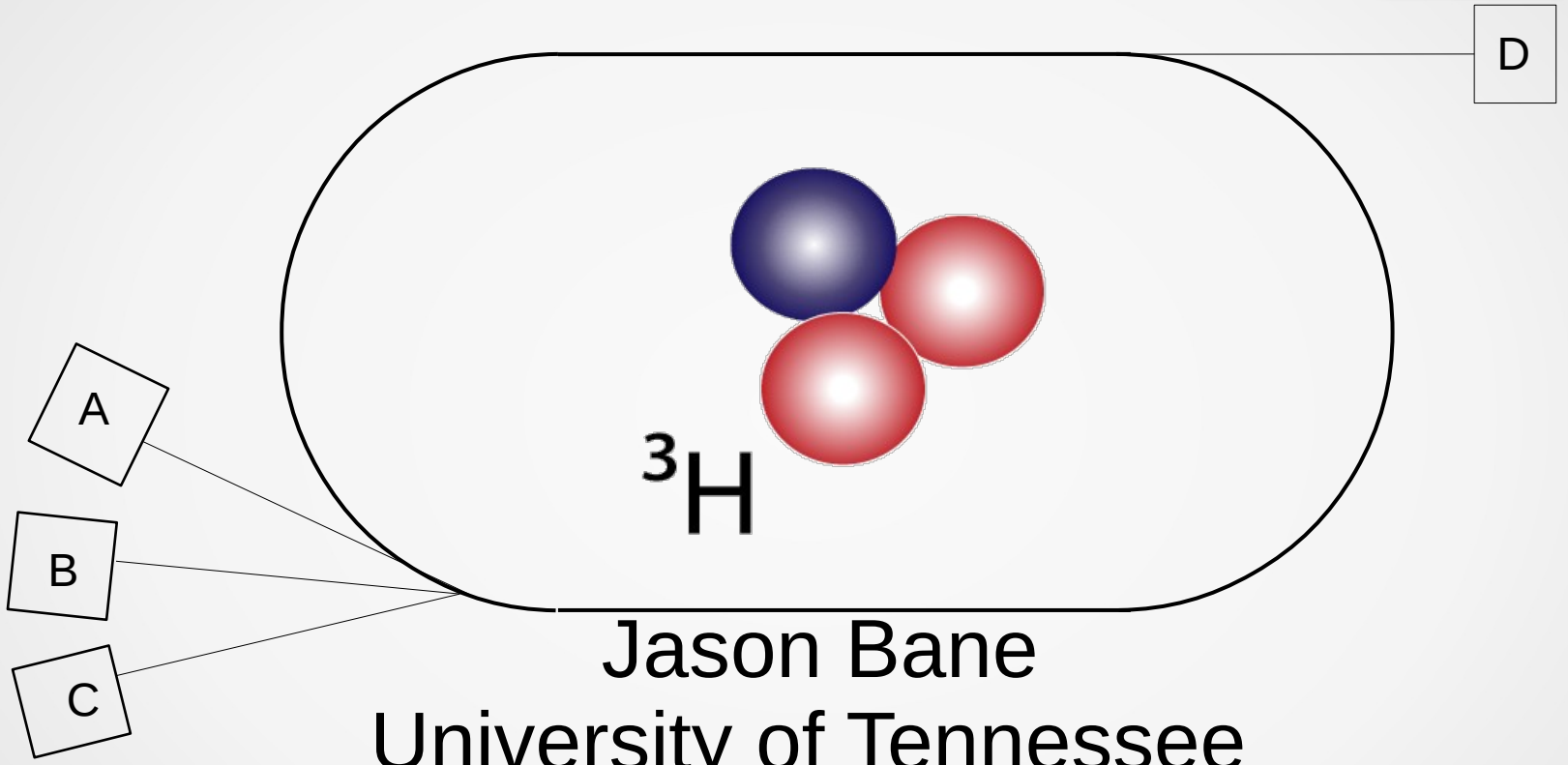
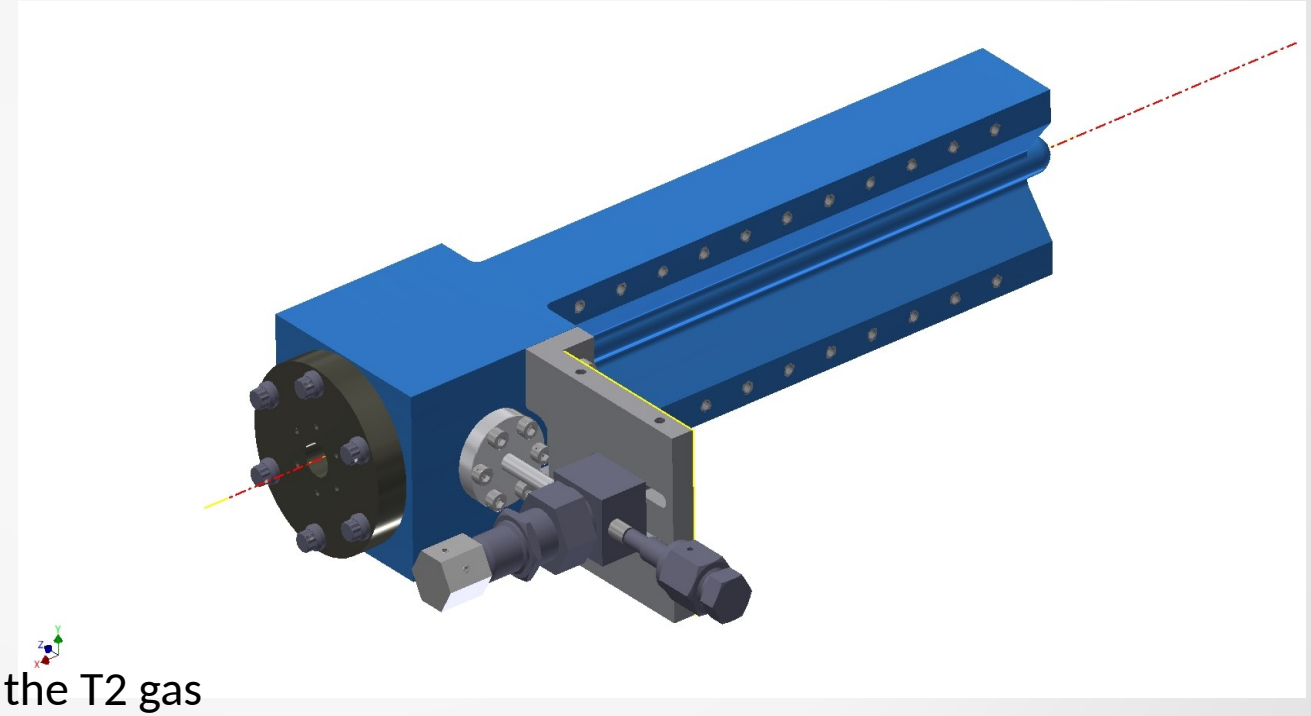
Tritium Experiments at Jlab.



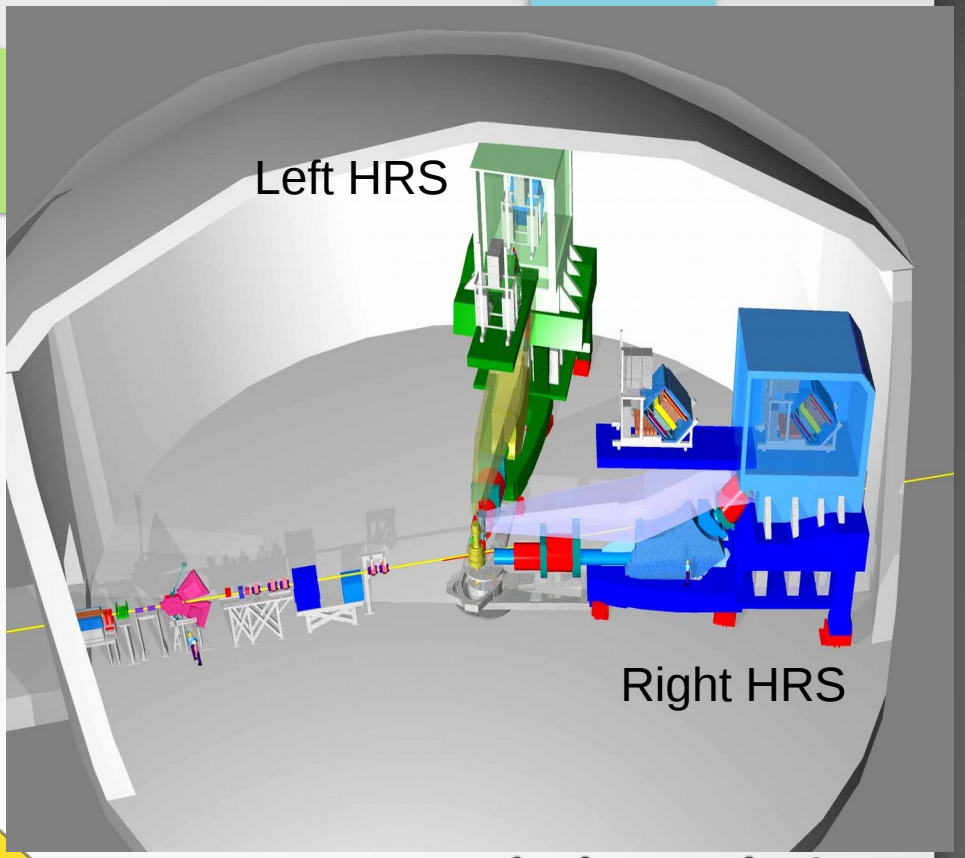
Jason Bane
University of Tennessee

Tritium Target

- Tritium Target specs
  - 1090 Ci of T2 (0.1 g)
  - ~200 psi at 295K
  - 25 cm long
  - ID of 12.7mm
  - Volume = 34 cc
  - Aluminum CF seals
  - Cell is “sealed”
  - No recirculation
  - JLAB does not “handle” the T2 gas

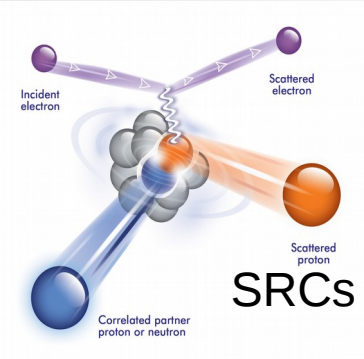


Hall A HRSs


Left HRS
Right HRS

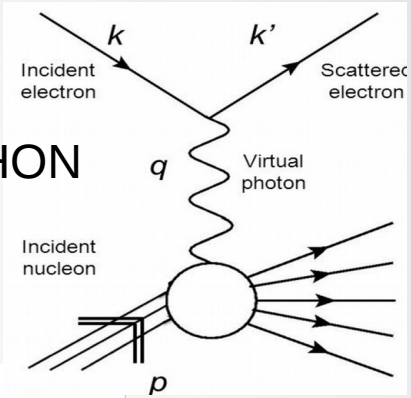
Scintillator
Lead-Glass Calorimeter
Gas Cherenkov
Straw Chamber
VDC

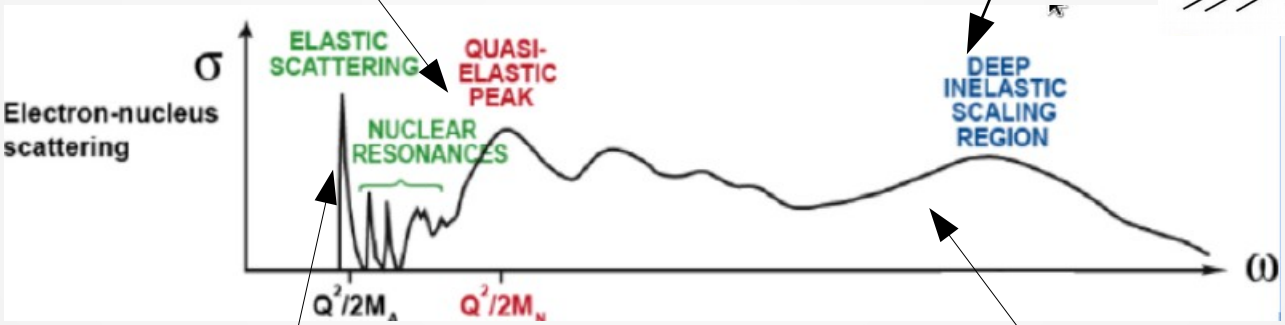
The Experiments!

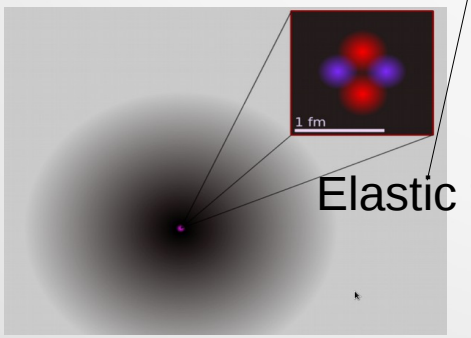


SRCs

MARATHON

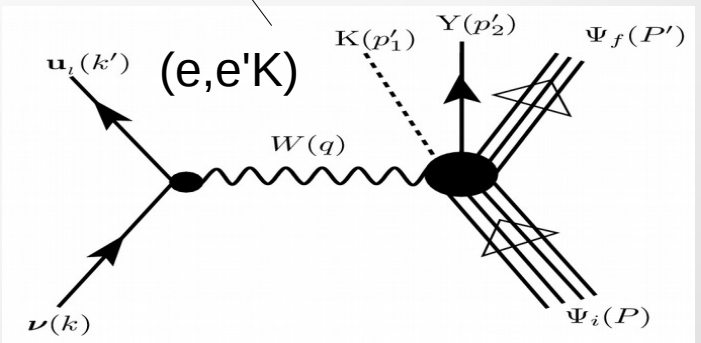






Elastic form Factors

(e,e'K)



Elastic form Factors (E12-14-009)

Currently

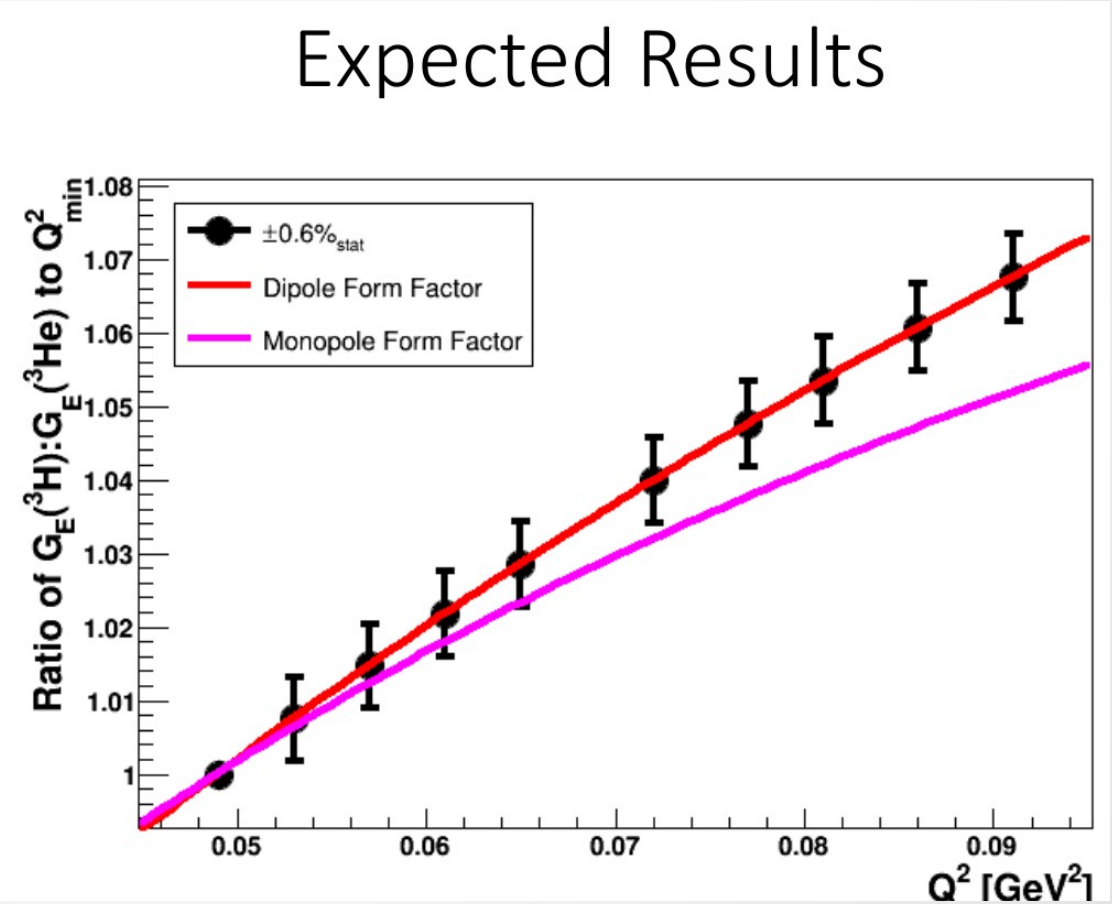
$\langle r^2_{rms}\rangle_{3He} - \langle r^2_{rms}\rangle_{3H} = (0.20 \pm 0.10)\text{fm}$

Make a 2% measurement of the form factor ratio:

$\langle r^2_{rms}\rangle_{3He} - \langle r^2_{rms}\rangle_{3H} = (0.20 \pm 0.03)\text{fm}$

Only 1.5 days of beam time requested for experiment.

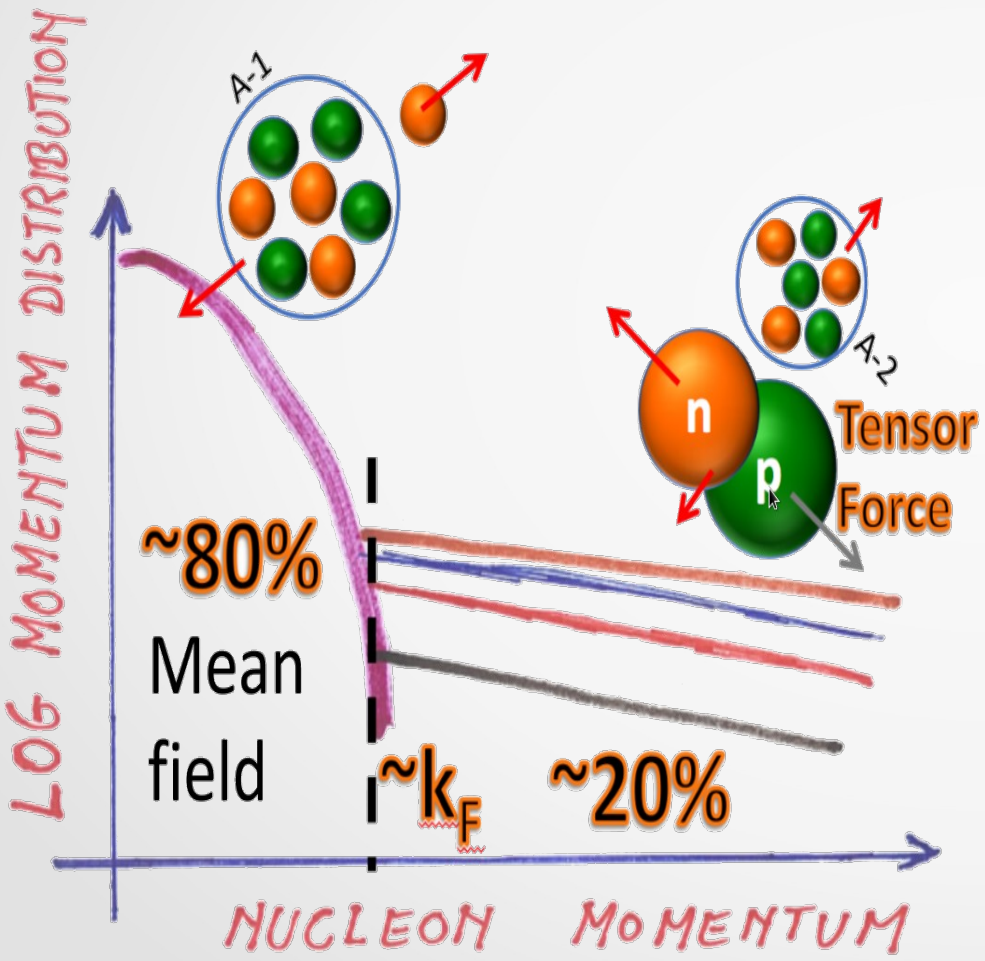
This experiment has been moved to the bench, due to the special Beam requirements .



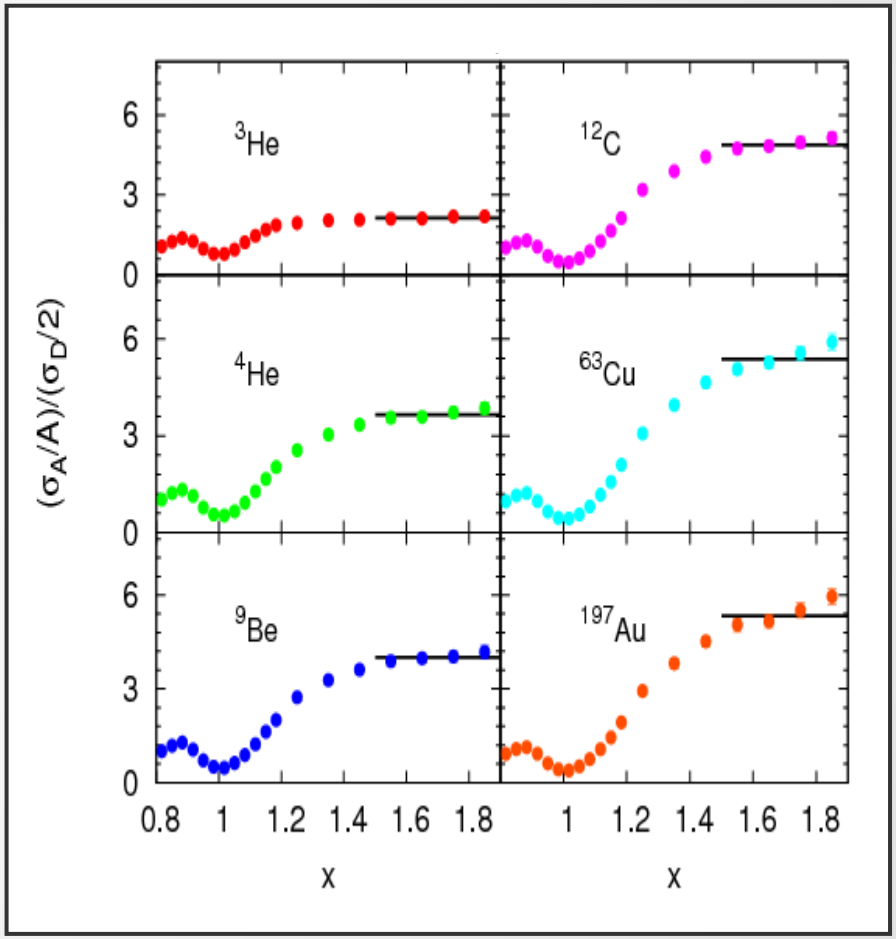
Hauenstein, 2017

Short Range Correlations!

Momentum Distribution



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



Isospin v. SRC (E12-11-112)

Isospin Independent

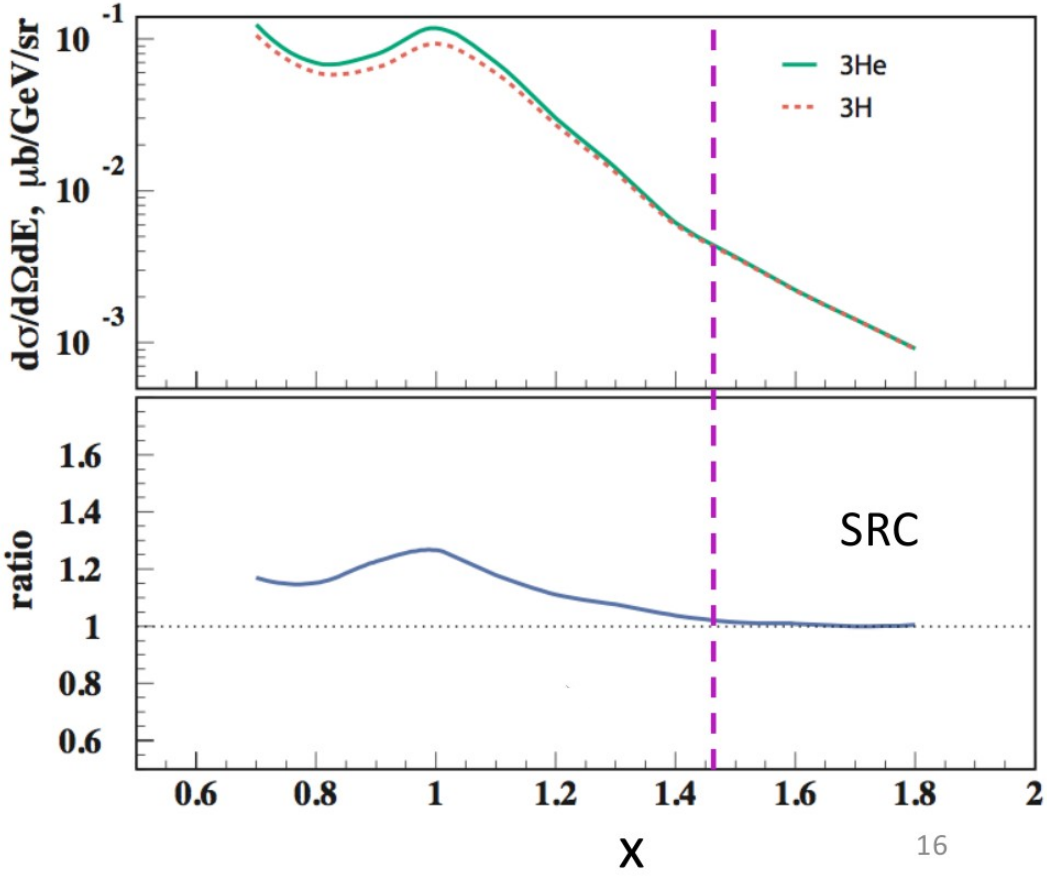
$$\frac{\sigma_{3He}/3}{\sigma_{3H}/3} = \frac{(2\sigma_p + 1\sigma_n)/3}{(1\sigma_p + 2\sigma_n)/3} \xrightarrow{\sigma_p \approx 3\sigma_n} 1.4$$

Full n-p dominance

$$\frac{\sigma_{3He}/3}{\sigma_{3H}/3} = \frac{(2pn + 1nn)/3}{(2pn + 1pp)/3} = 1.0$$

- Isospin dependence of 2N SRCs
- Better precision: extract ratio R(T=1/T=0)
- Much smaller FSI (inclusive)

Inclusive cross section calculations from M. Sargsian using AV18/UIX



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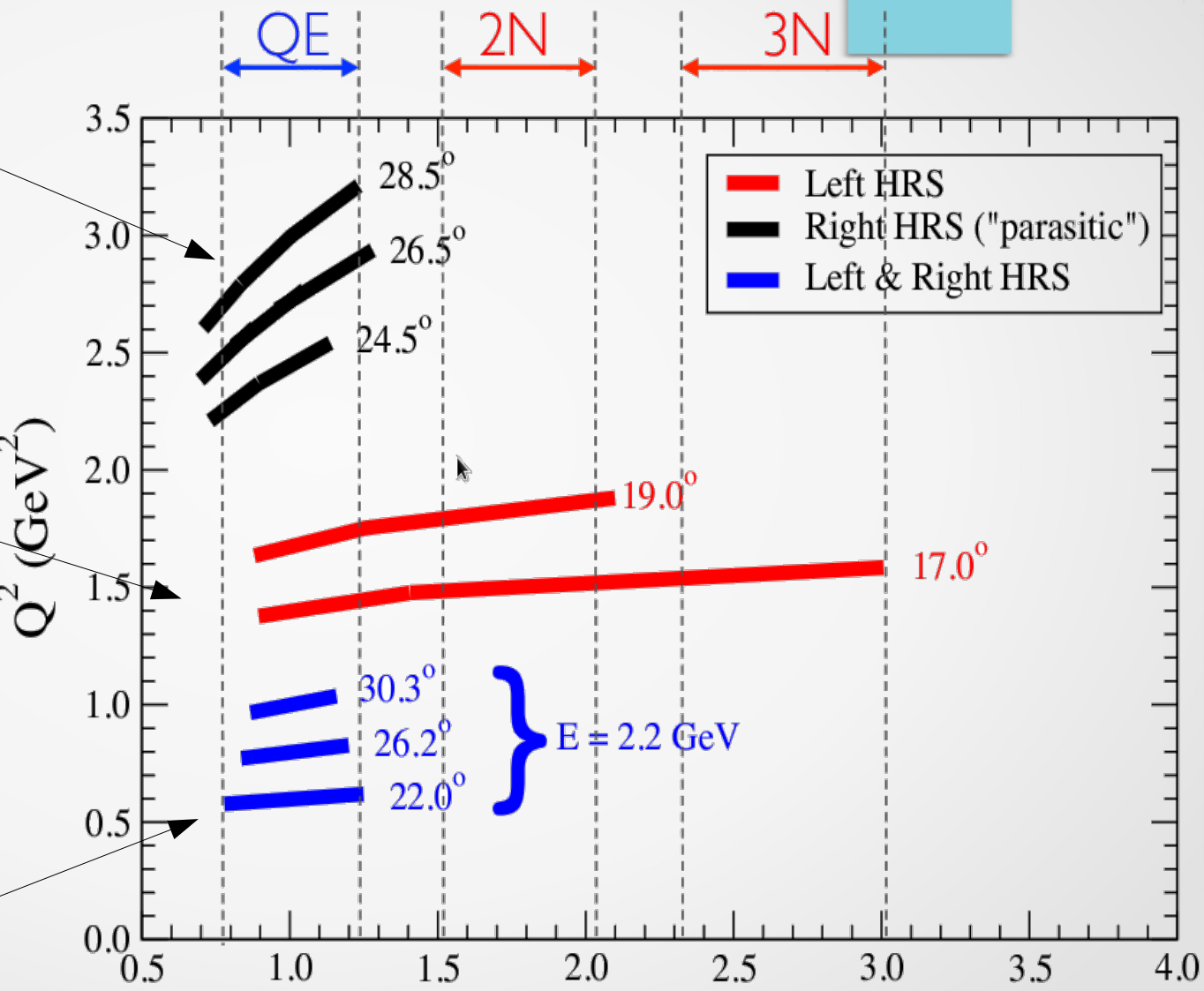
Isospin v. SRC (E12-11-112)

Right arm parasitic

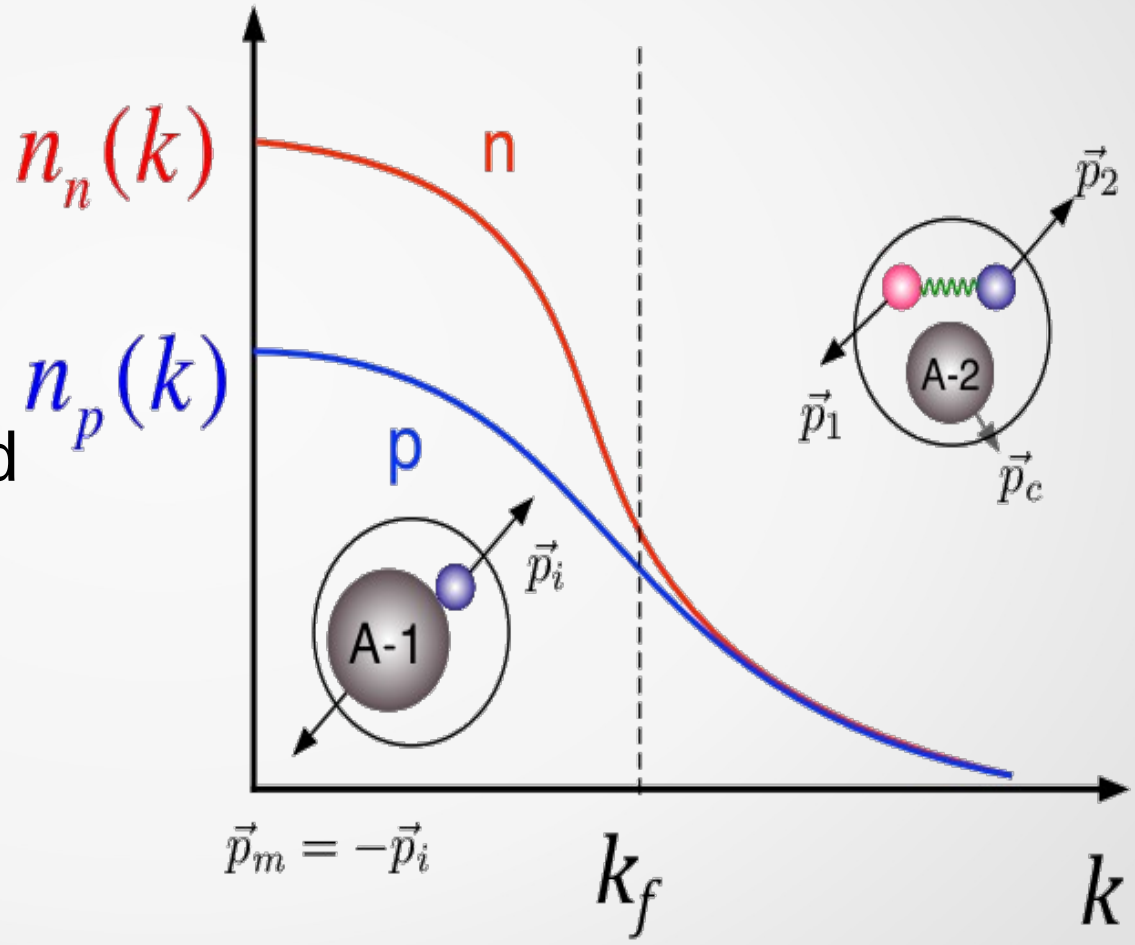
Main production-> 17.5 days at 4.4 GeV

Checkout and QE comparison 1.5 days at 2.2 GeV



Momentum Distributions (E12-14-011)

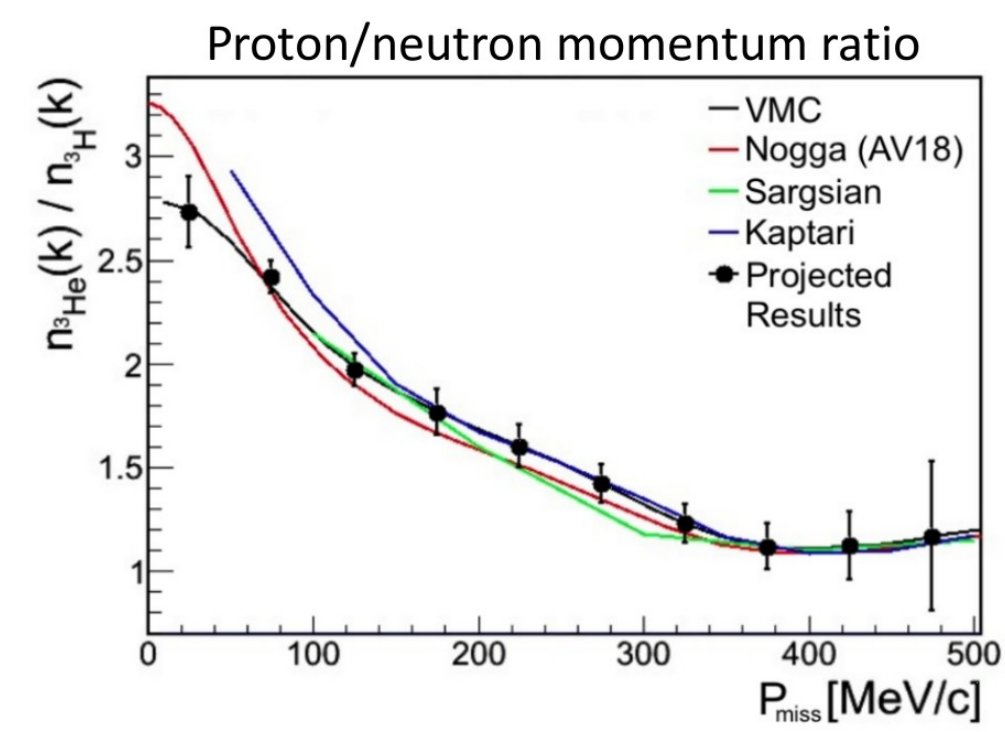
- Complete the first QE reaction ^{3}H and ^{3}He
- Using mirror nuclei, extract momentum distribution ratios
- Comparison of reduced cross section measurements to help with approximating FSI
- Using (e,e'p) Reaction



Momentum Distributions (E12-14-011)

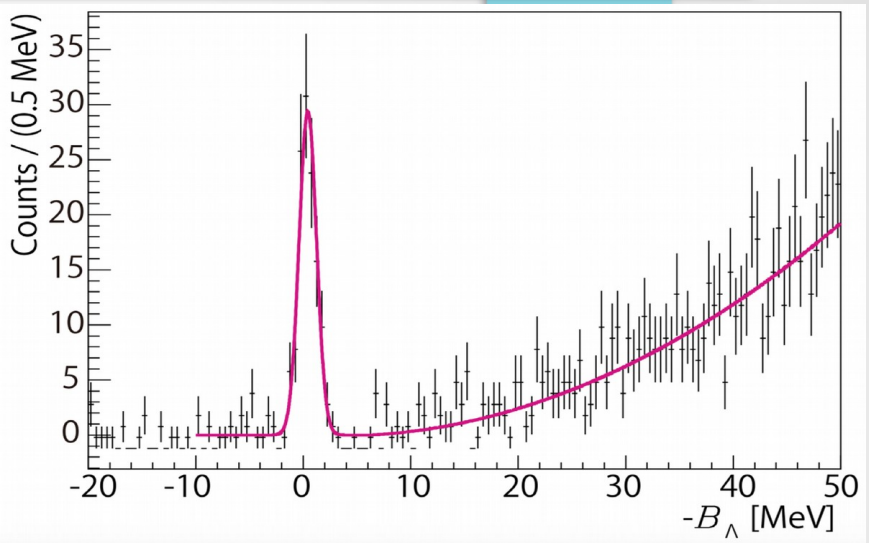
$\langle p_m \rangle$(MeV/c)	x	E_e(GeV)	θ_e	p_p	θ_p	Time* ^{3}H+^{3}He(d)
100	1.15	3.47	20.9°	1.61	48.7°	1
300	1.41	3.64	20.4°	1.35	58.6°	10

Expected results:

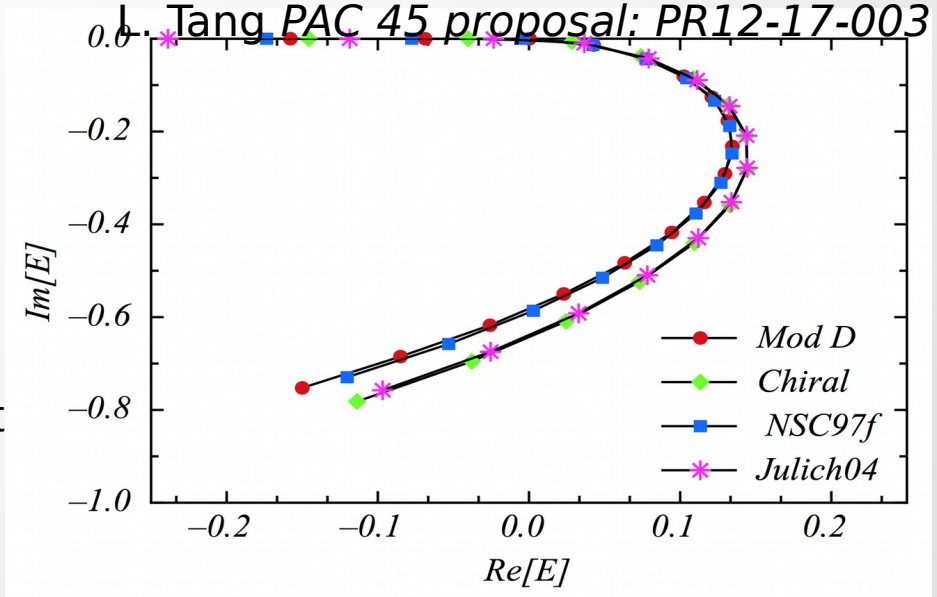


Kaon (e,e'k) (E12-17-003)

- Λnn resonance through electropoduction of K^+
  - $^3H(e,e'K^+)(\Lambda nn)$
  - Add an Aerogel Cherenkov counter
- Electron beam energy 4.524 GeV
  - e' LHRS 2.725 GeV/c (±4.5%)
  - e' LHRS angle 12.5° (6 msr)
  - K+ RHRS 1.5 GeV/c (±4.5%)
  - K+ RHRS angle 17.5° (6 msr)
- Requested 10 PAC days!
- Measure the binding energy (the real part of the energy eigenvalue) and the natural width (the imaginary part of the energy eigenvalue)
- Expected Results: Simulated spectroscopy that contains the Λn resonance and the Λ quasi-free Production.



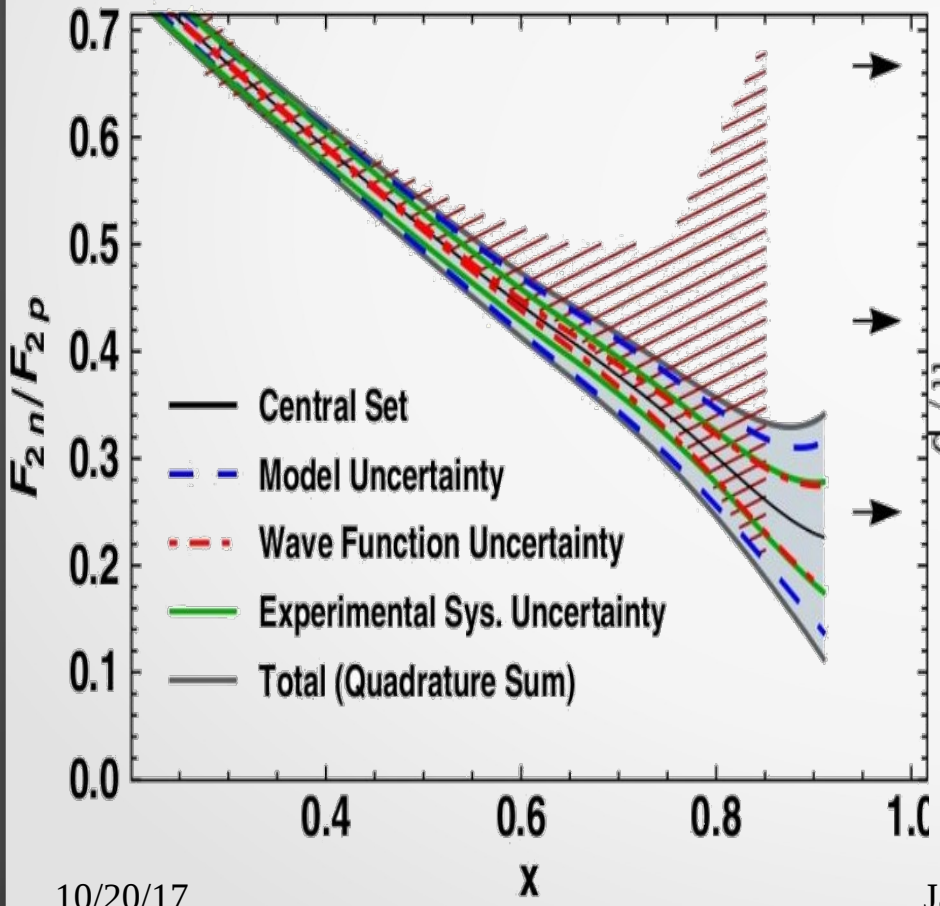
L. Tang *PAC 45 proposal: PR12-17-003*



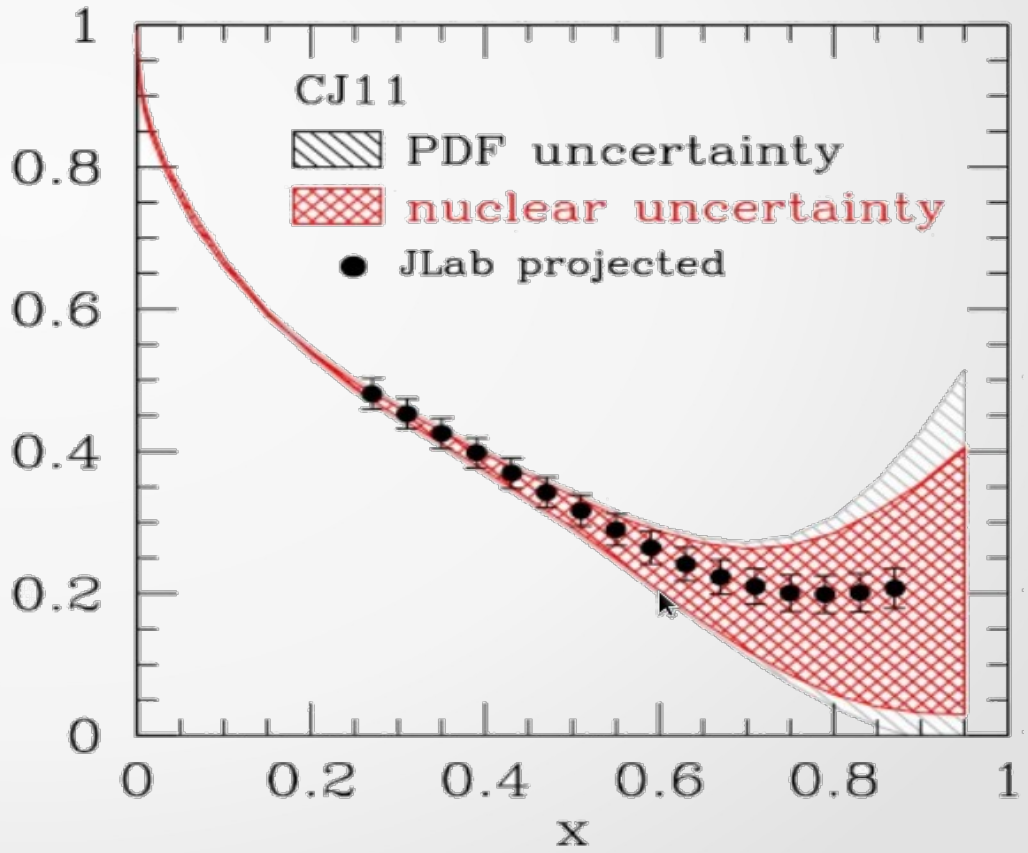
MARATHON (E12-10-103)

$$\sigma \propto F_2(x, Q^2) \xrightarrow{\text{Parton Model}} F_2(x) = x \sum e_i^2 (q_i(x) + \bar{q}_i(x)) \qquad \frac{F_2^n}{F_2^p} = \frac{1+4(d/u)}{4+(d/u)}$$

Arrington et al. PRL 108, 252001 (2012)



Projected Results

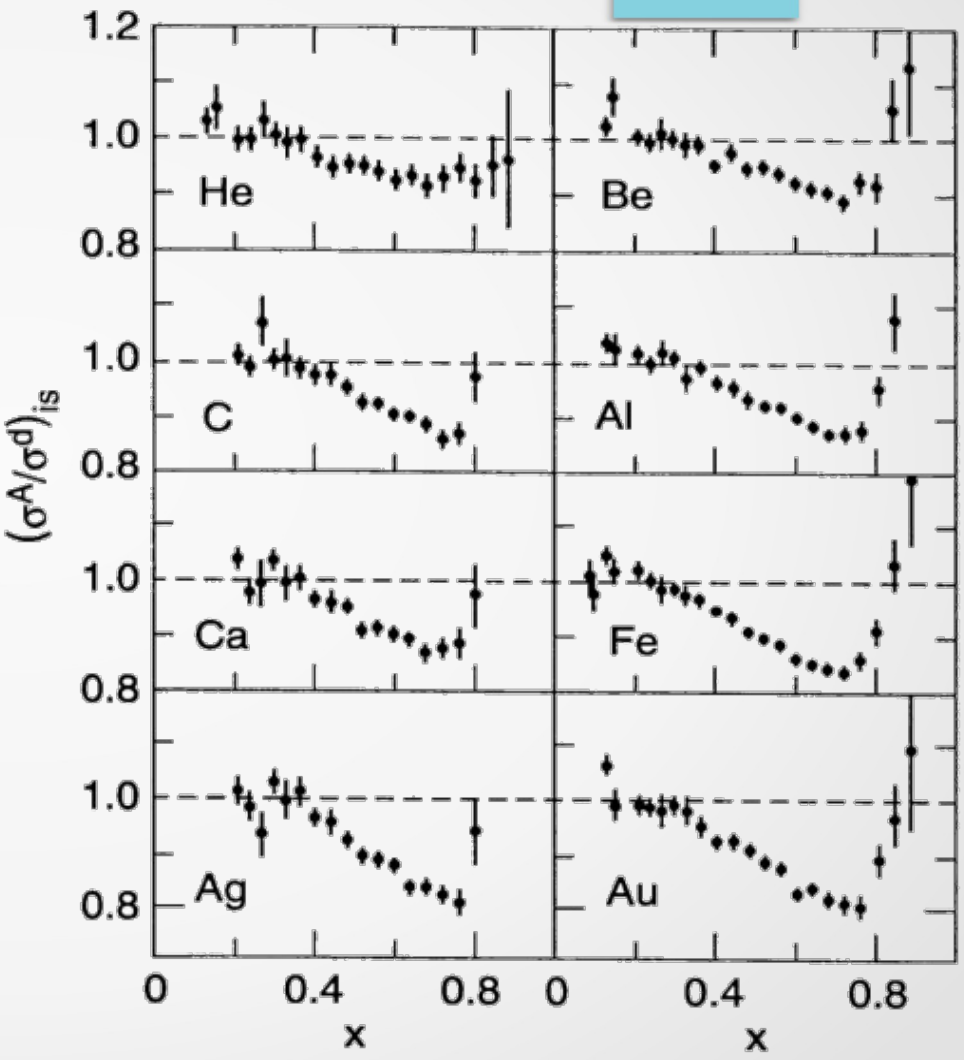


MARATHON (E12-10-103)

Use Tritium and ^{3}He, two mirror nuclei:

- EMC effect for A=3
  - Isospin dependence
- F_{2N}/F_{2P} ratio

- d/u quark distribution ratio.



SLAC E-139, 1984, J. Gomez et al.

Run plan

Begin running on December 1st.

- Complete commissioning.
- Begin Isospin dependence of SRCs
- Break for Winter Holiday
- Run MARATHON(DIS) for ~ 20 PAC days
- Break for the Summer
- Finish Isospin dependence of SRCs
- Run (e,e'p) SRCs for about ~12 PAC days
- Run (e,e'K^+) for about ~12 PAC days

Summary

- Jlab will play host to a group of highly sought out experiments using a Tritium target.
- Using the newly upgraded electron beam will allow for complex study of many regions.
- DIS with MARATHON
  - Isospin dependence of the EMC effect, d/u quark ration, and F_2^n/F_2^p ratio
- Inelastic scattering -Λnn resonance ..Kaons
- QE looking at SRCs
  - Isospin dependence and nuclear momentum distributions
- Elastic scattering – Elastic Form Factors and the charge radius.