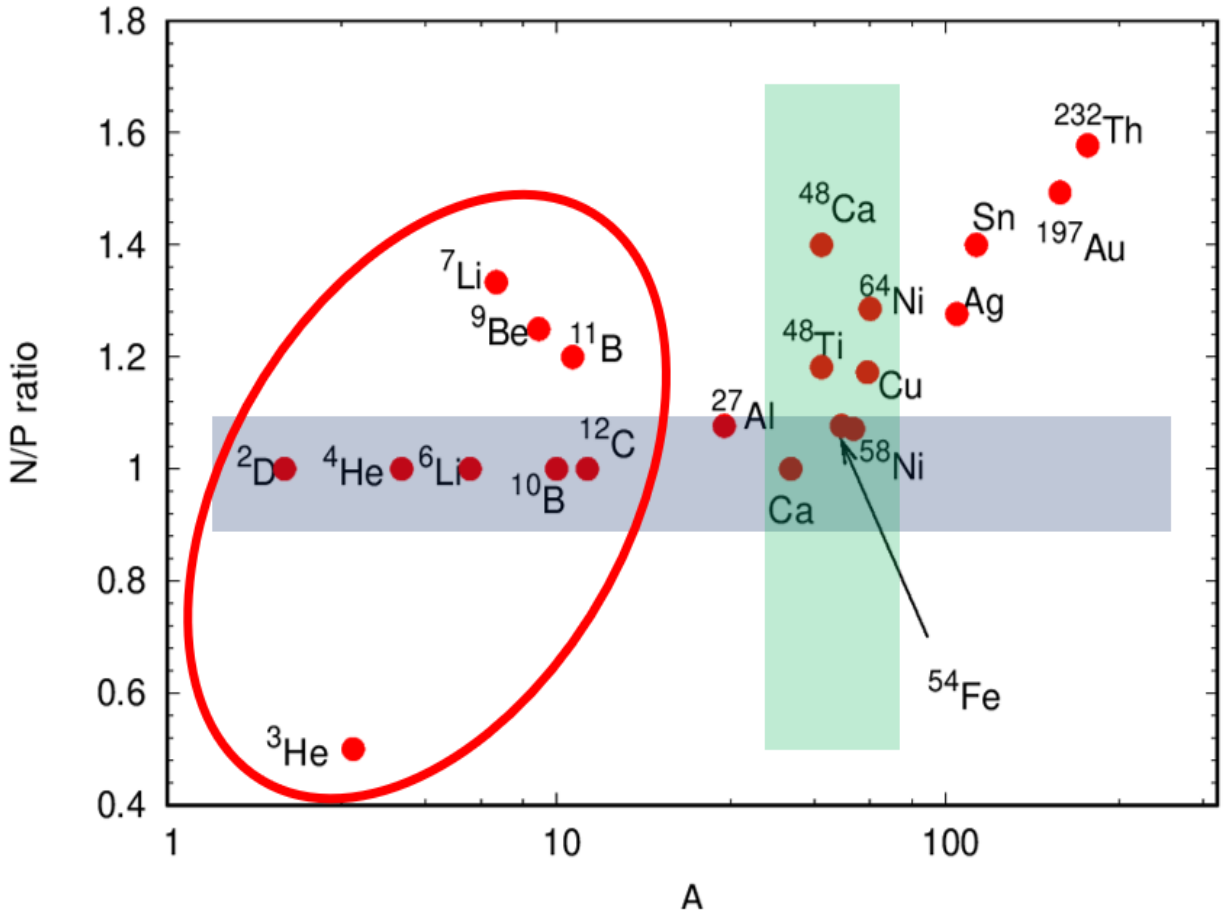
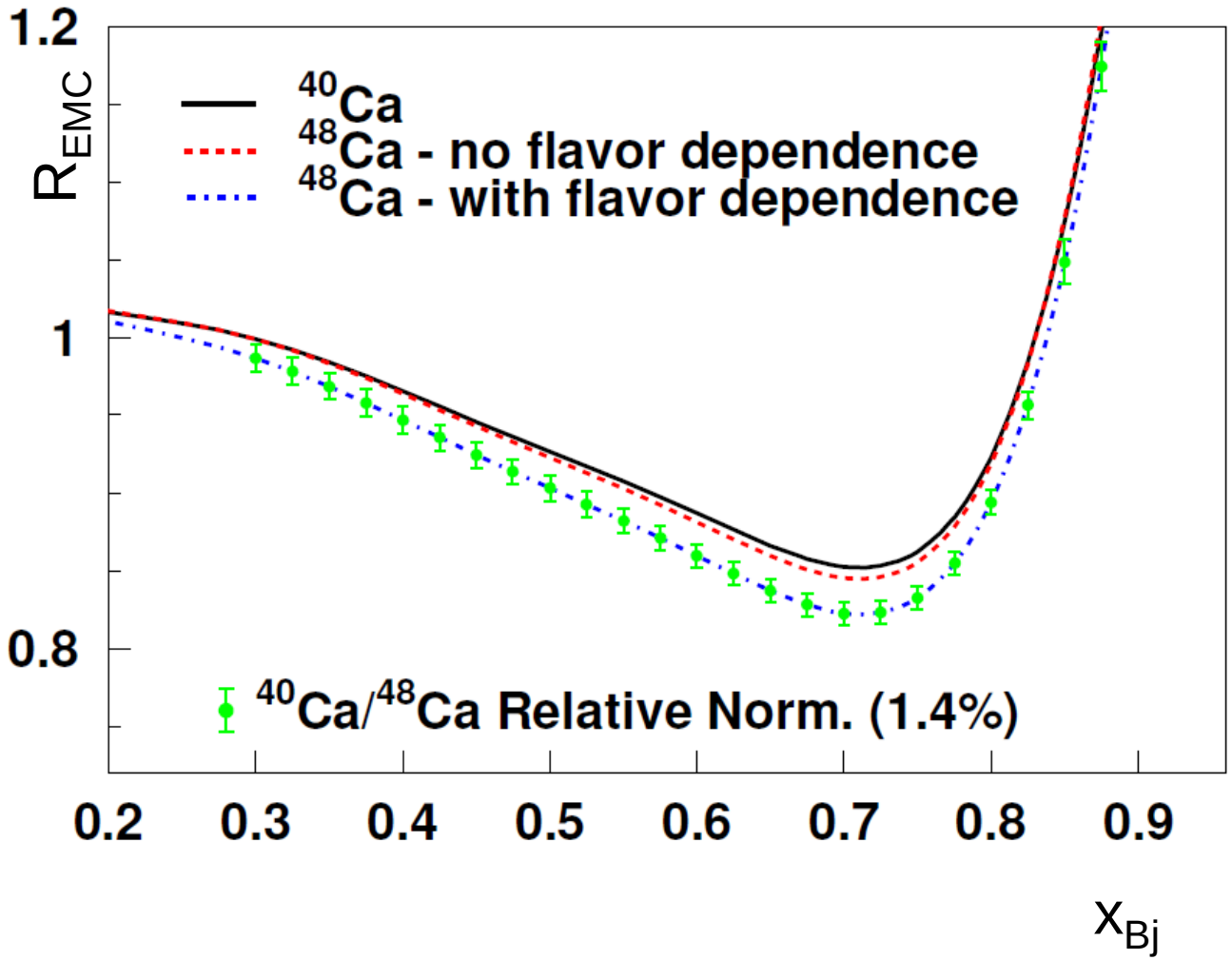
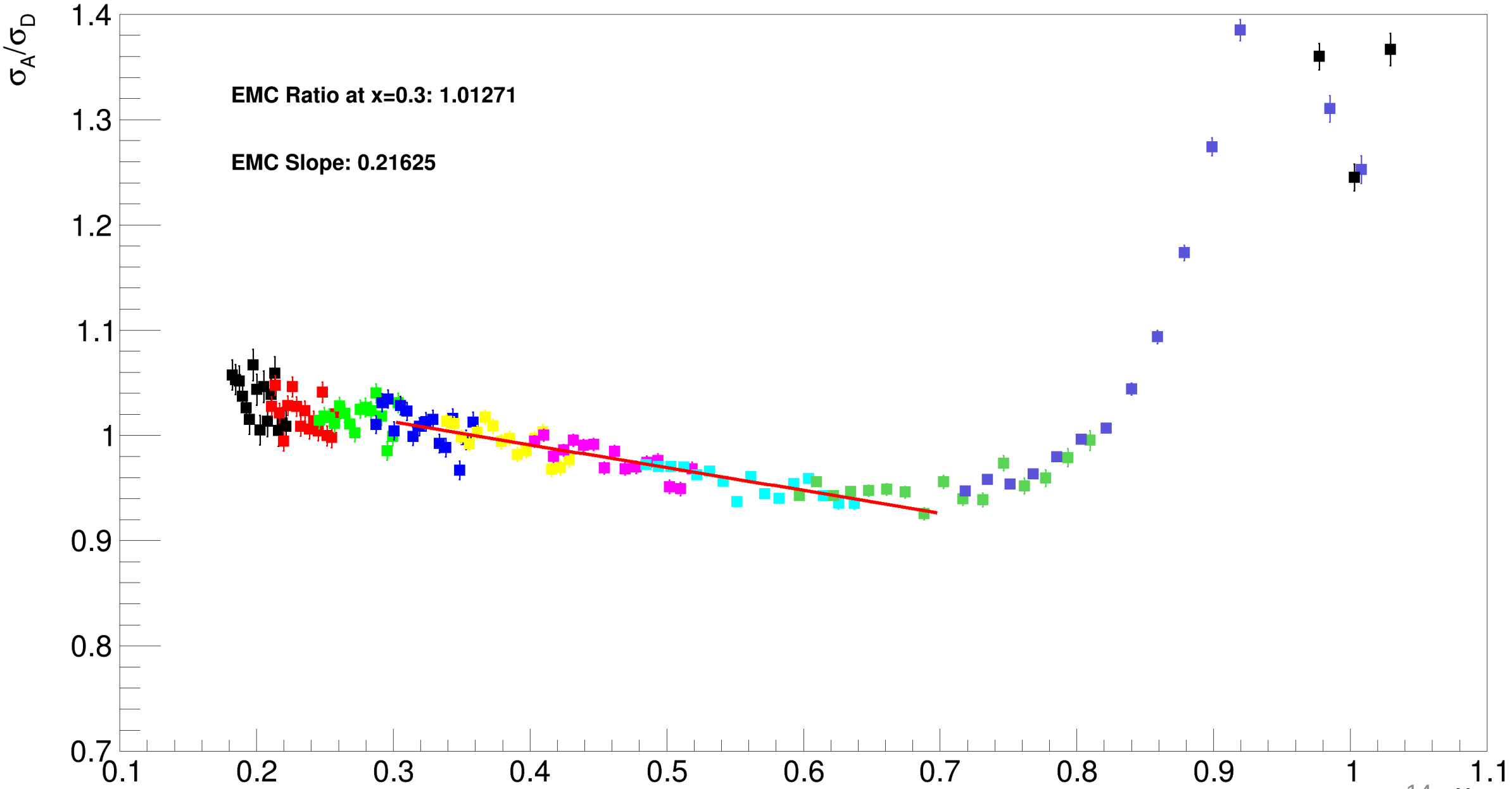


# Preliminary Results

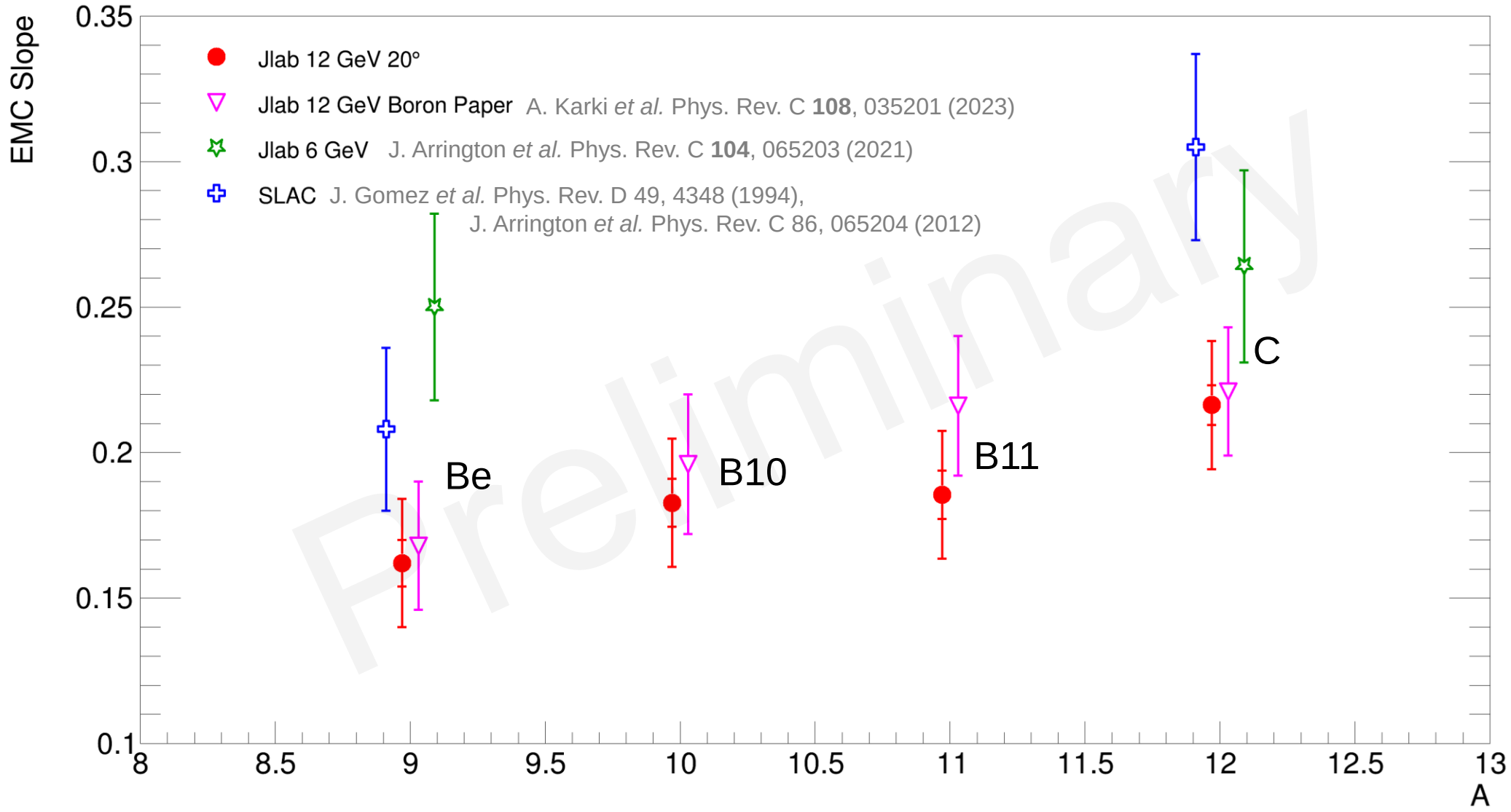
- Only one pass of detector calibrations completed
- Limited offset/detector efficiency corrections have been applied
- Need to iterate cross section model for radiative corrections
- Data quality checks ongoing

# EMC Ratio: Carbon at 20°



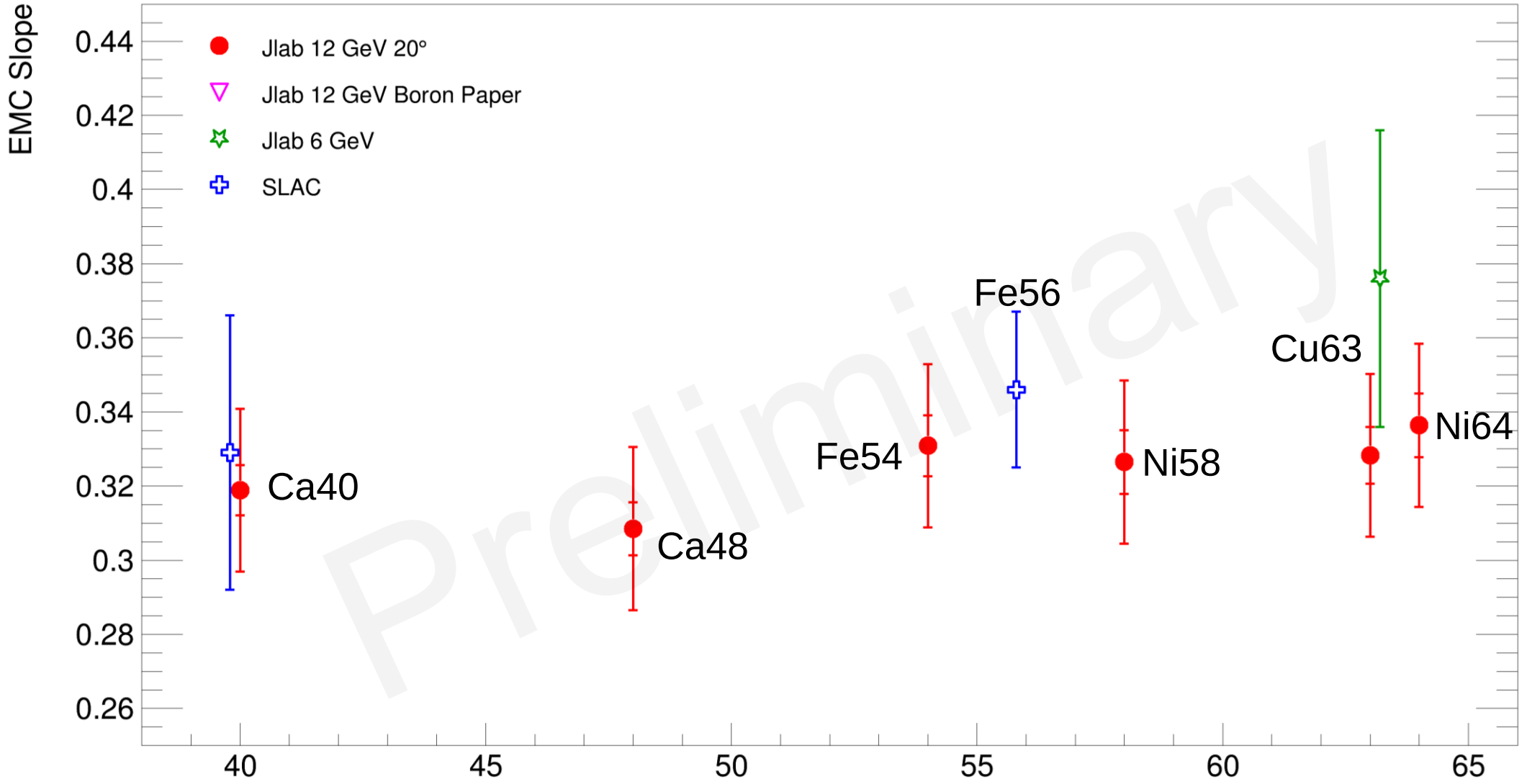

Each Color – Different Detector Configuration

# Preliminary Results - Be through C




*Preliminary estimated errors; expect final uncertainties to be smaller

# Preliminary Results – Ca40 through Ni64

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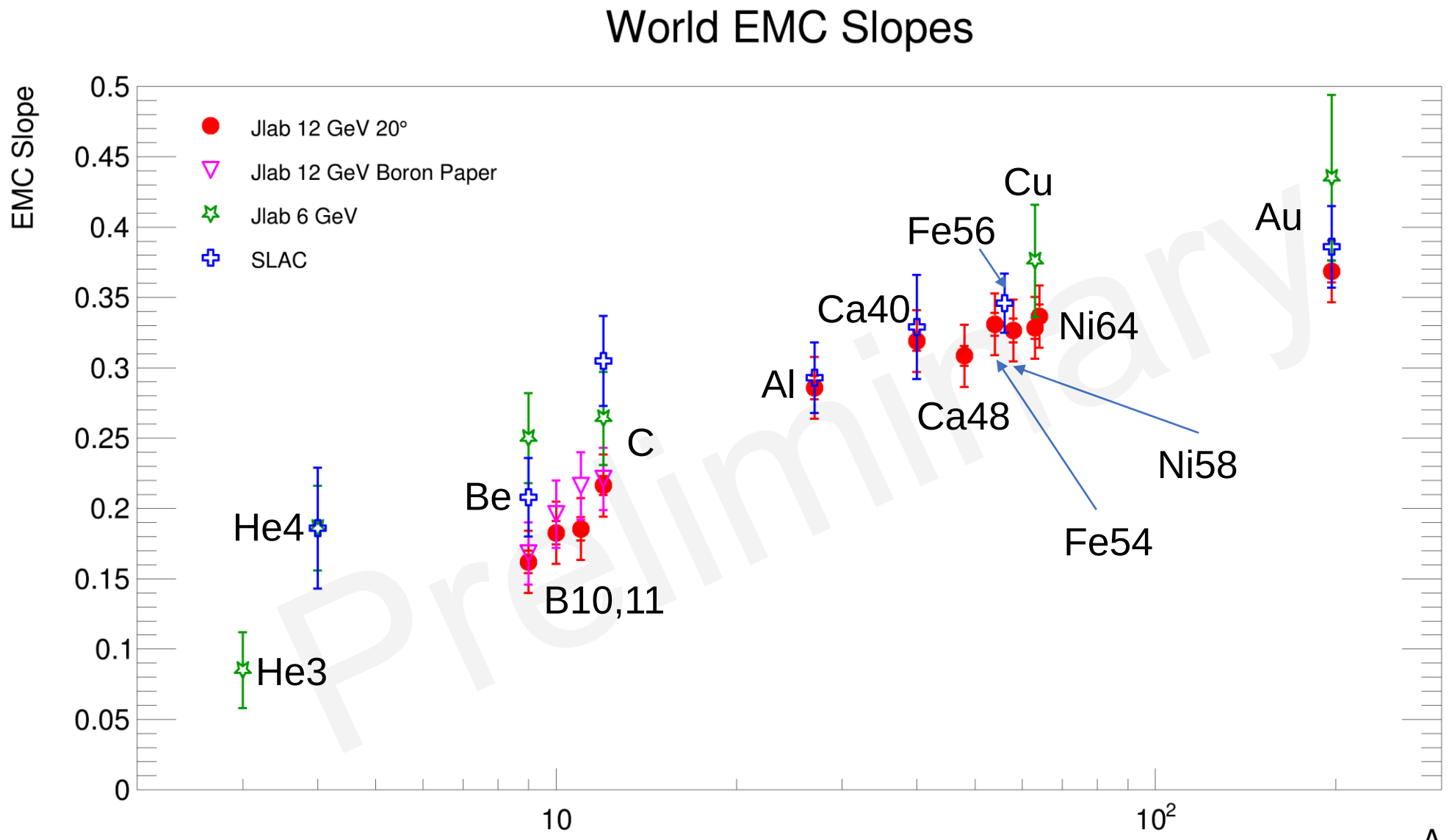
# Selected Preliminary Results

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# Summary

- The XEM2 collaboration completed data collection for experiment E12-10-008 at Jefferson Lab in Spring 2023
- Preliminary results look promising when comparing measured EMC slopes to targets with previously published measurements.
- No significant isospin dependence observed for the EMC Effect.
- What we have left:
  - Iterate detector calibrations, offsets, efficiencies
  - Investigate time-dependent effects observed in the data
  - Iterate cross section model for radiative corrections
  - Study targets that were negatively impacted by the beam

# Collaboration

## Graduate Students and Post-Docs


**Cameron Cotton**
**UVA**


Ryan Goodman
UTK


Abishek Karki
MSU


Casey Morean
CUA


Ramon Ogaz
UTK


Abhyuday Sharda
UTK


Burcu Duran
UTK


Tyler Hague
LBL


Zoe Wolters
UNH

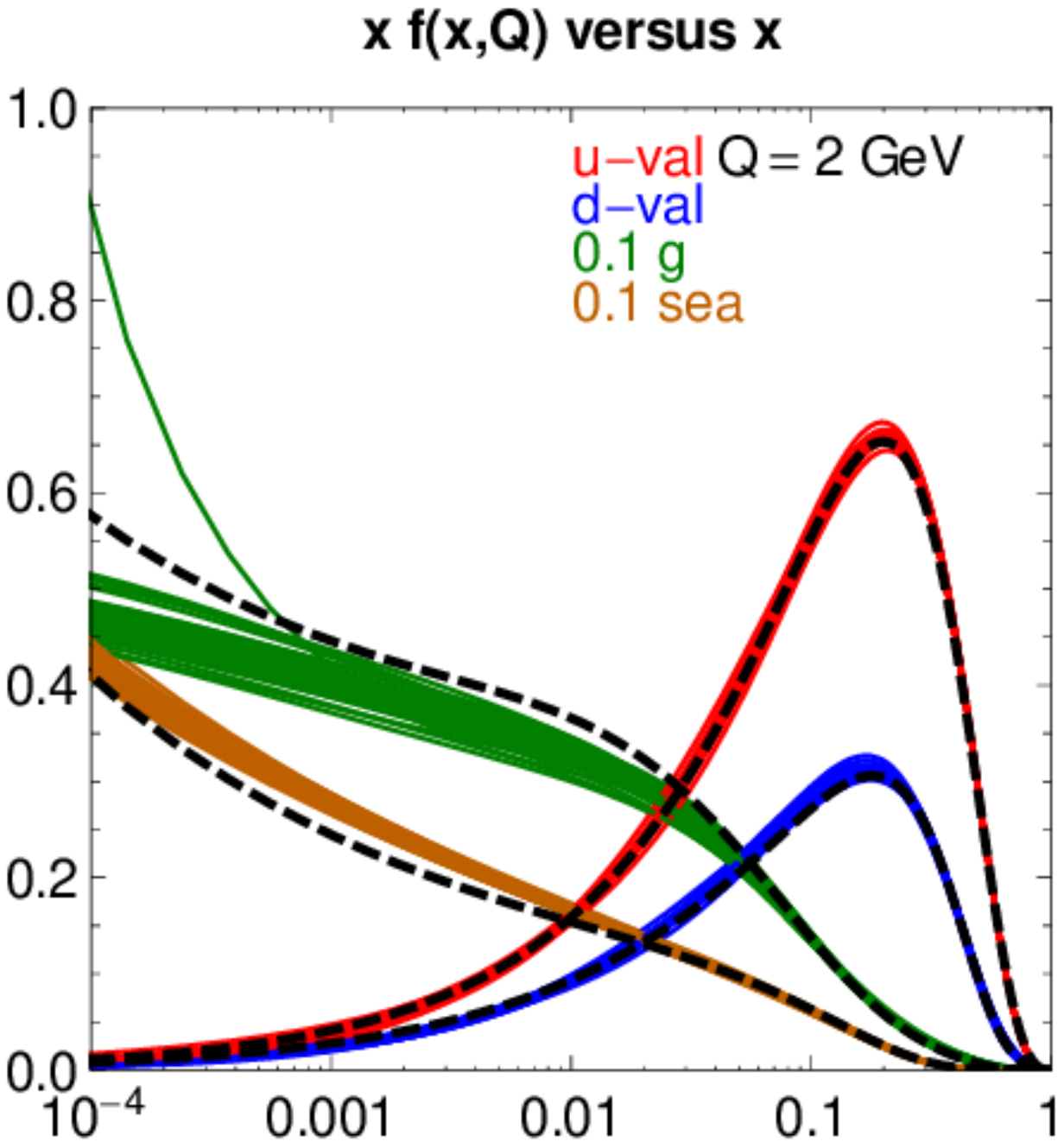
Not Pictured: Sebastian Vasquez (UCR)

**Spokespeople**:
John Arrington (LBL), Aji Daniel (Ohio U.), Donal Day (UVA),
Nadia Fomin (UTK), Dave Gaskell (JLab)

**Other Collaborators**:
Miguel Arratia (UCR), Dipangkar Dutta (MSU), Shujie Li (LBL), Dien Nguyen(UTK),
Nathaly Santiesteban (UNH), Xiaochao Zheng (UVA)

# Questions?

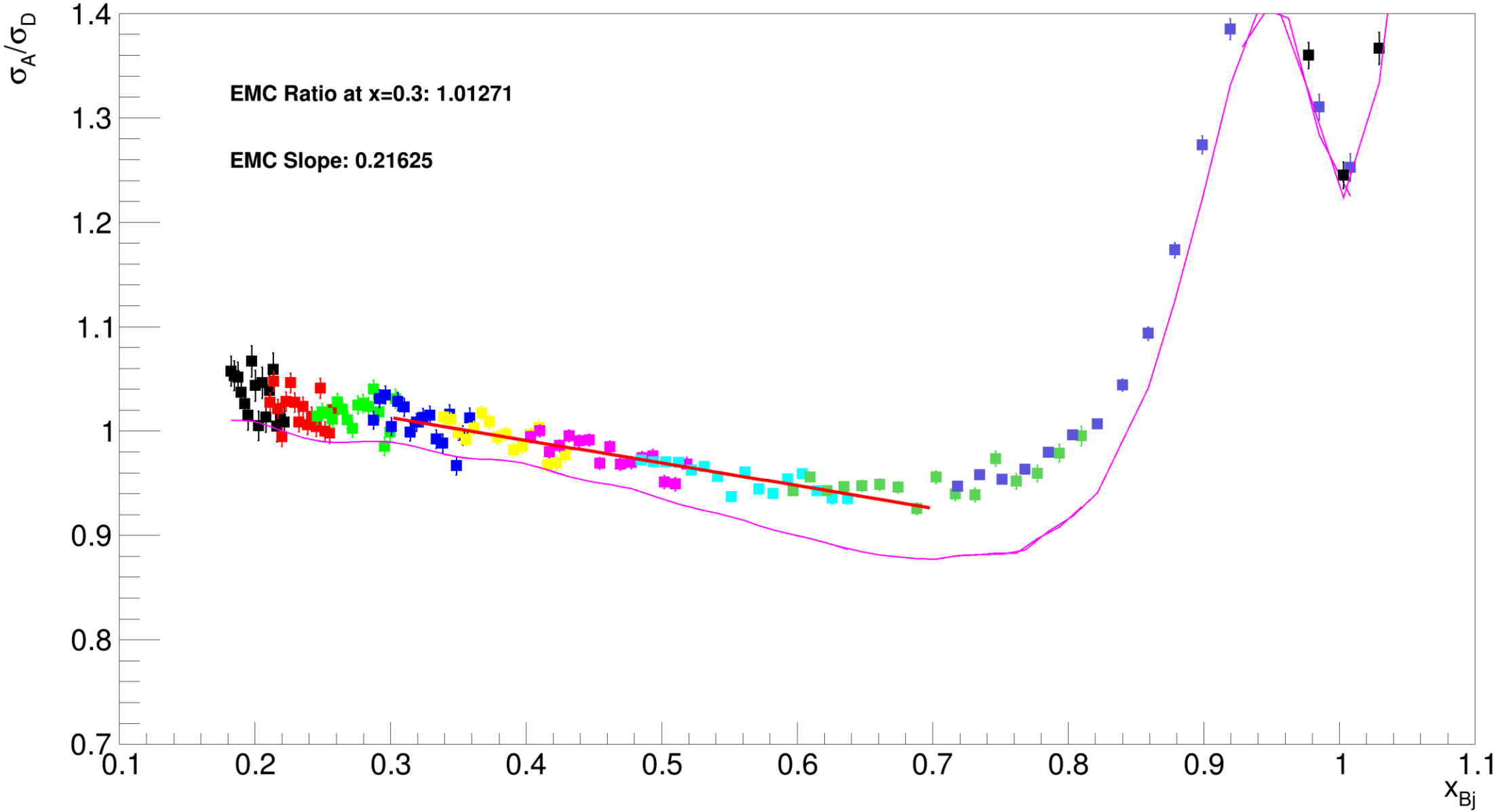
# Backup Slides




*P. Nadolsky et al.*, arXiv:1206.3321 [hep-ph]

Carbon at 20°

# EMC Ratio: $x_{Bj}$

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