Inclusive studies at 6 & 12 GeV: x-, Q^2-, and isotope-dependence

6 GeV proposal:

Verify x-, Q^2-dependence of ratios in 2N, 3N plateau regions

E02-109 results:

$^3He/^2H$ and $^4He/^2H$ ratios for $1.5 < x < 2$

Isospin dependence in 3N region:

$^3He/^3H$ ratios at $x > 2$
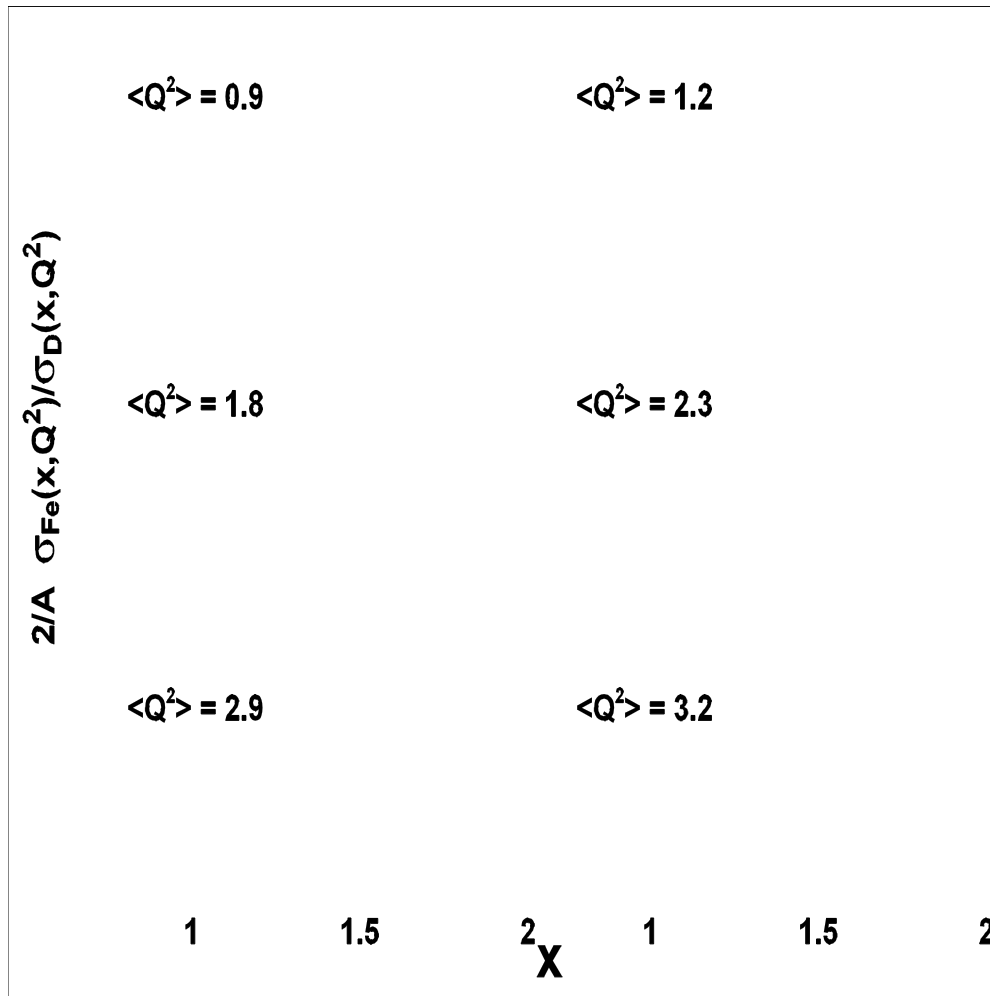
3-body breakup for ^3He, ^3H

Other options? Needs?

John Arrington
Physics Division, Argonne National Lab
SRC2007, Newport News, VA, Oct 26, 2007

SLAC A/D ratios

$\frac{2}{A} \; \sigma_{Fe}(x,Q^2)/\sigma_D(x,Q^2)$

$\langle Q^2 \rangle = 0.9$

$\langle Q^2 \rangle = 1.2$

$\langle Q^2 \rangle = 1.8$

$\langle Q^2 \rangle = 2.3$

$\langle Q^2 \rangle = 2.9$

$\langle Q^2 \rangle = 3.2$

| 1 | 1.5 | 2 | 1 | 1.5 | 2 |

X

- **Global analysis of SLAC measurements on ^{2}H and A>2** *Frankfurt,Strikman,Day,Sargsian, PRC 48,2451 (1993)*

- **σ decomposed into 1N, 2N, 3N,… components, predicts ratio for 1.5<x<2 dominated by 2N-SRC for all nuclei**

- **Ratios for A=3,4,12,27,56,197 give idea of relative number of 2N-SRCs.**

- **Limitations: Interpolate ^{2}H data to kinematics for other targets. Limited x coverage at high Q^2**

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CLAS A/³He ratios

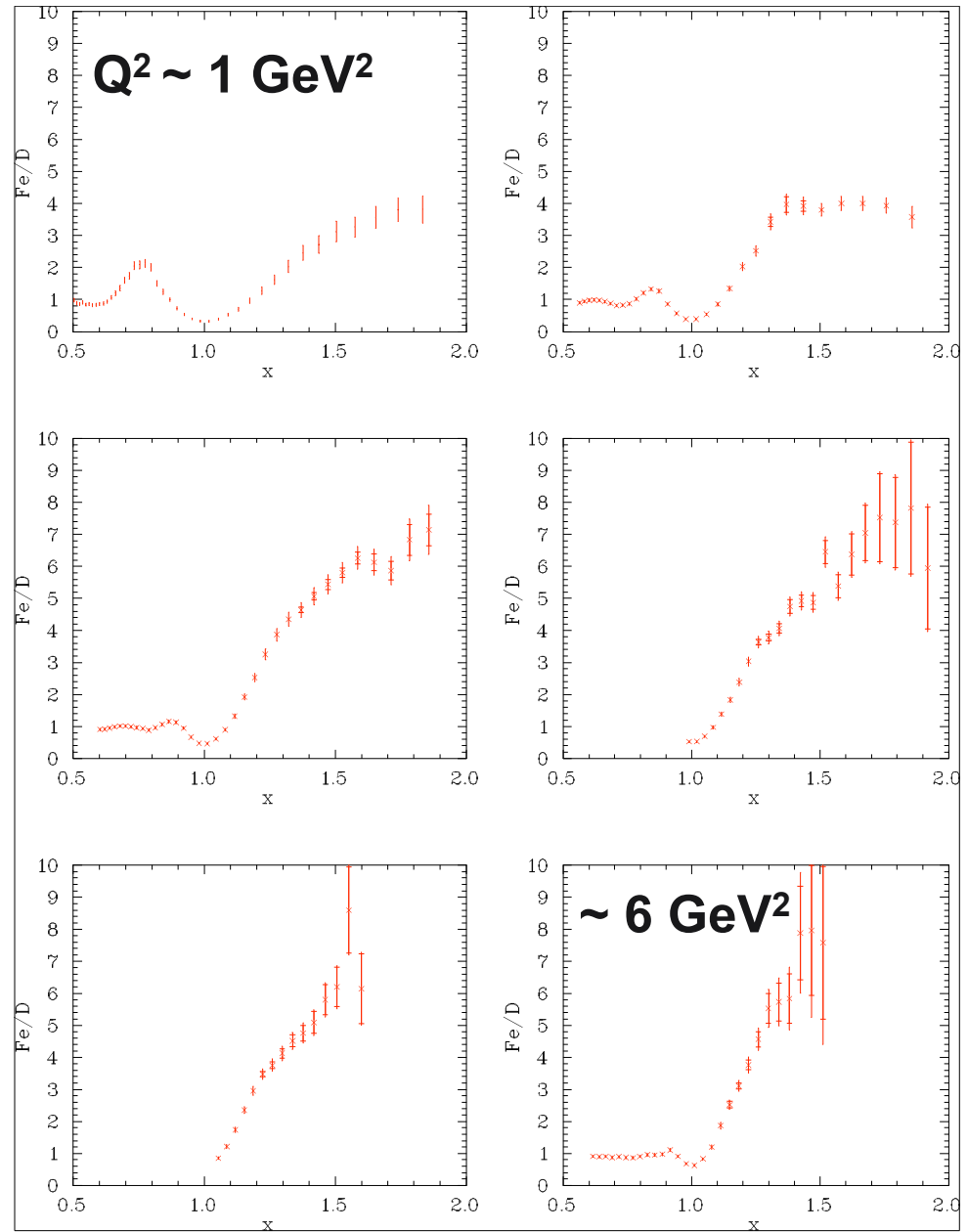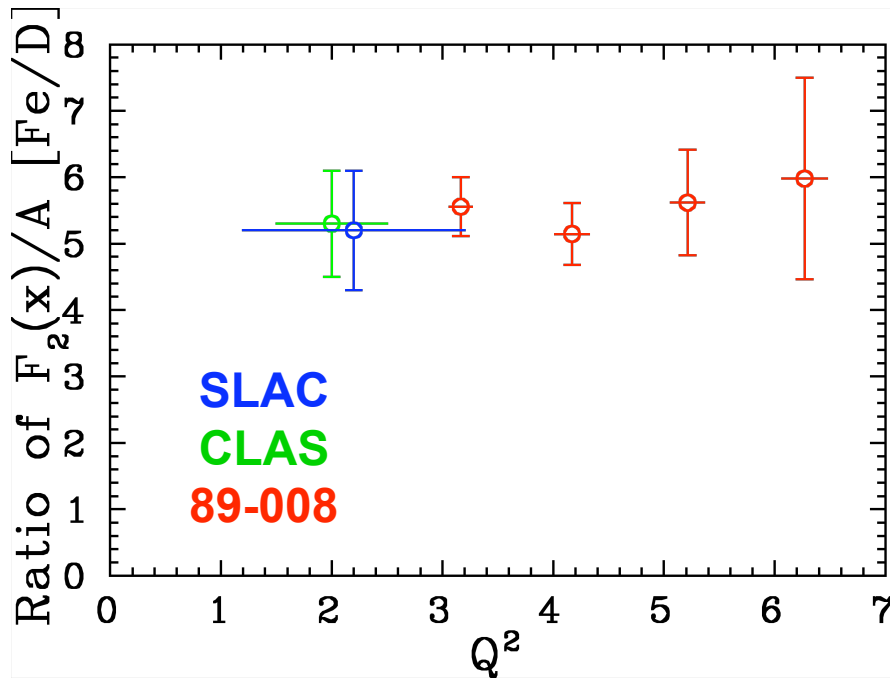*K. Egiyan, et al., PRC 68, 014313 (2003)*

Better systematic uncertainties (data taken at one time)

**Limited Q^2 range. No deuterium → rely on SLAC ³He/²H ratios**
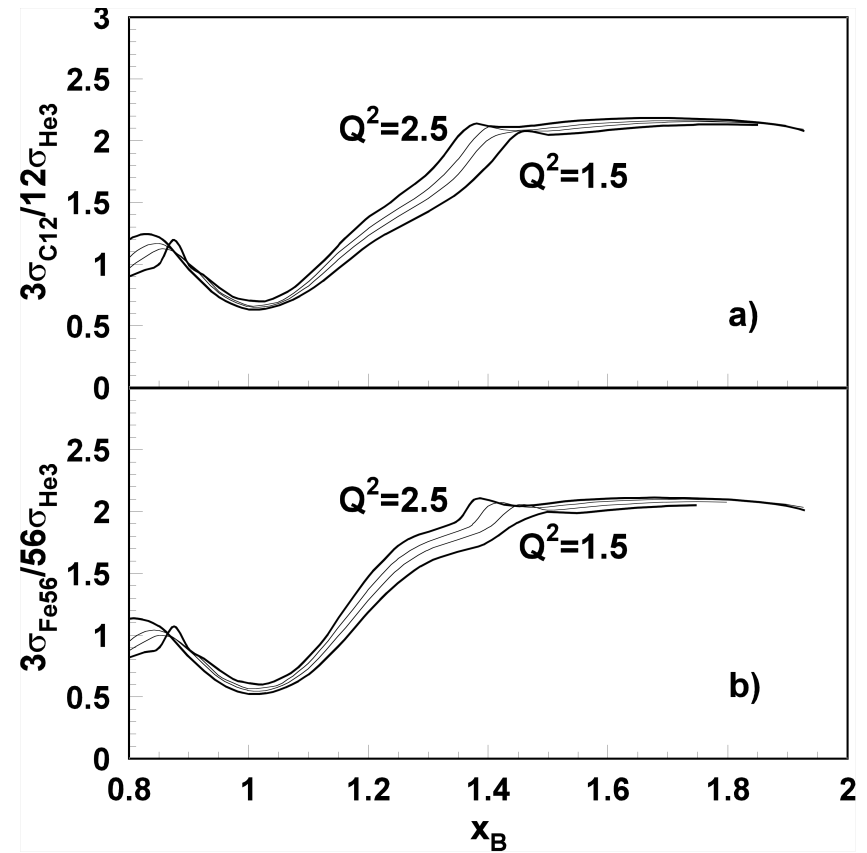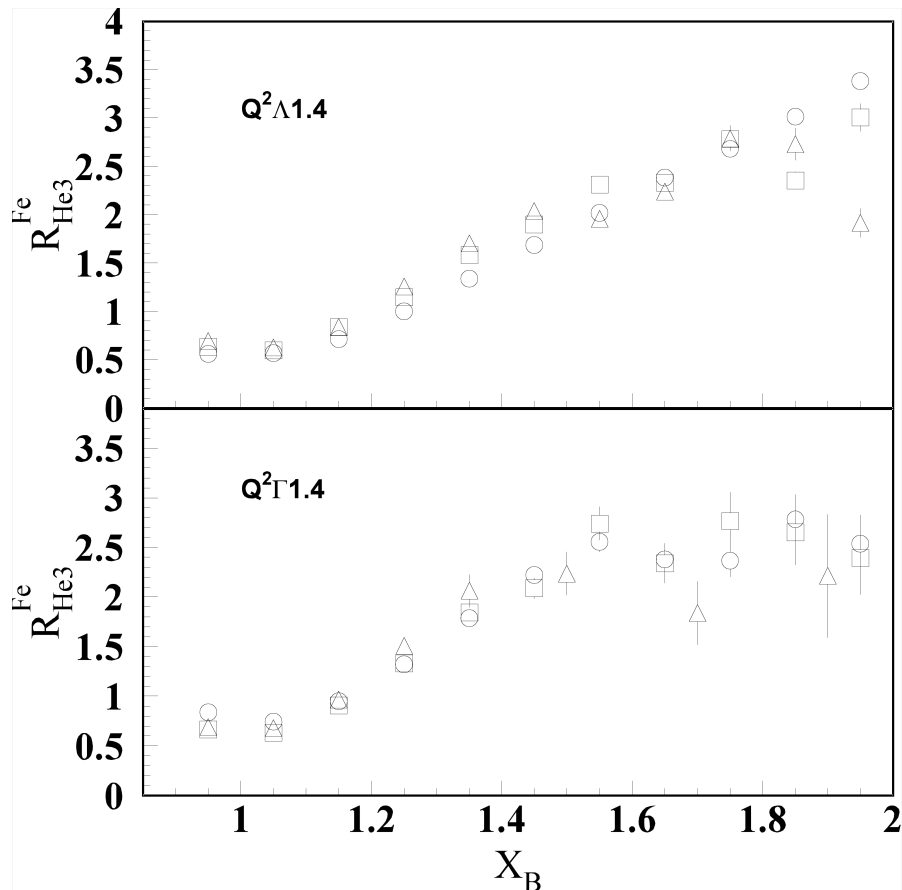
JLab E89-008

- **Inclusive scattering at 4GeV**
  - **Ratios go to higher Q^2**
  - **All data taken at one time**
  - **No ^{3}He, ^{4}He**
  - **Limited x coverage at high Q^2**
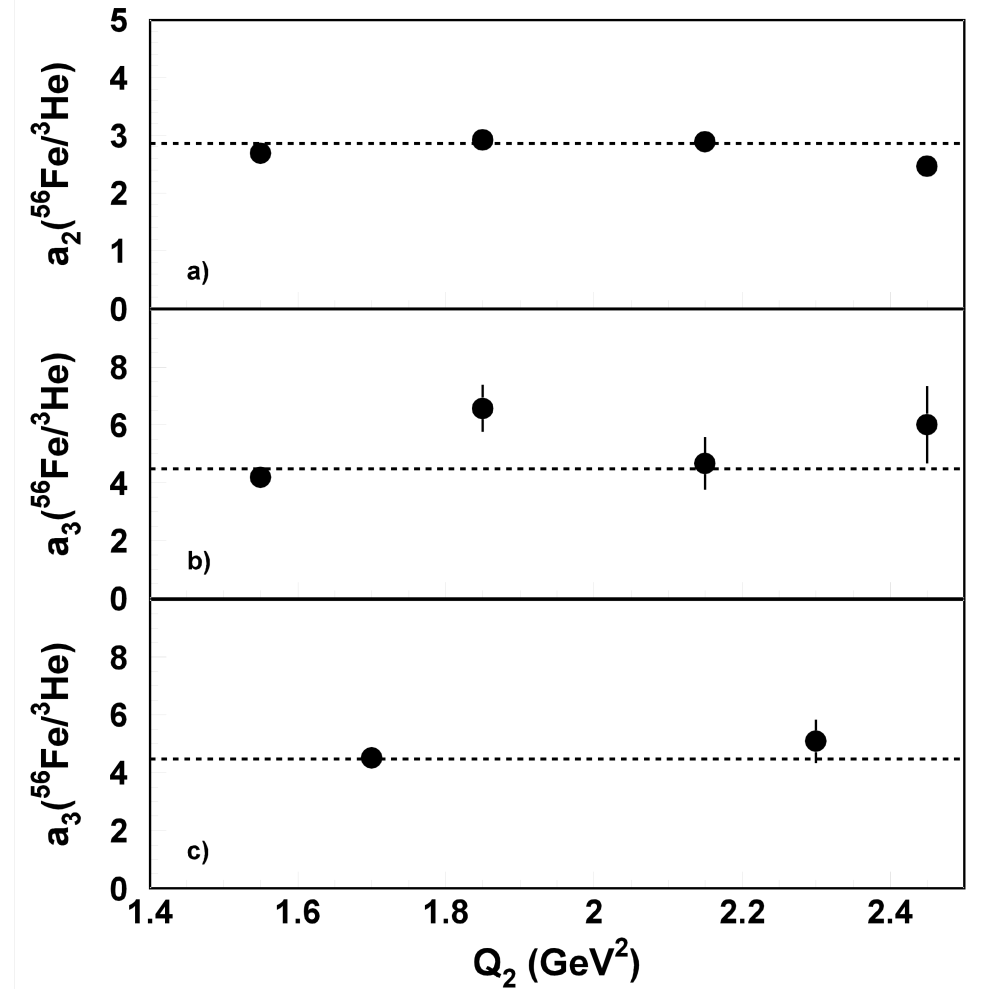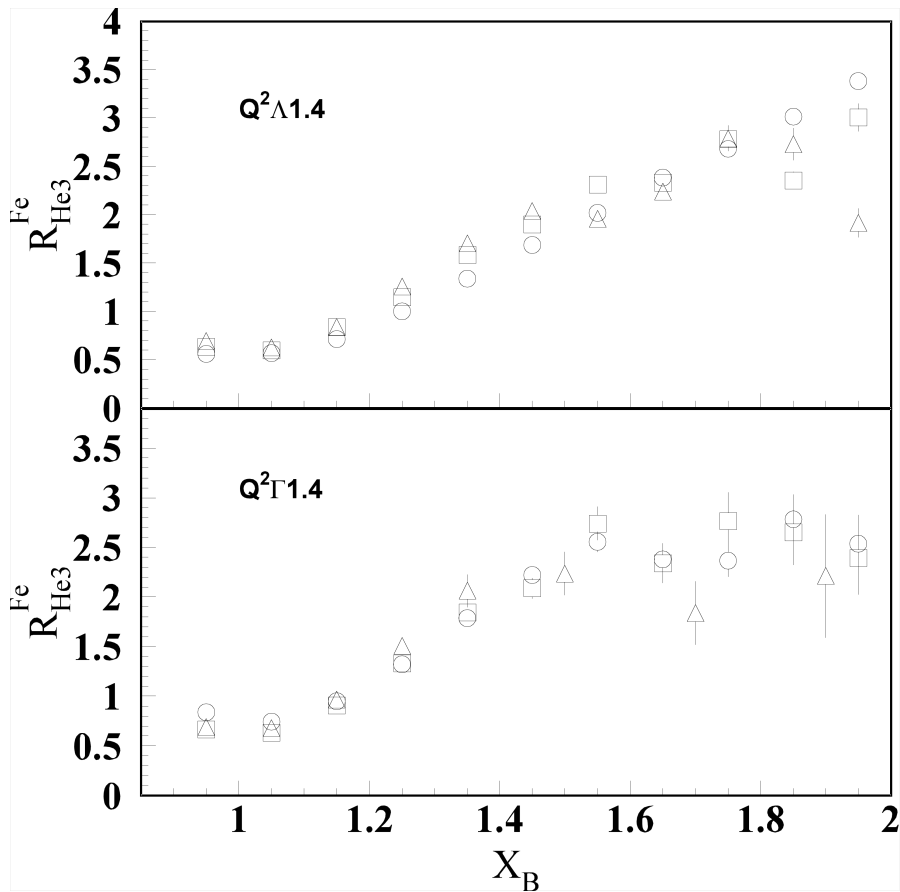
CLAS results, A/³He, up to x=3

K. Egyian, et al., PRL 96, 082501 (2005)

- **Improved ratios in 2N-SRC region**

- **Extend ratios to 3N-SRC region**
  (first direct measurement for $x > 2$)

- **No deuterium data**

- **Limited statistics to study x, Q^2 dependence for $x > 2$**
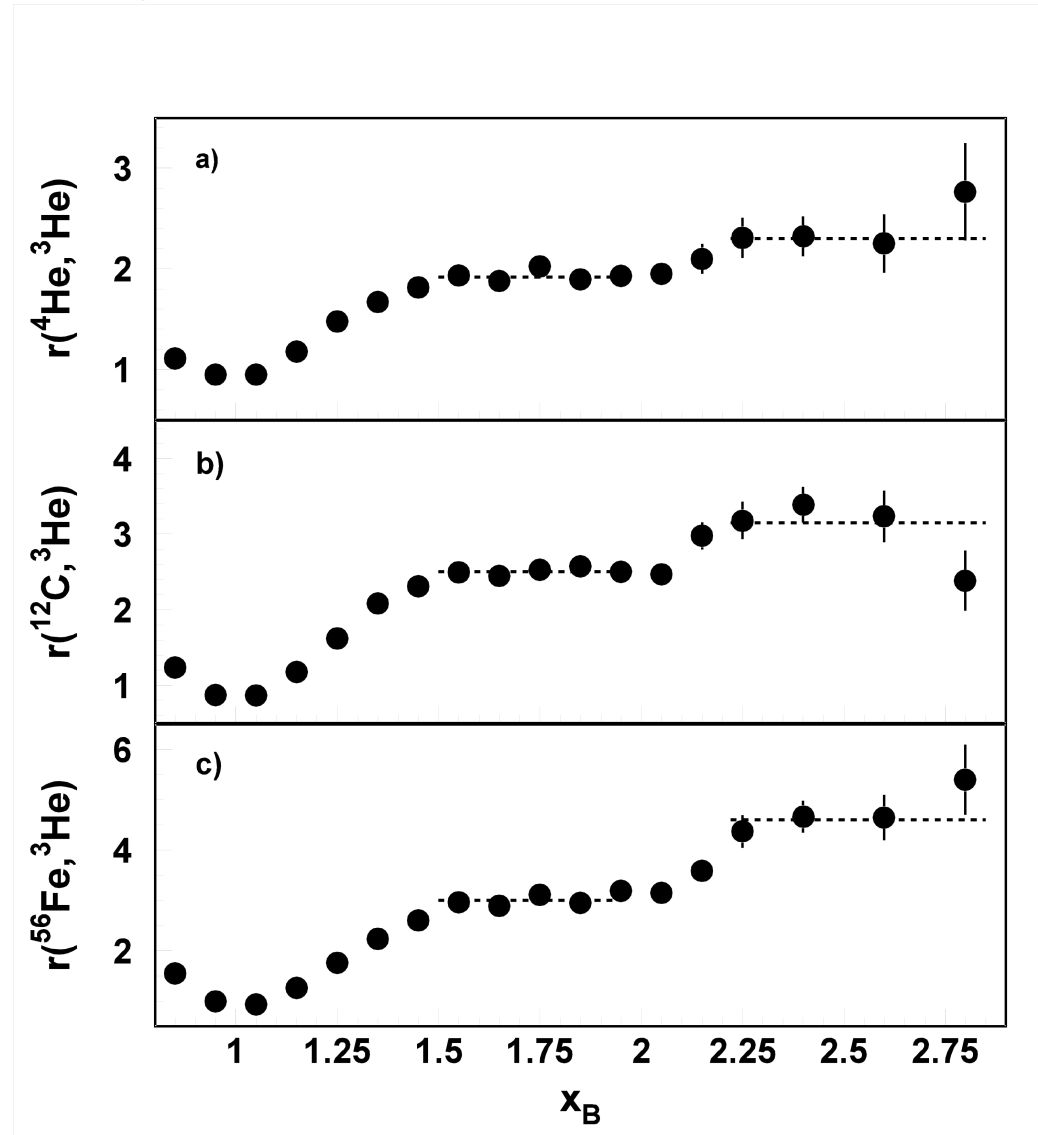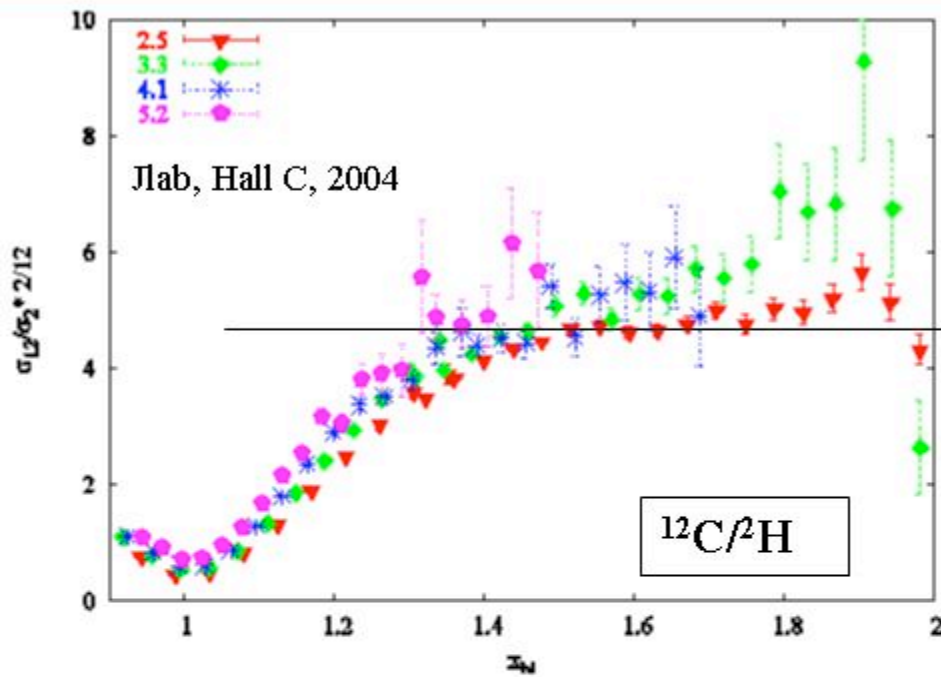
Q² dependence of the plateau

- **For x<2, have data over range in Q²**
- **For x>3, very limited Q² range - some hint that Q² not high enough**
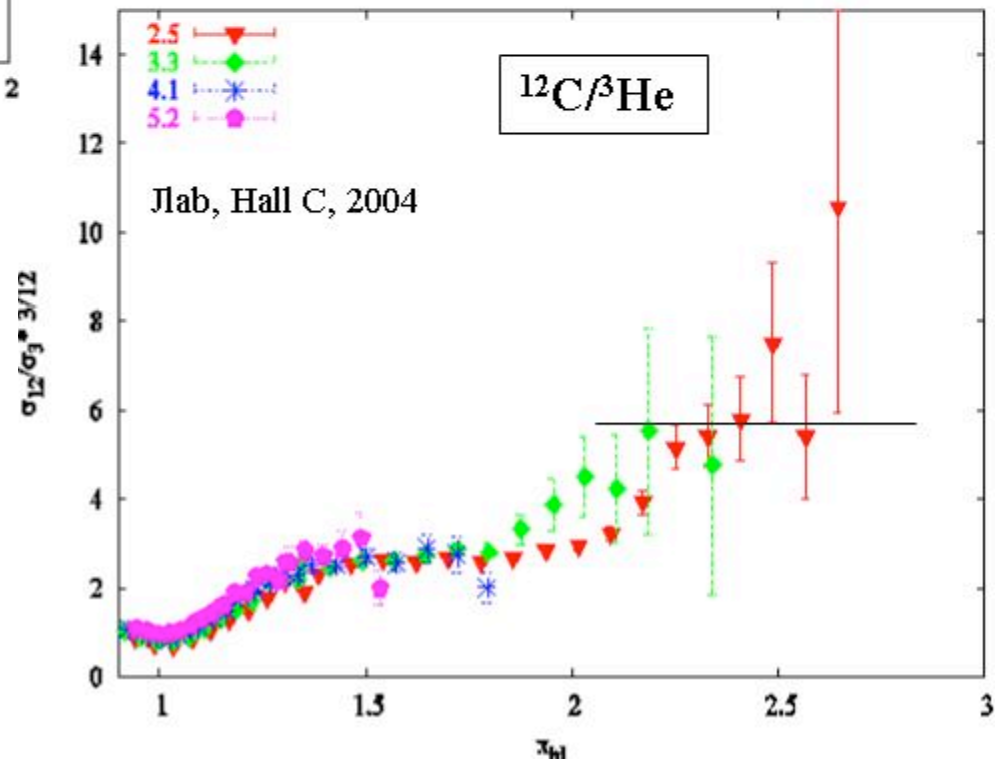
E02-019 preliminary ratios

$$\frac{2}{A}\frac{\sigma_A}{\sigma_D} = a_2(A)$$

$$\frac{3}{A}\frac{\sigma_A}{\sigma_{3_{He}}} = a_3(A)$$

Absolute cross sections and ratios for A=2,3,4,9,12,…

**Higher Q^2 for x>1.5 and x>2.3**

Limited statistics for x>2.3 (mainly limited by ^{3}He)

Isospin dependence?

- **Some details discussed in Mark's seminar, other talks during workshop**

- **What can we learn from inclusive scattering?**

- **Sample case: 2N SRCs in ^{3}He**
  - **No correlations: Expect p/n = 2 at for all x (all nucleon momenta)**

  - **SRCs isospin independent: Each nucleon can be part of a 2N SRC with the other 2 nucleons $\rightarrow$ p/n = 2 in the correlation tail.**

  - **SRCs entirely dominated by n-p pairs: Every high-momentum proton has associated high-momentum neutron $\rightarrow$ p/n=1 in tail**

  - **Measure of p/n in tail $\rightarrow$ sensitive to pp vs. pn contributions measure in 3H $\rightarrow$ sensitive to pn vs. nn contributions**

3He momentum distribution (Wiringa, et al.)
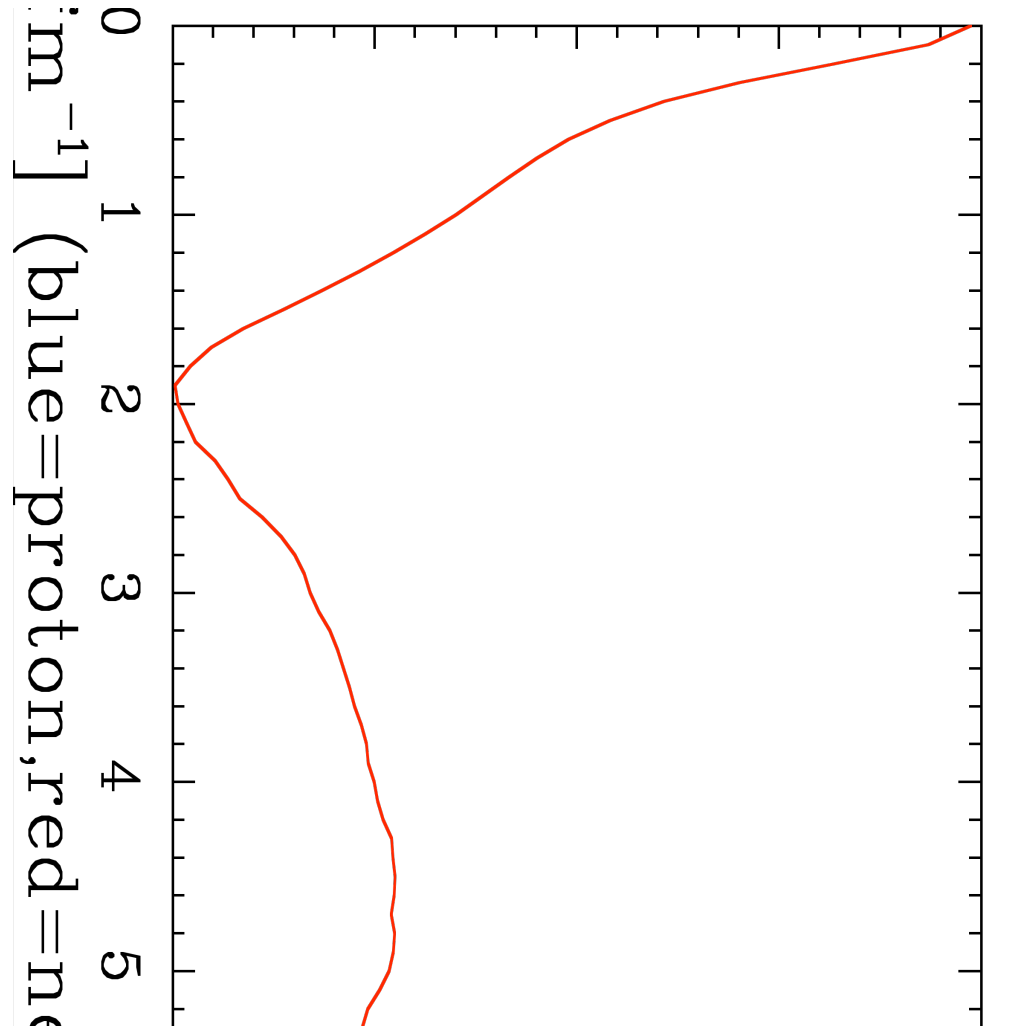
Current limitations

- **2N SRCs**
    - **Want single measurement with ratios to deuterium** [E02-019]
    - **Want range in N/Z** [E02-019: 3He and 4He, need more?]
    - **Want detailed measure of Q^2, x dependence in plateau region** (examine onset to scaling, verify x, Q^2 independence, etc…)

- **3N SRCs**
    - **Want to verify Q^2 sufficient for scaling** [Plan for PAC33]
    - **Want better statistics, x-coverage** [12 GeV expt. in Hall C]
    - **Want range of nuclei** [Good start with CLAS, more with 12 GeV]
    - **Want information on isospin dependence**
        - *All ratios taken relative to ^{3}He. ^{3}H would be best case.*
        - *Is ^{40}Ca vs. ^{48}Ca useful for studying neutron excess in denser system? Does it add to ^{3}H/^{3}He? Can it be interpreted well enough?*

PAC33: Q² dependence, high statistics, x>2.2

E = 3.6 GeV

Plateau from Hall B results
□ 19°
○ 21°
△ 23°
✳ 25°
▽ 27°

1.5-2.5 GeV²