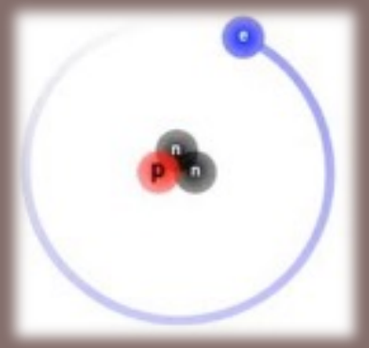


The x<3 experiment

Patricia Solvignon

UNH/JLab

Next generation nuclear physics with JLab12 and EIC

FIU

February 10-13, 2016

E12-11-112

Precision measurement of the isospin dependence in the 2N and 3N short range correlation region

Spokespeople: P. Solvignon (JLab/UNH), J. Arrington (ANL), D. Day (UVa), D. Higinbotham (JLab)

Main physics goals

Isospin-dependence

- ✓ Improved precision: extract R(T=1/T=0) to 3.8%
- ✓ FSI much smaller (inclusive) and expected to cancel in ratio

3N SRCs structure (momentum-sharing and isospin)

Improved A-dependence in light and heavy nuclei

- ✓ Average of ^{3}H, ^{3}He --> A=3 "isoscalar" nucleus
- ✓ Determine isospin dependence --> improved correction for N>Z nuclei, extrapolation to nuclear matter

Absolute cross sections (and ratios) for ^{2}H, ^{3}H, ^{3}He: test calculations of FSI for simple, well-understood nuclei

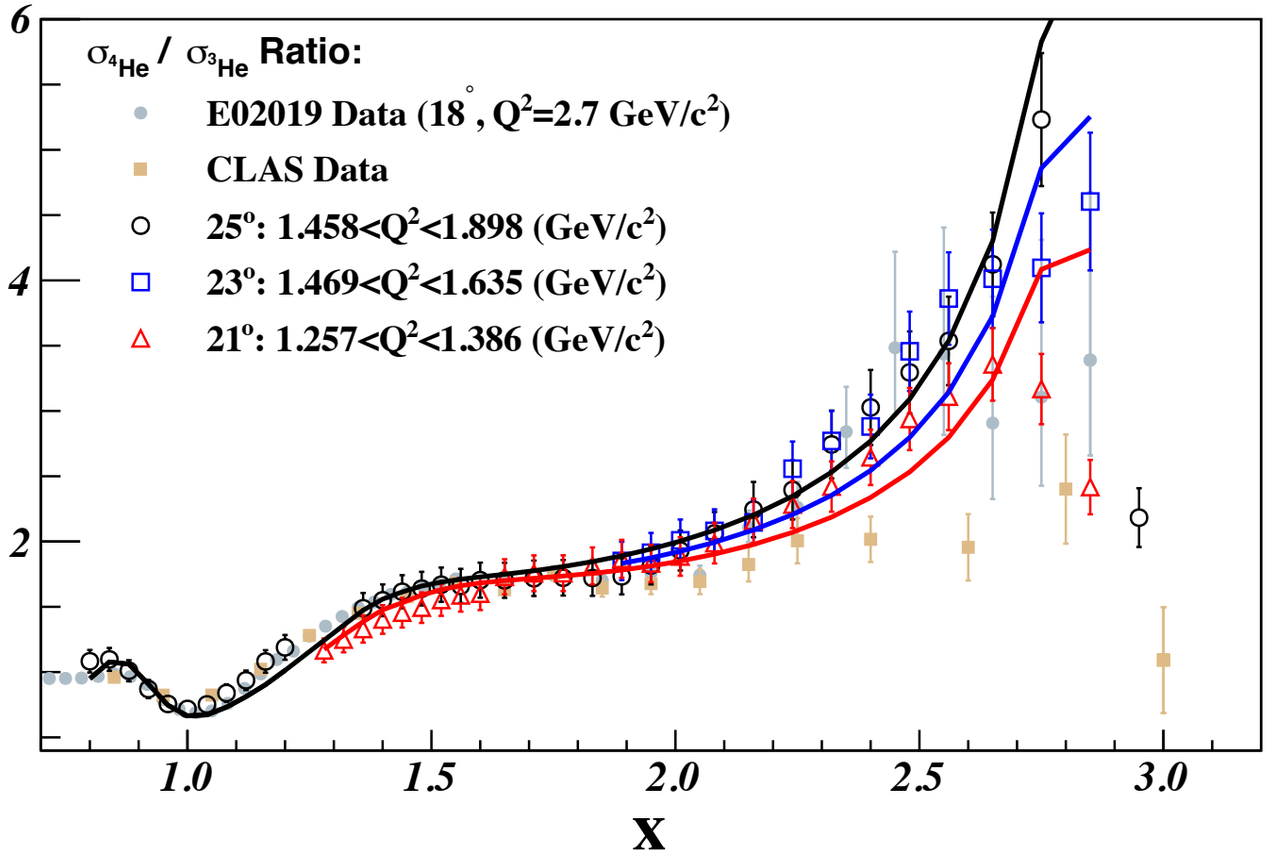
Preliminary Results of E08-014

Search for three-nucleon short-range correlations in nuclei

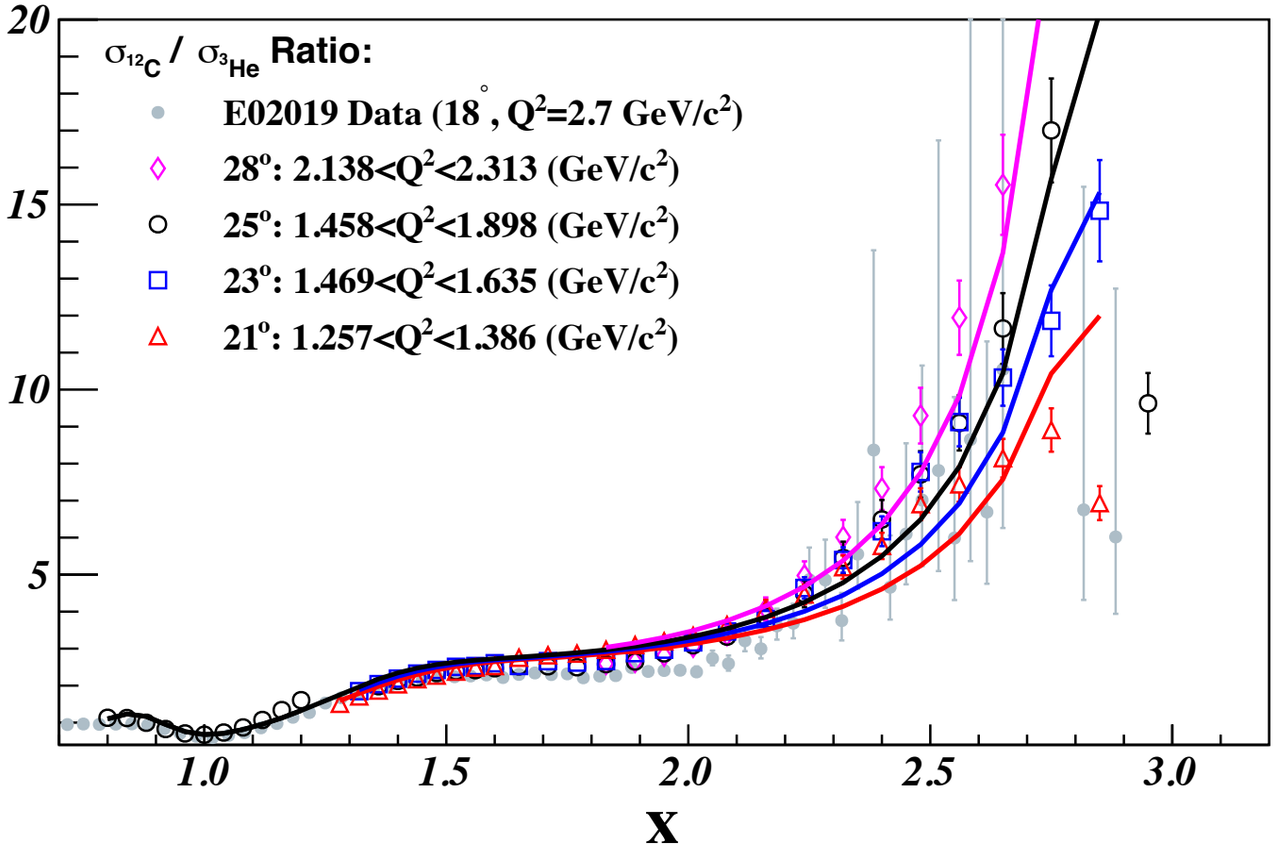
Z. Ye,[1,2] P. Solvignon,[3,4] P. Aguilera,[5] Z. Ahmed,[6] H. Albataineh,[7] K. Allada,[8] B. Anderson,[9] D. Anez,[10] K.

To be submitted to PRL

ratio ^{4}He/^{3}He



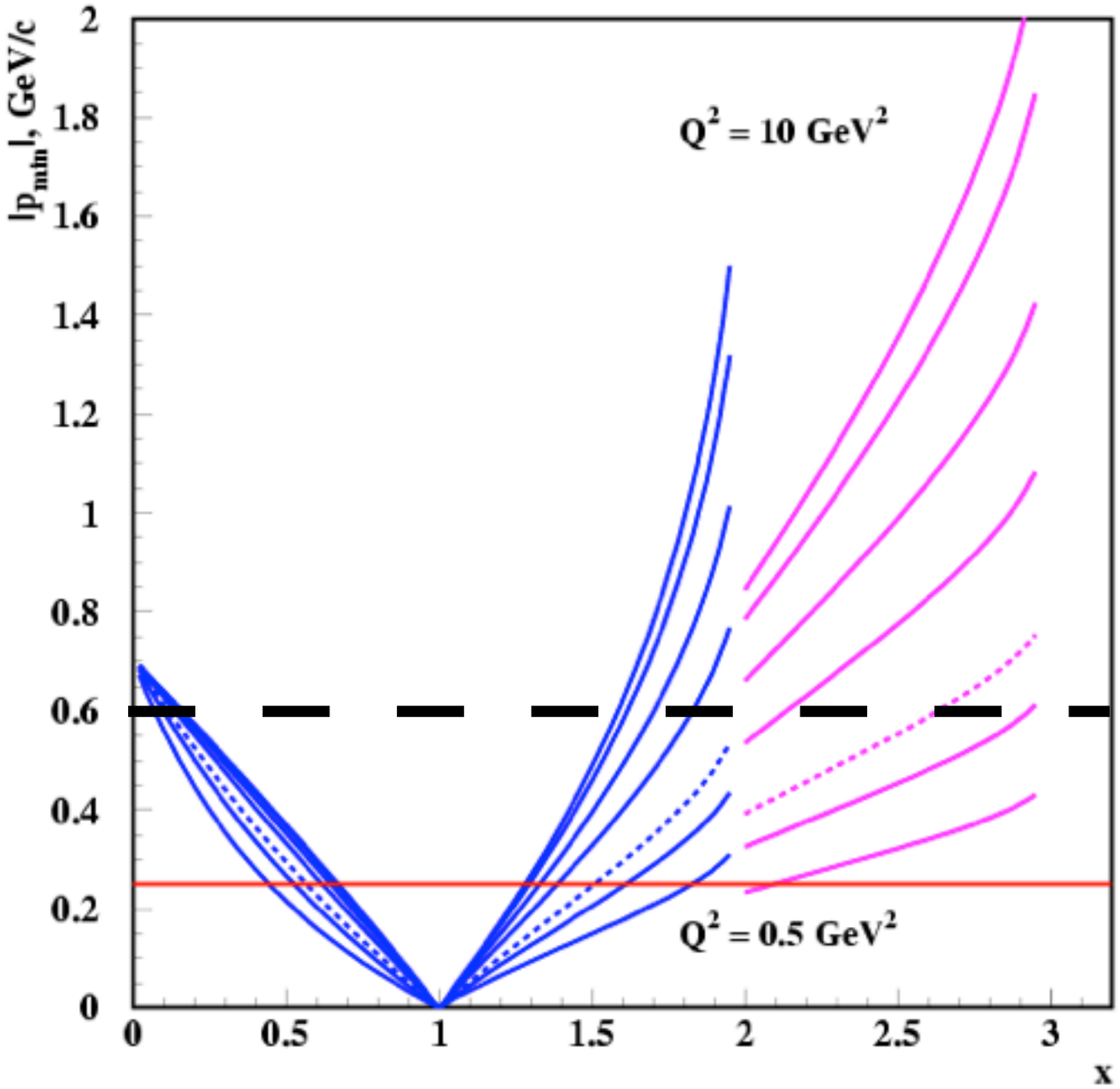
ratio ^{12}C/^{3}He



No hint of second plateau ?

E01-11-112 will perform the average of ^{3}H, ^{3}He --> A=3 “isoscalar” nucleus

Onset of Scaling for 2<x<3



No hint of second plateau ?

Maybe our Q^2 is too low ?!

Accessing the components of the spectral function

Taking deuterium data will allow:

1. Direct measures of the spectral function in the isospin 1 channel:

$$\frac{\left[\sigma(^3He) - \sigma(^3H)\right] / \left[\sigma(^3He) + \sigma(^3H)\right]}{\sigma(^2H)}$$

2. Direct measures of the difference of the spectral function in I=1 and I=0 channels:

$$\frac{\sigma(^3He) - \sigma(^3H)}{\sigma(^2H)}$$

These results will provide, in an independent way, a test of the observation of small values of (e,e'pp)/(e,e'pn) ratios.

Isospin study from $^3He/^3H$ ratio

Simple mean field estimates for 2N-SRC

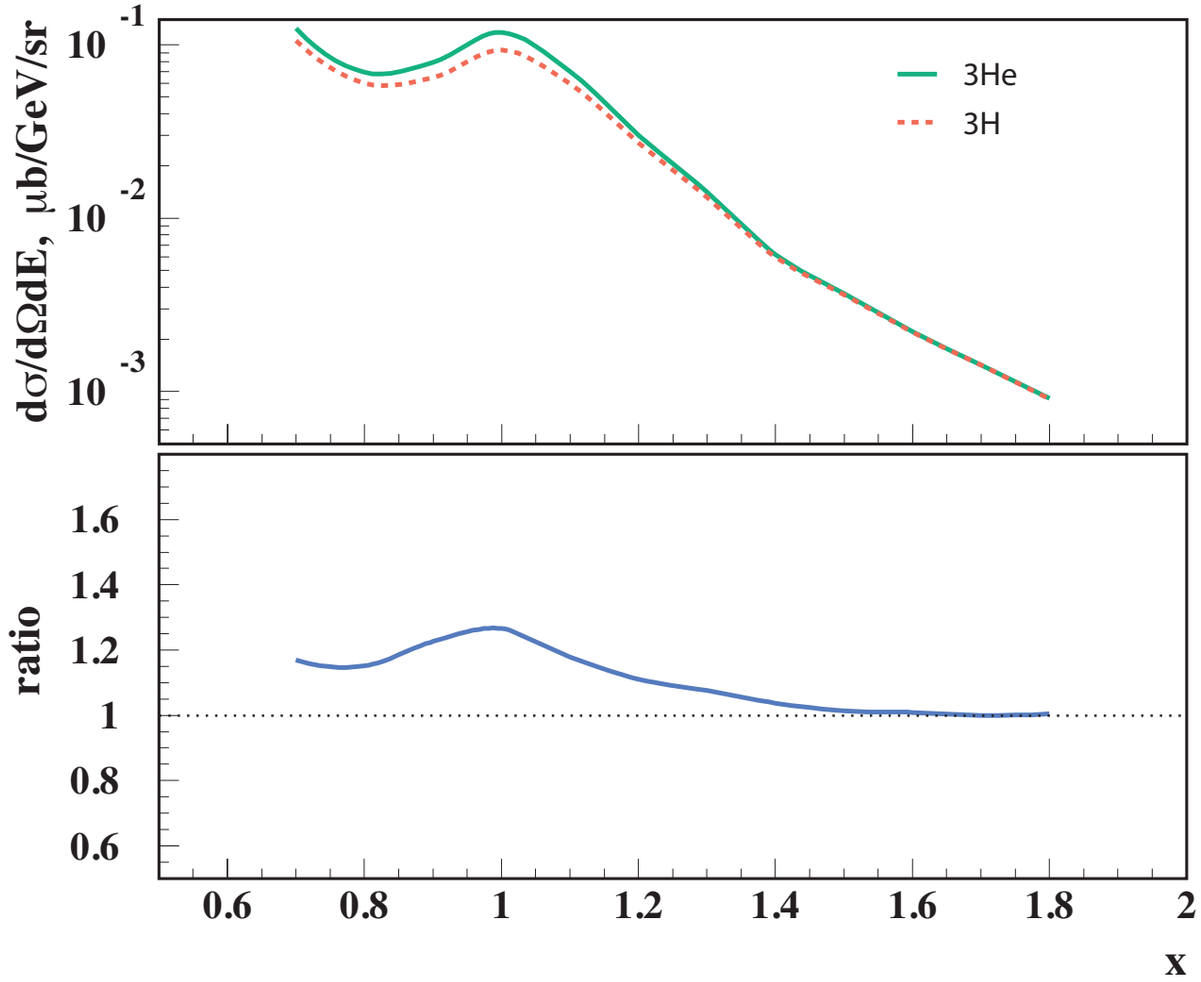
Isospin independent:

$$\frac{\sigma_{^3He}/3}{\sigma_{^3H}/3} = \frac{(2\sigma_p + 1\sigma_n)/3}{(1\sigma_p + 2\sigma_n)/3} \xrightarrow{\sigma_p \approx 3\sigma_n} 1.40$$

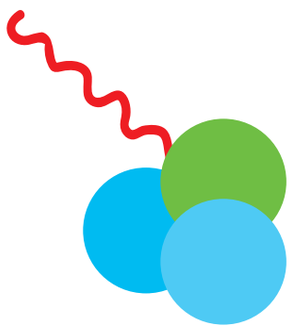
n-p (T=0) dominance:

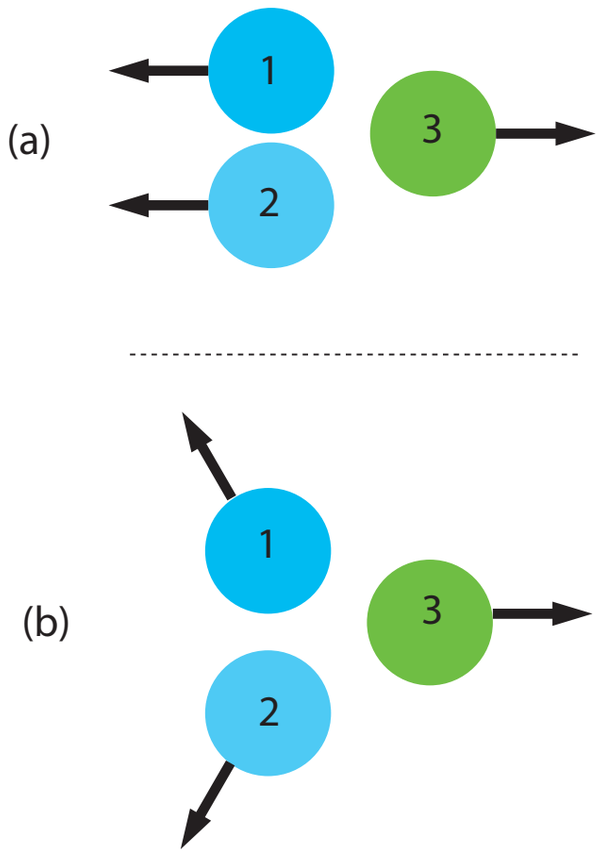
$$\frac{\sigma_{^3H}/3}{\sigma_{^3He}/3} = \frac{(2pn + 1\cancel{nn})/3}{(2pn + 1\cancel{pp})/3} = 1.0$$

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



3N-configuration





extremely large momentum

$p_3 = p_1 + p_2$

"Star-configuration"

$p_1 = p_2 = p_3$

(a) yields $R(^3He/^3H) \approx 3.0$ if nucleon #3 is always the doubly-occurring nucleon

(a) yields $R(^3He/^3H) \approx 0.3$ if nucleon #3 is always the singly-occurring nucleon

(a) yields $R(^3He/^3H) \approx 1.4$ if configuration is isospin-independent, as does (b)

$R \neq 1.4$ implies isospin dependence AND non-symmetric momentum sharing

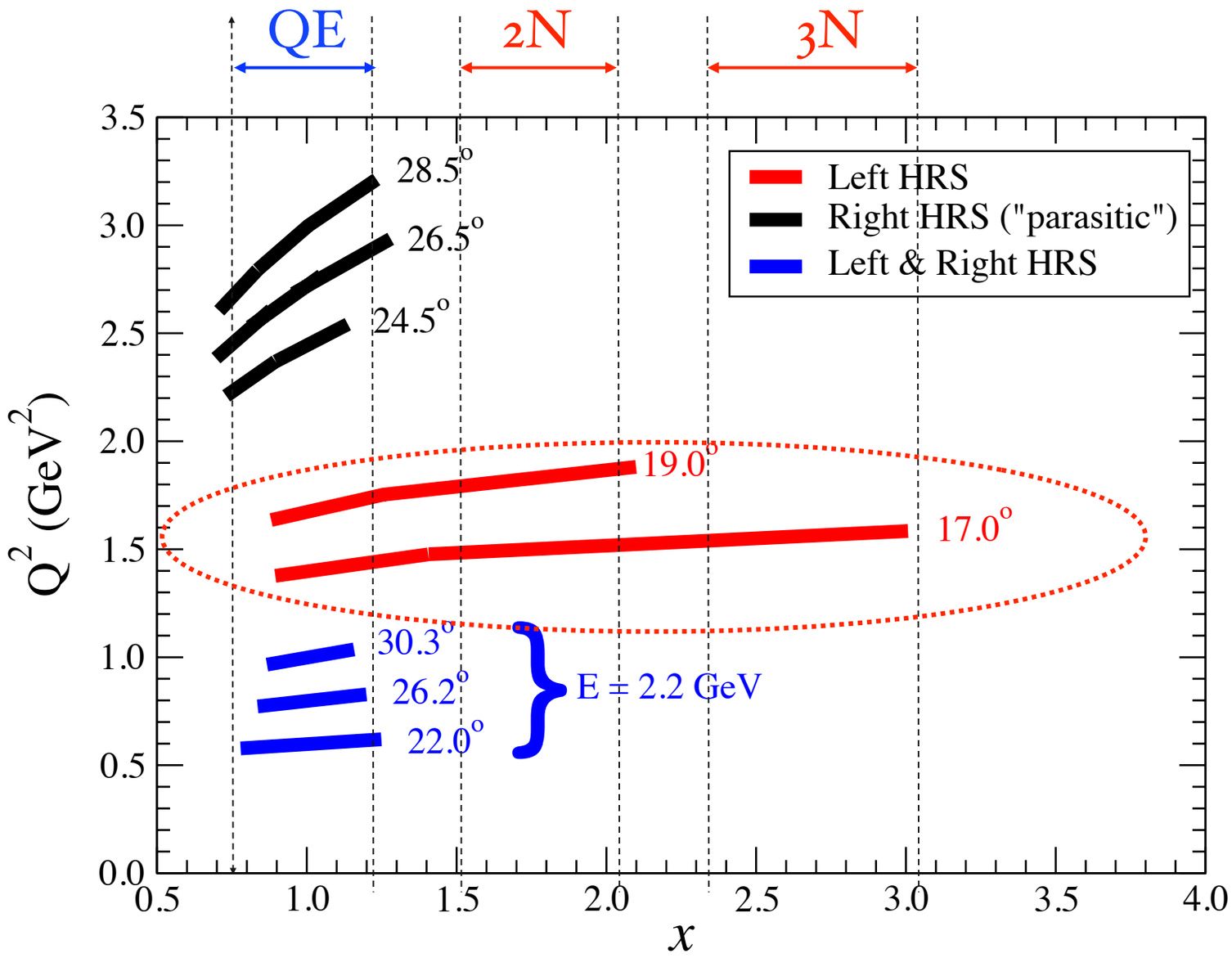
E12-11-112: kinematics

Beam current: 25 μA, unpolarized, Raster interlock

Beam energy:

17.5 Days 4.4 GeV [main production]

Left HRS running (380 hours)



E12-11-112: kinematics

Beam current: 25 μA, unpolarized, Raster interlock

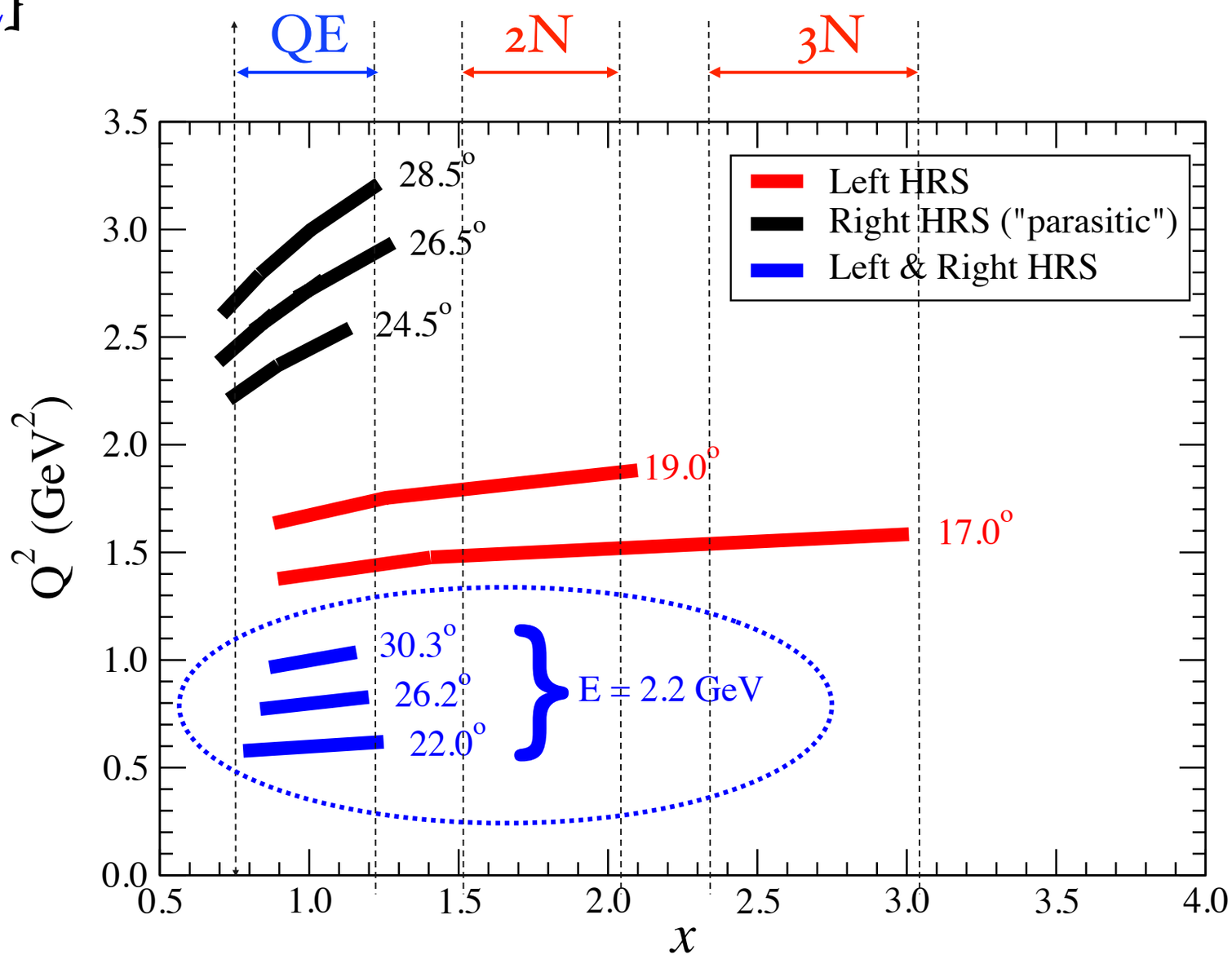
Beam energy:

17.5 Days 4.4 GeV [main production]

1.5 days 2.2 GeV [checkout+QE]

Left HRS running (380 hours)

Left+Right HRS running (about 1 day)



E12-11-112: kinematics

Beam current: 25 μA, unpolarized, Raster interlock

Beam energy:

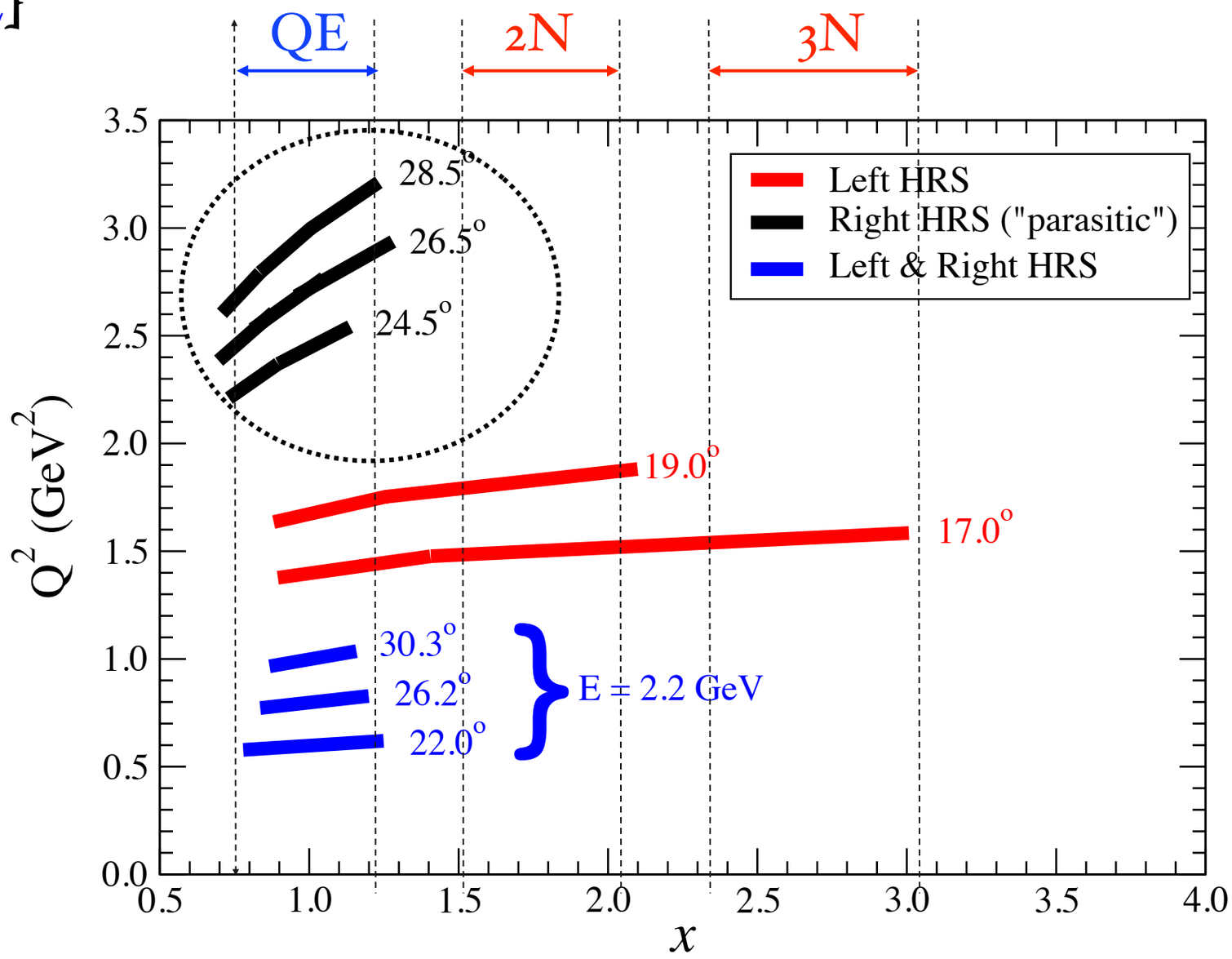
17.5 Days 4.4 GeV [main production]

1.5 days 2.2 GeV [checkout+QE]

Right HRS running ("parasitic")
Existing ^{3}H QE data
limited $Q^2 \leq 0.9$ GeV^2

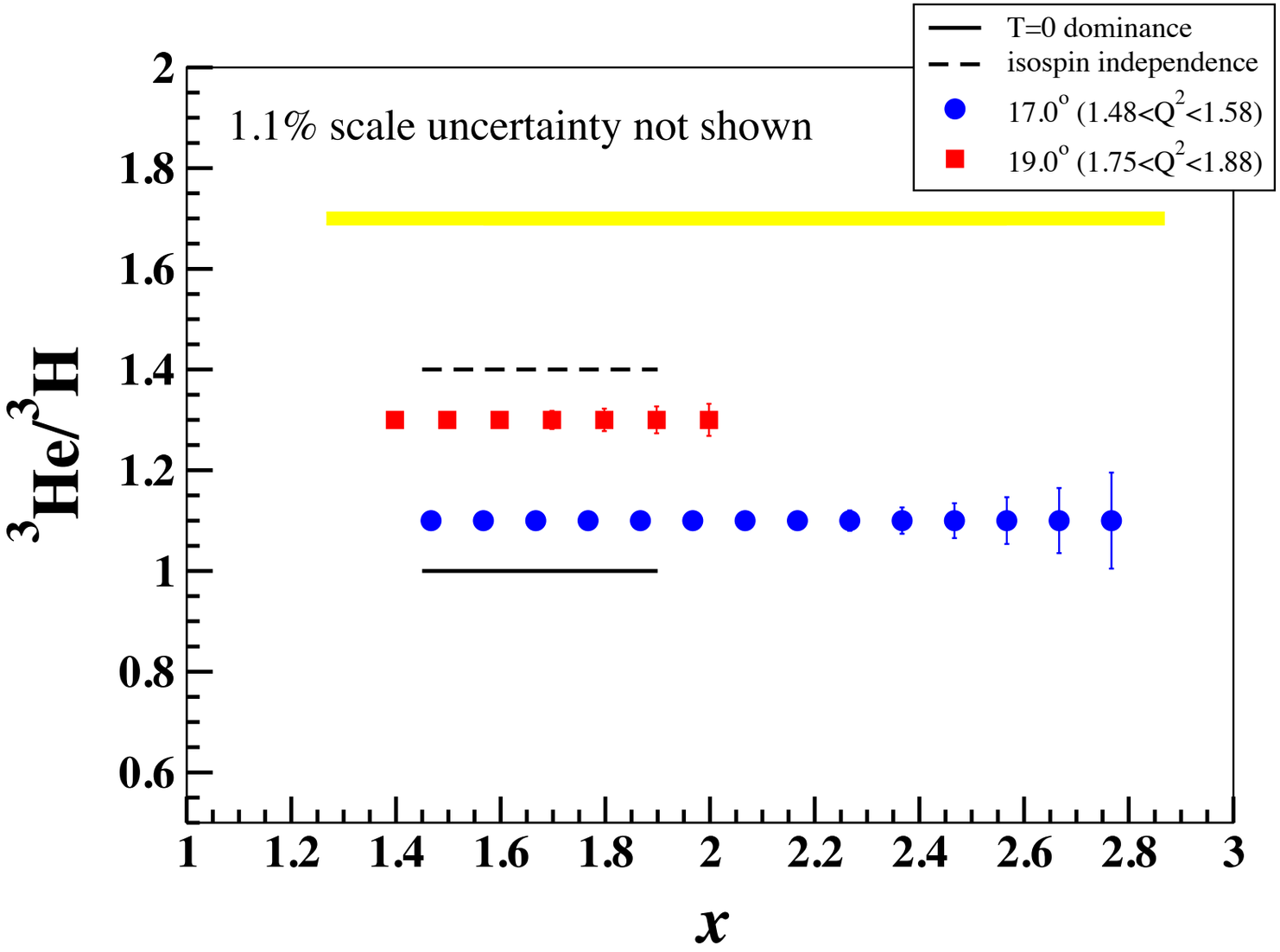
Left HRS running (380 hours)

Left+Right HRS running (about 1 day)



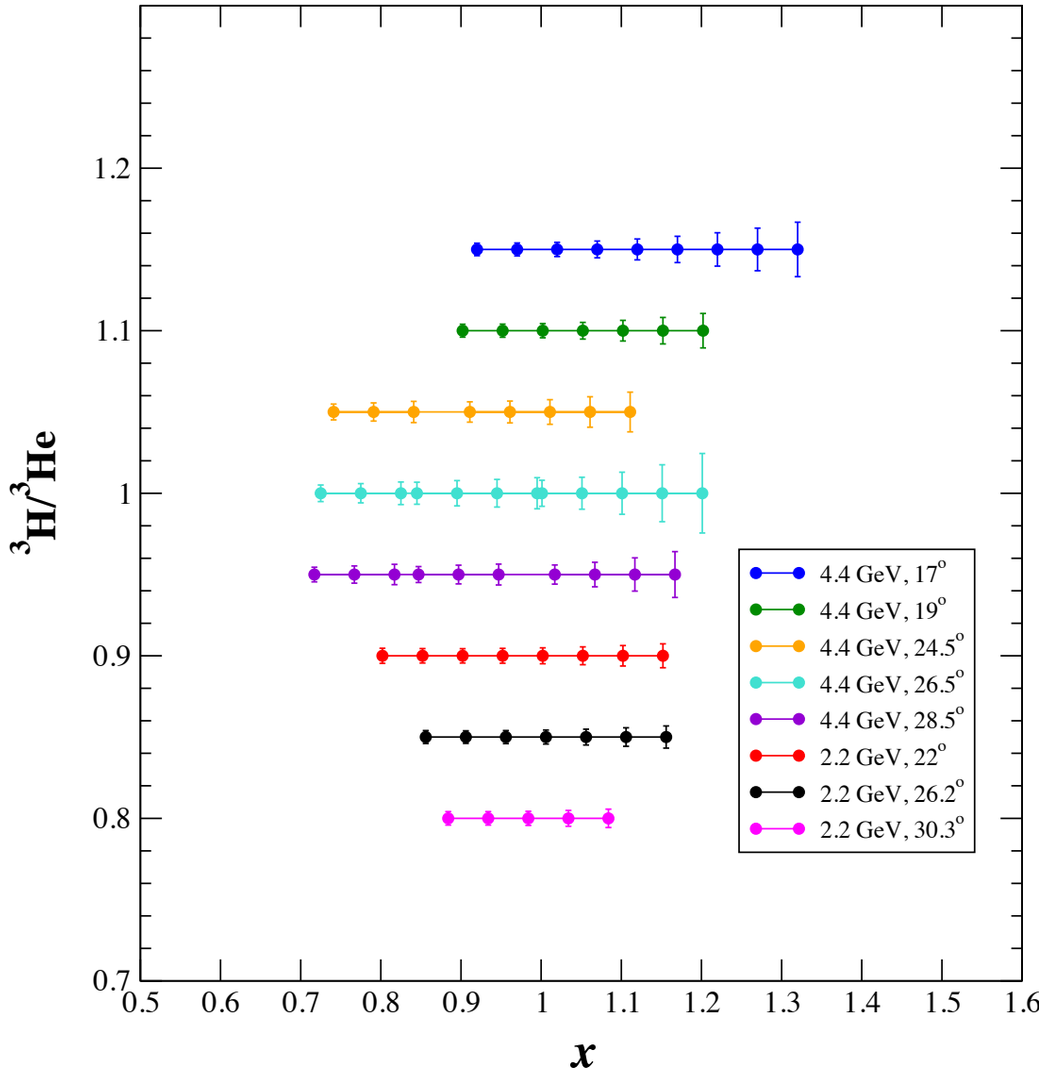
E12-11-112: projected results

Isospin study of SRC



At x>2, $^3He/^3H \neq 1.4$ implies isospin dependence AND non-symmetric momentum sharing

Extraction of G_M^n

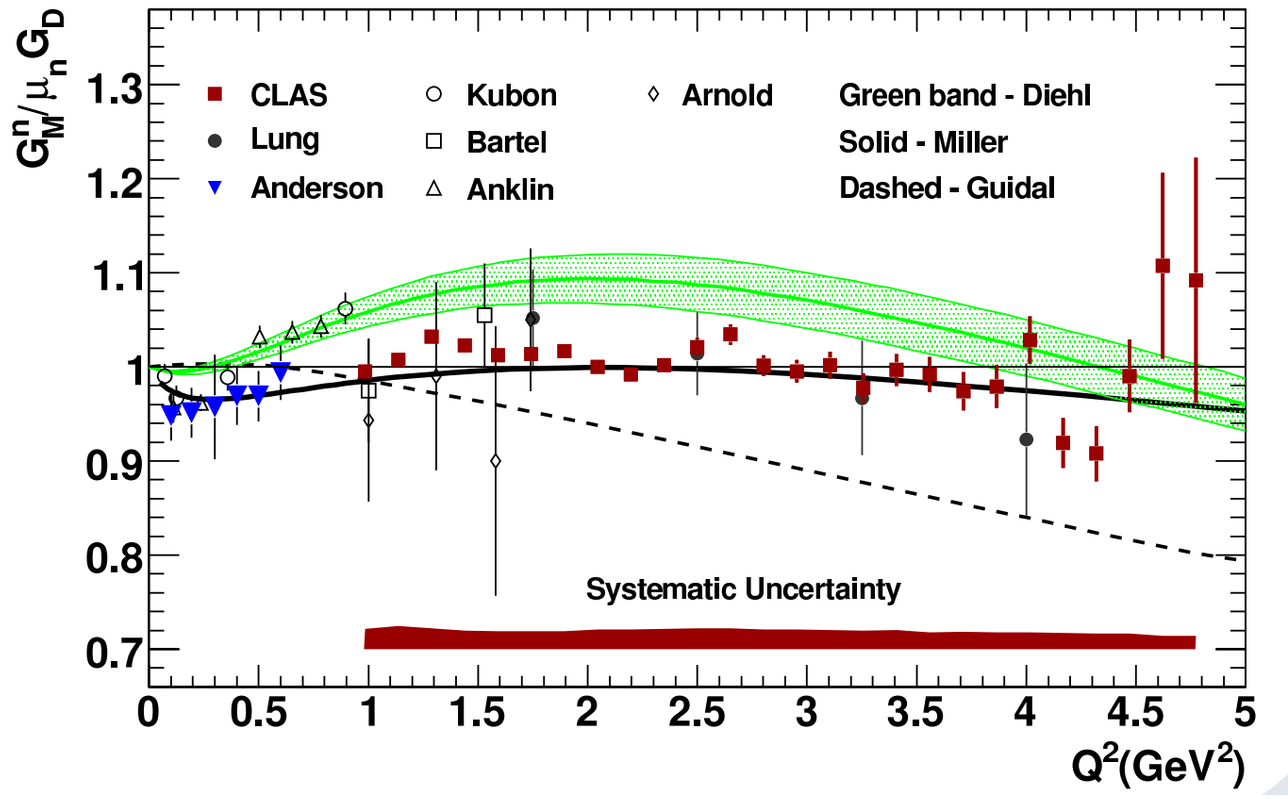


In PWIA, $^3He/^3H$ with 1.5% uncertainty corresponds to 3% on G_M^n

E12-11-112: Neutron Magnetic FF

World ^{3}H QE data:
$Q^2 \leq 0.9 GeV^2$

This experiment:
0.6, 0.8, 1.0, 1.4, 1.7,
2.4, 2.7 and 3.0 GeV^2



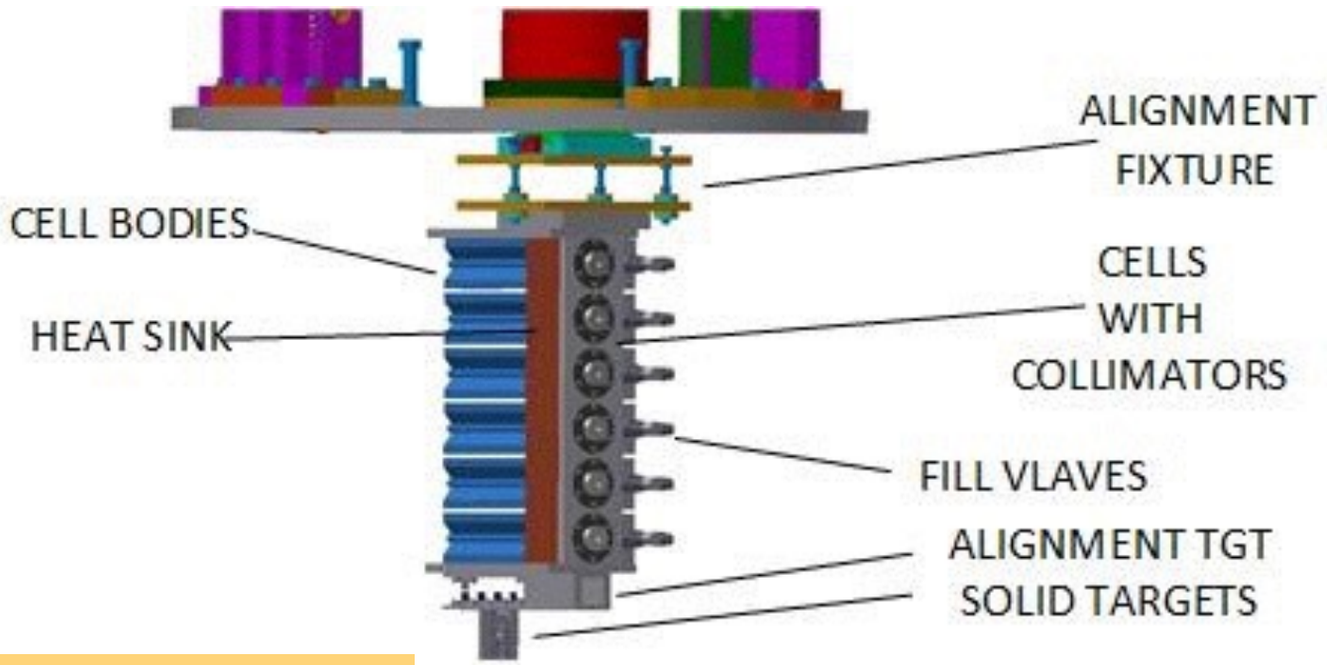
In PWIA, ^{3}He/^{3}H with 1.5% uncertainty corresponds to 3% on G_M^n

- Limited to $Q^2 \leq 1$ GeV^2, where QE peak has minimal inelastic contribution
- This is the region with ~8% discrepancy between the Ankin, Kubon data and the CLAS ratio and the Hall A polarized ^{3}He extraction.

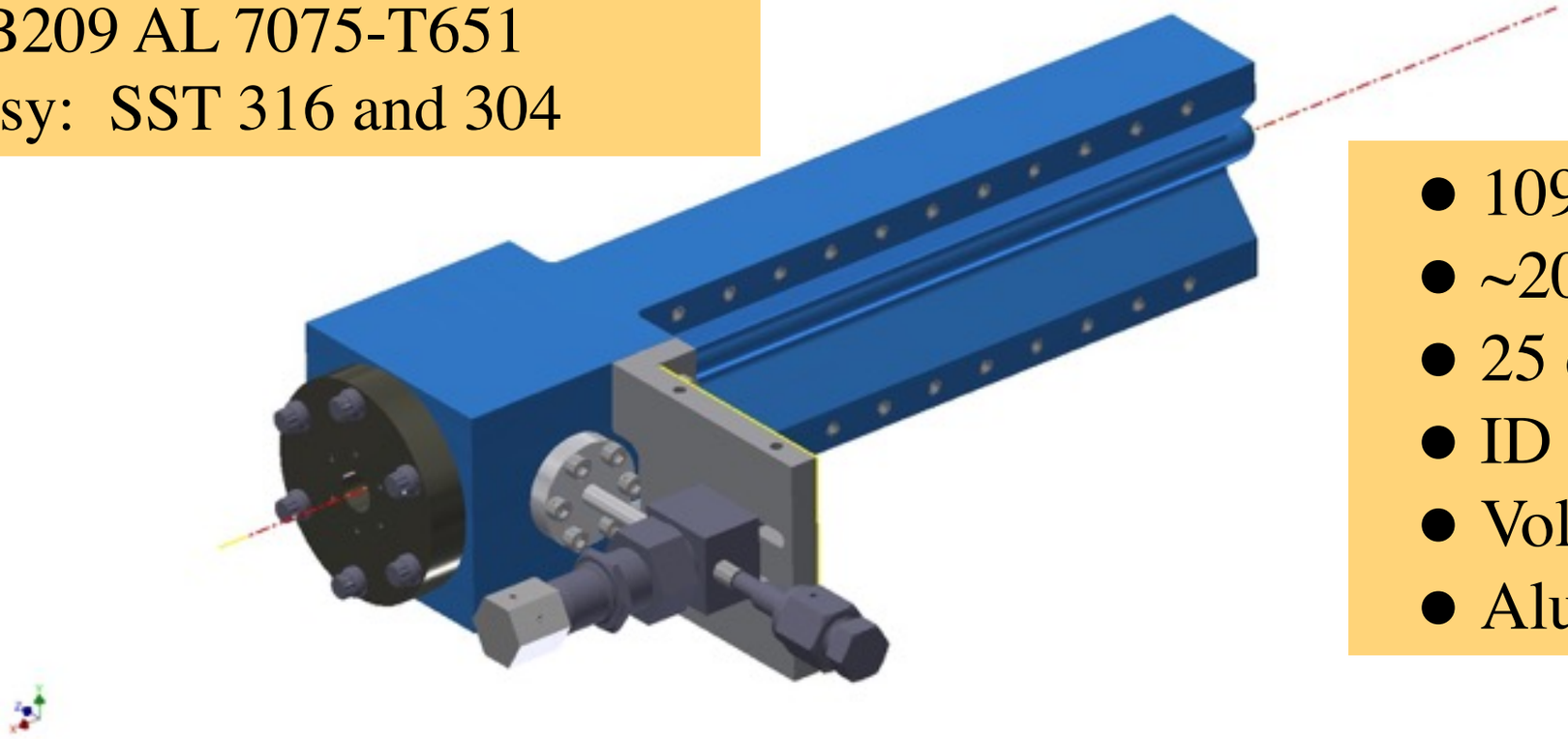
Nuclear effects expected to be small, largely cancel in ratio

The Target System

From D. Meekins (JLab)



- Main Body and Entrance Window: ASTM B209 AL 7075-T651
- Valve assy: SST 316 and 304



- 1090 Ci of T2 (0.1 g)
- ~200 psi at 295K
- 25 cm long
- ID of 12.7mm
- Volume = 34 cc
- Aluminum CF seals

Tritium Experiments scheduled to run in February 2017

Thank you