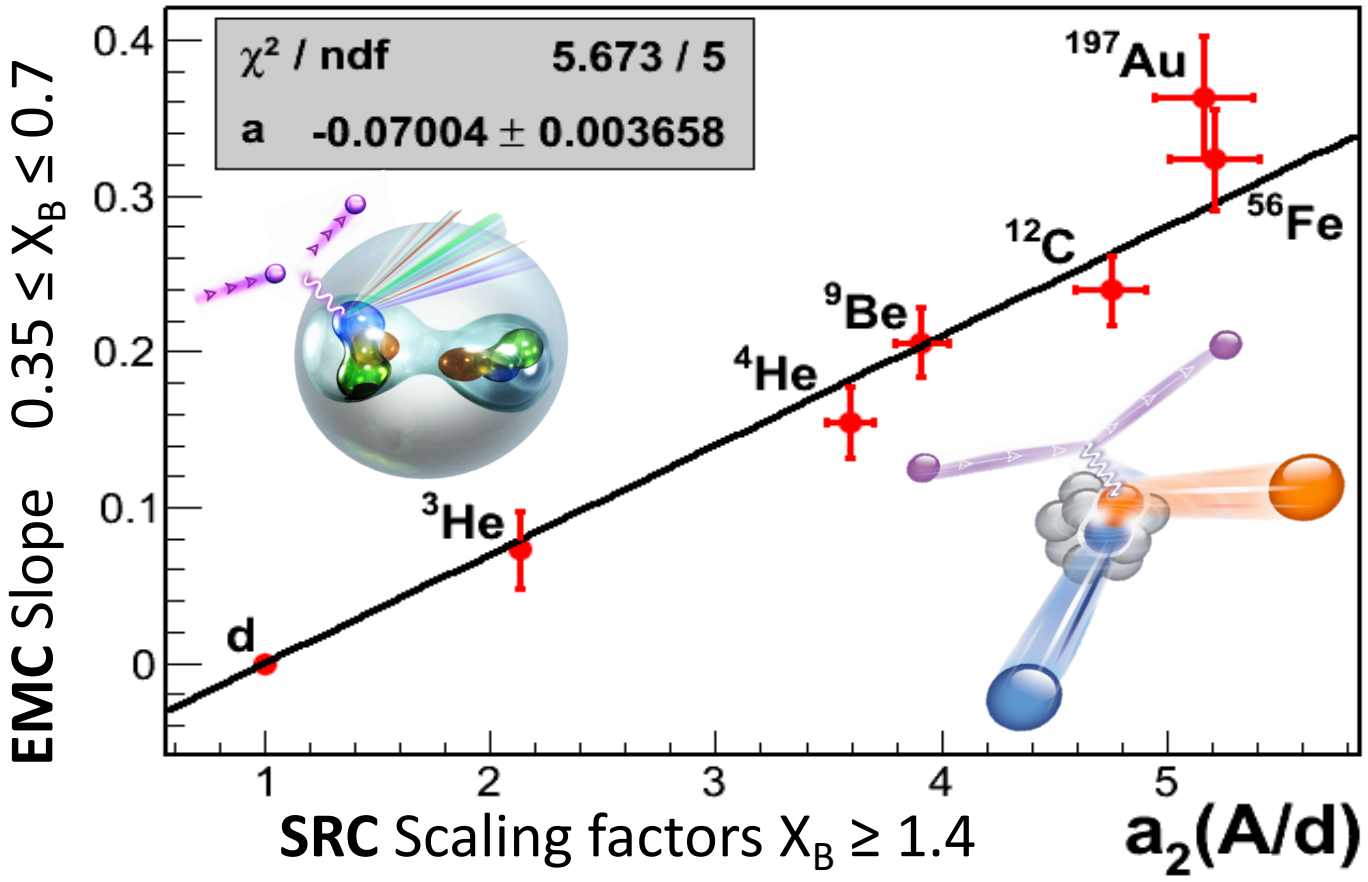
EMC-SRC Correlation



O. Hen et al., Int. J. Mod. Phys. E. **22**, 1330017 (2013).

O. Hen et al., Phys. Rev. C **85** (2012) 047301.

L. B. Weinstein, E. Piasetzky, D. W. Higinbotham, J. Gomez, O. Hen, R. Shneor, Phys. Rev. Lett. **106** (2011) 052301.

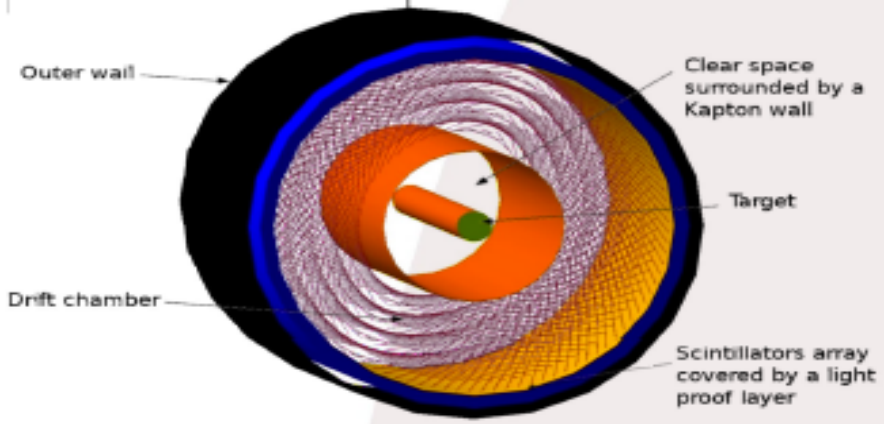
Tagged Structure Functions (JLab12)

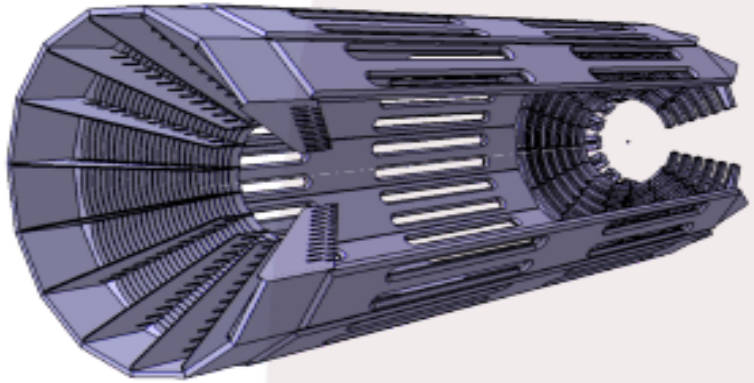
The EMC-SRC correlation and recent theoretical models indicate that the EMC effect is associated with high virtuality, SRC nucleons in nuclei.

- We are leading the JLab program to measure the structure function of nucleons in deuterium as a function of their relative momentum.
- This will be the first direct test of the underlying physics driving the EMC effect and the EMC-SRC correlation.
- Continue as part of the EIC program.
- Talk by Axel Schmidt

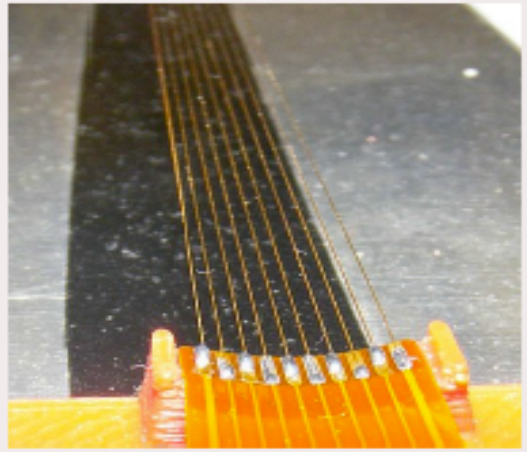


The ALERT Detector





- **A Low Energy Recoil Tracker**
  - Replace the CLAS12 silicon vertex tracker (SVT) and the first layer of micromegas
- **GEANT4 simulation**
  - To define the characteristics of the wire chamber
- **Hyperbolic drift chamber**
  - Stereo angles significantly complicate the mechanics
  - We tested electronic options
    → first prototype used DREAM Front-End Board
- **Scintillators for TOF and total energy measurement**
  - Advanced GEANT4 simulations have been performed
- **Work in Progress**
  - Choice of material to be optimized for several components
    - We focused on main challenges to demonstrate that we can build a working detector
    - Optimization of different parameters is underway
  - Integration of electronics and other elements
    - We have less channels than micromegas to read, so we do not expect this to be a major challenge

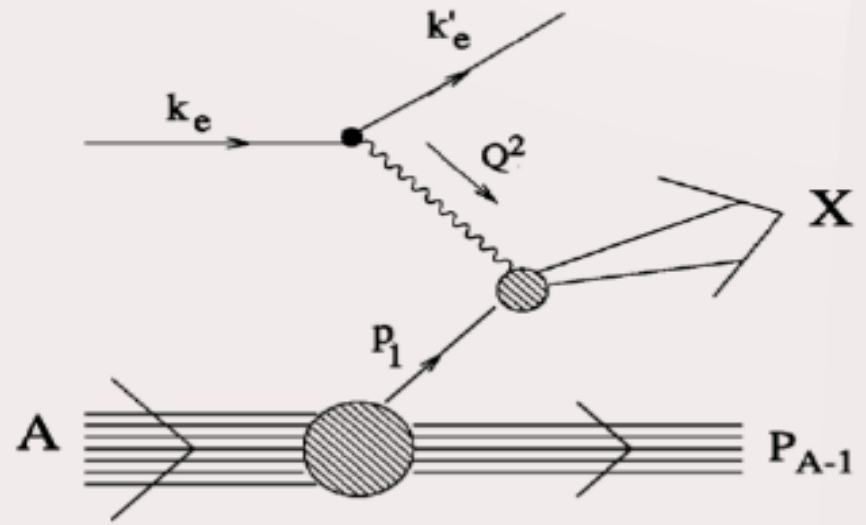


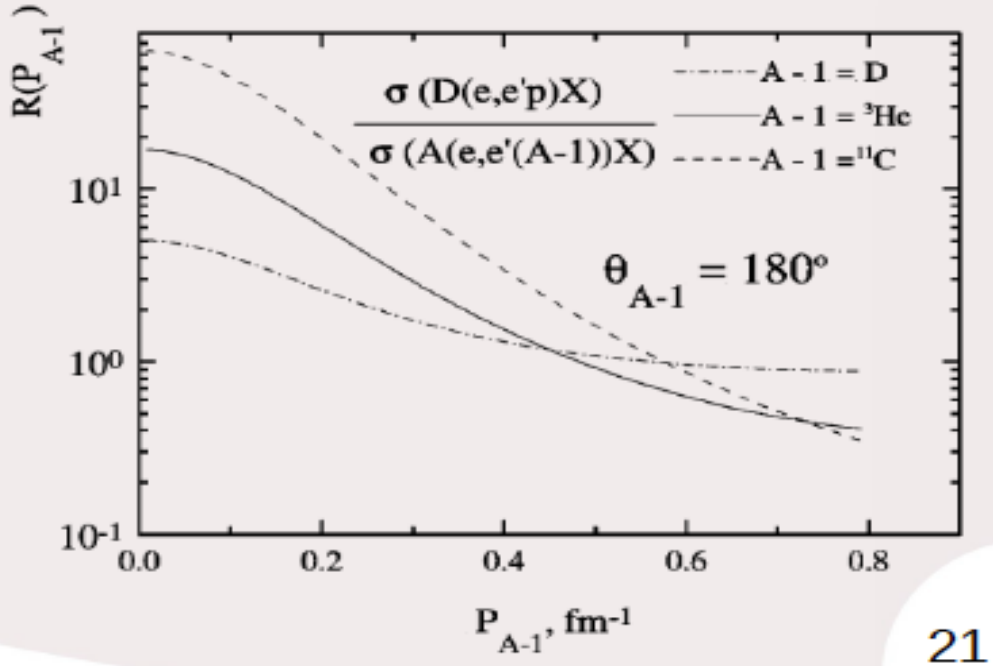
Test with a 2mm wire gap on a curved surface

Testing the Spectator Mechanism

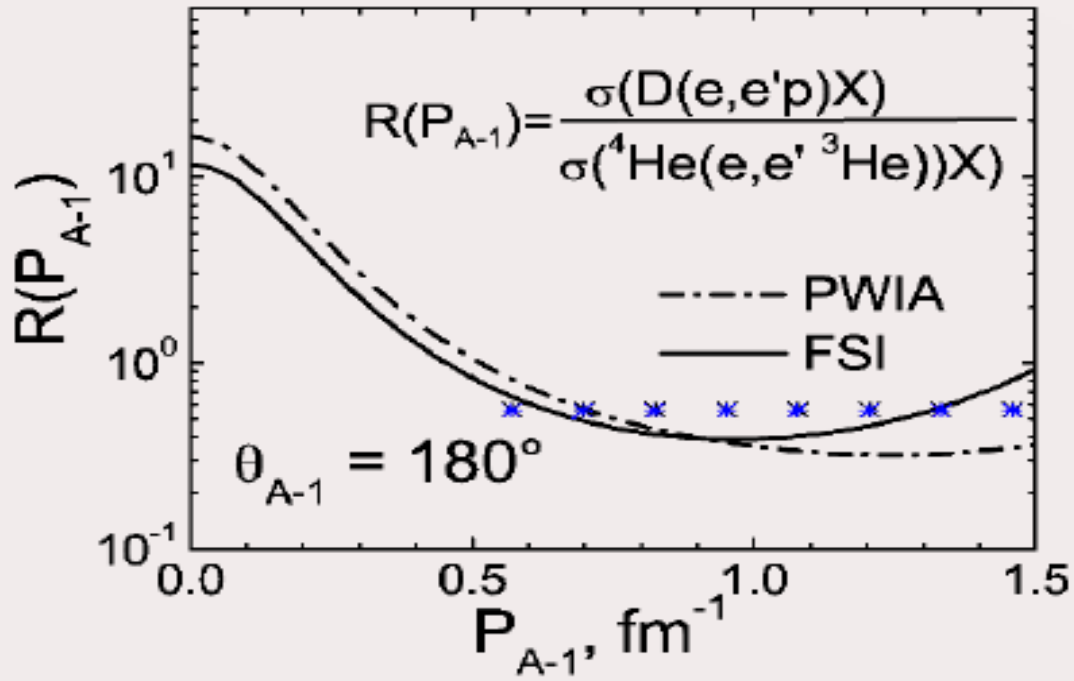
- **Spectator recoil for deuterium target**
  - The nucleon inside the nucleus which does not interact with the virtual photon and other hadronic products of the reaction
  - Its detection can be used to control FSIs
  - Used by CLAS successfully for neutron structure function measurement (Bonus run)

- **Spectator recoil for ^{4}He target**
  - The detection of the recoil nucleus (A-1) intact gives an extra indication that FSI is small
  - The Fermi distribution extends to higher momentum





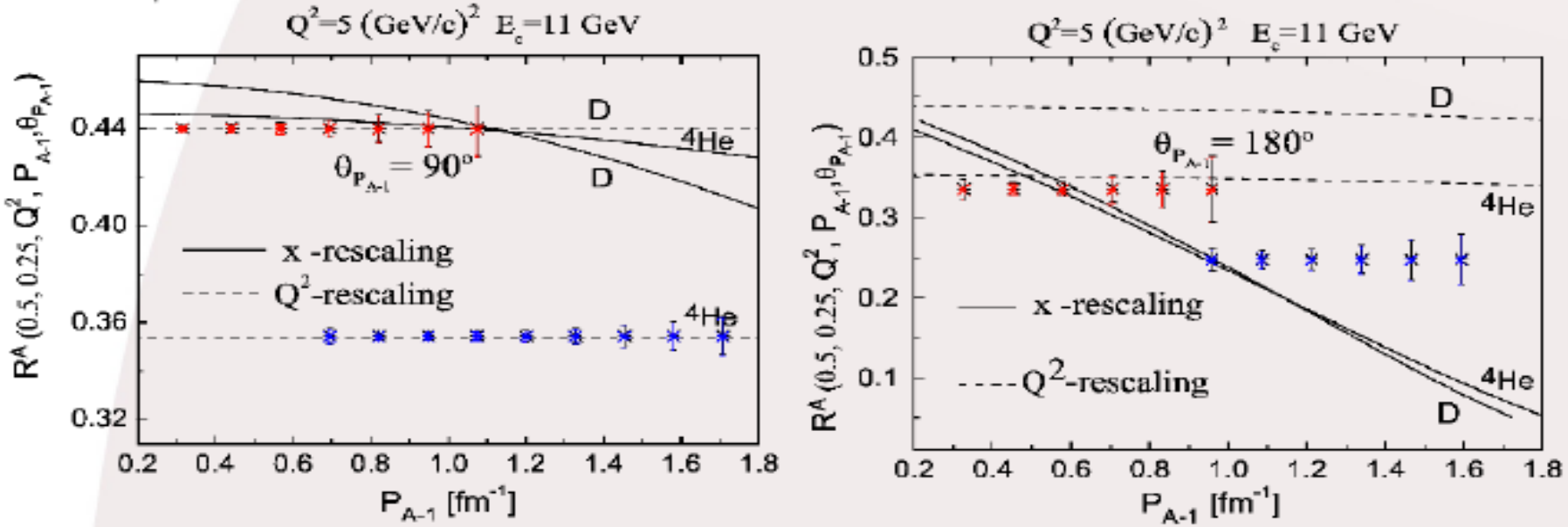
Testing the Spectator Model



- **First step is to test FSI models**
  - Can be tested in large momentum and angle range with very good precision
  - Comparison of Helium and Deuterium targets
  - First measurement of its kind on ^{4}He

C. Ciofi degli Atti, L. P. Kaptari, and S. Scopetta, Eur. Phys. J. A5, 191 (1999)

x or Q^2-Rescaling ?

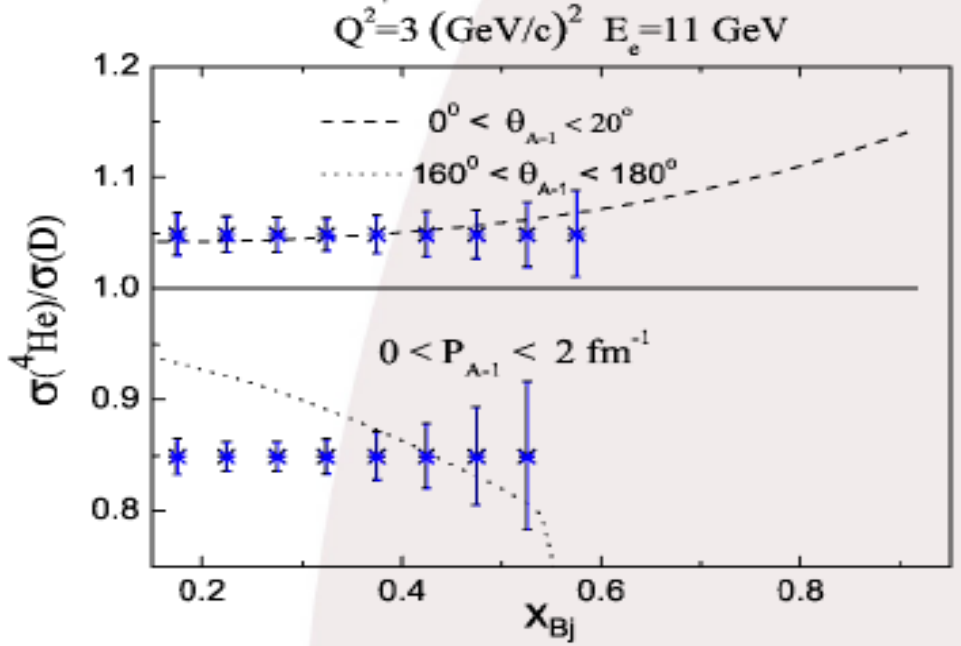


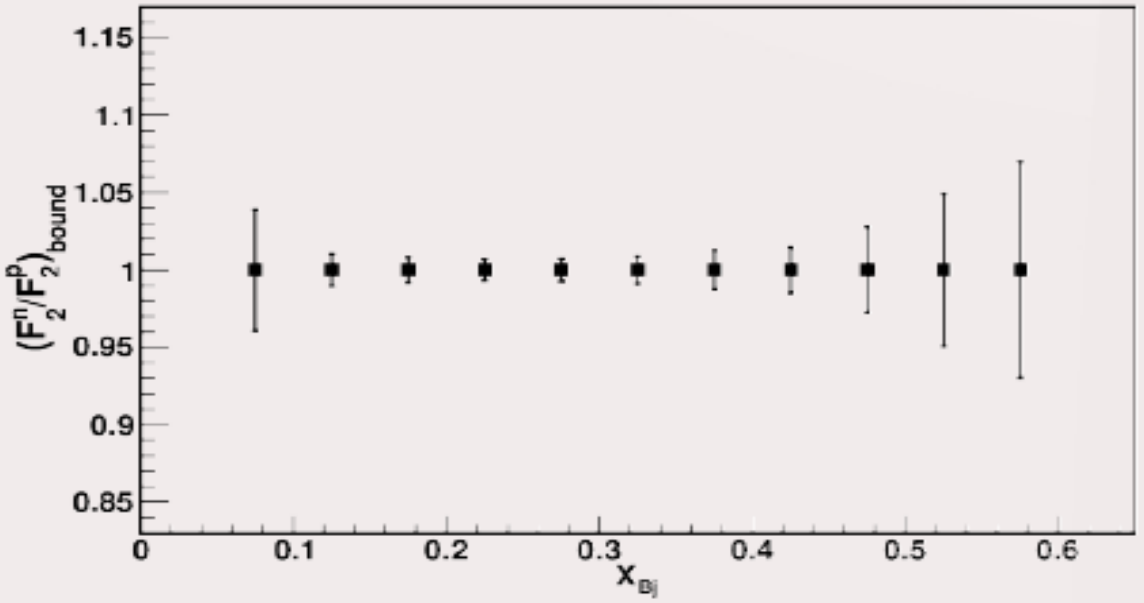
- **The nucleon virtuality is directly linked to the spectator momentum**
- **Rescaling models behave differently with tagged measurements**
  - It is impossible to differentiate x and Q^2 rescaling with inclusive measurements but they give very different signature in tagged measurements
  - Comparison of ^{2}H to ^{4}He is particularly interesting
    - It conserves the nucleus isospin symmetry
    - ^{4}He is a light nuclei with a sizable EMC effect
    - The two rescaling effects are cleanly separated by the comparison between the two nuclei
    - They complement each other in spectator momentum coverage

C. Ciofi degli Atti et al. Eur. Phys. J., vol. A5 (1999) 191

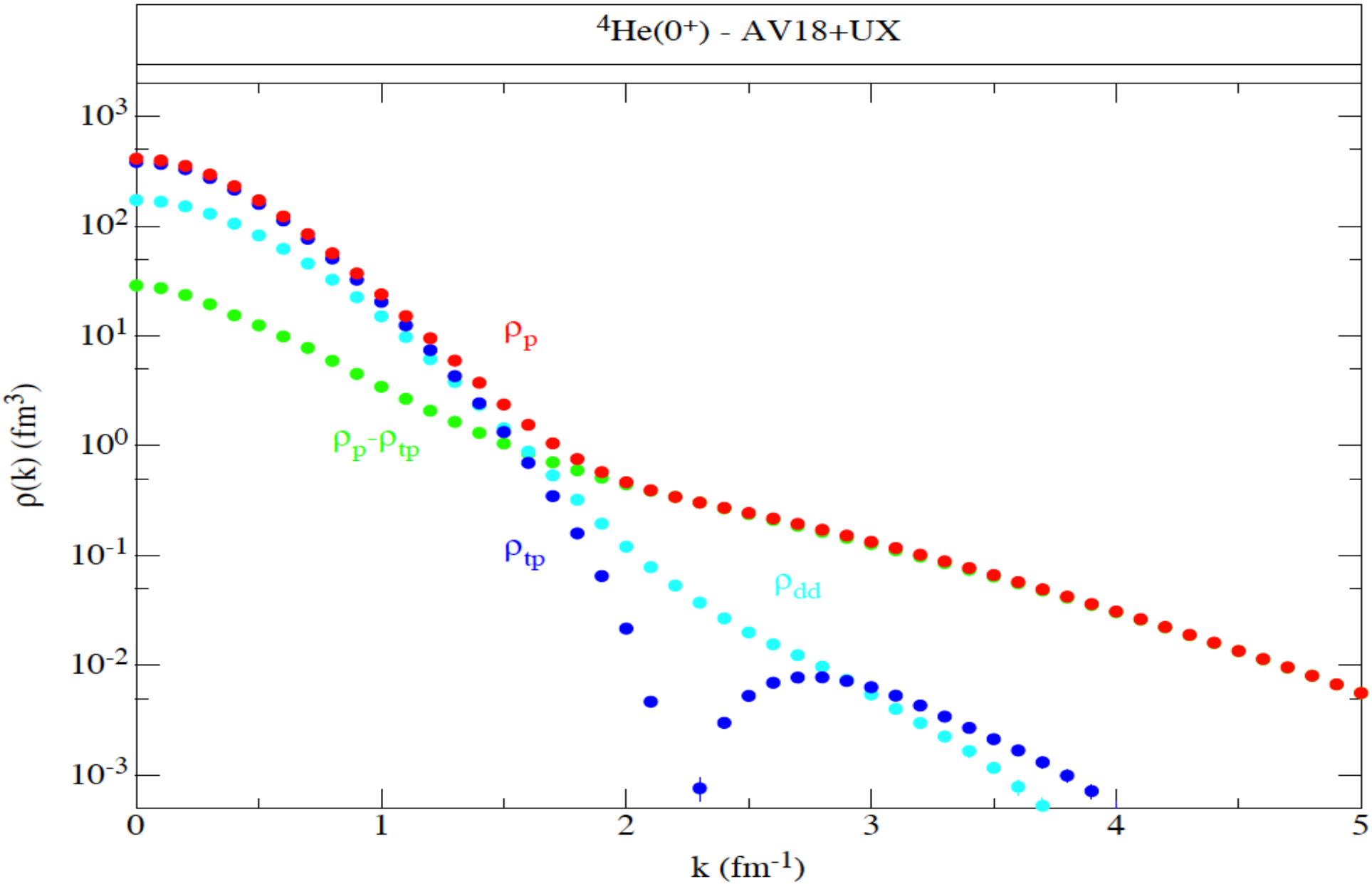
C. Ciofi degli Atti et al. Phys.Rev. C76 (2007) 055206

More Tests of the EMC Models





- **Tagged DIS gives many other opportunities to test the EMC models**
  - In binding model, the EMC effect is due to the cancellation of much larger effects that can be separated with spectator detection
- **Tagged DIS can also be used for flavor selection**
  - We can test how the d/u ratio changes in the nuclear medium


^{4}He(0$^+$) - AV18+UX
10^3
10^2
10^1
10^0
10^{-1}
10^{-2}
10^{-3}
ρ(k) (fm^3)
ρ_p
ρ_p-ρ_{tp}
ρ_{tp}
ρ_{dd}
0
1
2
3
4
5
k (fm^{-1})

EMC tagged by Backwards-Recoiling Hight-Momentum Nucleons

Measuring the EMC Effect with tagged high momentum recoil nucleons

A Letter of Intent to Jefferson Lab PAC 38, Aug. 2011

O. Hen (contact person), E. Piasetzky, I. Korover, J. Lichtenstadt, E. Piasetzky, I. Pomerantz, I. Yaron, and R. Shneor
Tel Aviv University, Tel Aviv, Israel

M. Amarian, G. Dodge, L.B. Weinstein (spokesperson)
Old Dominion University, Norfolk, VA, USA

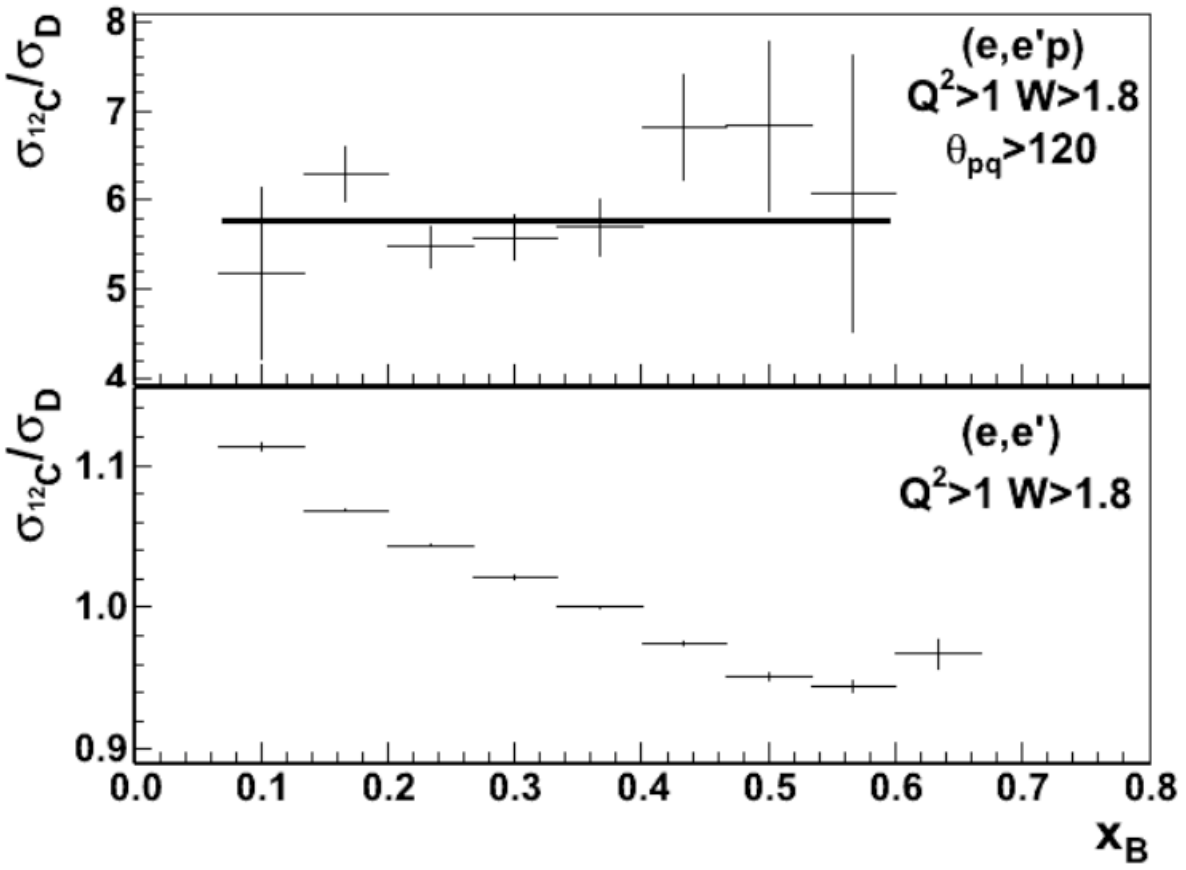
G. Ron
Hebrew University, Jerusalem, Israel

W. Bertozzi, S. Gilad (spokesperson), A. Kelleher and V. Sulkosky
Massachusetts Institute of Technology, Cambridge, MA, USA

B.D. Anderson, A.R. Baldwin, and J.W. Watson
Kent State University, Kent, OH, USA

J.-O. Hansen, D.W. Higinbotham, M. Jones, S. Stepanyan, B. Sawatzky, and S. A. Wood (spokesperson), J. Zhang
Thomas Jefferson National Accelerator Facility, Newport News, VA, USA

Very preliminary data from CLAS



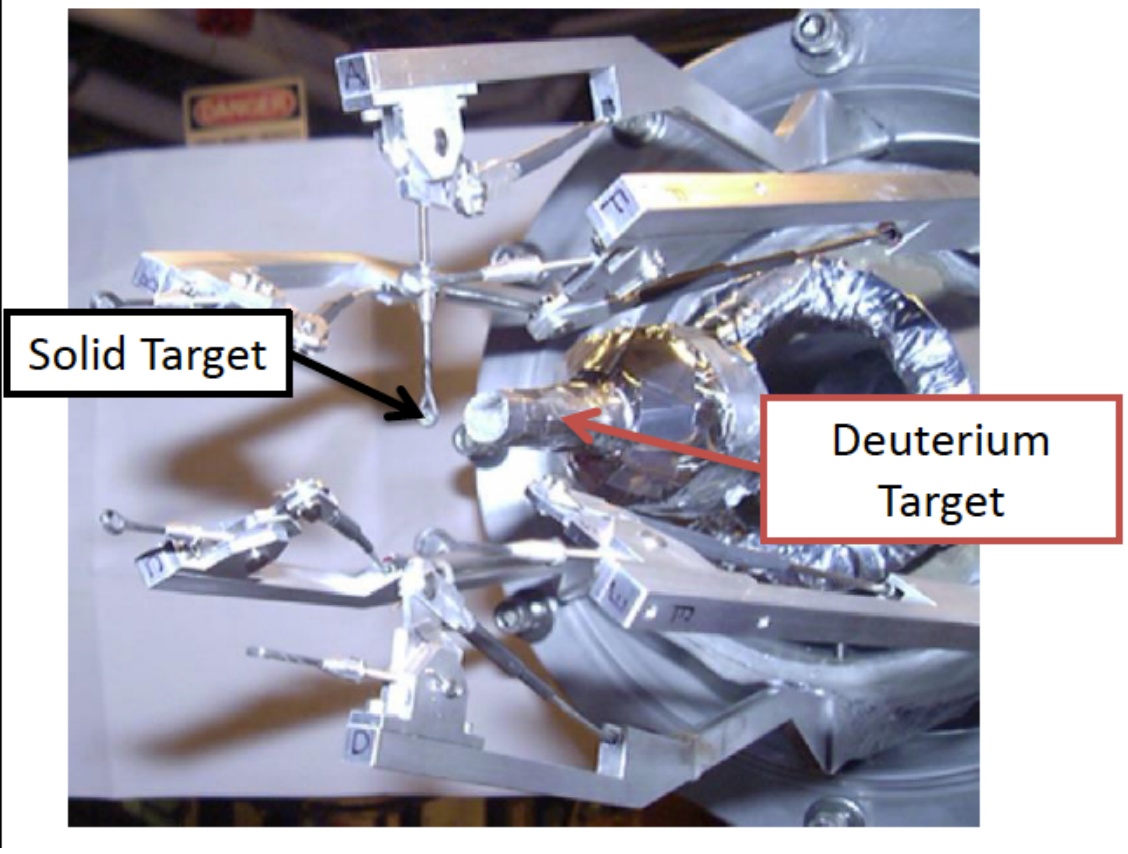
Naïve expectations:

- Per-nucleon tagged x-section ratios will be flat with x_B
- Ratio will be $a_2(A/d)$

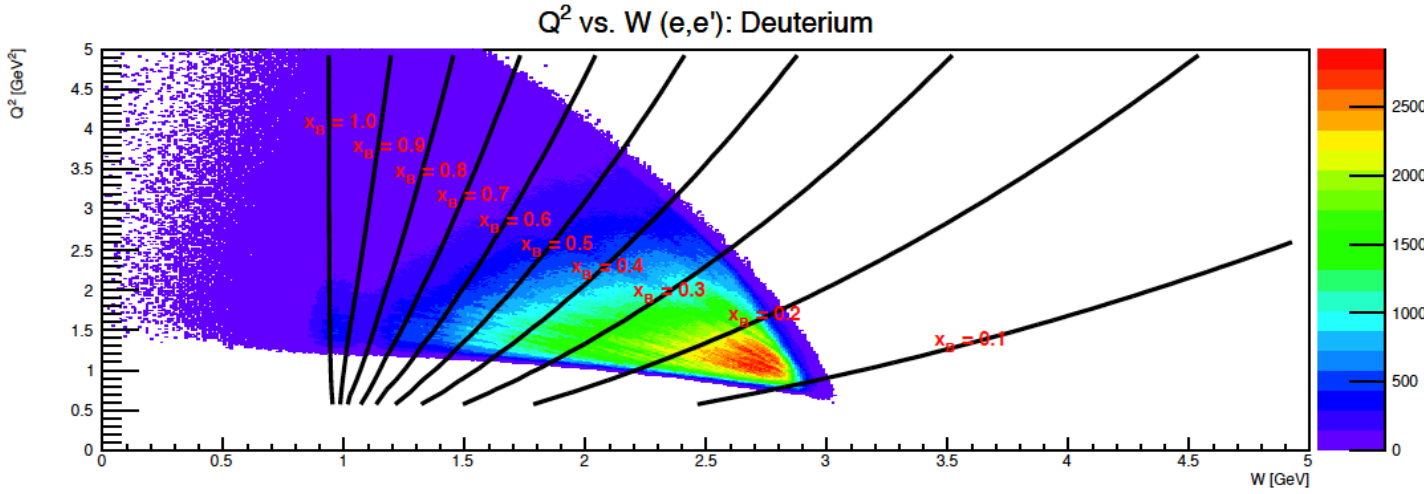
Data Mining from EG2c Run

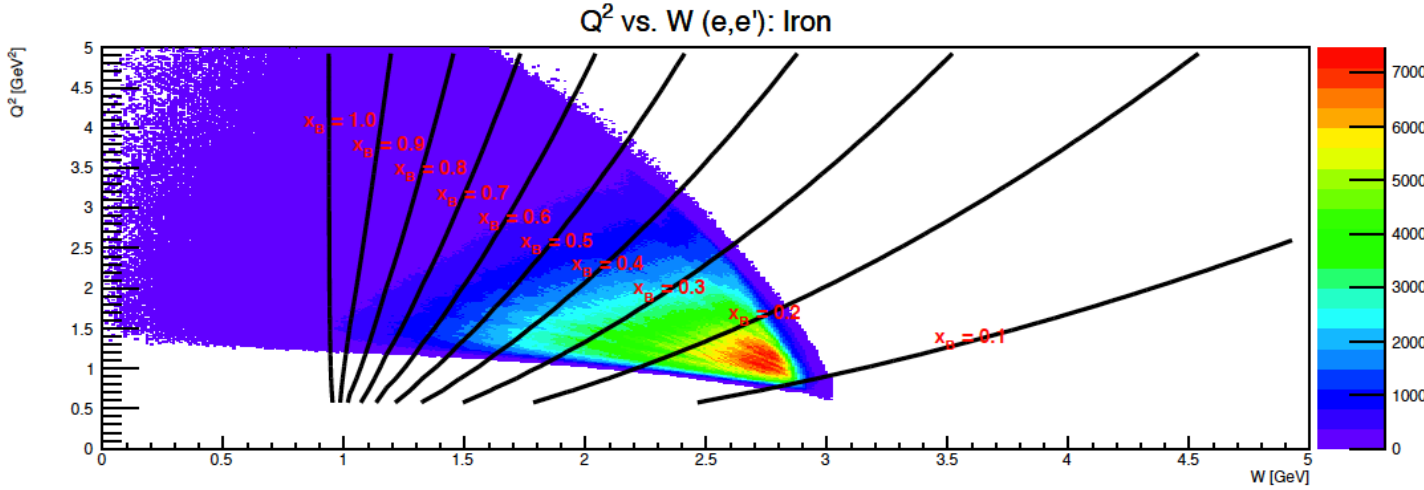
Barak Schmookler, MIT

CLAS target setup



DIS cut: $Q^2 > 1.25$ (GeV/c)^2; $W > 2.0$ GeV





Untagged (Inclusive) EMC

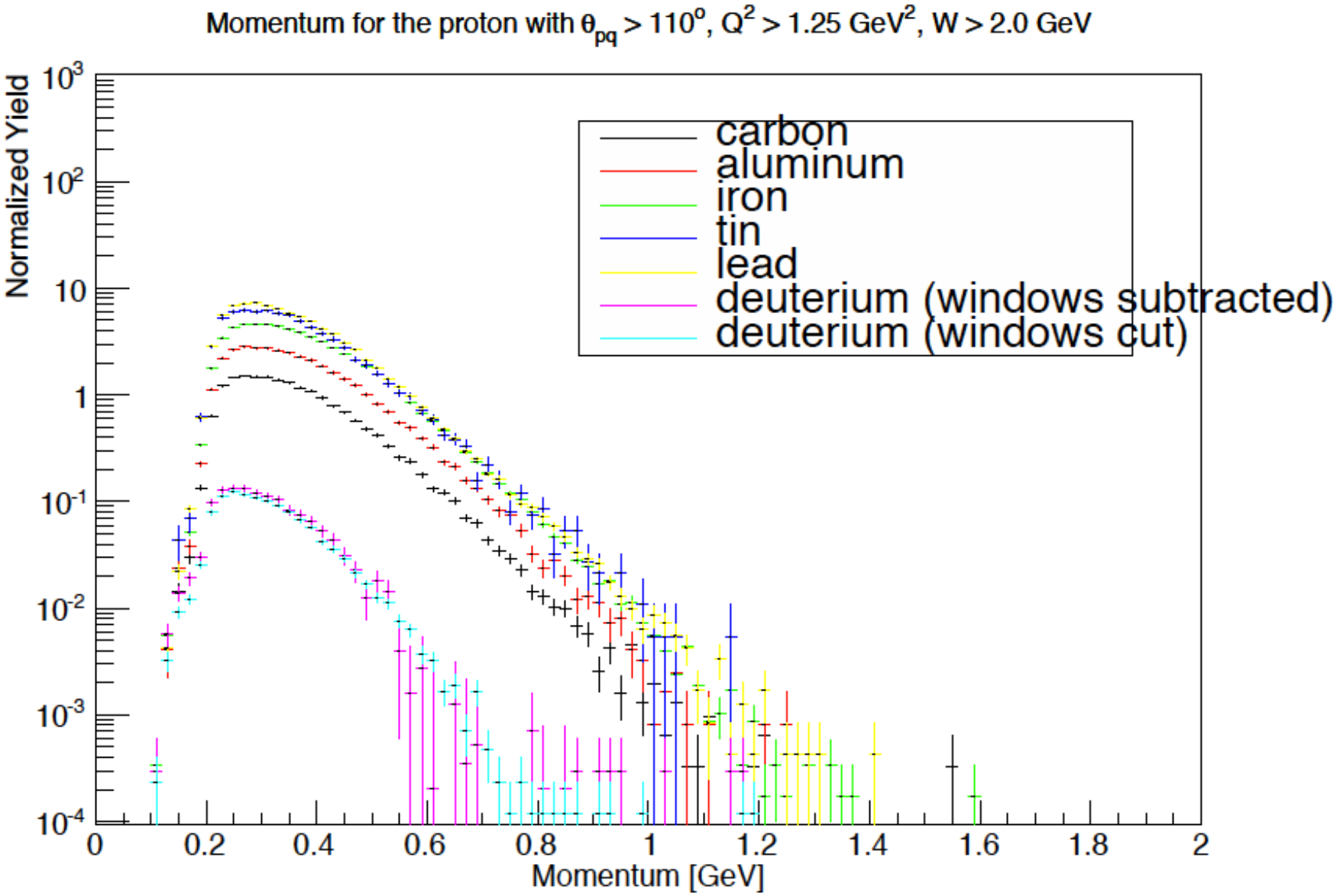
Need to check!

Target	Measured	Published Slope
C/d	-0.25 ± 0.041	-0.292 ± 0.023
Al/d	-0.18 ± 0.045	-0.325 ± 0.034
Fe/d	-0.45 ± 0.041	-0.388 ± 0.032
Sn(Ag)/d	-0.55 ± 0.05	-0.496 ± 0.051
Pb(Au)/d	-0.58 ± 0.045	-0.409 ± 0.039

Table 1: Inclusive EMC Slopes. The slopes are extracted from the ratio $(\sigma(A)/\mathrm{A})/(\sigma(d)/2)$. The cuts applied to select DIS kinematics are $Q^2 >$ 1.25 GeV/c and W $>$ 2.0 GeV/c^2. Published results are taken from *CERN*, *SLAC*, *JLAB*.

DIS tagged by a Backwards Recoiling Proton

- Only one proton observed
- Deuterium not corrected for acceptance
- None are corrected for transparency



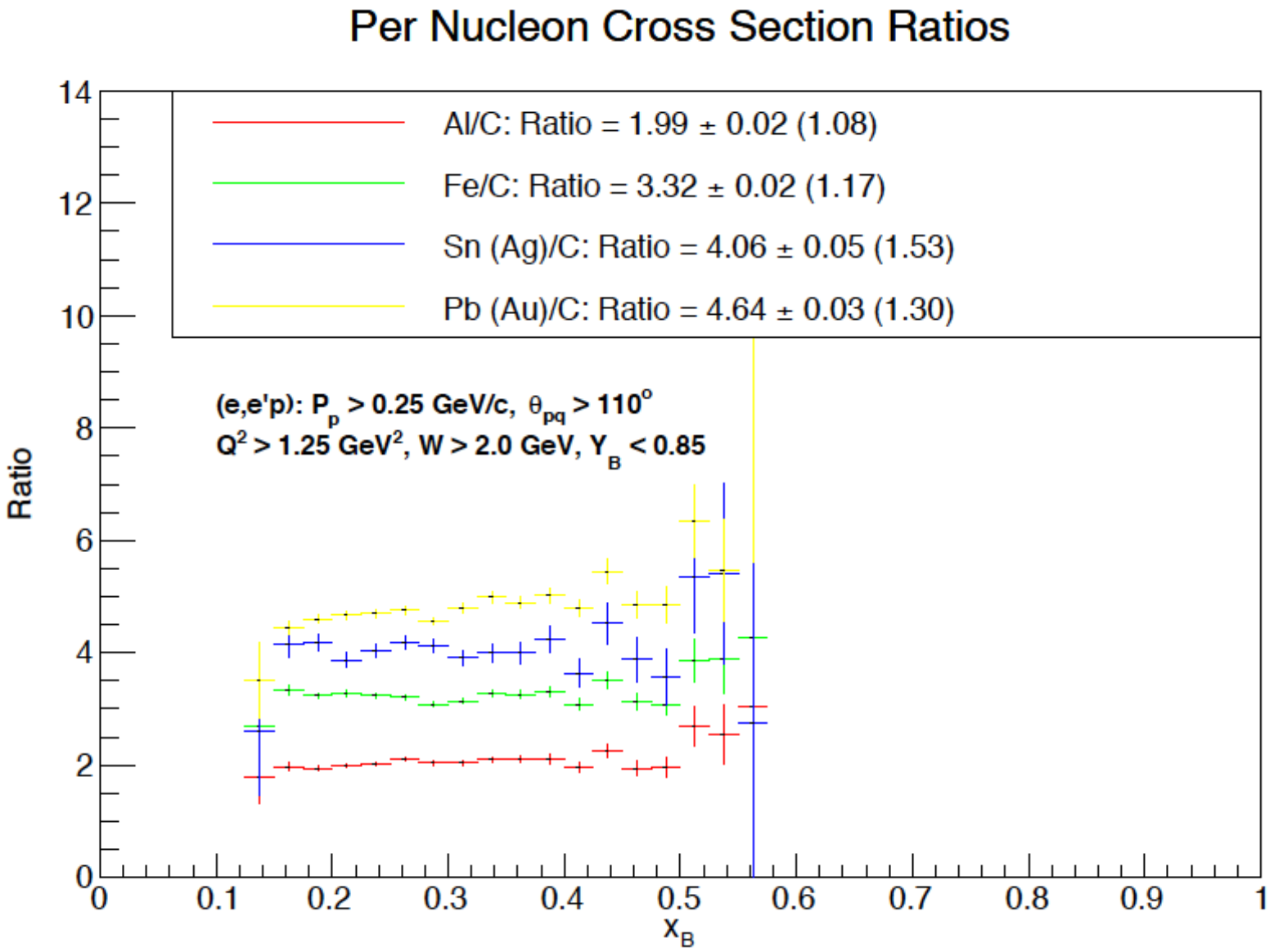
EMC "Tagged" by a Backwards Recoiling Proton

NAIVE EXPECTATION:

- Ratios will be flat
- Ratios of A/C will be $a_2(A/d)/a_2(C/d)$

BUT!

- Ratios are significantly larger – $a_2(A/d)/a_2(C/d)$ denoted in ( )



Questions

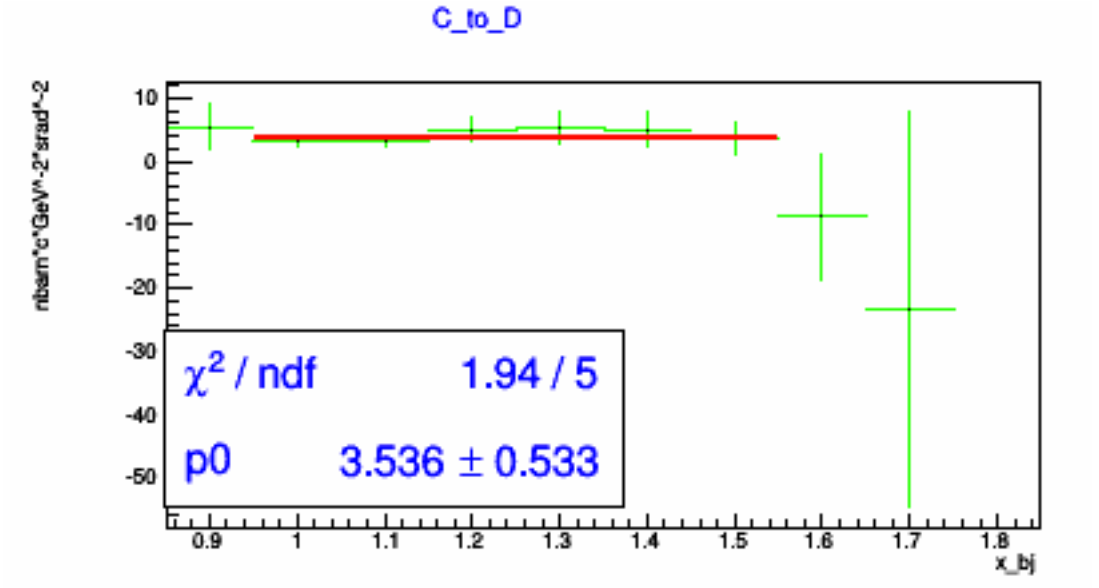
What can explain the large ratios?

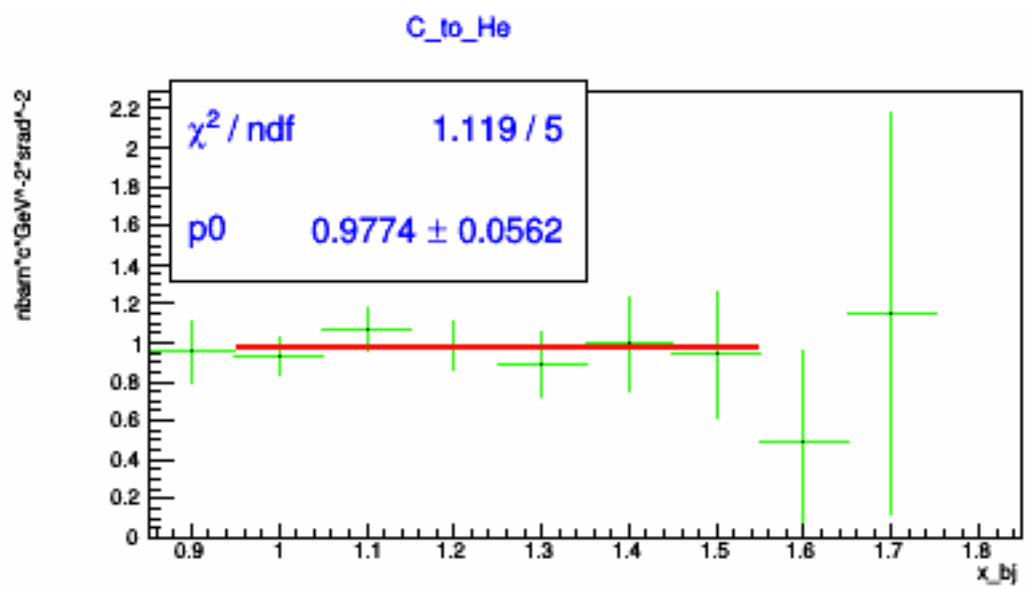
4 suggestions: FSI

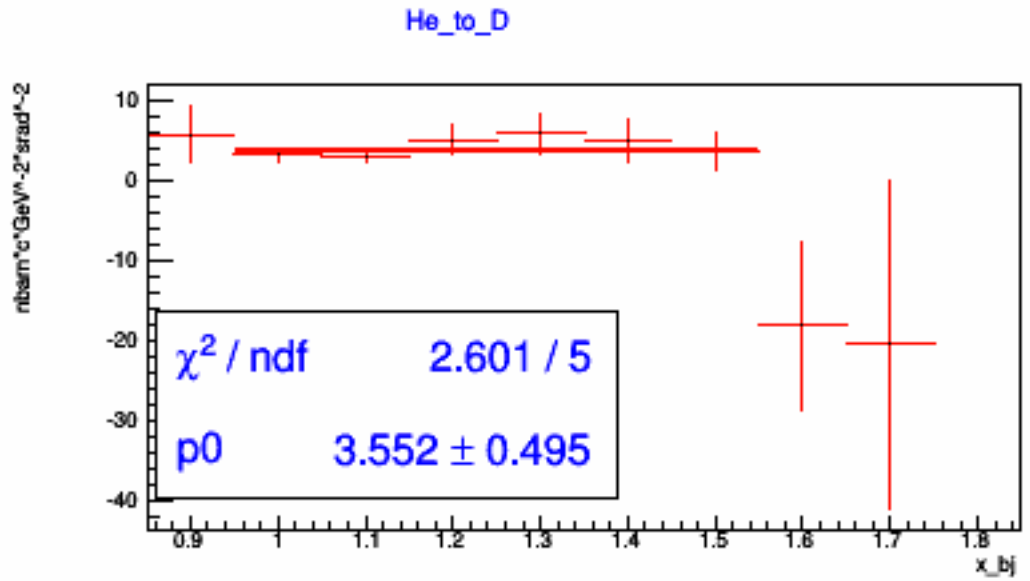
Any hope to explain the large ratios quantitatively by FSI?

Is there another explanation? What?

Sanity Check: “Tagged” Ratios in QE Kinematics (SRC)

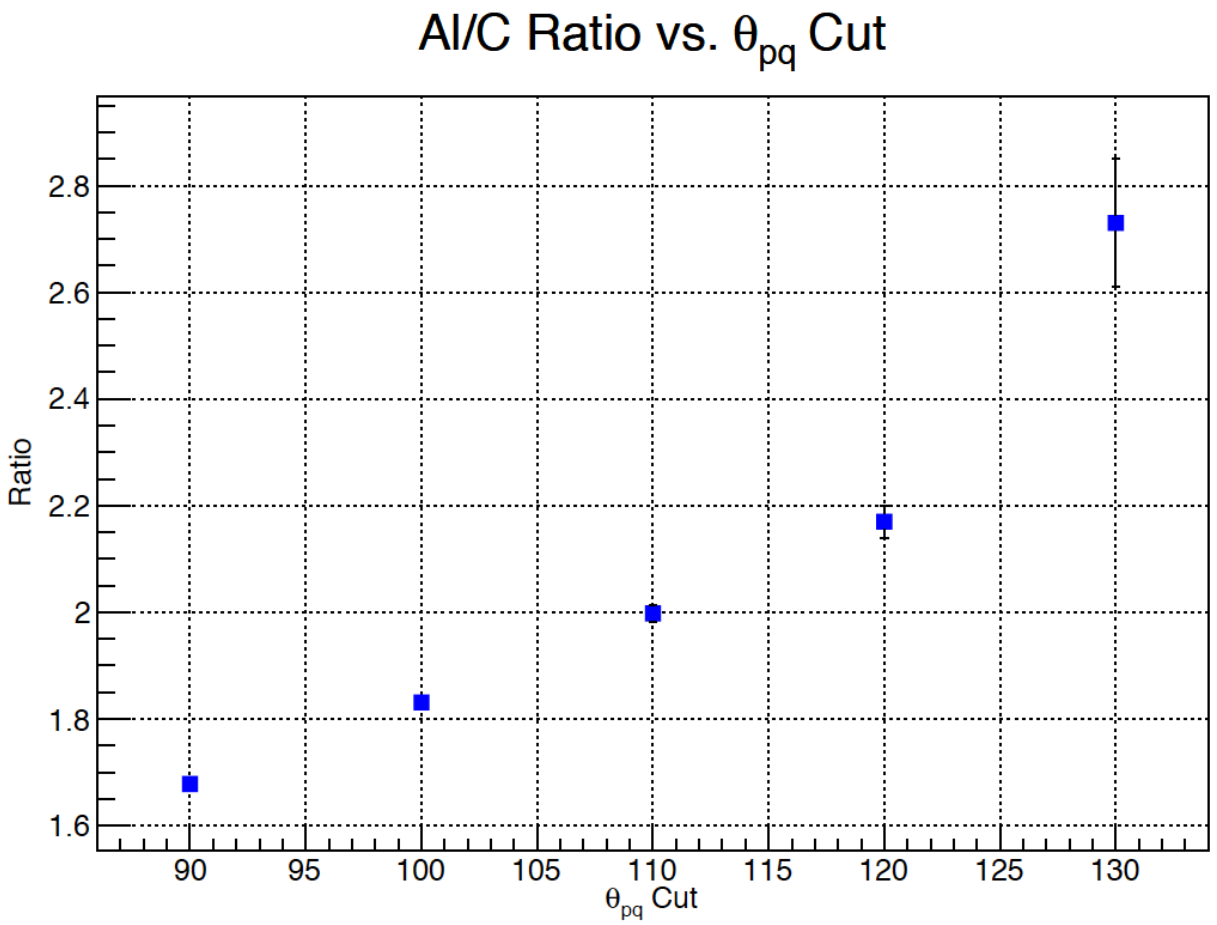


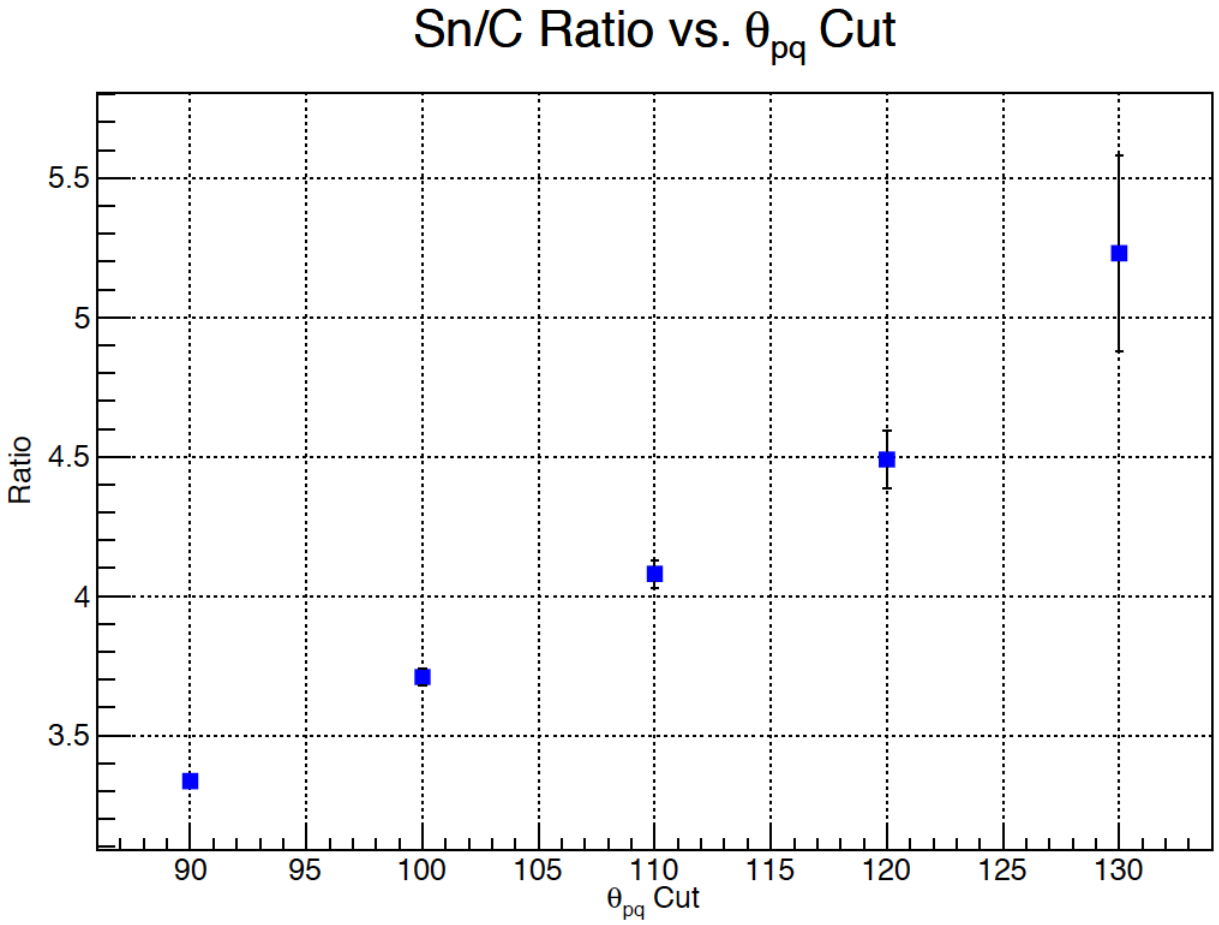




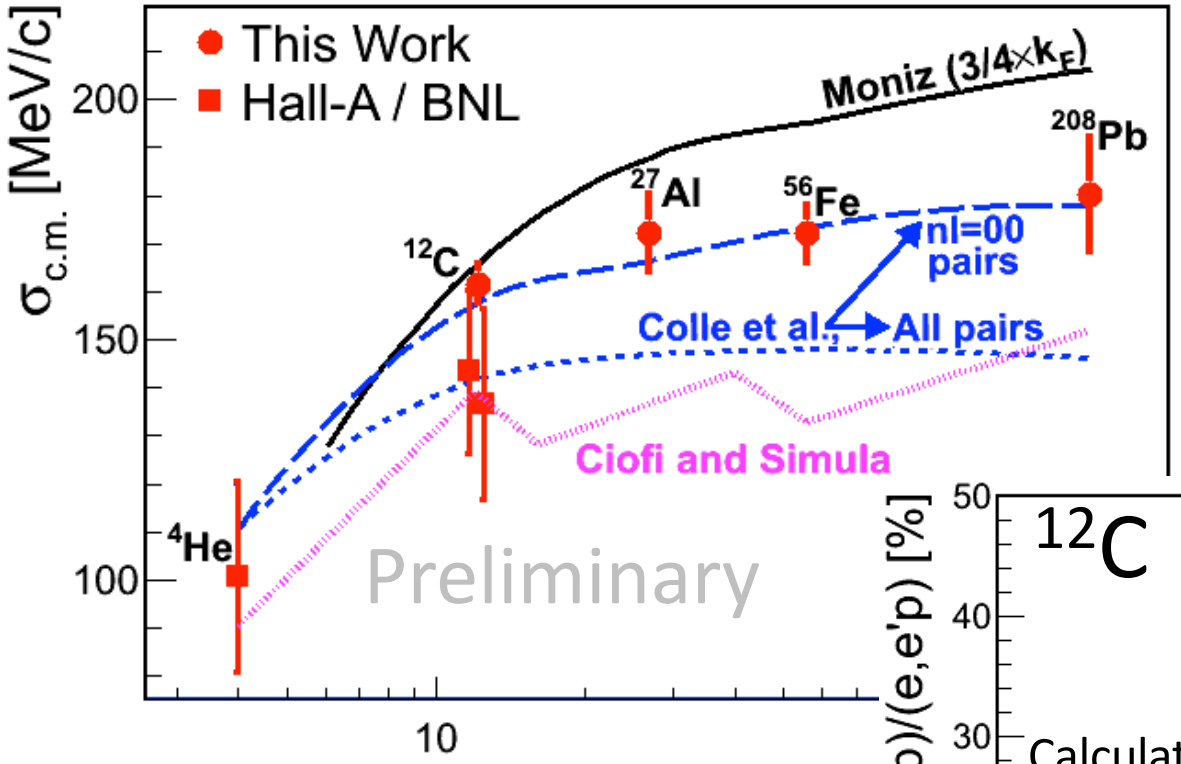
Even Stranger?

Dependence of Ratio on θ_{pq} Cut

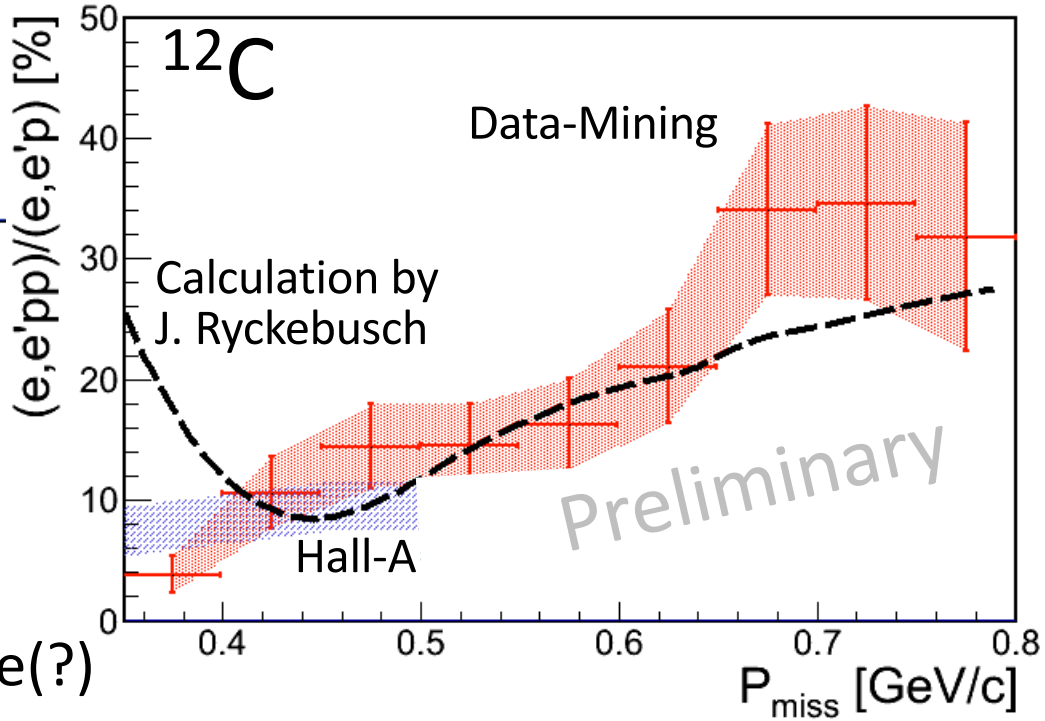




Data-Mining Example



- Extraction of the c.m motion of pp-SRC pairs in nuclei.
- Comparison with calculations to constrain nuclear pairing models.



- Observed increase in the fraction of pp-SRC pairs.
- Indication of transition from Tensor and Scalar dominance(?)

F_{2n}/F_{2p}