

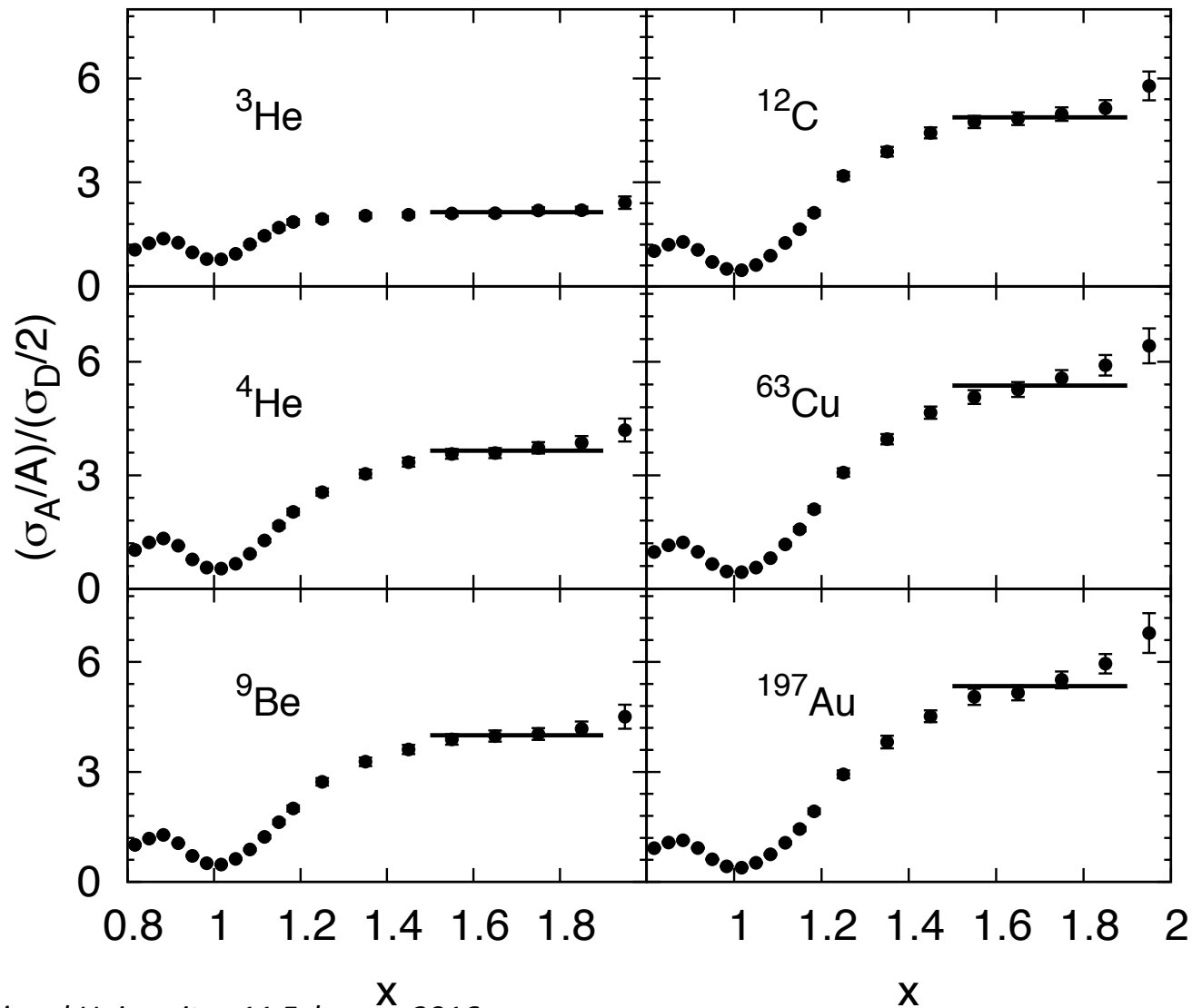


Tagged EMC Effect and the EMC-SRC Connection

Douglas W. Higinbotham

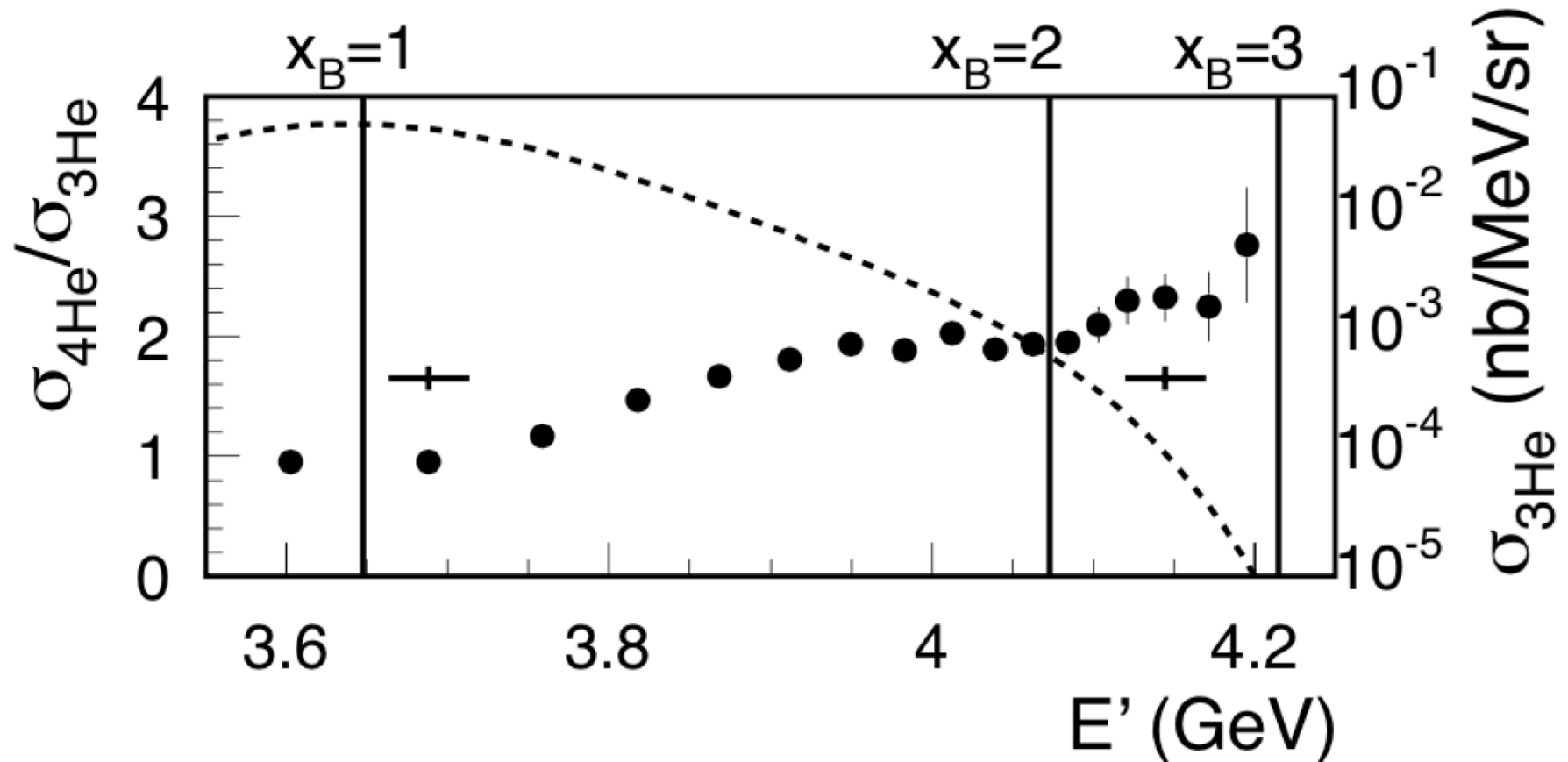
SRC Results From Jefferson Lab Hall-C

N. Fomin et al., Phys. Rev. Lett. **108** (2012) 092502.



The $x > 2$ Region Is Experimental Challenging

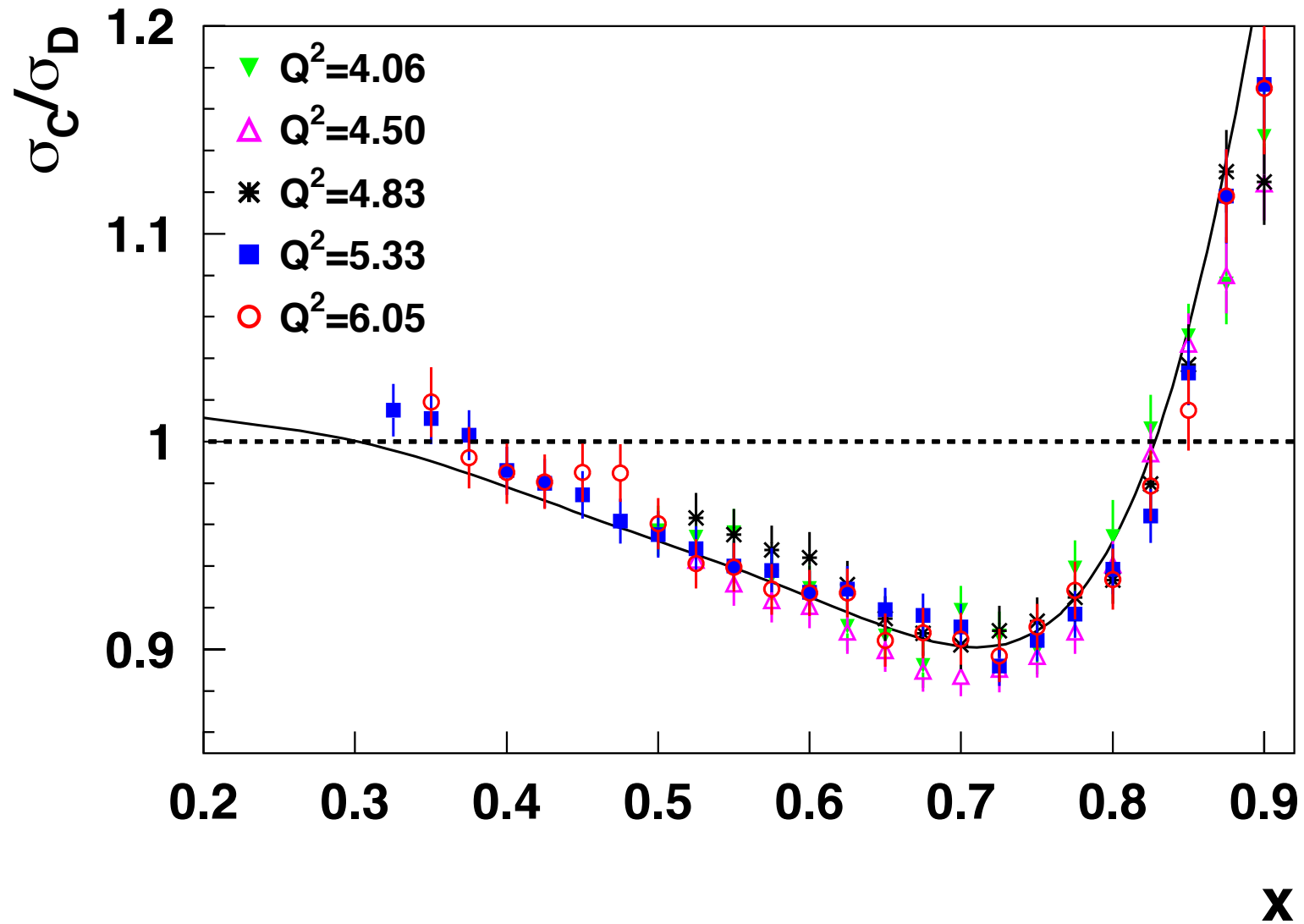
D.H. and Or Hen, Phys. Rev. Lett. 114 (2015) 169201.



Warning: Smearing's and/or backgrounds (e.g. Al end-caps) can cause a plateau.

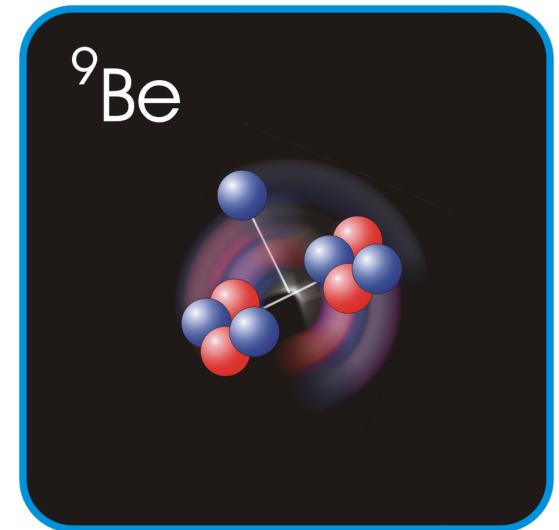
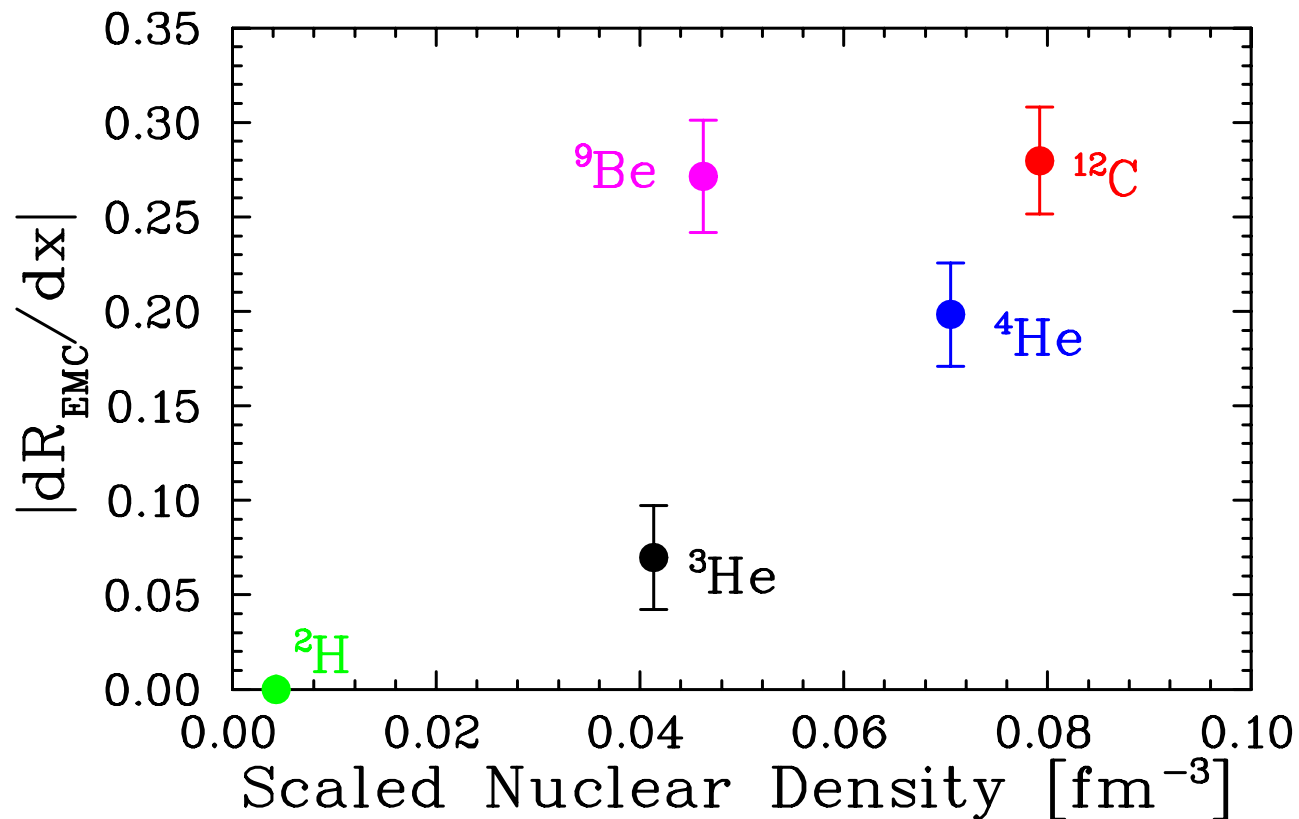
EMC Results from Jefferson Lab Hall-C

J. Seely *et al.*, Phys, Rev. Lett. **103** (2009) 202301.



New Insights from Beryllium EMC Data

J. Seely *et al.*, Phys. Rev. Lett. **103** (2009) 202301.



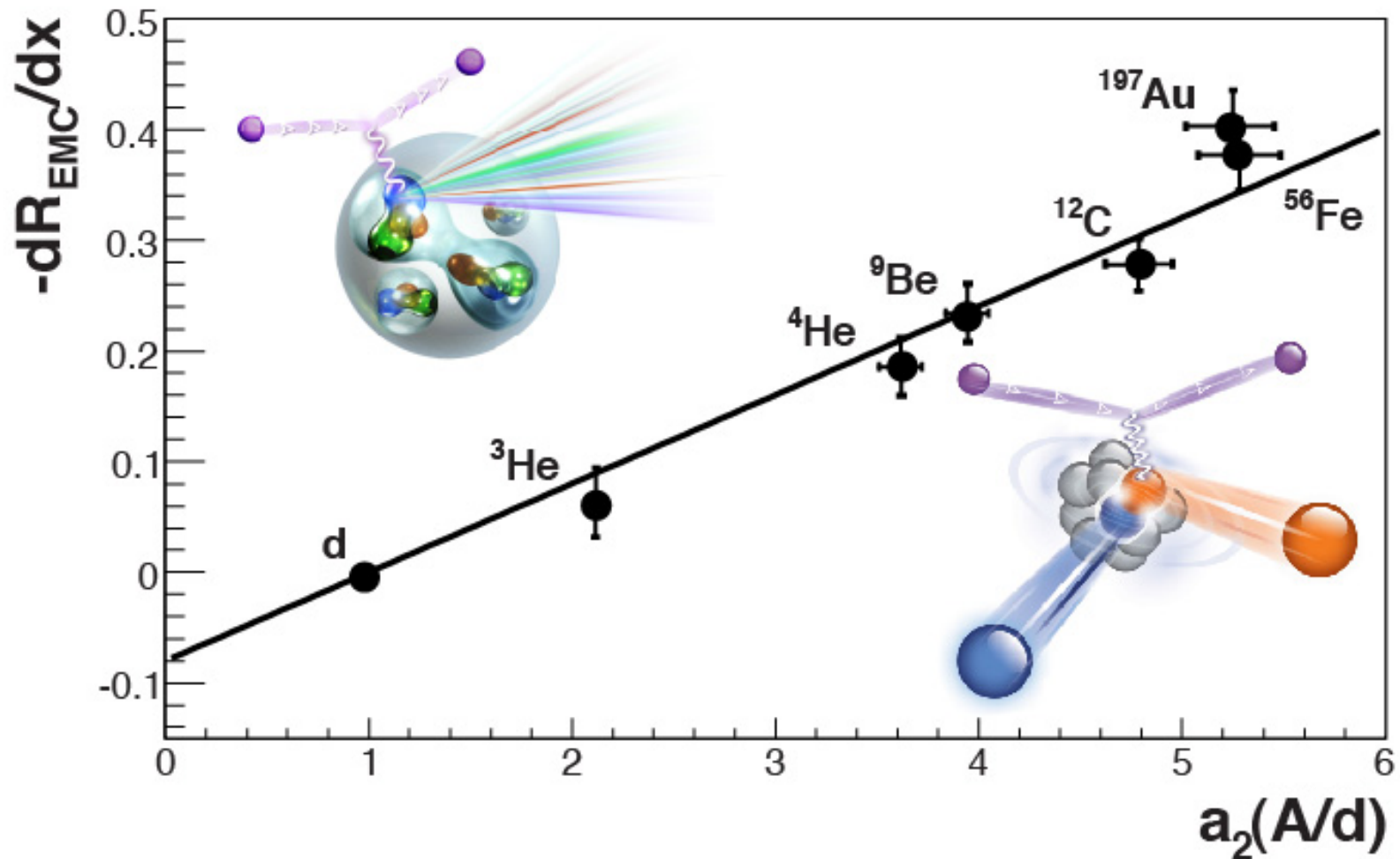
- Plot shows slope of ratio σ_A/σ_D at EMC region.
- EMC effect correlated with **local density** not average density.

SRC and EMC Correlation

L. Weinstein *et al.*, Phys. Rev. Lett. **106** (2011) 052301.

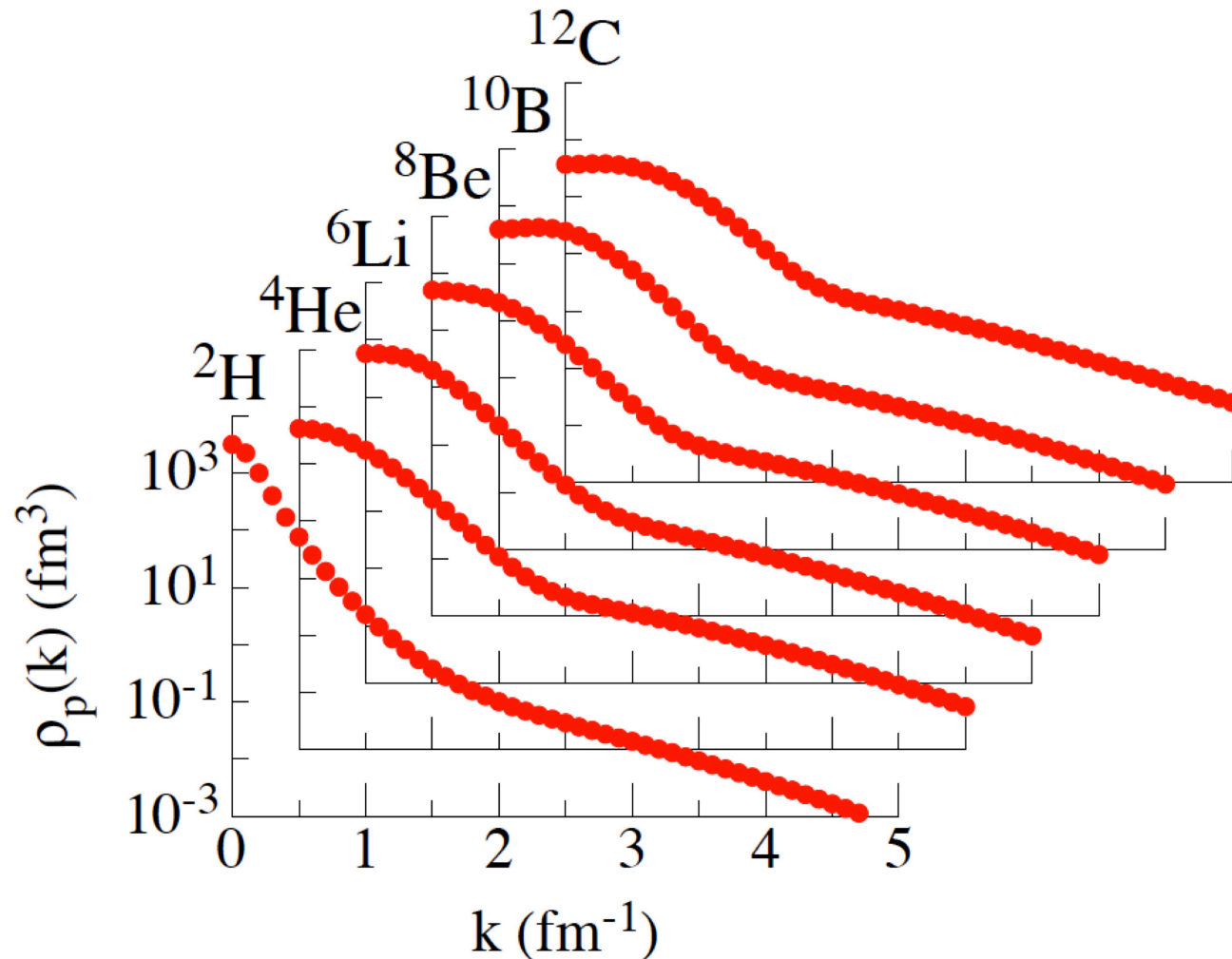
O. Hen *et al.*, Phys. Rev. C **85** (2012) 047301.

N. Fomin *et al.*, Phys.Rev.Lett. **108** (2012) 092502.



Momentum Distributions

R. B. Wiringa, R. Schiavilla, Steven C. Pieper, and J. Carlson, Phys. Rev. C 89, 024305

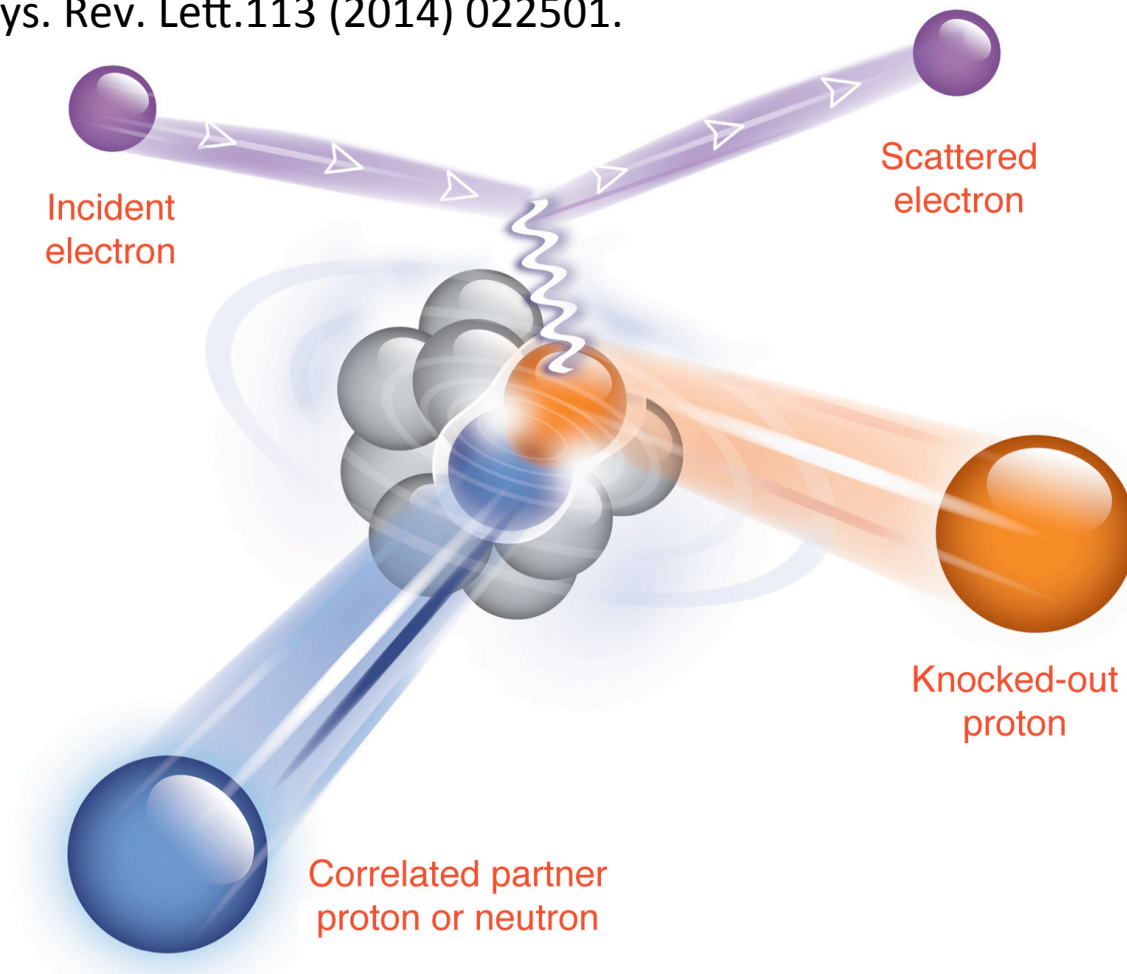


for high *initial* momentums, k , $\rho_A(k) \cong N * \rho_D(k)$

“Classic” $A(e,e'pN)$ SRC Measurements

R. Subedi *et al.*, Science 320 (2008) 1476.

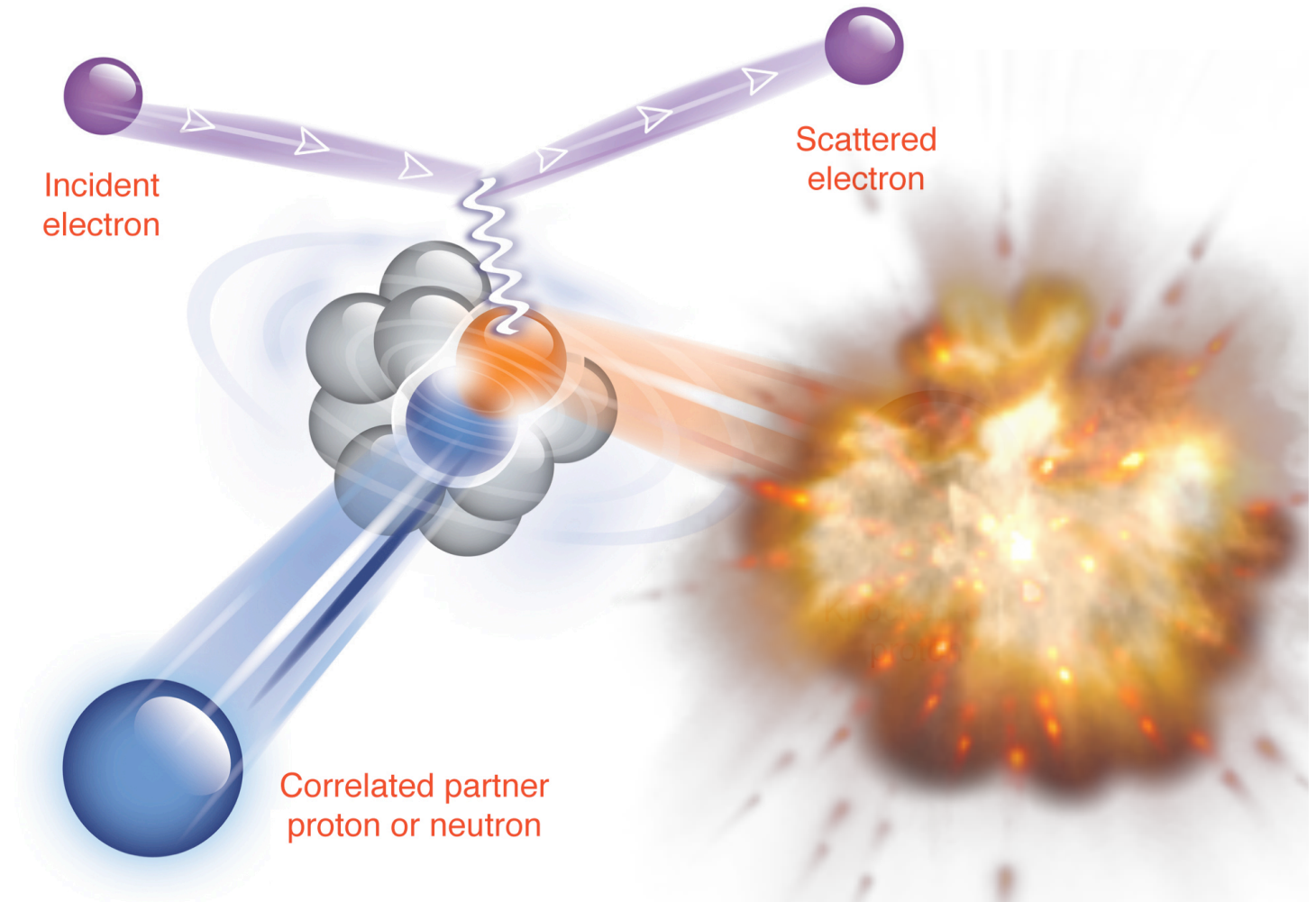
I. Korover *et al.*, Phys. Rev. Lett. 113 (2014) 022501.



Experiment is simply to see if what happens if we tag recoils.
Will we end see any?!

Tagged EMC Effect Measurement

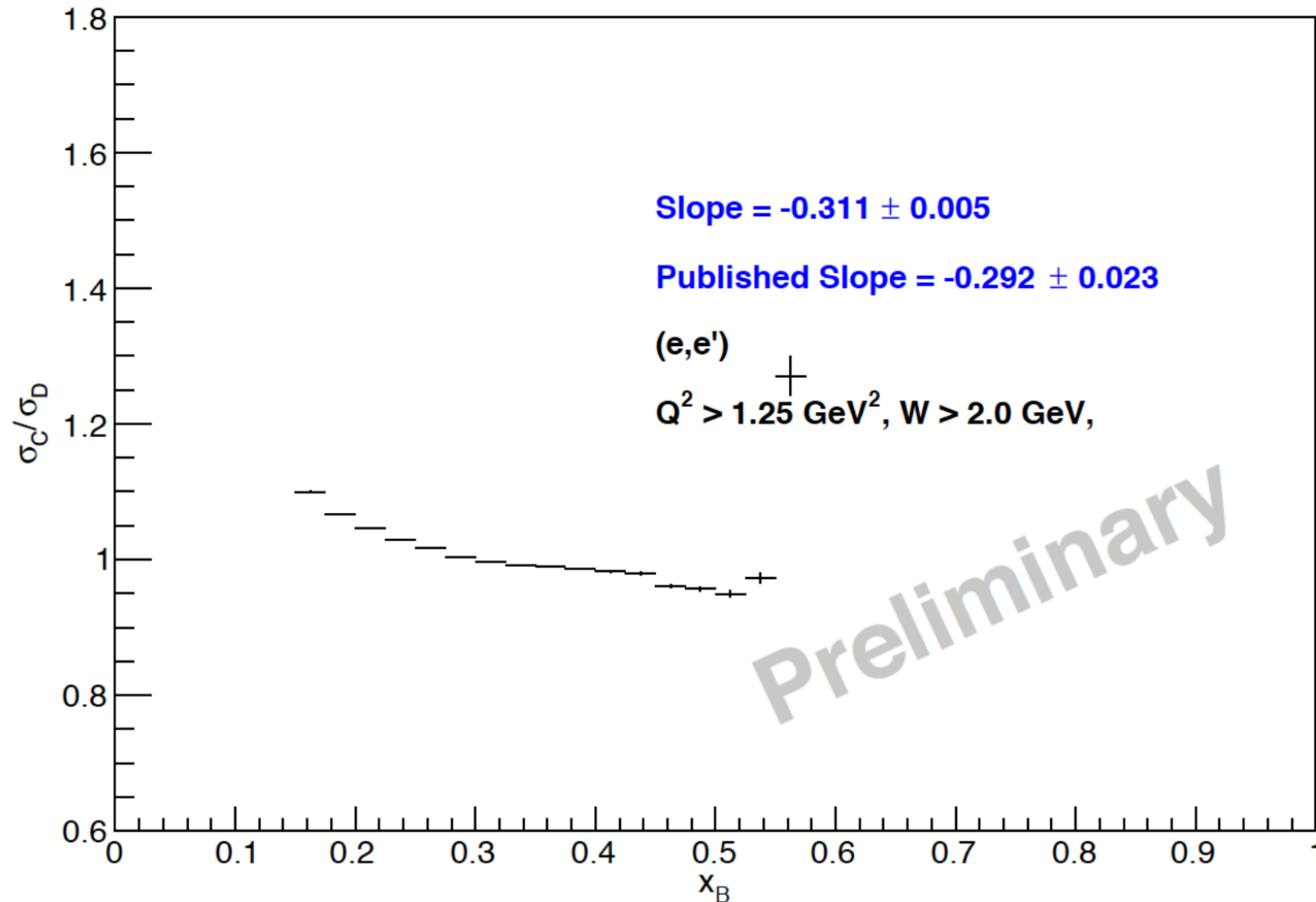
Cartoon if SRC-EMC are indeed connected.



Experiment is simply to see if what happens if we tag recoiling nucleons in EMC kinematics.

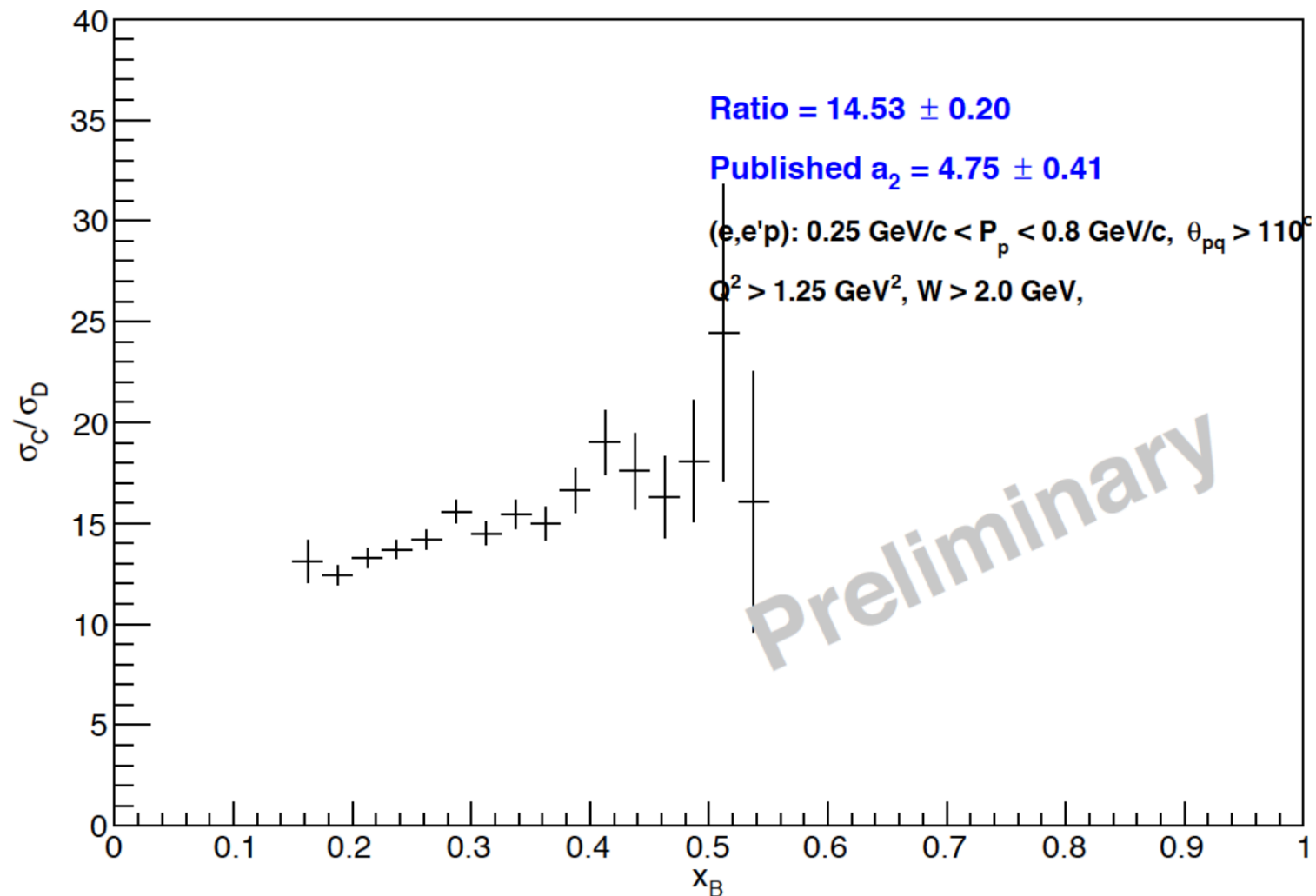
CLAS Data Mining (EMC Effect)

Analysis done by Barak Schmookler (MIT)



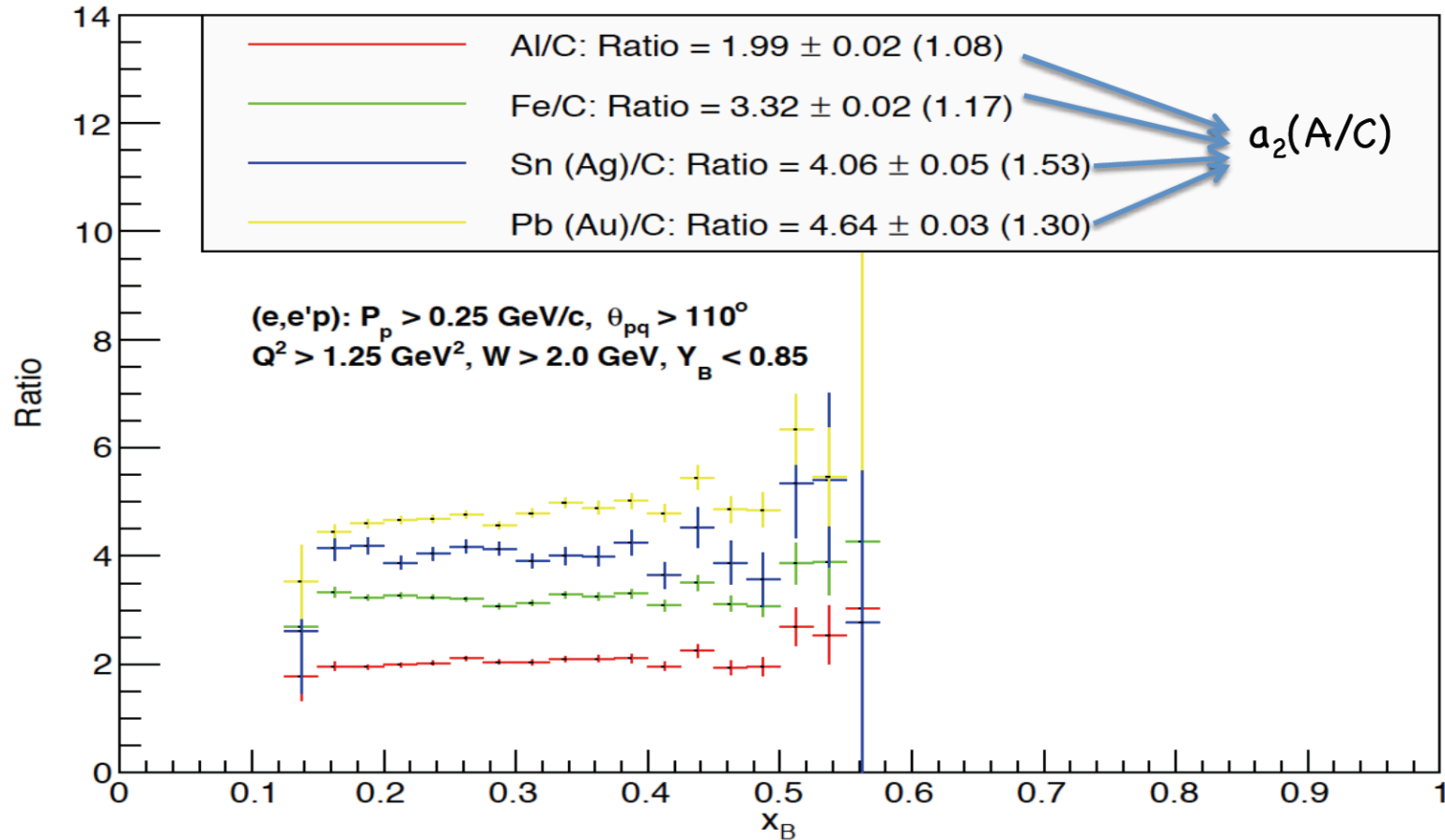
CLAS Data Mining (Tagged EMC)

Analysis done by Barak Schmookler (MIT)



Ratio of Solid Target Data

Since cryotargets (i.e. the deuterium) can have significant energy loss & geometric effects, Barak also made the ratios of the various solid targets.



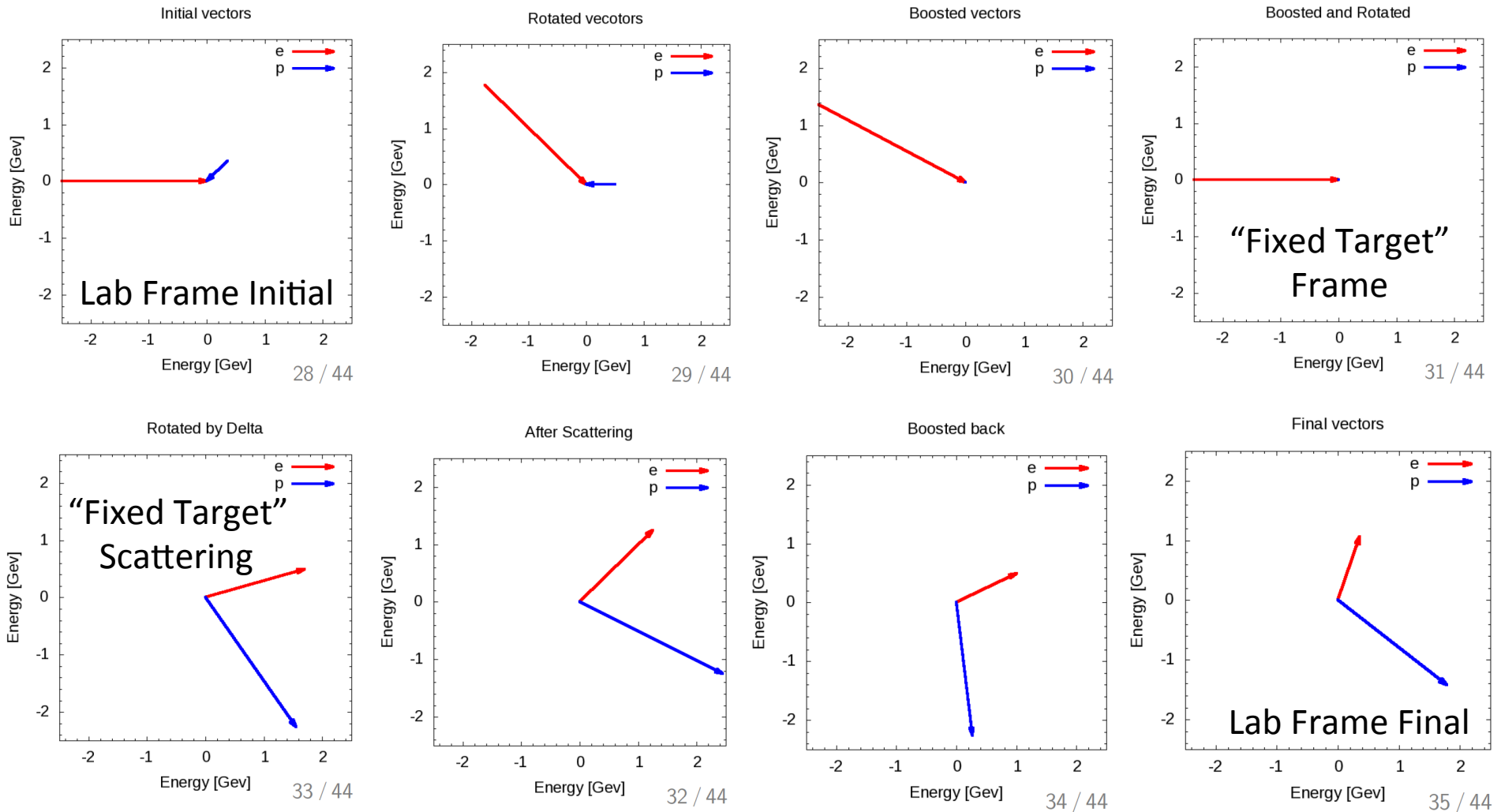
This preliminary signal is much larger than our naïve expectations based on SRC ratios.

Qualitative Understanding of Tagged EMC

- Build a Phenomenological Monte Carlo Model
 - Use Lorentz transformations to go to the rest frame of initial-state nucleon
 - Start with free structure functions & simple initial-state momentum distribution
 - Easy to fold such a toy model over acceptances
- Straight forward to add complexity
- Not a substitute for theory calculations, but hopefully can provide some insight into what model ingredients are the most important.

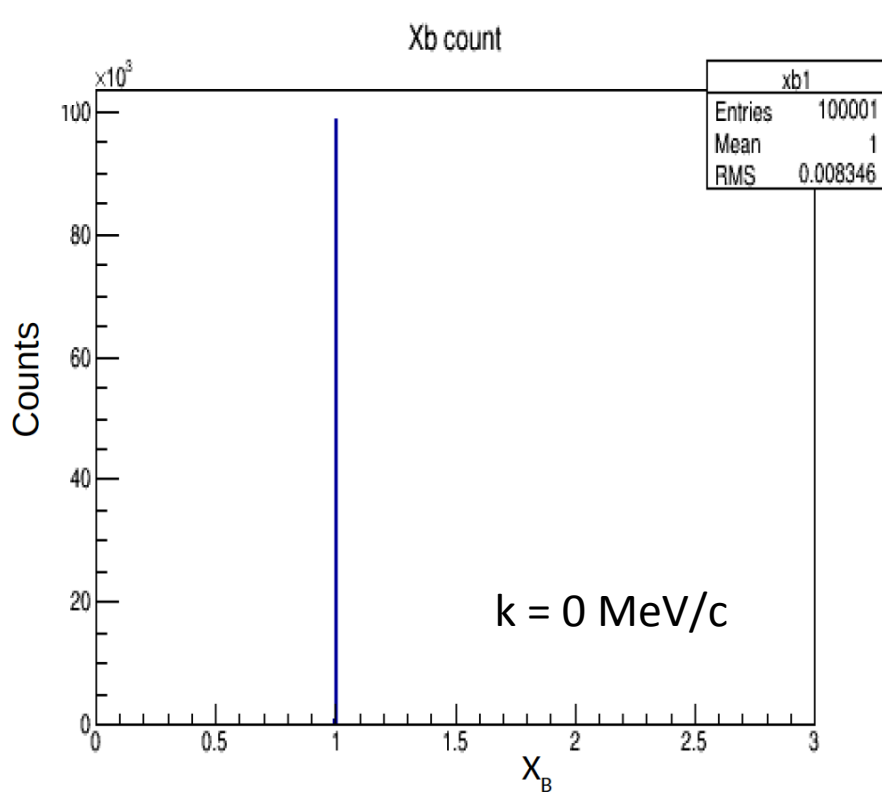
Example of Transformations

Inspired by Kijun Park's EIC $D(e, e' p_{\text{recoil}})$ Monte Carlo, Coding by Jason Bane

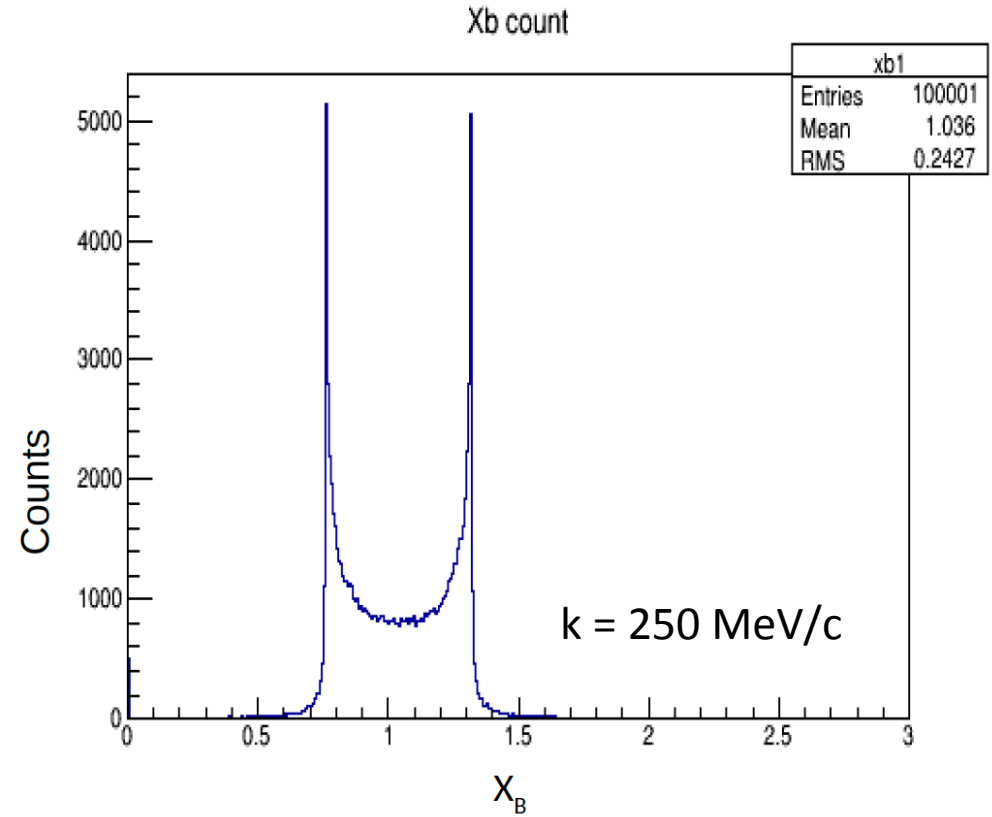


Initial Results

Simple unweight elastic scattering from isotropic, fixed magnitude initial momentums.



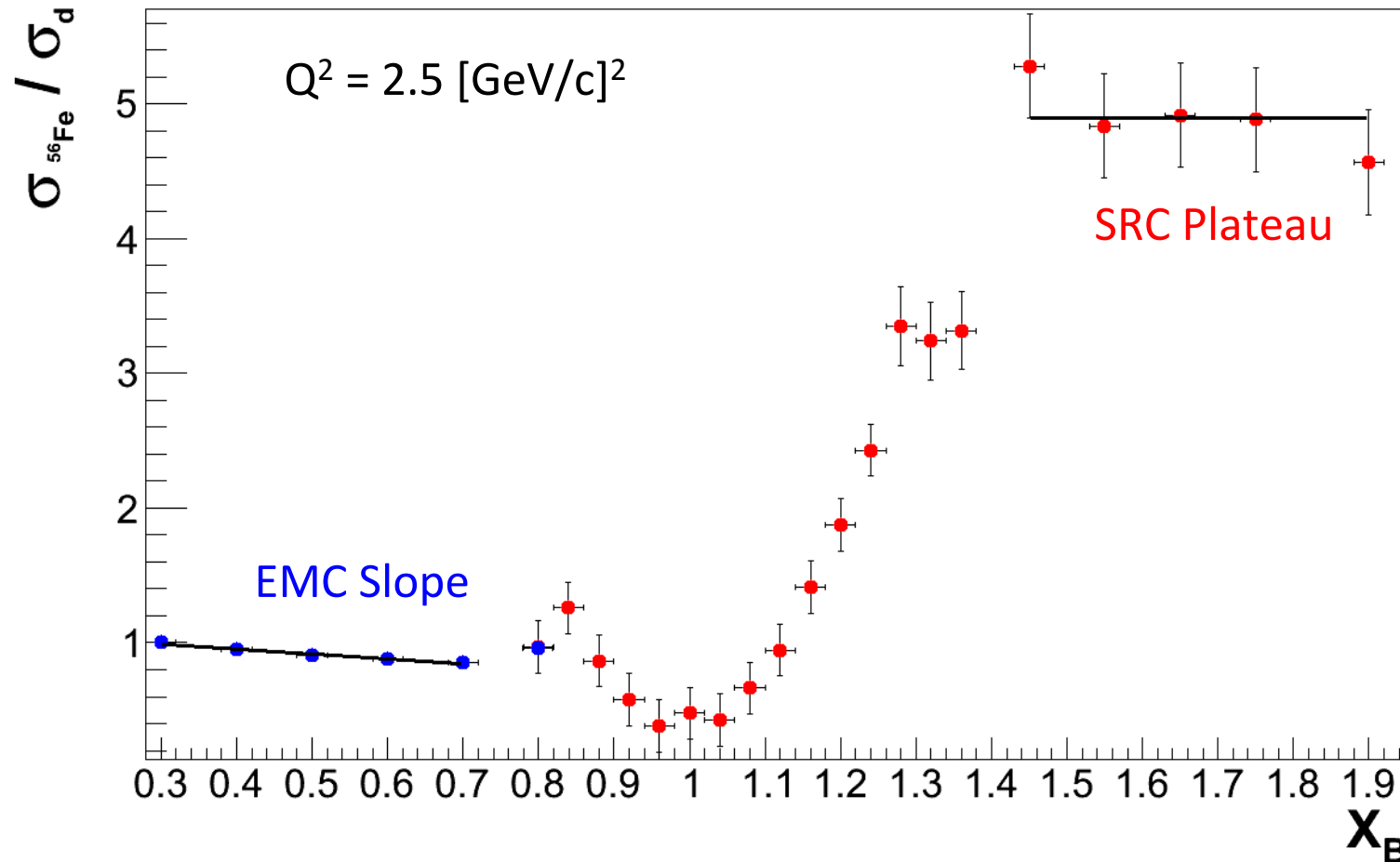
Delta function at $x_B = 1$ as one would expect.



The shifted peaks caused by collider and anti-collider kinematics.

Holistic View of the EMC & SRC Data

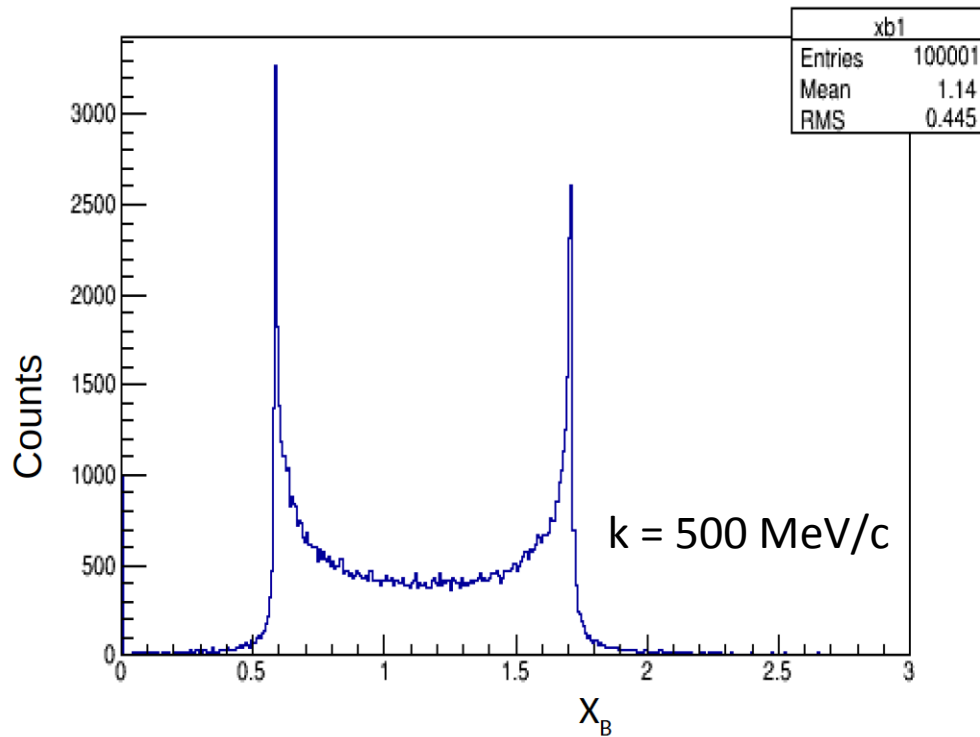
D. Higinbotham *et al.*, arXiv:1003.4497



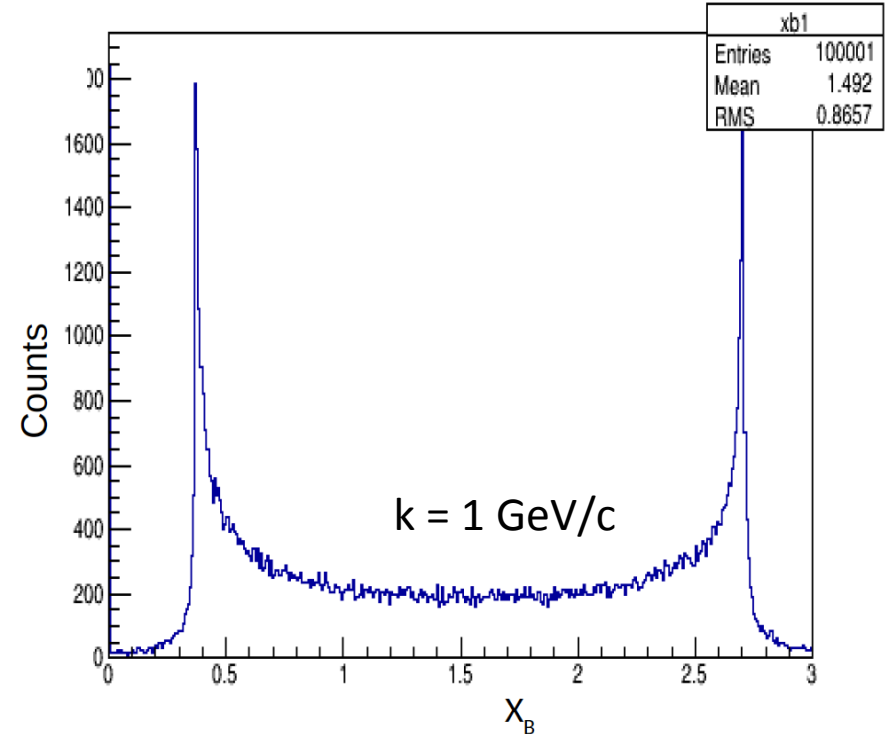
- Scaling plateaus are likely due to proton-nucleon **local density** correlations
- So could the **EMC slopes** ($x_B < 0.7$) and **SRC plateaus** ($x_B > 1.5$) correlated?!

High Initial Momentums

Again still just un-weighted, elastic kinematics of hitting moving nucleons (isotropic).



Initial moment linked to the SRC experiments.
(i.e. typically 300 – 600 MeV/c)



Extreme initial-state momentum.
(i.e. extremely improbable)

Next need to add cross section weighting.

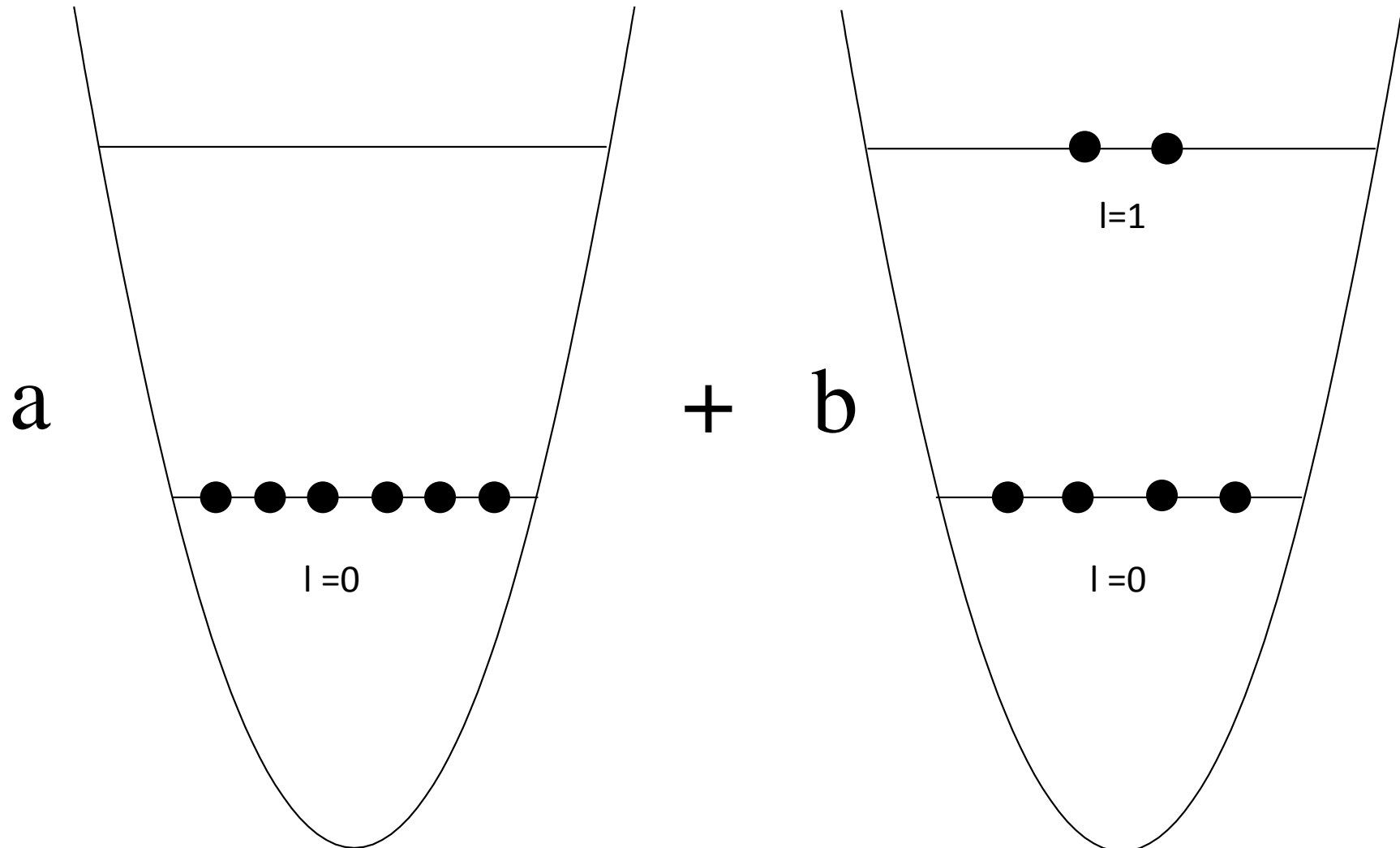
Summary

- An phenomenological connection has been made between the deep inelastic scattering $x_B < 1$ (e,e') ratio and $x_B > 1$ short-range correlation (e,e') ratios.
- Tagged EMC is an experimental way to gain future insight into this connection.
- **Preliminary Tagged EMC Effect Results are showing a huge effect, much larger than one would naively expect from the SRC plateaus!**
- Working with toy models & Monte Carlos as well as theorists to try to understand what is going on.
(i.e. Misak, Ian, *et al.* get to work 😊)
- *New, dedicated tagged EMC experiments coming in Hall B (tagged neutrons) & Hall C (tagged protons)!*

Backup Slides

Quark State of Overlapping Nucleons

Deuteron has a quadrupole moment in all frames of reference



Realistic Momentum Distribution

Benhar et al., Phys. Lett. B 177 (1986) 135.

