E08-014: X>2

Patricia Solvignon

Jefferson Laboratory

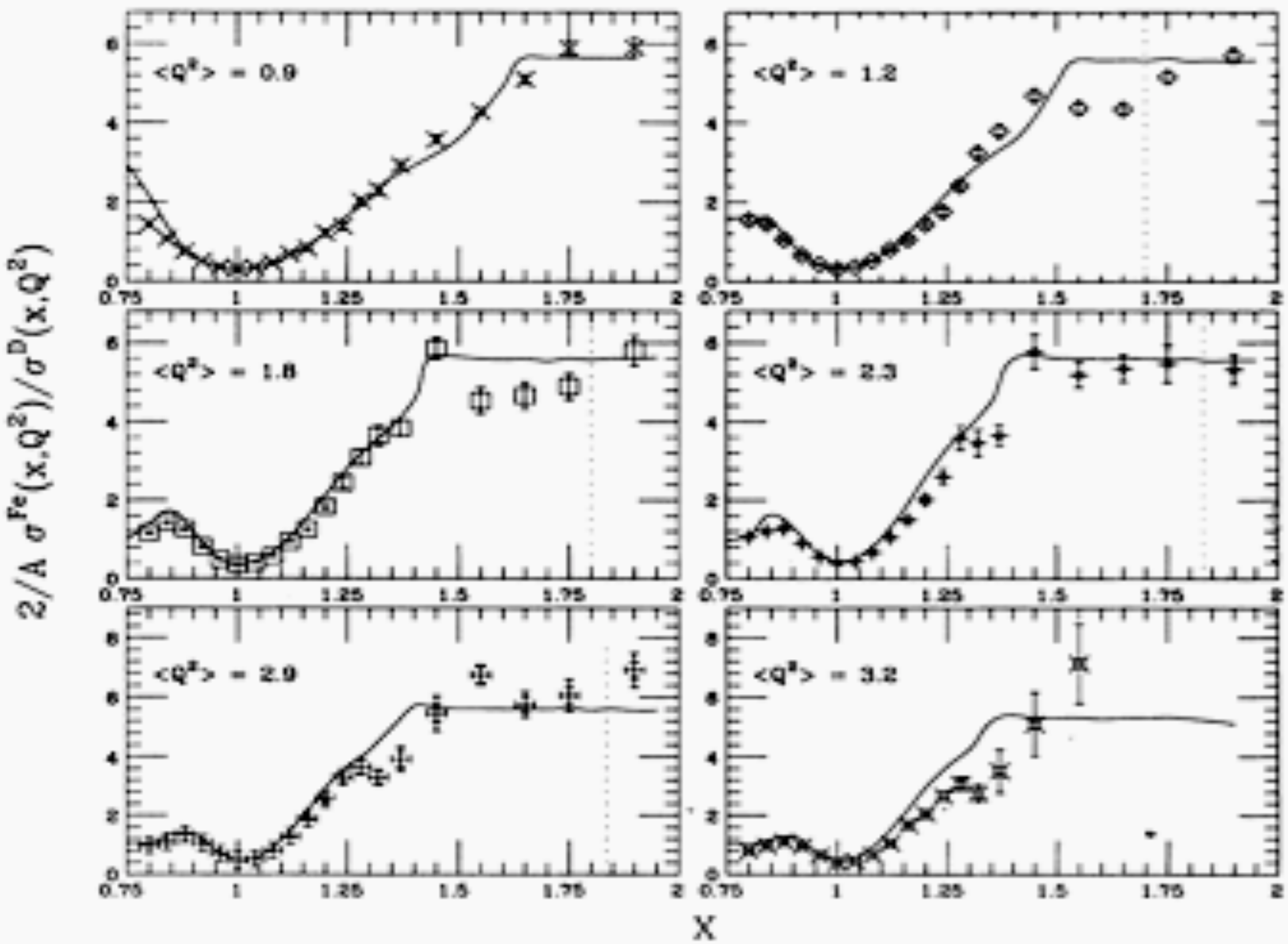
Spokepeople: John Arrington (ANL), Donal Day (UVa),
Doug Higinbotham (JLab), Patricia Solvignon (JLab)

Postdoc: Xiaohui Zhan (ANL)

Graduate students: Zhihong Ye (UVa)
Fatou Ndoye (Université Cheikh Anta Diop)

Hall A Collaboration Meeting
December 9-10, 2010

SRC EVIDENCE AT SLAC



Frankfurt, Strikman, Day, Sargsian, PRC48, 2451 (1993)

Ratio of cross section (per nucleon) shows plateau above x ≈1.4, as expected if high-momentum tails dominated by 2N-SRCs

Ratio in plateau, proportional to the number of 2N SRCs

$a_2(^3He)=1.7\pm0.3$

$a_2(^4He)=3.3\pm0.5$

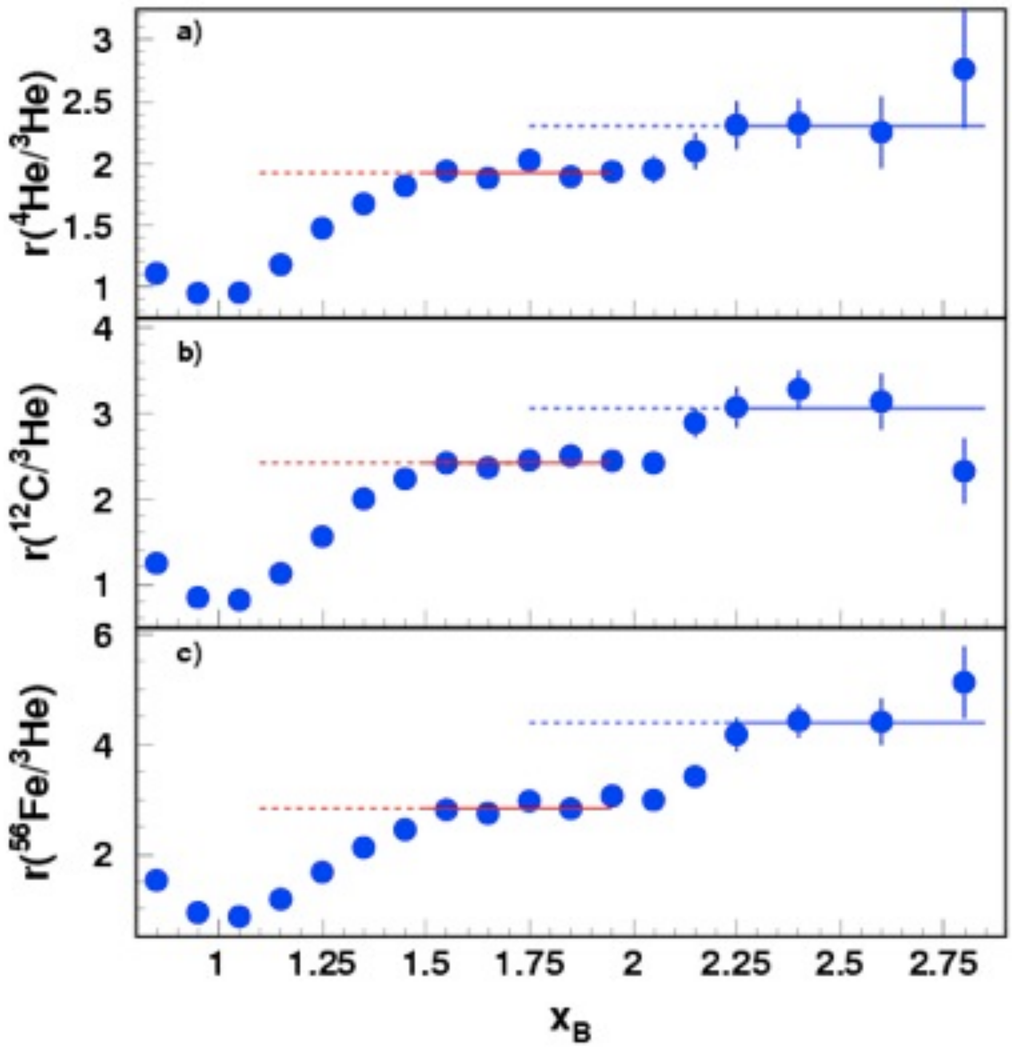
$a_2(^{12}C)=5.0\pm0.5$

$a_2(^{27}Al)=5.3\pm0.6$

$a_2(^{56}Fe)=5.2\pm0.9$

$a_2(^{197}Au)=4.8\pm0.7$

INDICATION OF 3N-SRC FROM CLAS

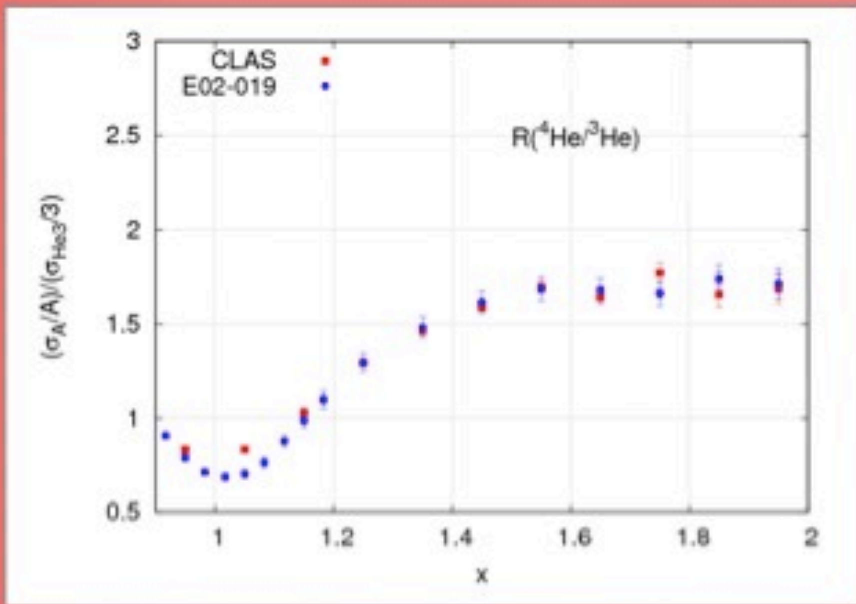


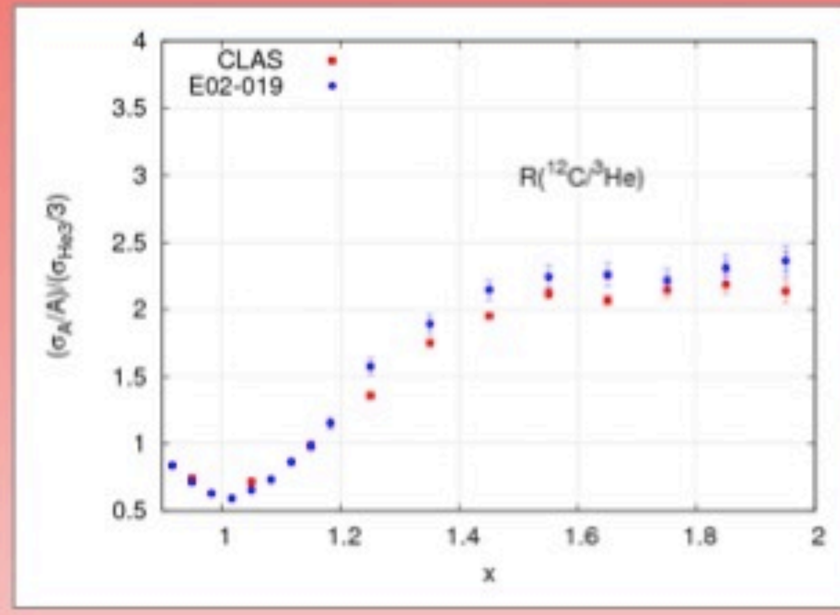
K. Egiyan et al, PRL96, 082501 (2006)

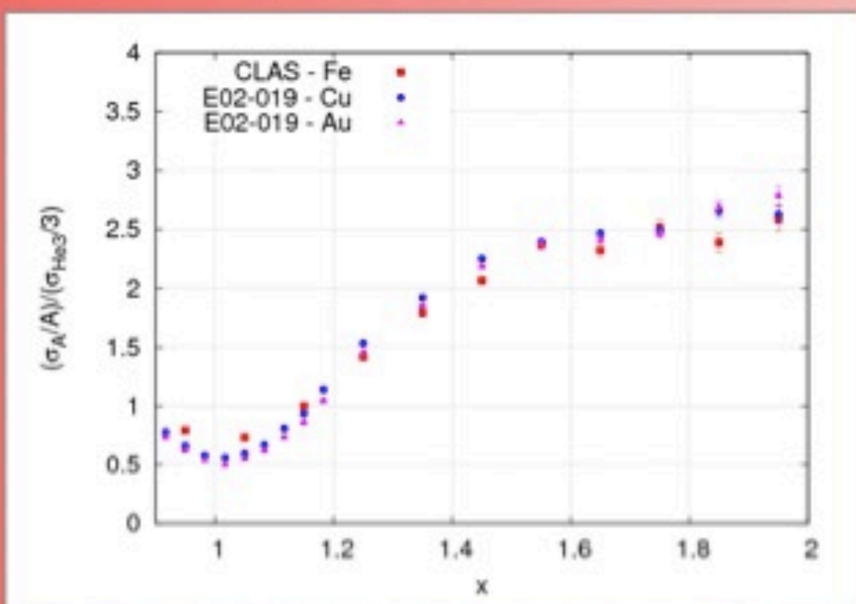
Experimental observations

- ✓ Confirmation of 2N-SRC at x>1.5
- ✓ Indication of 3N-SRC plateau
- ✓ Isospin dependence ?

2N correlations in ratios to ^{3}He



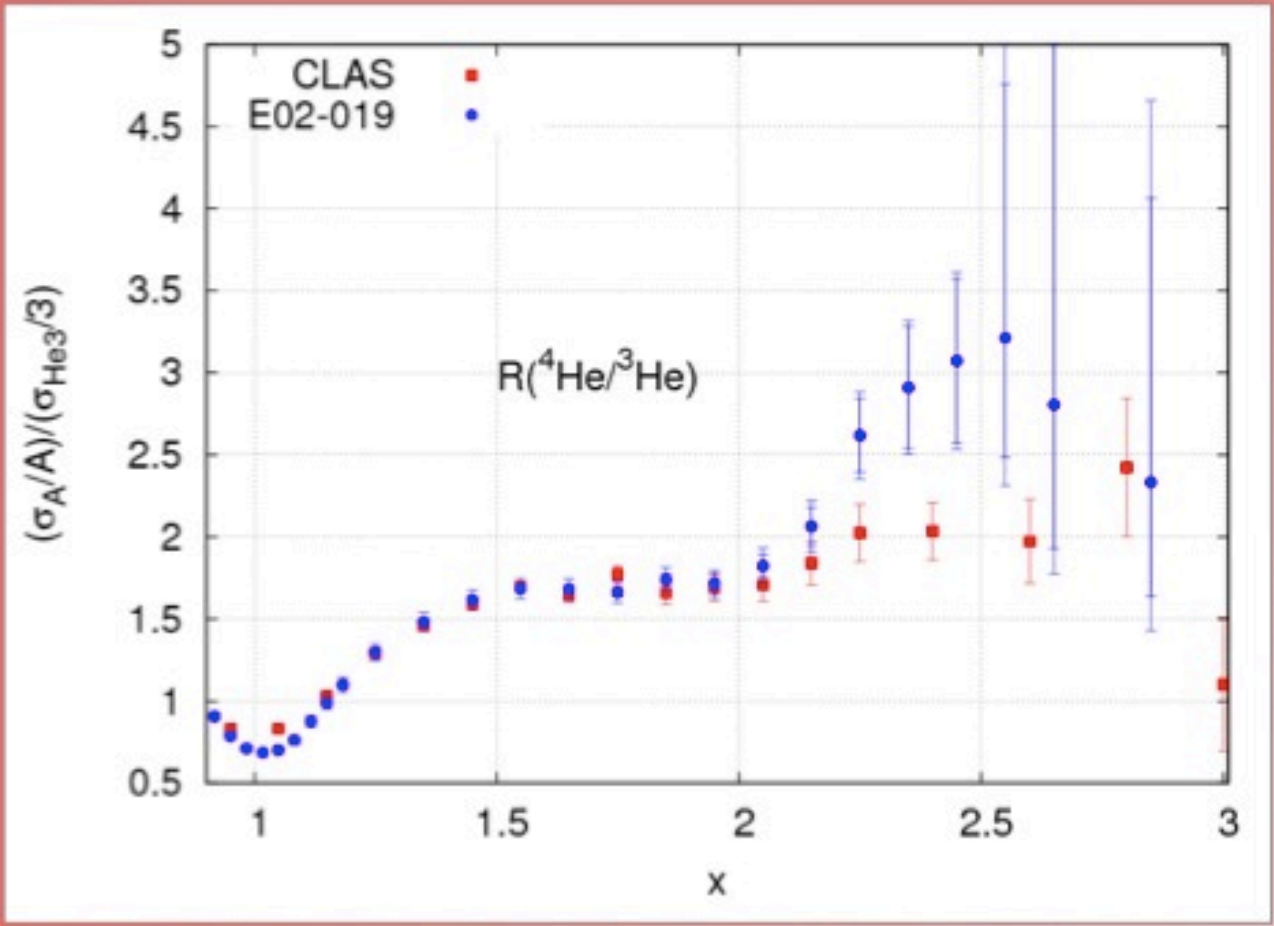




Can extract value of plateau – abundance of correlations compared to 2N correlations in ^{3}He

Slide from Nadia Fomin, JLab User Group Meeting

E02-019 Ratios

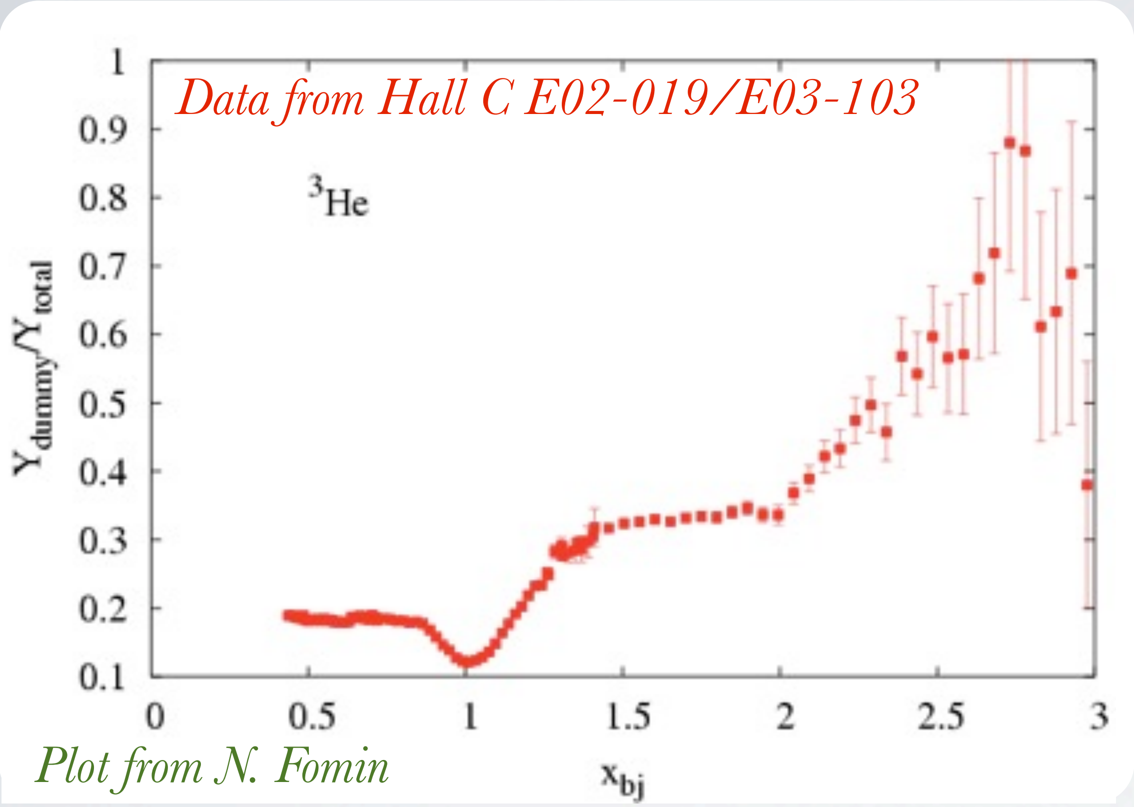


Q² (GeV²)
CLAS: 1.4-2.6
E02-019: 2.5-3

Slide from Nadia Fomin, JLab User Group Meeting

- Excellent agreement for x≤2
- Very different approaches to 3N plateau, later onset of scaling for E02-019
- Very similar behavior for heavier targets

CRYO-WINDOW CONTAMINATION



Advantage of PR08-104:

- Will use 20cm target
- HRS resolution: cut away most of the window contribution
- Empty can running: subtract the remaining contamination

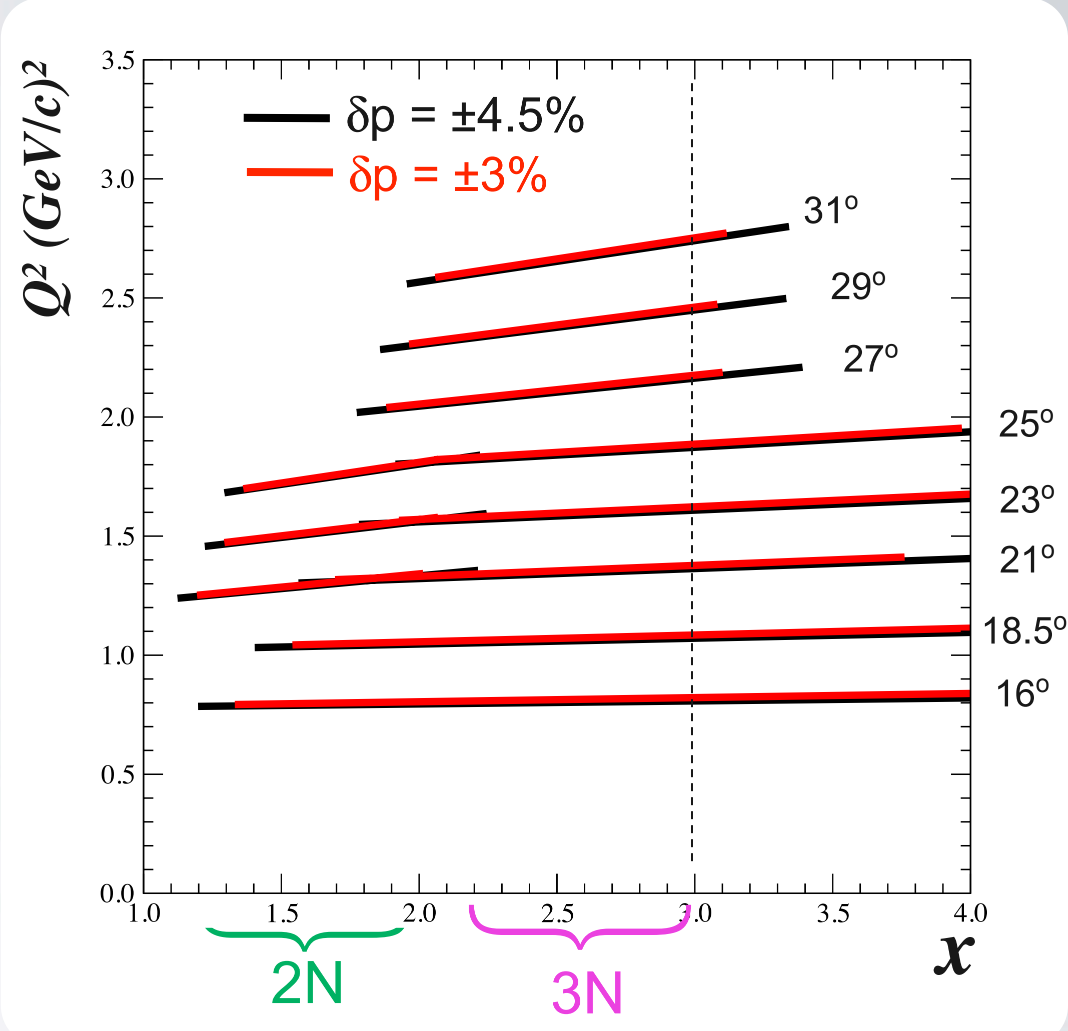
EXPERIMENT E08-014

- Study onset of scaling, ratios as a function of α_{2n} for $1<x<2$

- **Verify and define scaling regime for 3N-SRC:**
  – 3N-SRC over a range of density: ^{40}Ca, ^{12}C, ^{4}He ratios
  – Test α_{3n} for $x> 2$

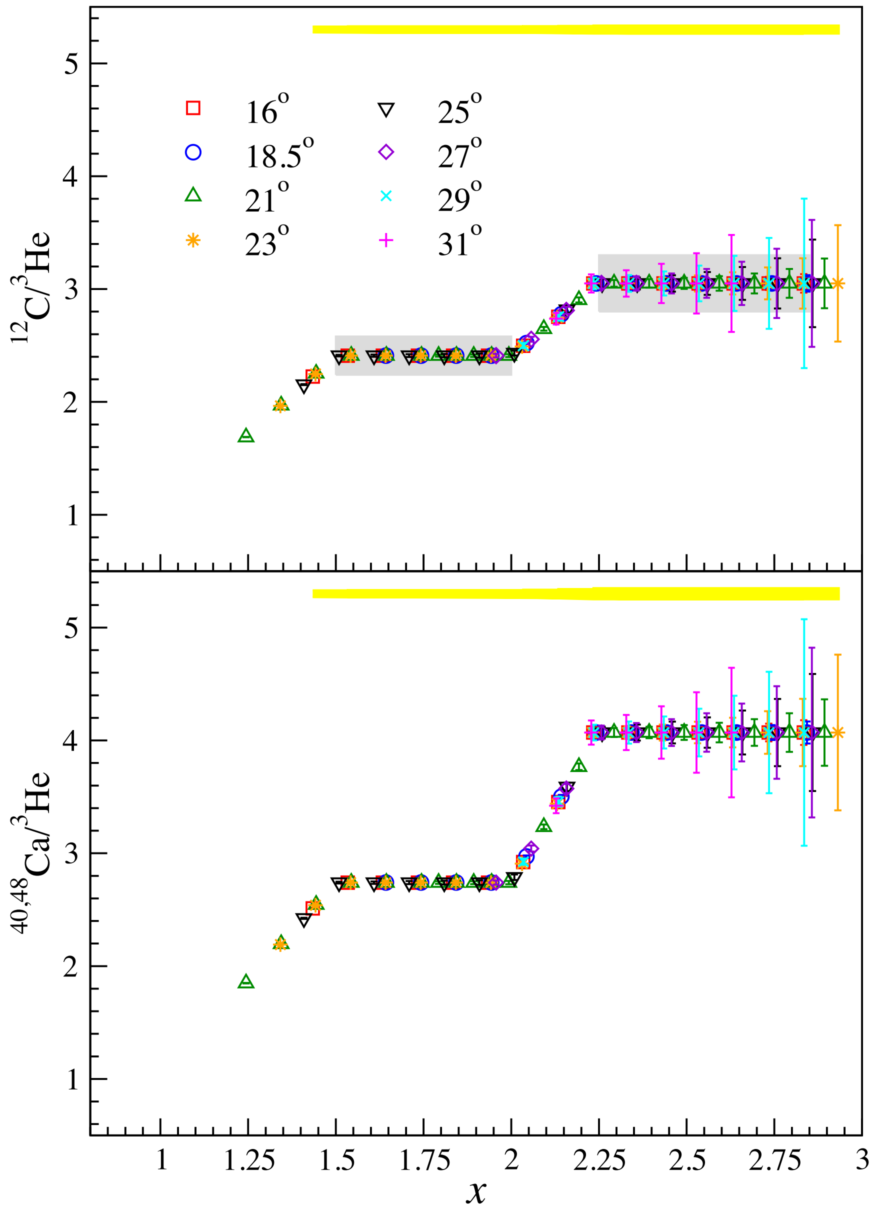
- Absolute cross sections: test FSI, map out IMF distribution $\varrho_A(\alpha)$

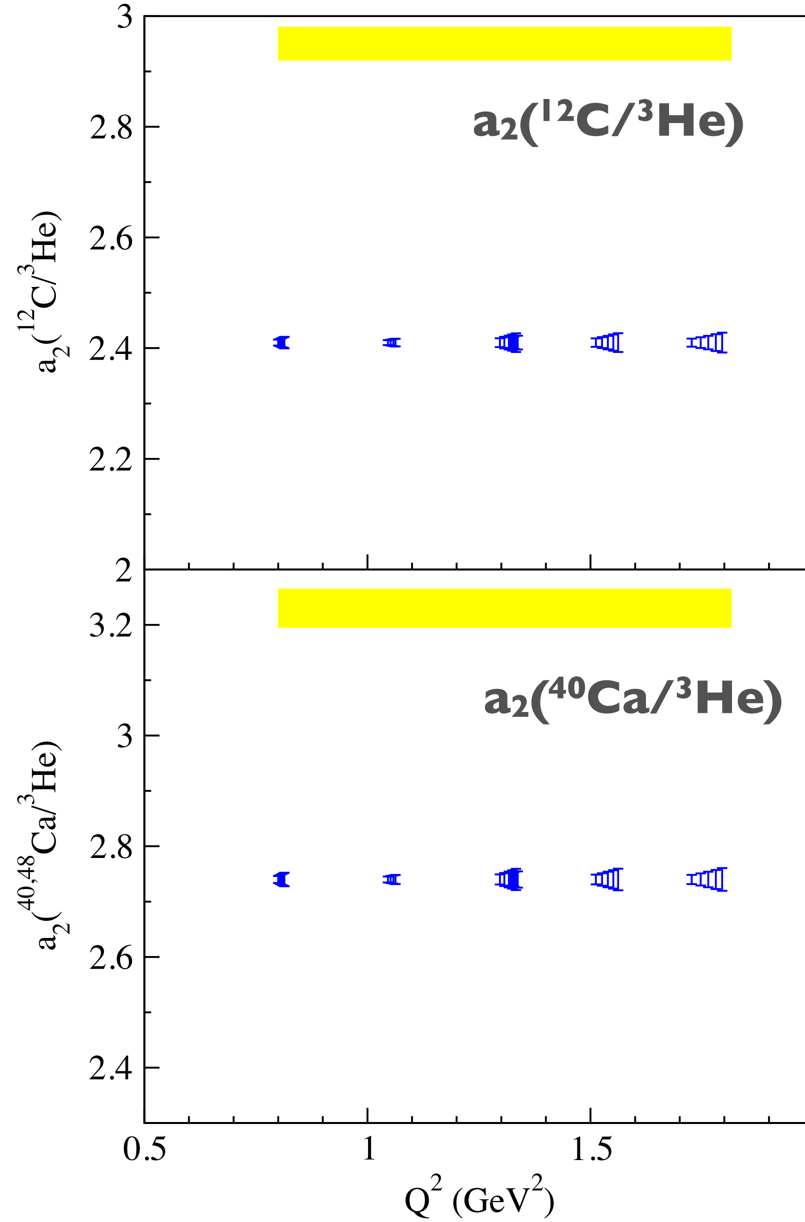
needed for $q_A(x)$ convolution
(EMC, hard processes in A-A collisions, …)



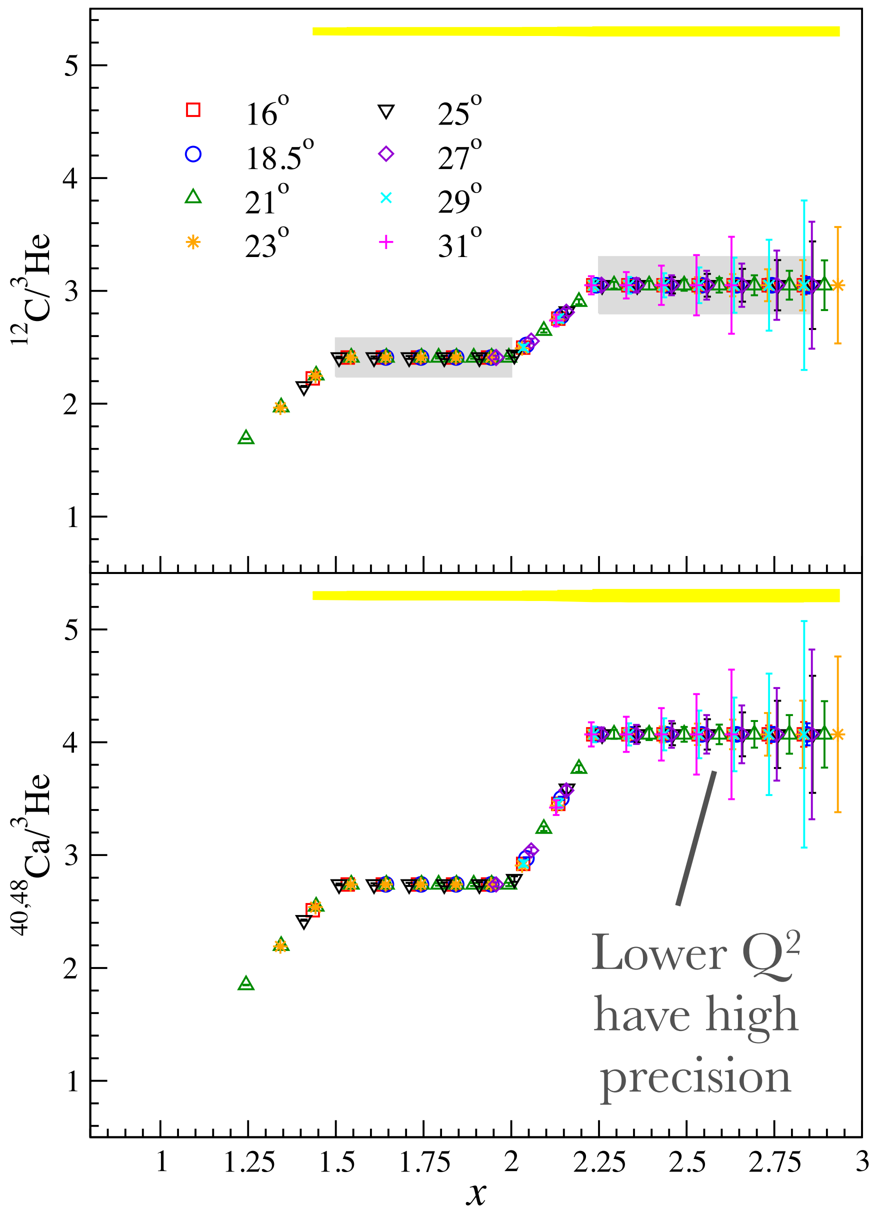
- **Isospin effects on SRCs: ^{48}Ca vs. ^{40}Ca**

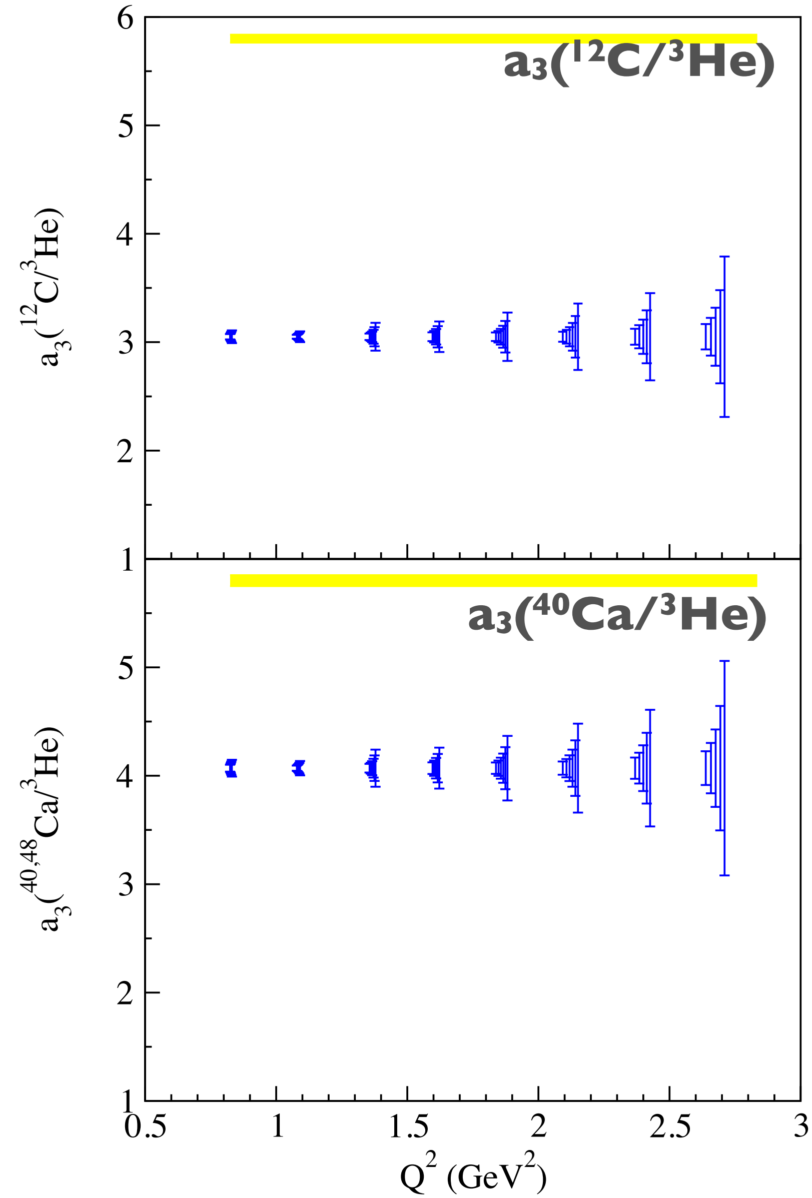
A/³He RATIO: MAP OUT 2N-SCALING REGION



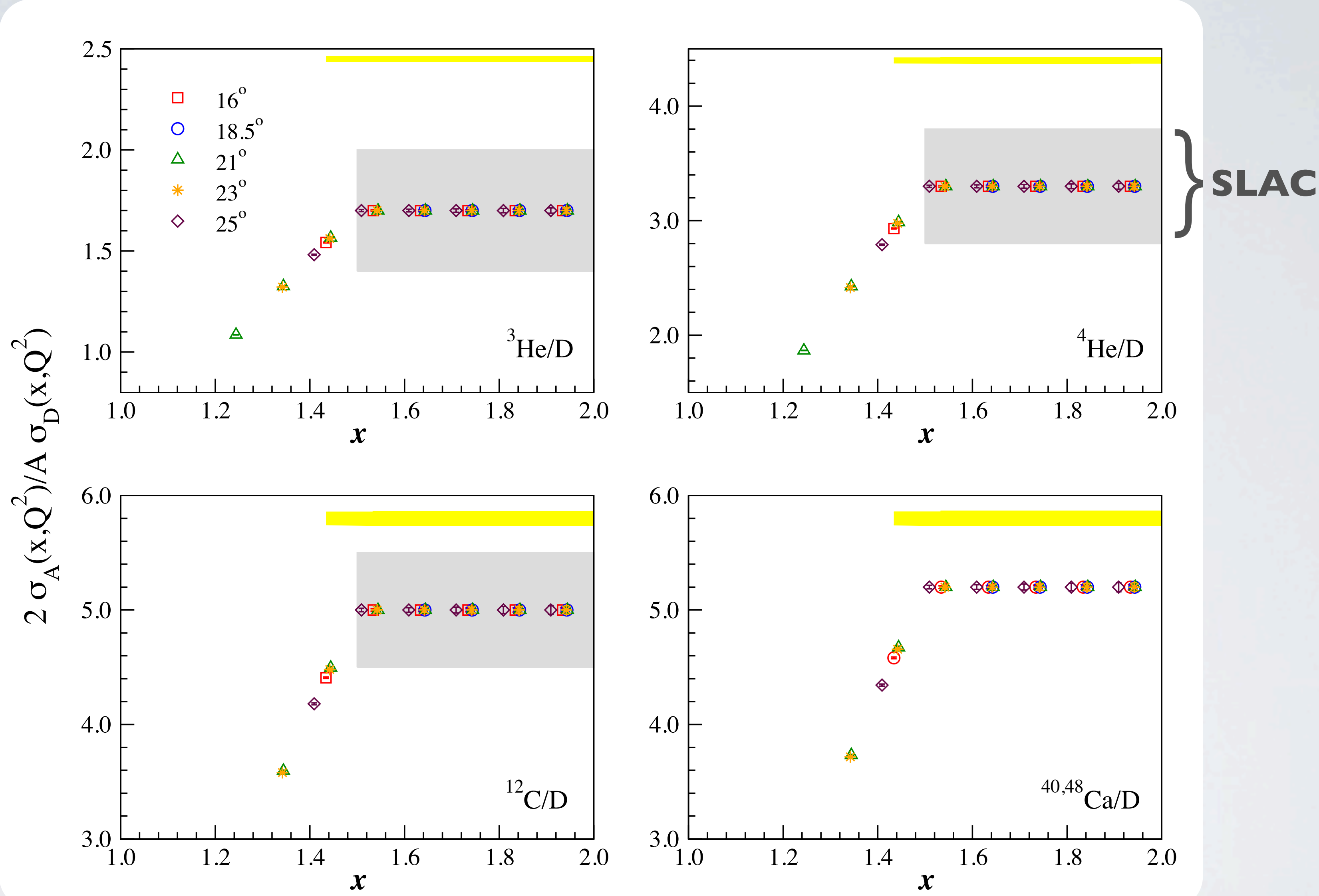


A/^{3}He RATIO: MAP OUT 3N-SCALING REGION





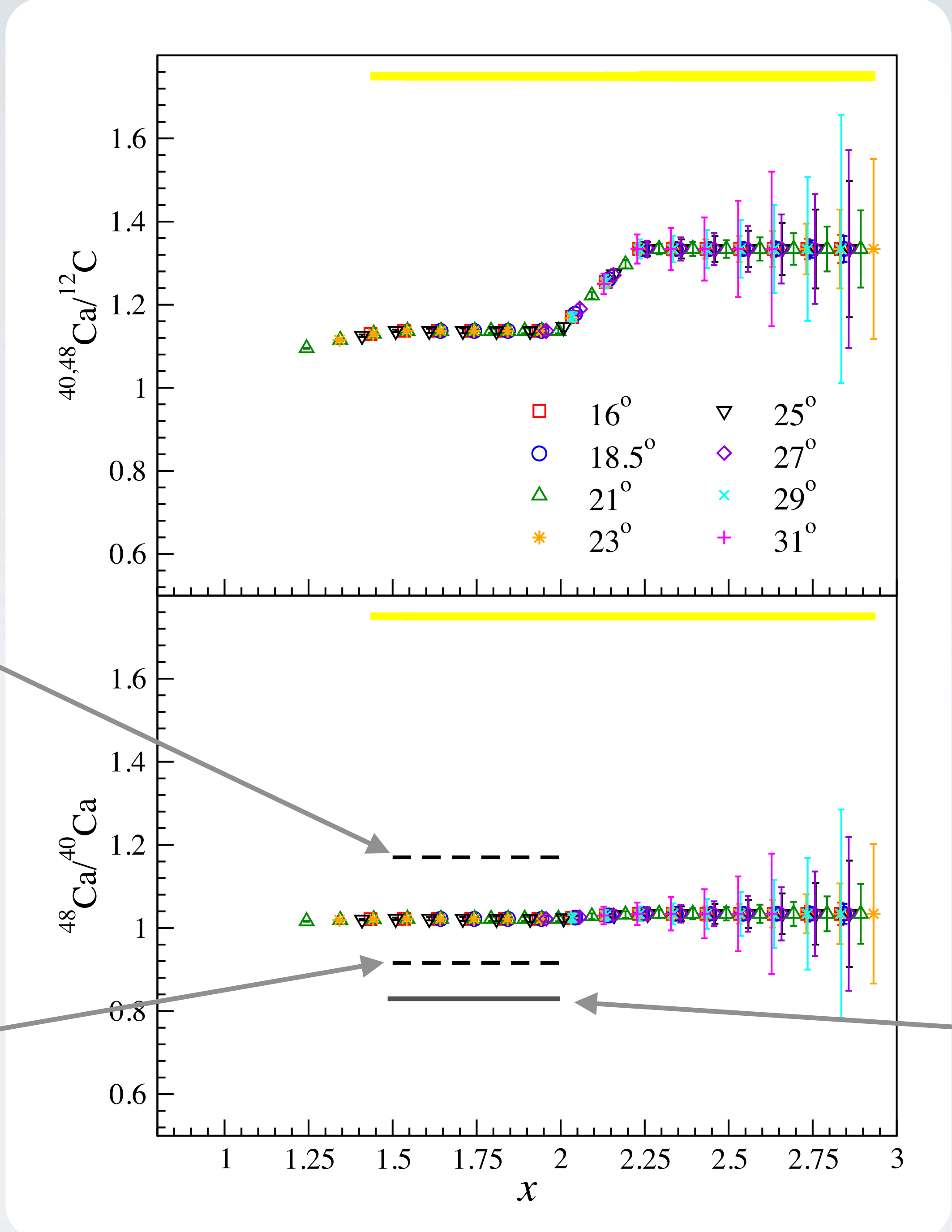
A/D RATIO: MAP OUT SCALING ONSET VS. X, Q^2



Improved test of scaling and a_2 extraction
Add heavy isoscalar study

1.2-2.8% scale uncertainty not shown

ISOSPIN STUDY FROM $^{48}Ca/^{40}Ca$ RATIO

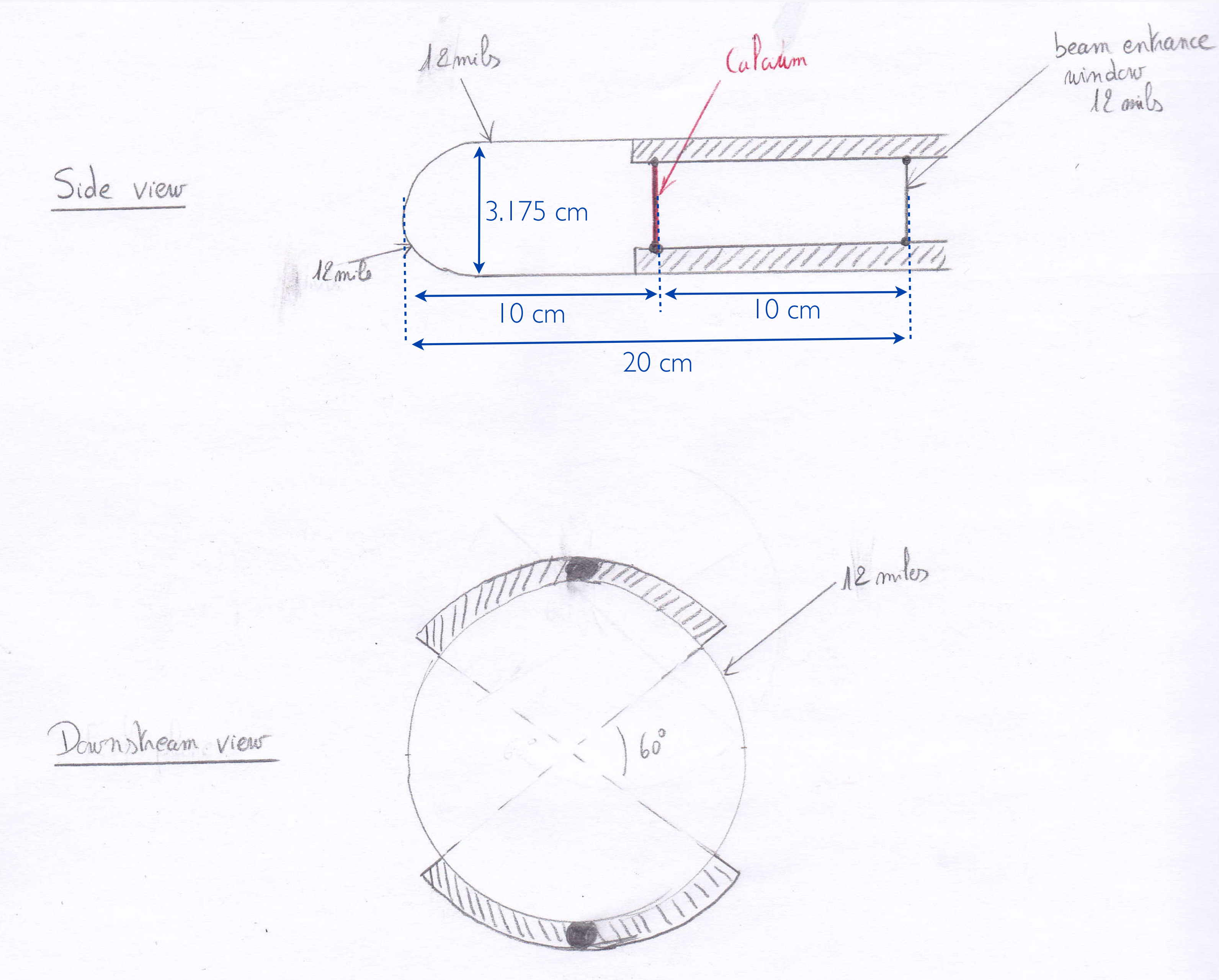


Mean field prediction for pn-dominance in 2N-SRC

Mean field prediction for isospin independence in 2N-SRC

No extra n-p pair

CALCIUM TARGET



SUMMARY

Inclusive scattering measurements from E08-014 will produce a detailed study of:

★Q^2 dependence of 2N, 3N-SRC from A/^{2}H, A/^{3}He and A/^{4}He ratios

★Study of isospin dependence of 2N-SRC

★Look at isospin dependence in 3N-SRC region

➥ Nice complement to the results of 2N knock-out experiments

Running in April-May 2011

EXTRA SLIDES

TARGET SPECS

Target	T(K), P(psia), L(cm)	Thickness(g/cm^2)
^{2}H	22.0, 22.0, 20.0	3.35
^{3}He	8.0, 200.0, 20.0	1.38
^{4}He	8.0, 200.0, 20.0	2.28
Al Entrance	N/A, N/A, 0.035	0.09
Al Exit	N/A, N/A, 0.035	0.09
Al Wall	N/A, N/A, 0.035	0.09

Target	T (K)	P (psia)	length (cm)	RL (g/cm^2)	I^{limit} (μA)
^{2}H	22.0	22.0	20.0	3.35	60.0
^{3}He	8.0	200.0	20.0	1.38	60.0
^{4}He	8.0	200.0	20.0	2.28	60.0
	thickness (cm)				
^{12}C	0.50			0.95	80.0
^{40}Ca	~~0.43~~ 0.50			0.66	40.0
^{48}Ca	~~0.43~~ 0.50			0.66	40.0

TARGET CRYOGENIC NEEDS

Hall:	A	Experiment:		x>2 (dedicated period) 4/12/2010-4/20/2010.			
Targets: (+)		Material	Length	Wall Mat	Thick*dens	Max Beam	
			cm		(g/cm2)	uA	GeV
	Target 1	LD2	20		3.2	60	3.3
	Target 2	3He 14 atm	20		1.4	60	3.3
	Target 3	4He 14 atm	20		2.3	60	3.3

Target Powers:		Beam On		Beam Off		Operating Temperature	
	Target 1	480	W	150	W	22	K
	Target 2	270	W	150	W	8	K ****
	Target 3	360	W	150	W	8	K ****

Additional Heat Load 1 (e.g. shield) if any: Operating Temperature:

Beam Off:		W
Beam On:		W

Additional Heat Load 2 (e.g. non-standard magnet) if any: Operating Temperature:

Beam Off:		W
Beam On:		W

Standard spectrometers/magnets in use (e.g. SHMS, HRS-L, ...), describe on base load template

#1	HRS_L
#2	HRS_R
#3	

Technical Details, if known:

	P_{inlet}	dP	T_{inlet}	T_{return}	Flow (g/s)	Liquifaction Load	Load***
	atm	atm	K	K	g/s	g/s	
Target 1	12	9	15	20	15		630
Target 2	3	0.5	4	20	9	****	420
Target 3	3	0.5	4	20	11	****	510
N_2	5		90				

**** option to run at higher temperature with 15K coolant?

- \+ 3He and 4He only one is cold at a time, could be together with LD2
- ++ Only one in beam
- * 3 atm supply is preferred
- ** 0.5 atm max is preferred
- *** at inlet temperature

Table from Jian-Ping Chen

E08-014 SYSTEMATICS

	$\delta\sigma/\sigma$	$\delta R/R$	$\delta R/R$
		(normalization)	(pt-to-pt)
Acceptance correction	2.0%*	0.5-2.0%	0.0-1.0%
Radiative correction	2.0%*	-	0.3%
Tracking efficiency	1.0%*	-	0.2%
Trigger efficiency	0.5%*	-	0.1%
PID efficiency	1.5%*	-	0.2%
Target thickness	0.5-2.0%	1.1-2.0%	-
Charge measurement	0.5%	-	0.5%
Energy measurement	0.05%	-	-
COMBINED UNCERTAINTY	4.1-4.6%	1.2-2.8%	0.7-1.2%
Uncertainty on a2,a3		1.5-3.0%	
CLAS		6.3-8.1%	
SLAC		10-18%	

Most kinematics are systematics dominated

KINEMATICS

	^3He	^2H	^4He	^{12}C	^{40}Ca	^{48}Ca	Total (per kin)	
16°	3.0	3.9	1.5	0.8	1.2	1.3	6	
18.5°	3.6	3.6	2.1	0.9	2.1	2.2	7	
21° (2N)	3.6	5.2	2.1	1.4	1.8	1.8	8	
21° (3N)	4.5	-	1.3	1.2	2.7	2.8	6	
23° (2N)	4.5	4.3	1.7	1.7	4.4	4.6	11	
23° (3N)	9.0	-	2.6	2.4	5.4	5.6	13	
25° (2N)	9.0	8.3	3.4	3.4	8.7	9.2	21	
25° (3N)	18.0	-	5.2	5.0	10.8	11.2	25	
27°	36.0	-	10.4	10.0	21.7	22.5	50	
29°	63.0	-	18.1	17.4	37.8	39.2	88	
31°	63.0	-	18.1	17.5	37.9	39.3	88	
Total (per tgt)	109	13	33	31	67	70	~323	per HRS

13.5 days (data taking) + 3.5 days (calibration + overhead)
= 17 days of beam time