Update on the 12 GeV EMC Effect Experiment in Hall C

Cameron Cotton

Hall C Users Meeting
February 17th, 2022

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

Outline

- Physics Motivation
- E12-10-008 Physics Goals
- E12-10-008 Targets & Kinematics
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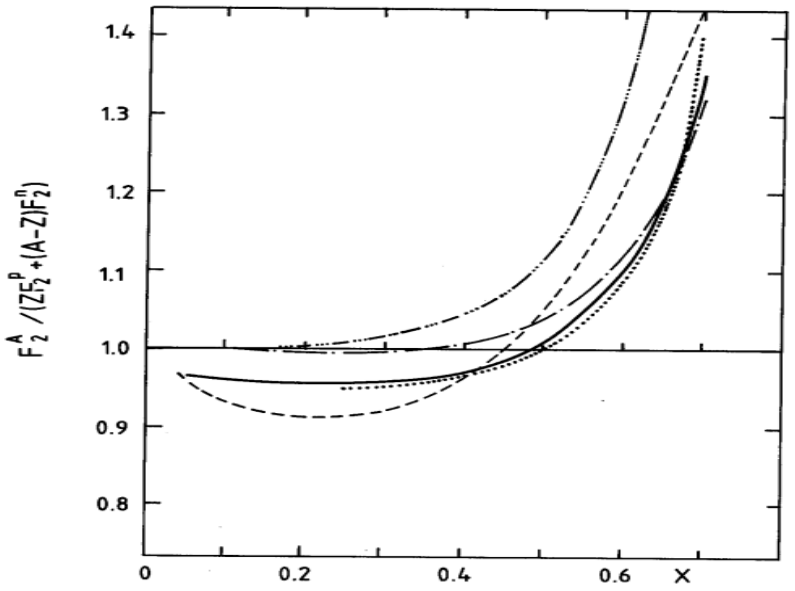

EXPERIMENT

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

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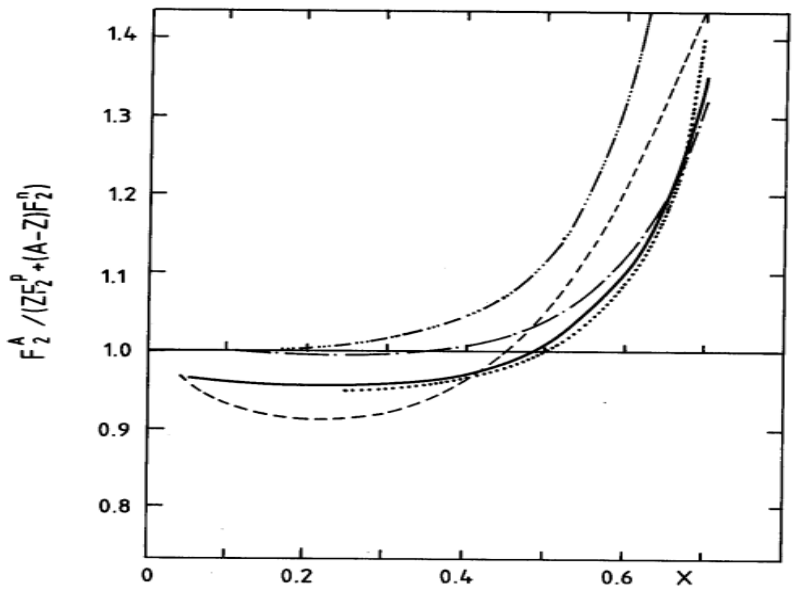
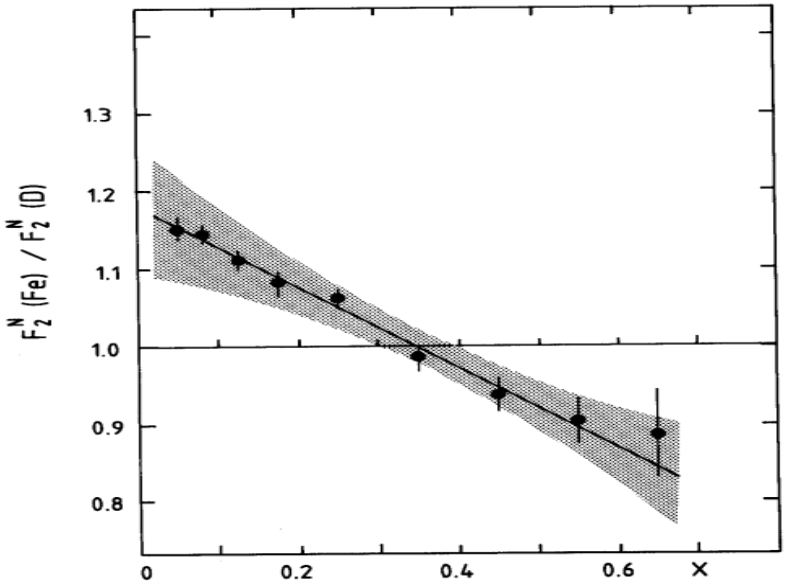


EXPERIMENT

Quark distributions are modified in nuclei???



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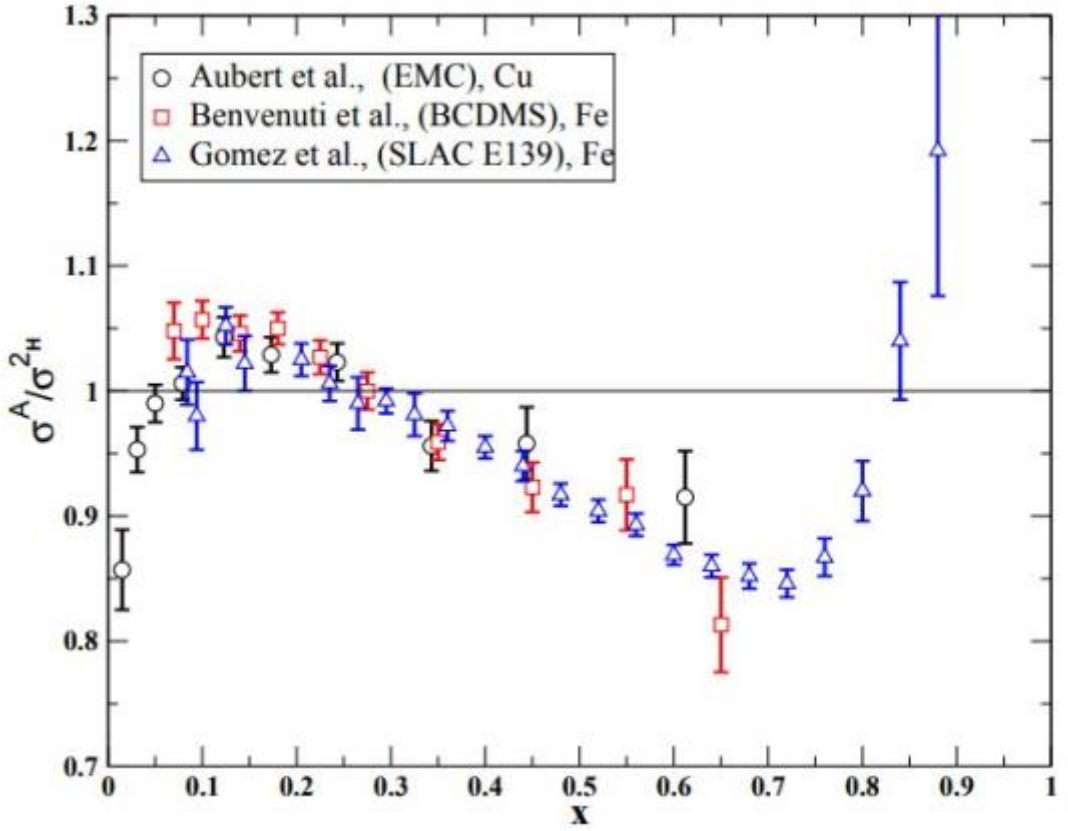
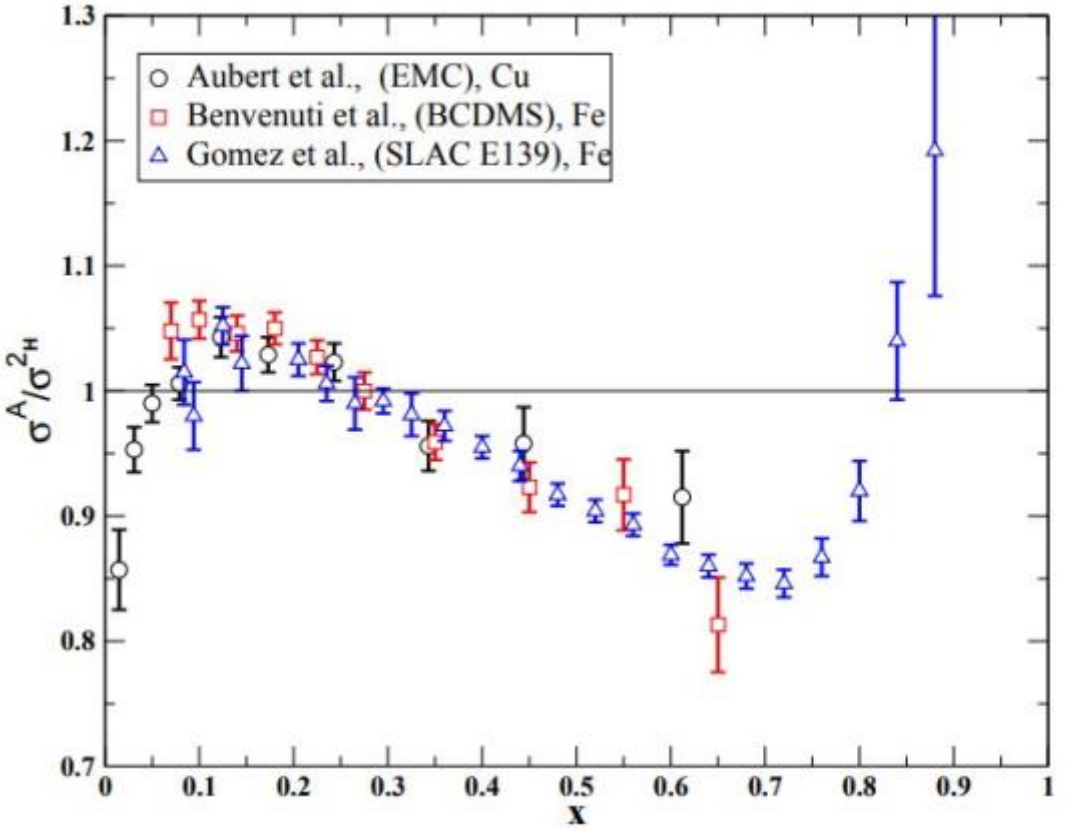


Motivation: Discovery of the EMC Effect

- **The EMC Effect remains one of the biggest unsolved mysteries in nuclear physics.**
- **1000s of papers** have been written about the EMC Effect in the last 40 years - **still no consensus.**



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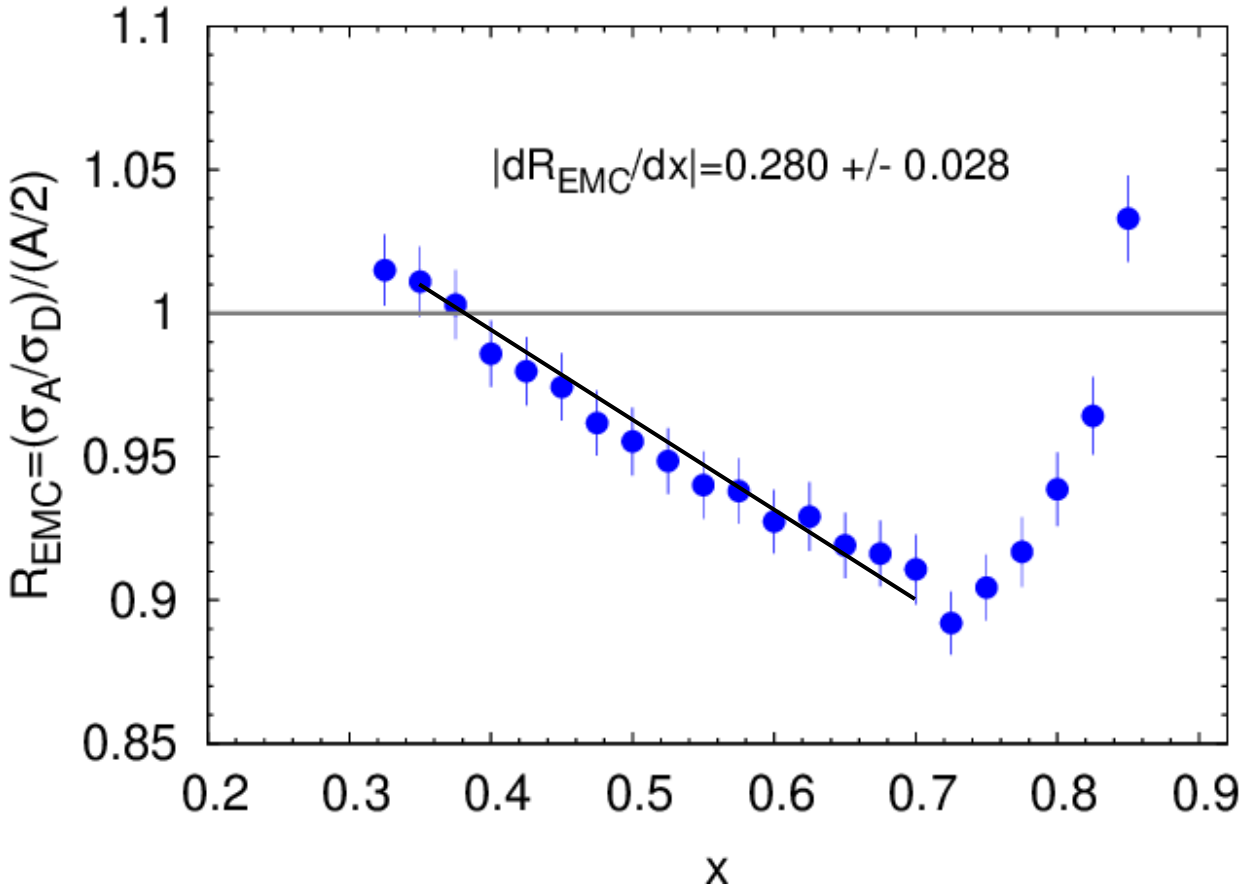
- The “size” of the EMC Effect in a given nucleus is determined from the slope in the range: $0.35 < x < 0.7$



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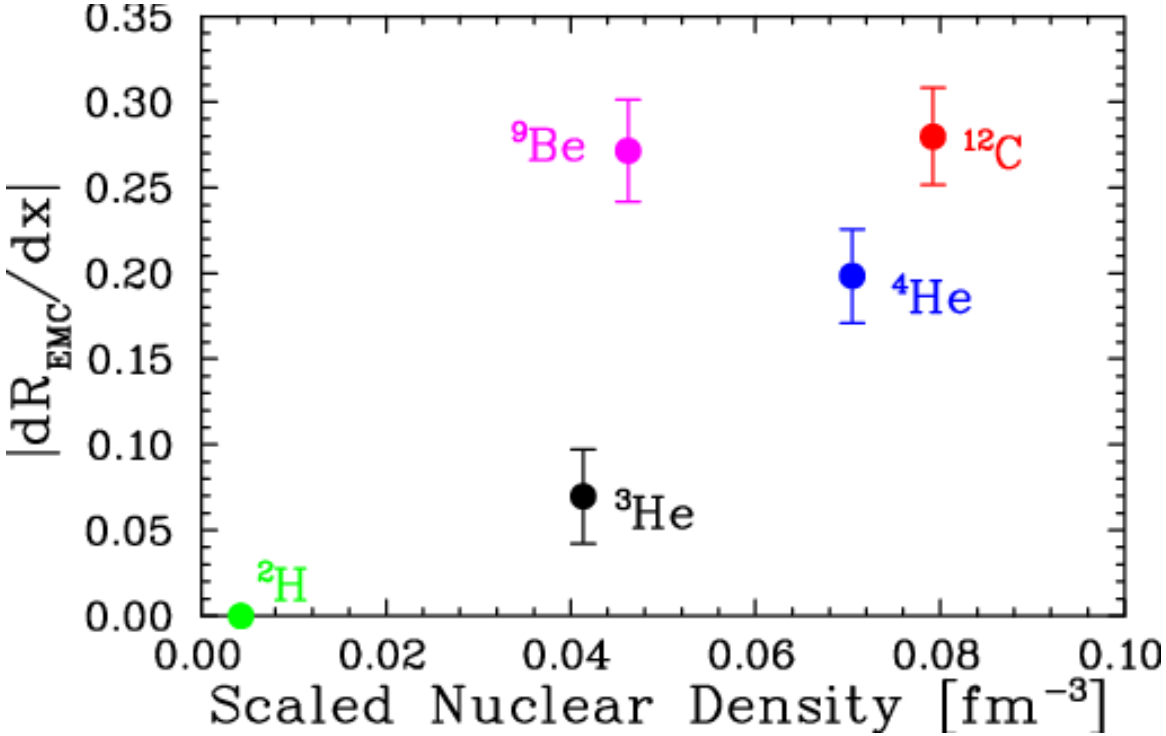

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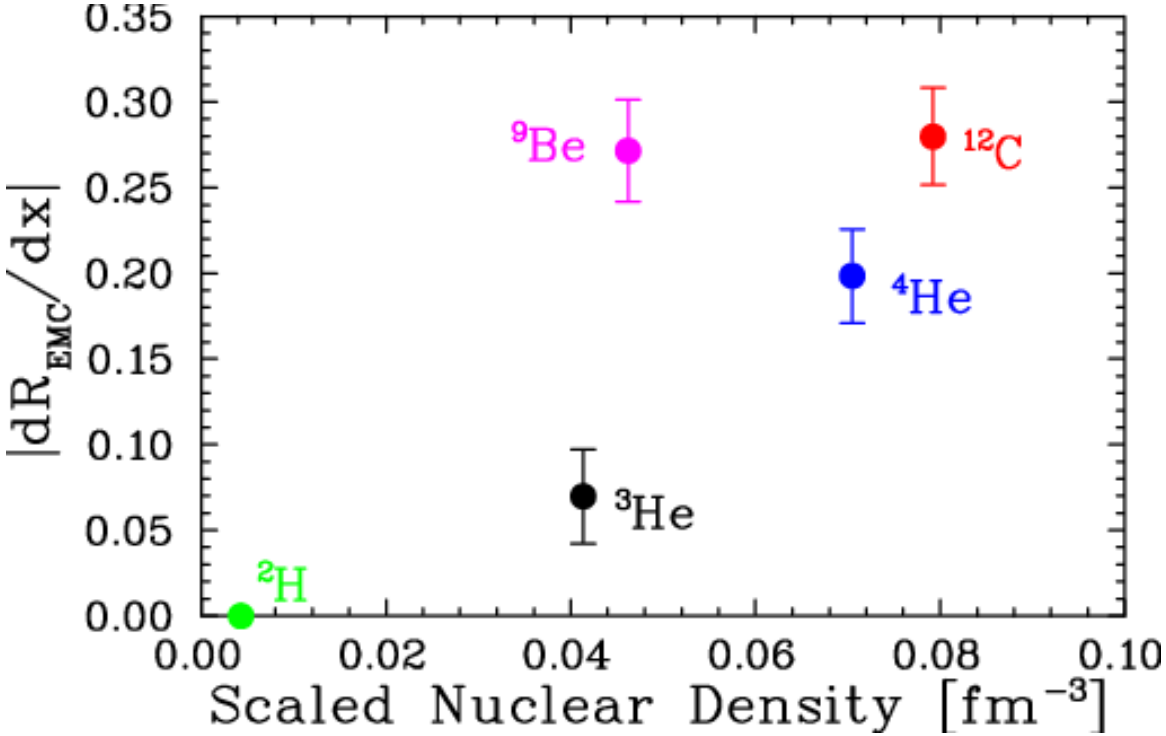
- **What is the driving force behind the EMC Effect?**



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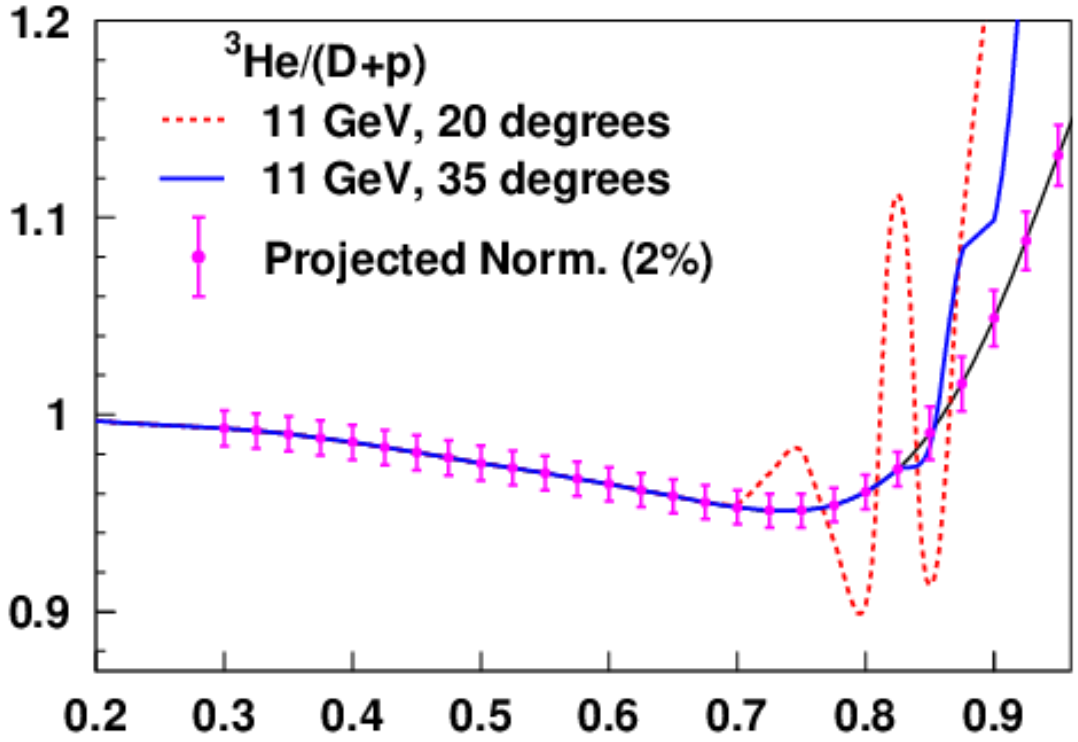
- 3He/D ratio requires a large isoscalar correction to extract the EMC Effect.



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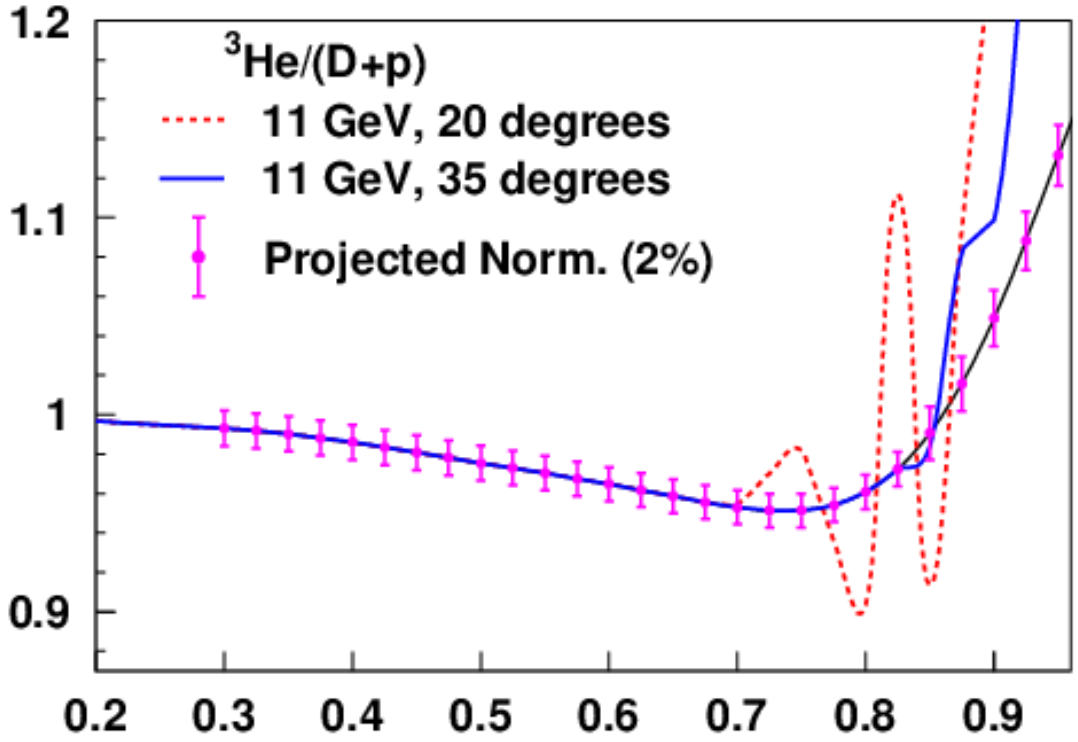

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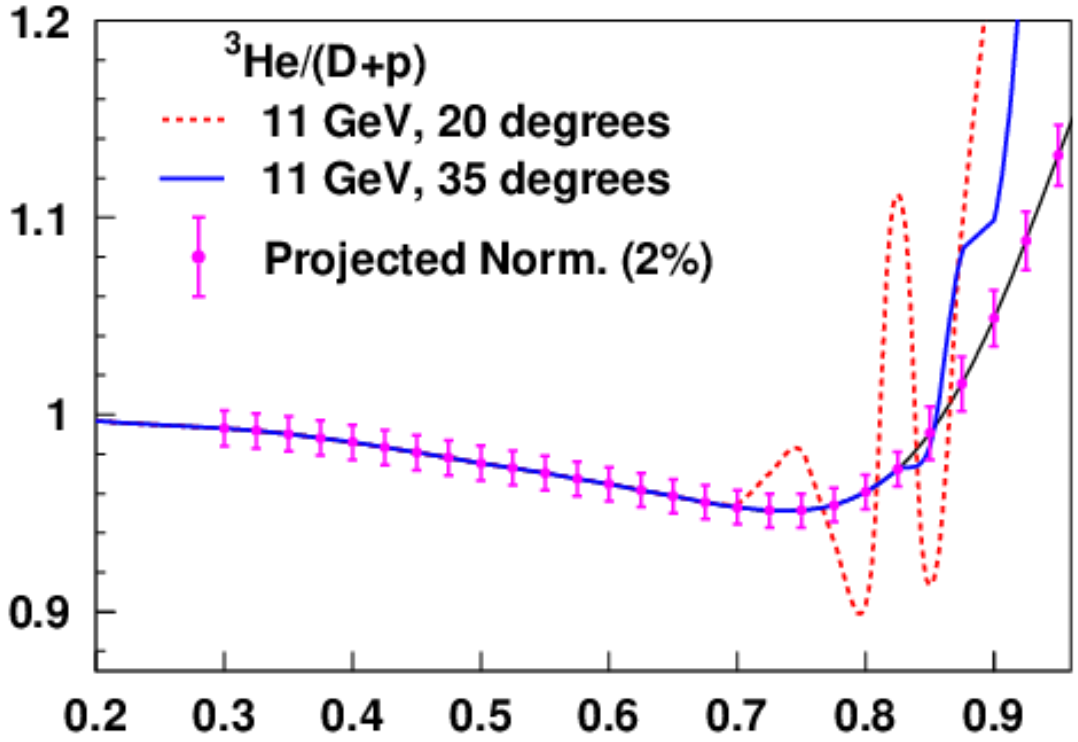

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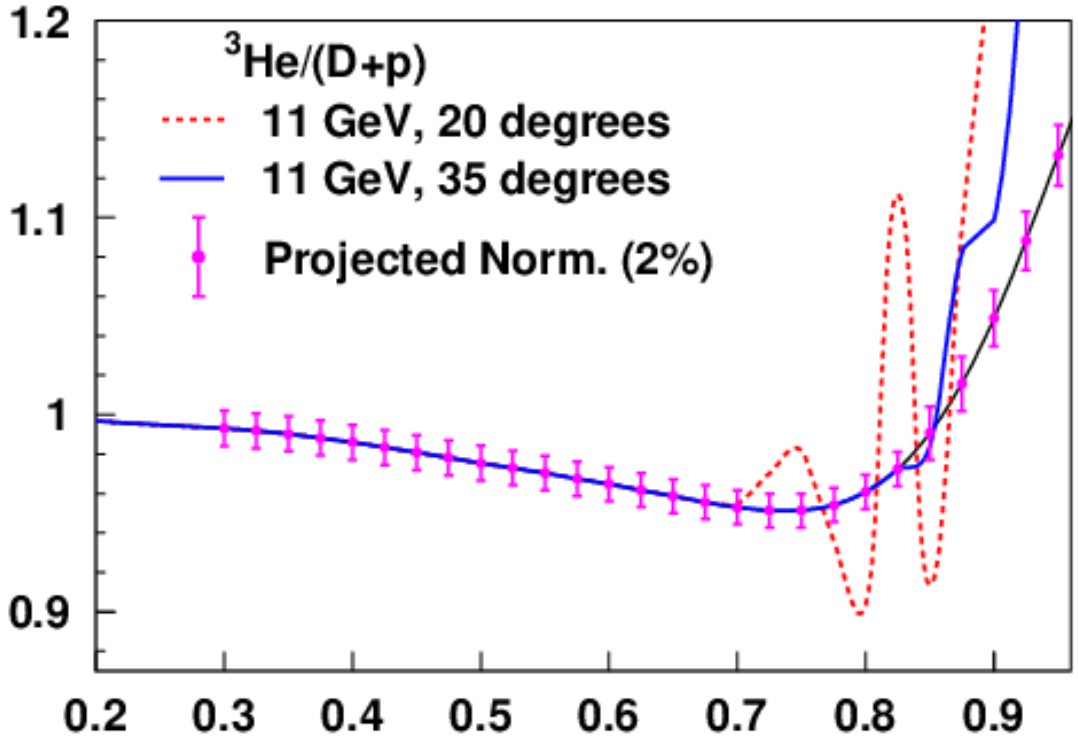
- Resonance structure pushed out to x>0.8 at large Q2, allowing for comparison with 3He/D data out to larger x to validate isoscalar correction model.



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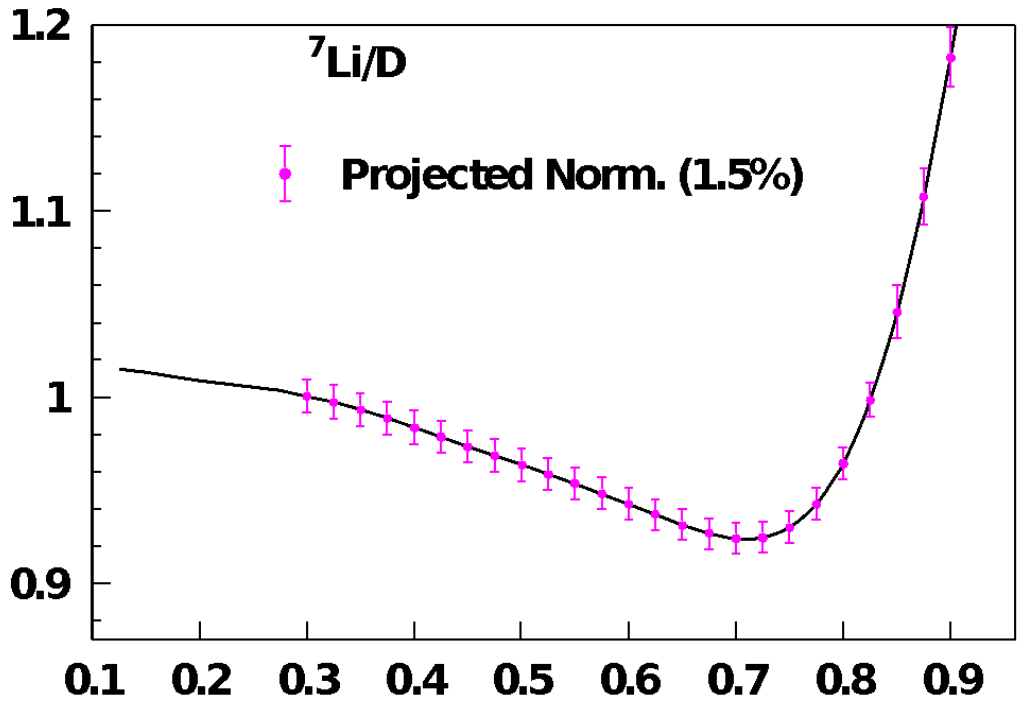

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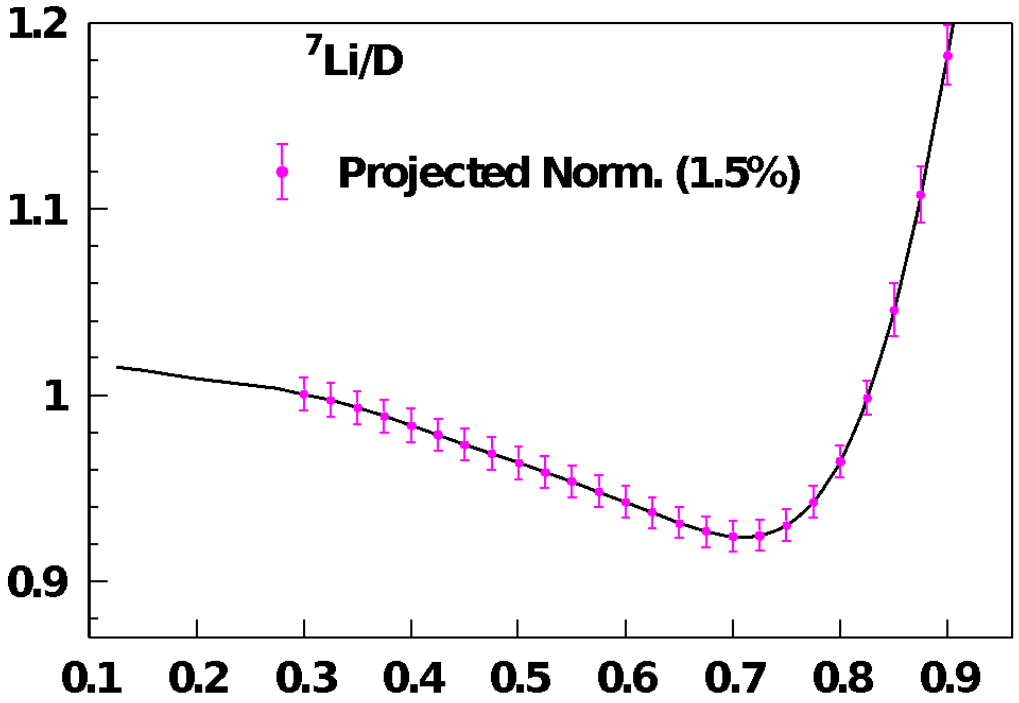

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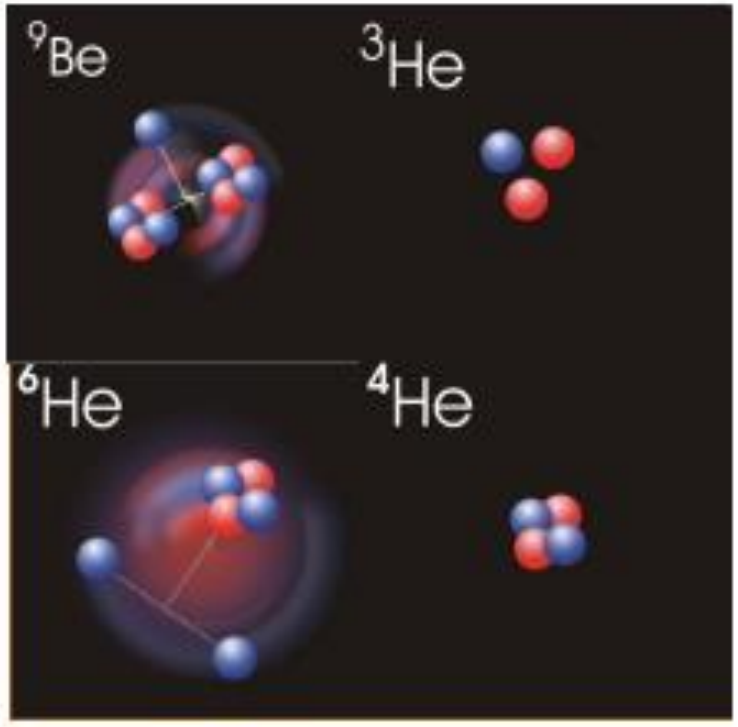
- Light nuclei provide a great environment to study nuclear structure and clustering within the nucleus.



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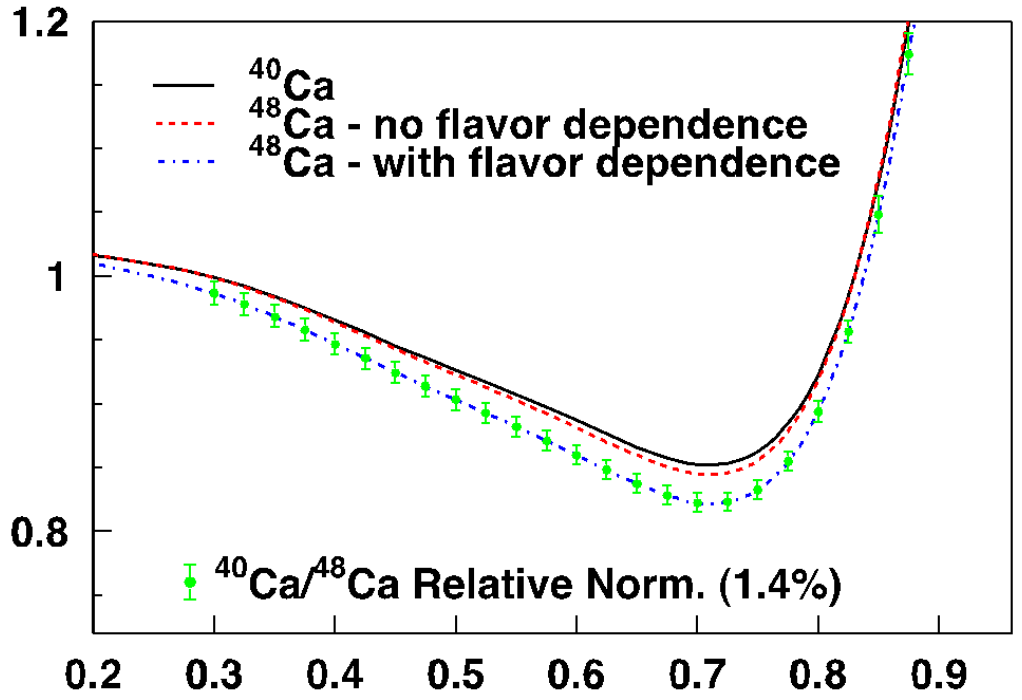

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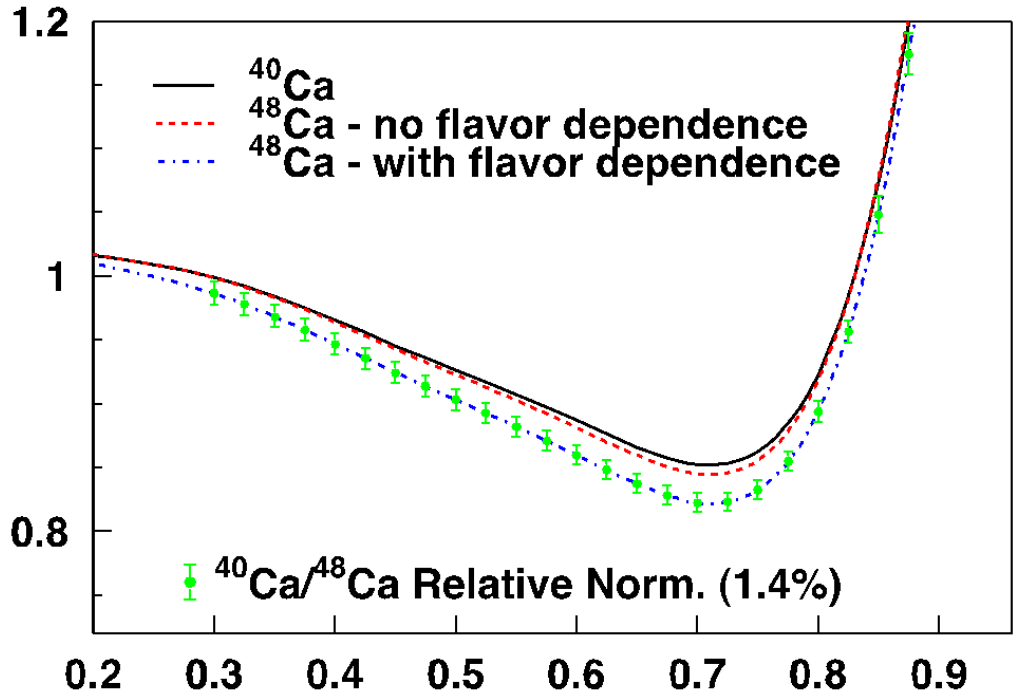
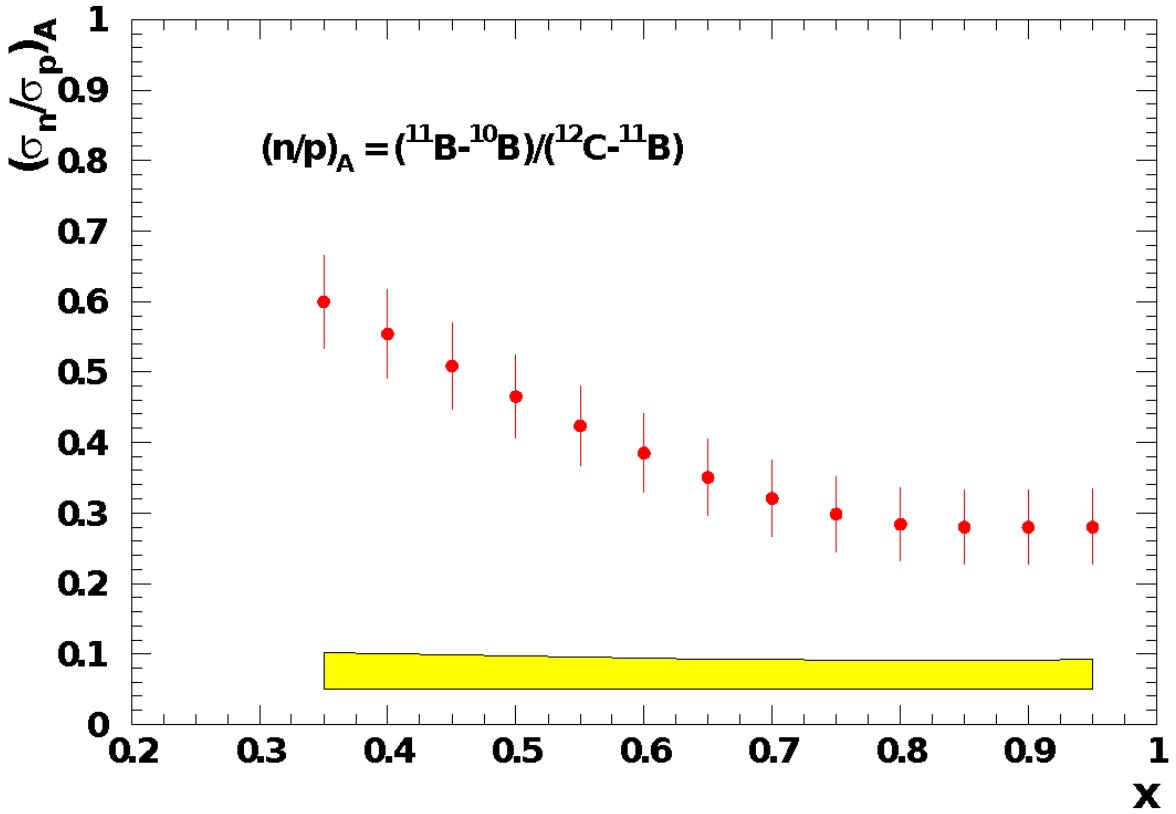
- The flavor-dependent CBT Model predicts a **~3% difference** between 40Ca and 48Ca at x=0.6.
- On the other hand, we would expect a **difference of <1%** if there is no flavor dependence.



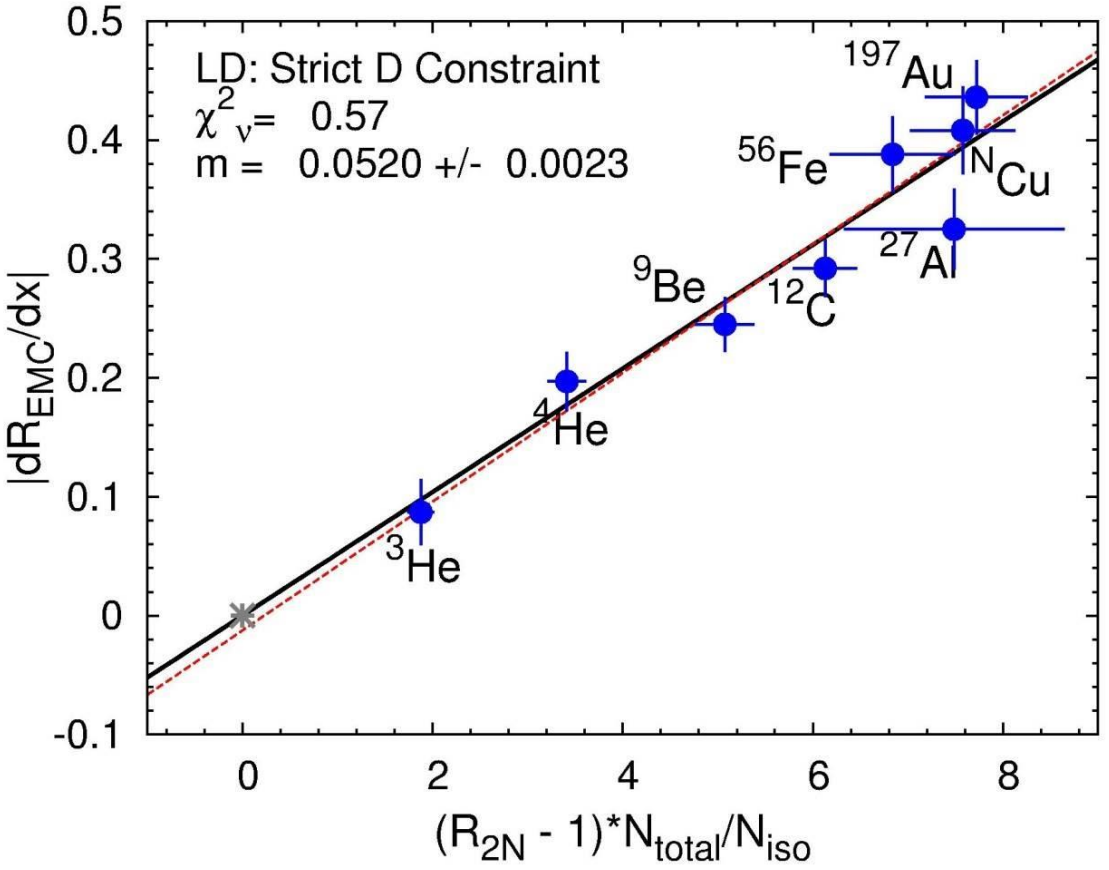
Physics Goals: n/p ratio

- We will be able to **extract the n/p ratio in nuclei** by comparing cross sections of adjacent nuclei.
- This may provide insight into nuclear modeling that is required to extract n/p cross sections from D/p.



Physics Goals: EMC-SRC Correlation

- There is a strong correlation between the size of the EMC Effect and SRCs.
- With data from our experiment and the x>1 experiment that will be discussed in the next talk, we will **add many more nuclei to investigate this connection.**



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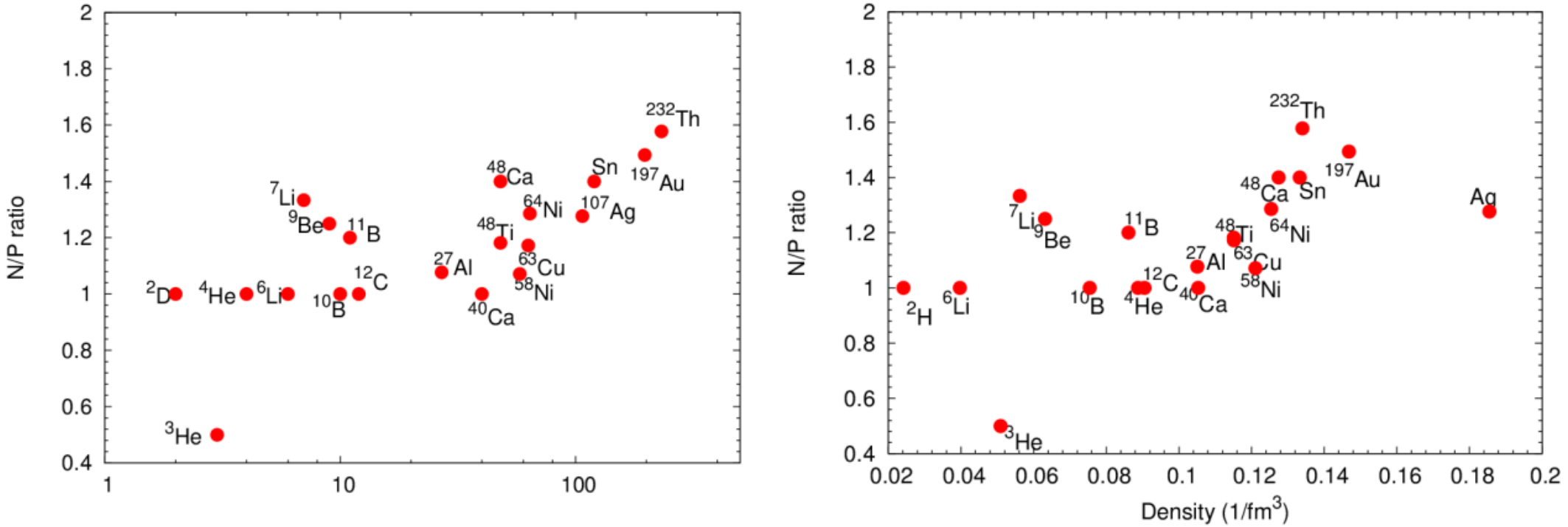
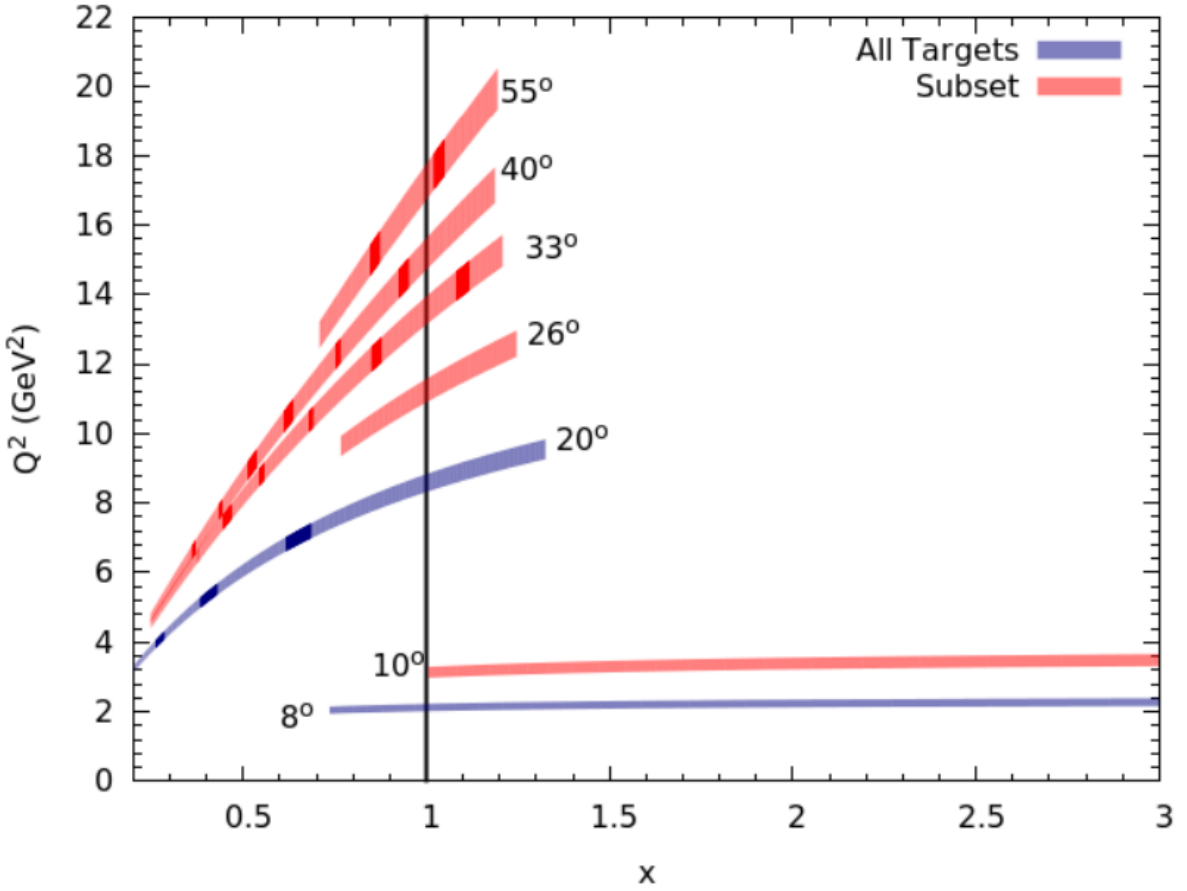
Upcoming Run: Targets



- Coverage of large range of target masses, densities, and n/p values.
- Many new light targets (cluster structure).

Upcoming Run: Kinematics

- Kinematic coverage for both EMC and x>1 experiments.
- EMC and x>1 will run in parallel in the hall, utilizing both the SHMS and HMS detectors.
- Coverage of a large range of angles to examine Q2 dependence of structure functions.
- Total 23 PAC days for Phase I and II
  - Phase I completed in 2018 (2 days)



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Preliminary Results: Canonical EMC Plots

- Phase I – Collected data for several light nuclei
- Data showing characteristic EMC Effect shape.

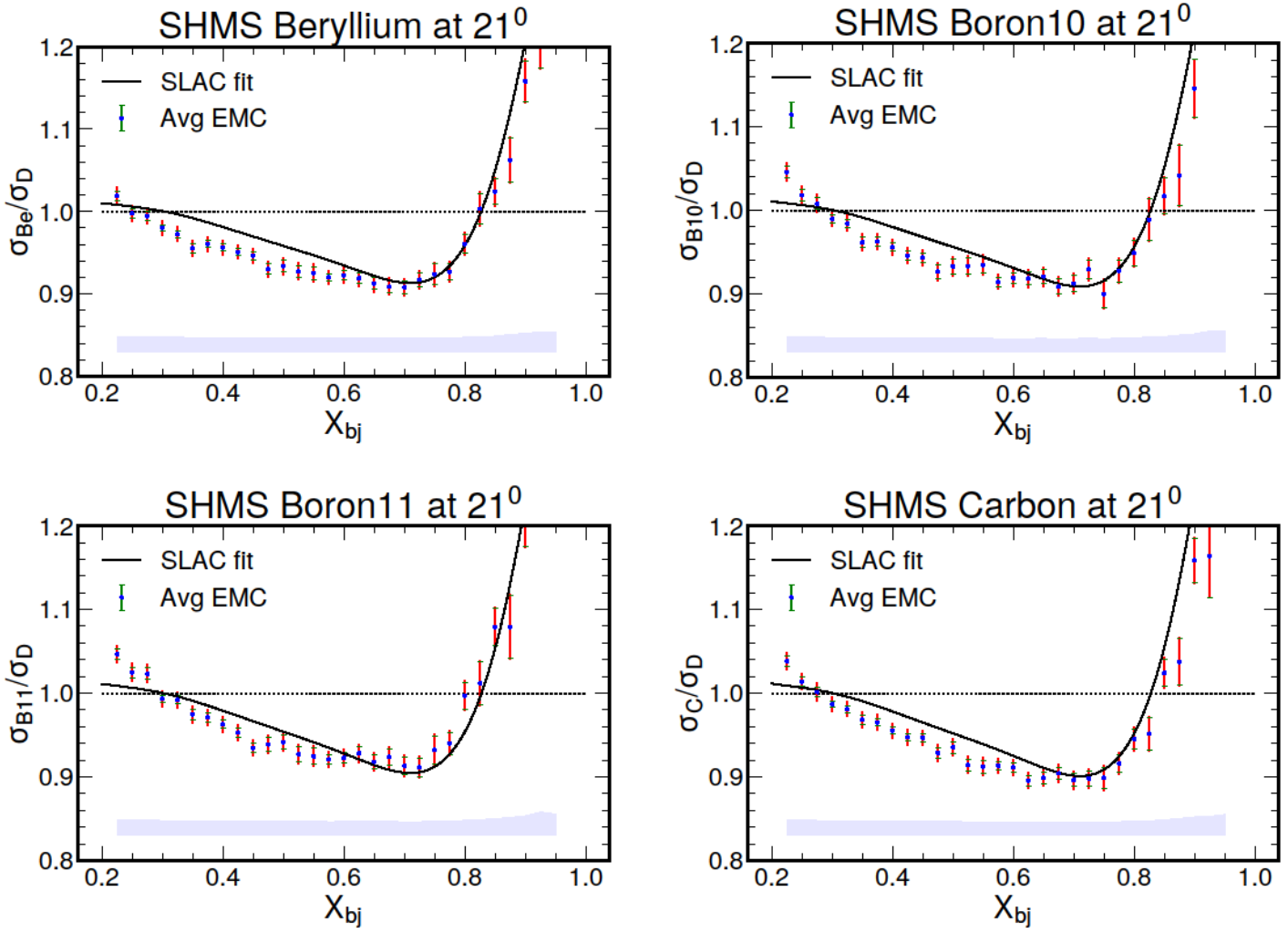
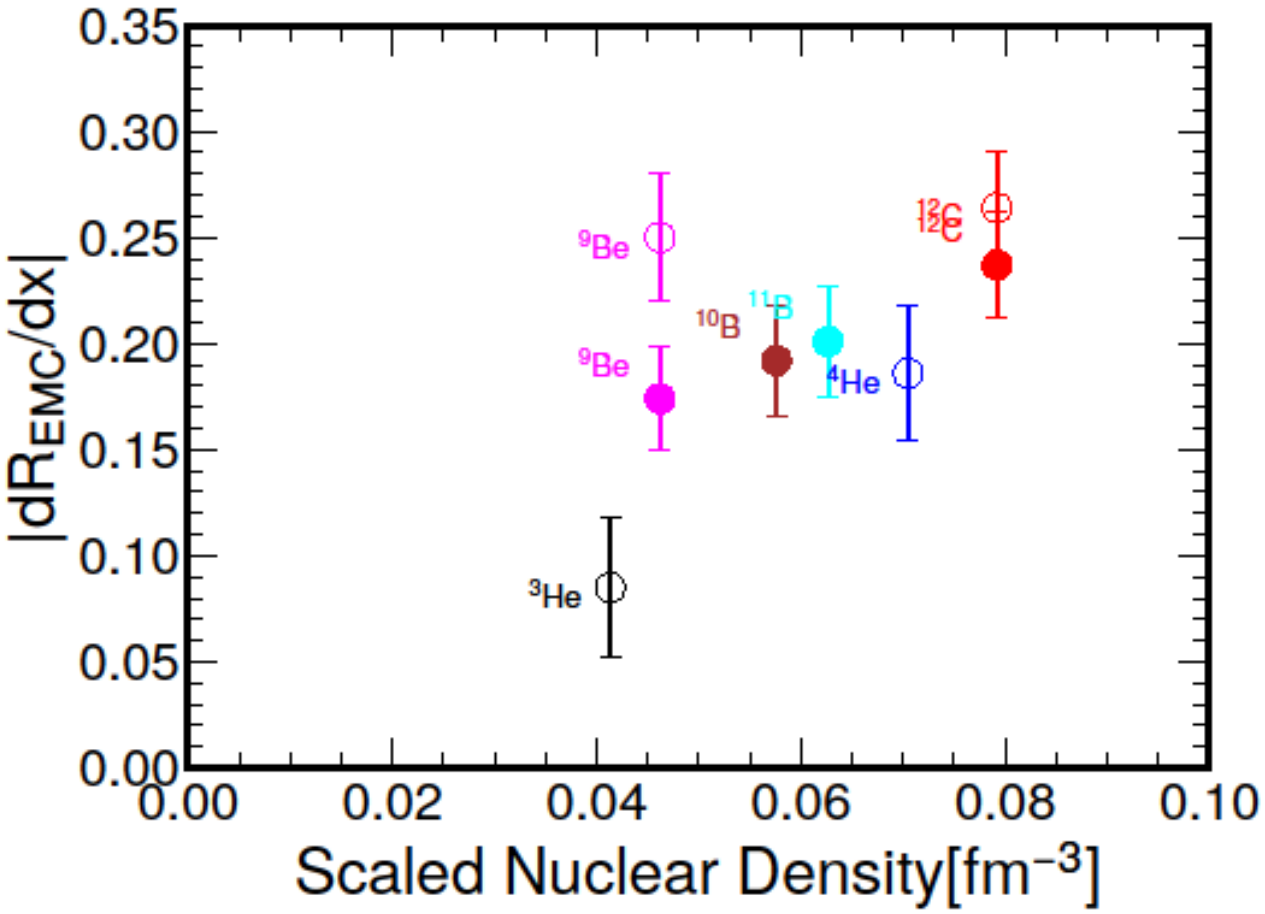


Figure Credit: Abishek Karki

Preliminary Results: EMC Slope v. Density

- Filled points are 12 GeV data
- Unfilled points are 6 GeV data



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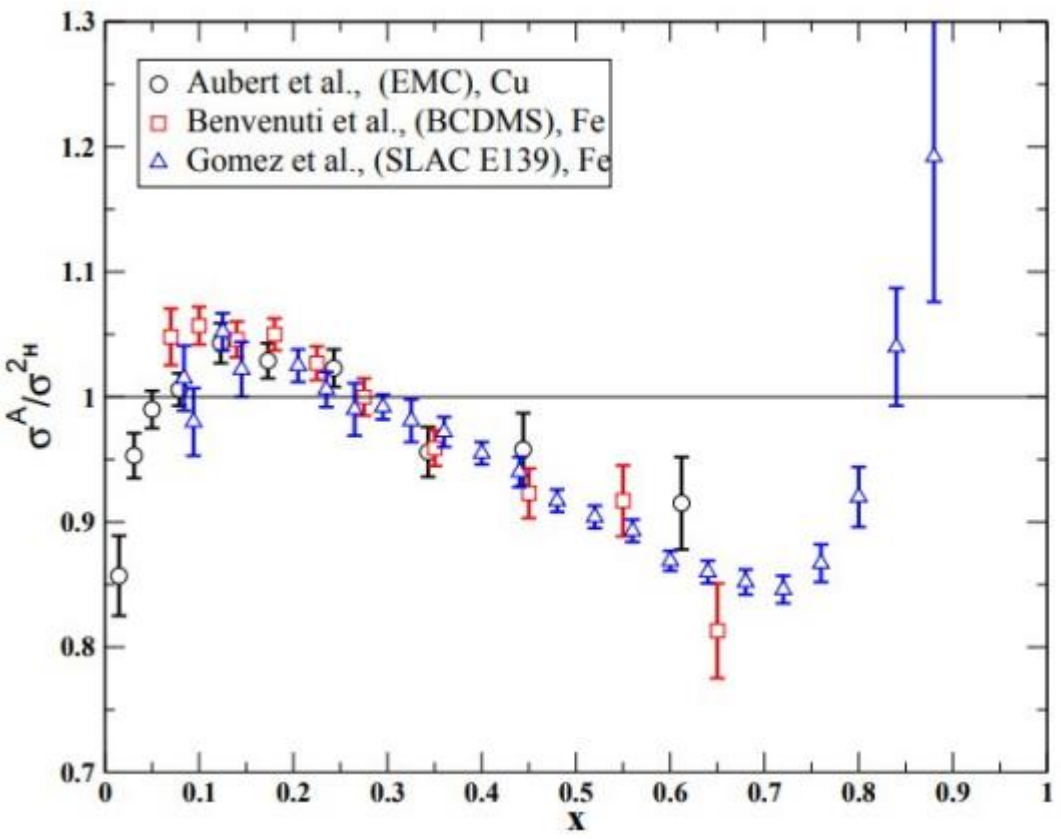

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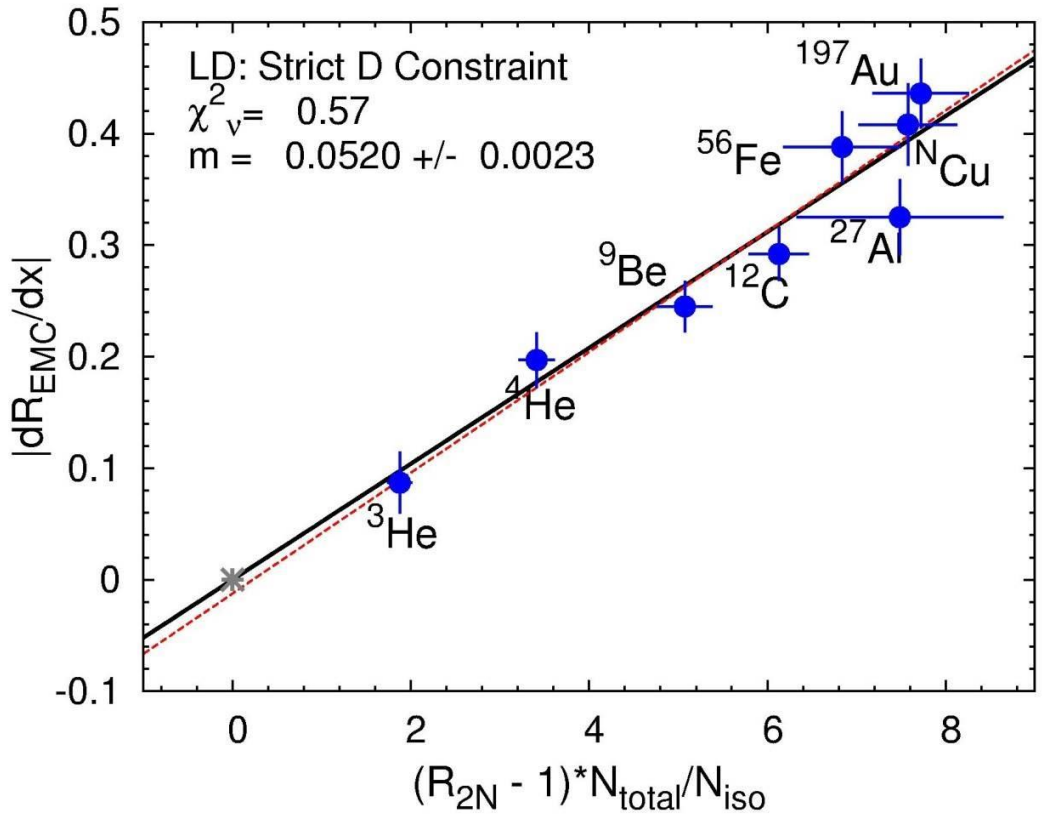

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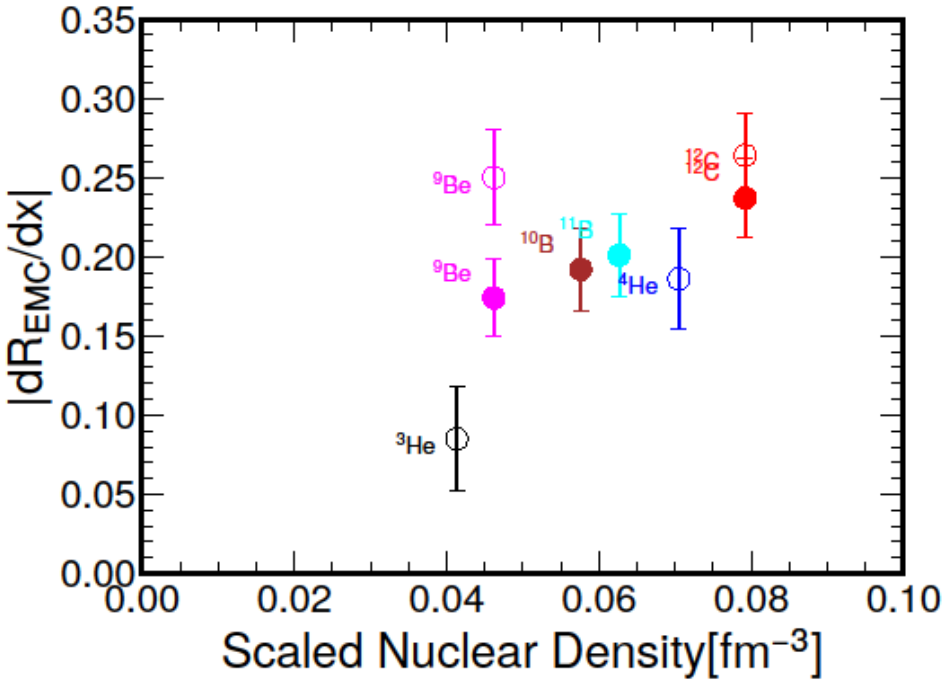

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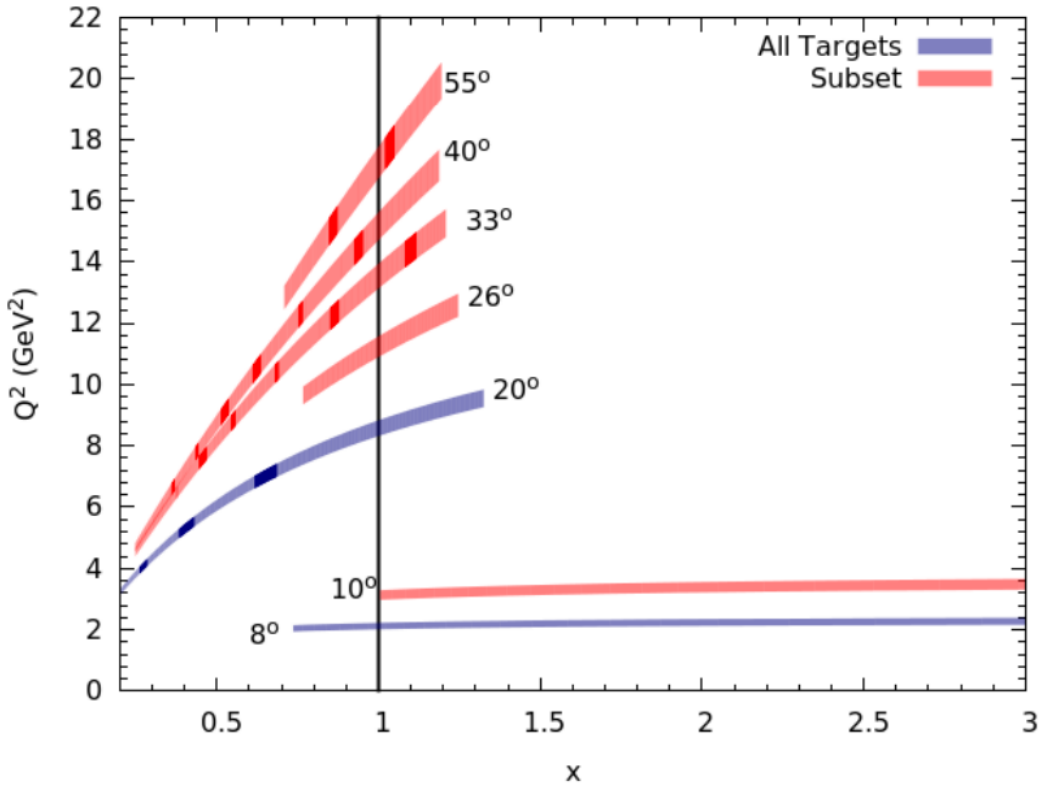
- **Phase II will run this summer!**



Questions?