PR12-26-012

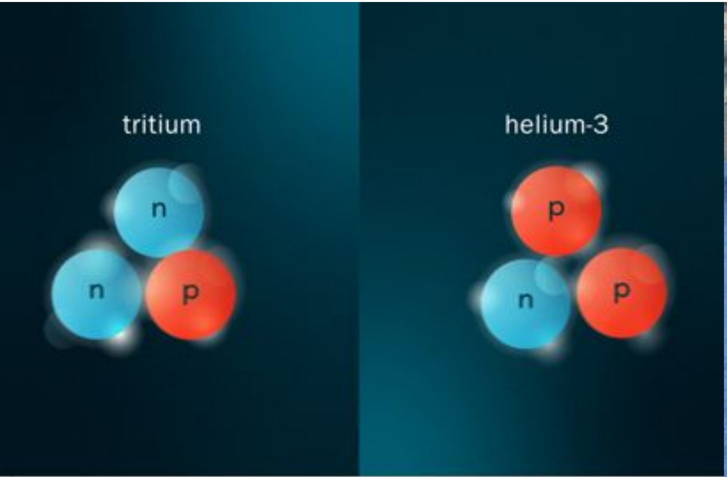
Probing the isospin and momentum structure of three-nucleon short-range correlations in the $^3H/^3He$ mirror system

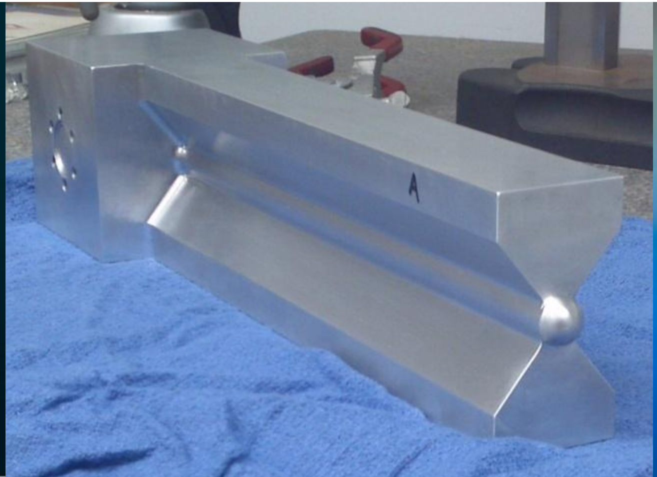
A run group proposal to PAC54

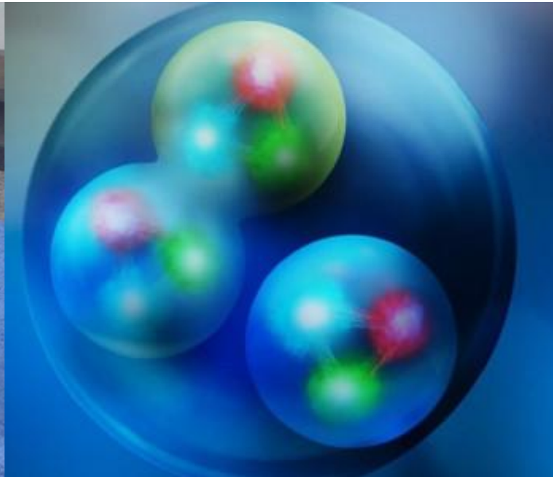
Spokespersons:

John Arrington (LBNL), <u>Shujie Li</u> (LBNL)

PAC54@JLab, July 7, 2026







A Clean A=3 Test of 3N-SRC Scaling

Question: Can 3N-SRCs be isolated in the simplest 3-body nuclei through α and Q^2 scaling?

Method:

- Measure $^3H/^3He$ inclusive QE ratios at $Q^2 \approx 1.6$ and 2.7 GeV^2 with **SHMS**. (in parallel with PR12-26-011)
- Same Hall A tritium target design with added collimation
- Hall A → Hall C SHMS: larger acceptance, higher Q^2

Why A=3: mirror cancellation, fixed nnp/npp configurations, small Fermi motion, no 3N center-of-mass (COM) smearing

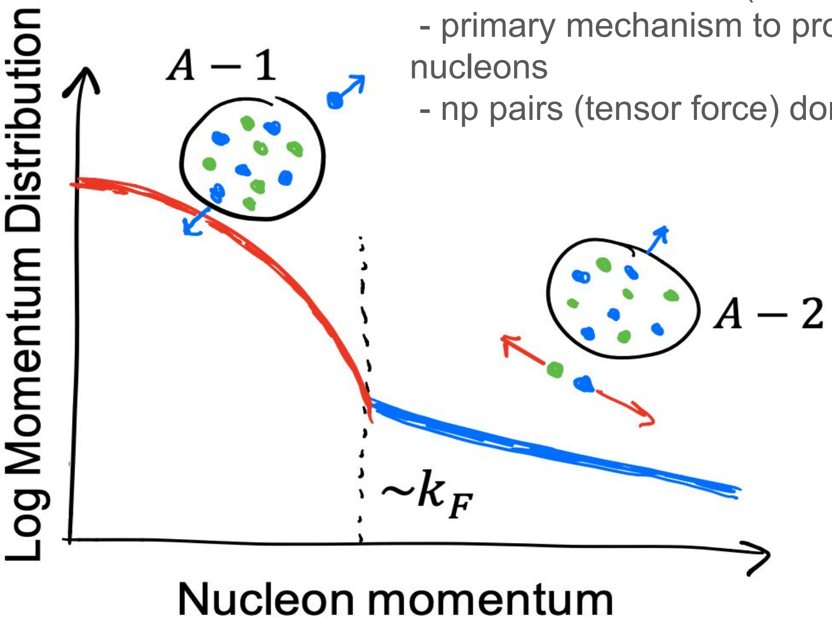
Possible outcomes:

- ❖ Map out the 2N-SRC to 3N-SRC transition, and provide stringent constraints to 3N system
- ❖ If scaling is established → isolated 3N-SRC benchmark

Short-range Correlations in Nuclei

1. **Independent particle shell model**
   - mean-field motion up to Fermi motion $\mathbf{k_F}$

2. High-momentum 2N-SRC pairs.
- large back-to-back momentum
- low center-of-mass (COM) motion
- primary mechanism to produce $\mathbf{>k_F}$ nucleons
- np pairs (tensor force) dominant



Cartoon from A. J. Tropiano, S. K. Bogner, R. J. Furnstahl, PRC 104, 034311 (2021)

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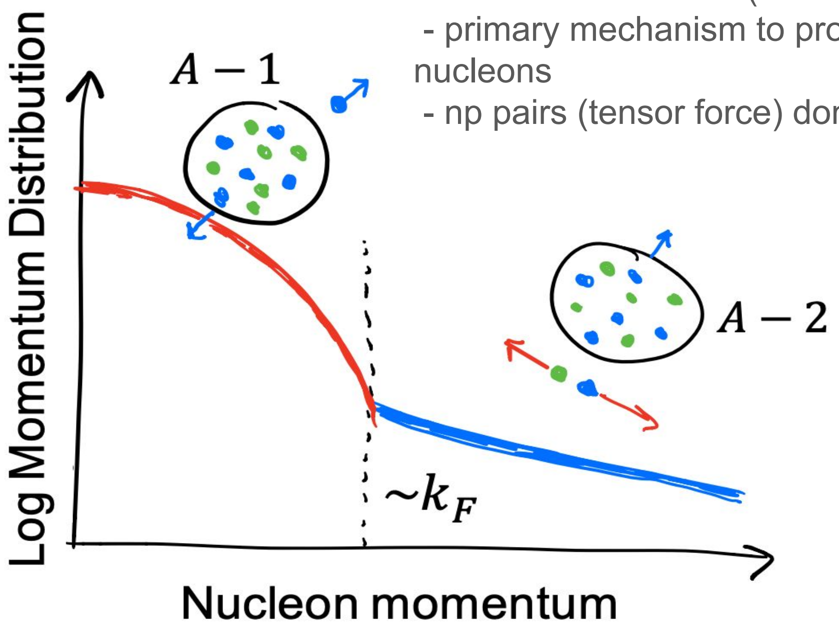
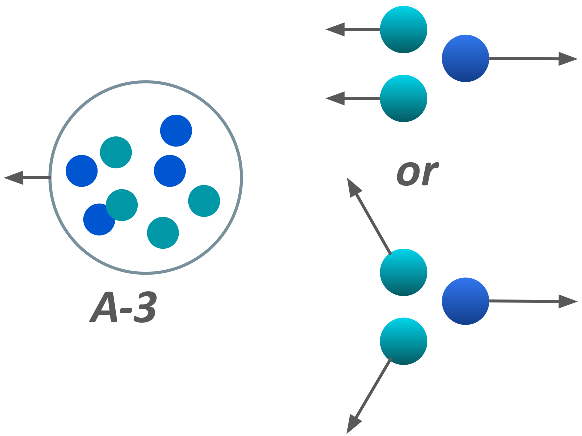


Cartoon from A. J. Tropiano, S. K. Bogner, R. J. Furnstahl, PRC 104, 034311 (2021)

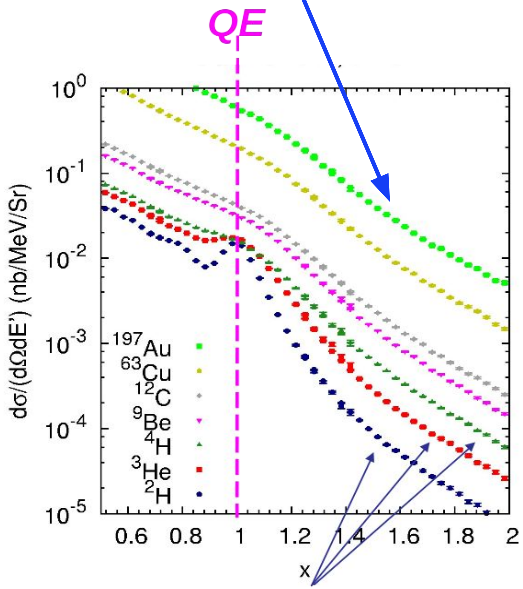
3. 3N SRC configuration:
- 3 nucleons with correlated large ($>\mathbf{k_F}$) momentum but small COM
- Isolate 3N SRC in electron scattering to study:
  - Isospin configurations
    - ppp, nnn, **ppn, nnp**
  - Which nucleon gets the highest momentum?



2N SRC Scaling in (e,e’)

Isolate 2N SRC by suppressing low-momentum contributions

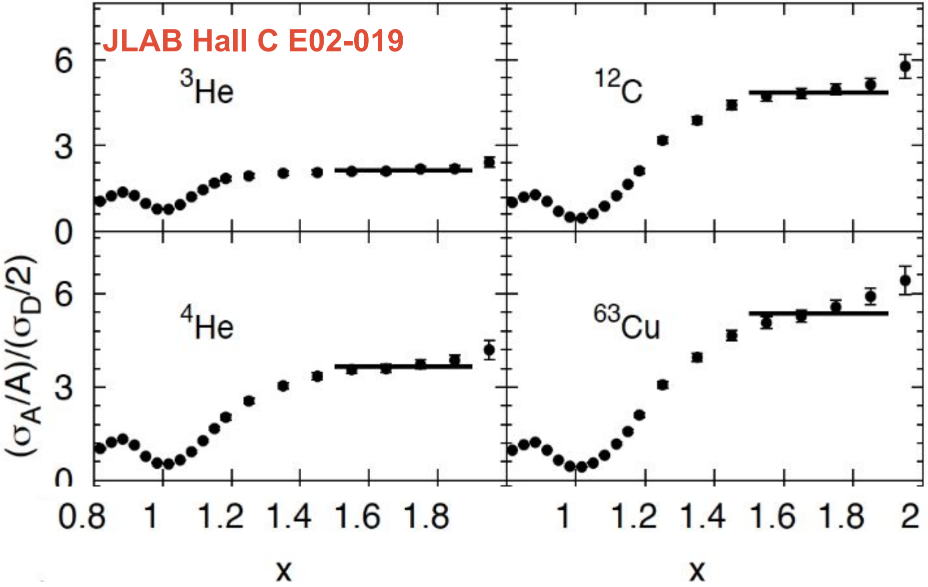
$$\sigma_A = \overset{0}{\cancel{\sigma_{QE}}} + \boxed{a_2(A)\sigma_2} + a_3(A)\overset{0}{\cancel{\sigma_3}} + \ldots$$



High momentum tails should yield **constant ratio** *if SRC-dominated*

N. Fomin, et al., PRL 108 (2012) 092052

Plateaus in A/D cross section ratio



3N-SRC Scaling Search in 6 GeV Era

The usual path:

- In (e,e'), isolate 3N SRC by suppressing mean-field and 2N contributions at **high Q^2**,

Looking for A/^{3}He scaling at x>2:

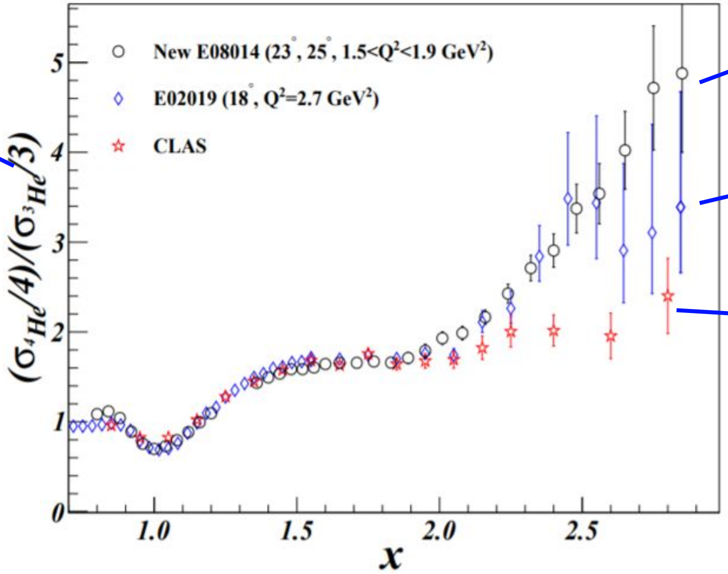
$$\sigma_A = \sigma_{QE} + a_2(A)\sigma_2 + a_3(A)\sigma_3 + \ldots$$

0 0

Major experimental challenge: rate, resolution…

- No positive signal so far.

A/^{3}He compares a mixed-isospin numerator to the ppn-only denominator

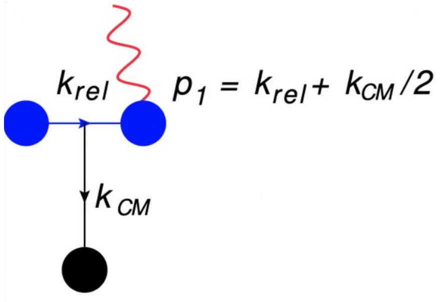


No scaling observed at that Q^2

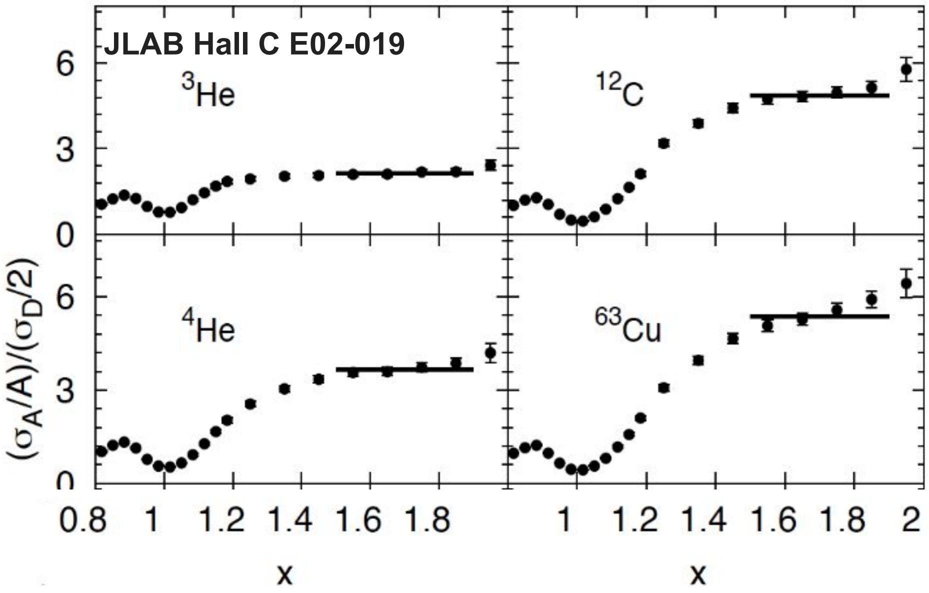
Large stats error due to small cross sections at high Q^2

Reported the x>2 plateau, but re-analysis suggested an artifact of bin-migration effects due to limited CLAS6 resolution.

Re-assessing the Scaling Threshold



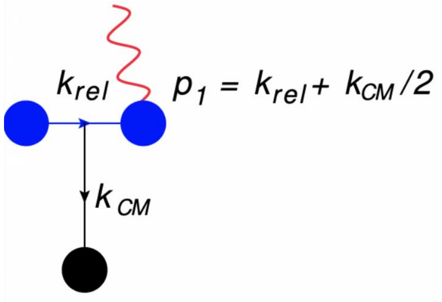
The 2N-SRC scaling onset is clearly **A-dependent**



Scaling is established when
$\min(p_1) := k_{min} > k_F + k_{CM}/2$

heavier nuclei
→ larger $\mathbf{k_F}$ and $\mathbf{k_{CM}}$
→ larger **threshold p_1** for scaling onset

Re-assessing the Scaling Threshold



SRC scaling variable for e' kinematics:

Light-cone variable α: the light-front momentum distribution.

If approximated in 2N;

$$\alpha_{2N} = 2 - \frac{q_- + 2m}{2m} \frac{\sqrt{W^2 - 4m^2} + W}{W}$$

Scaling is established when

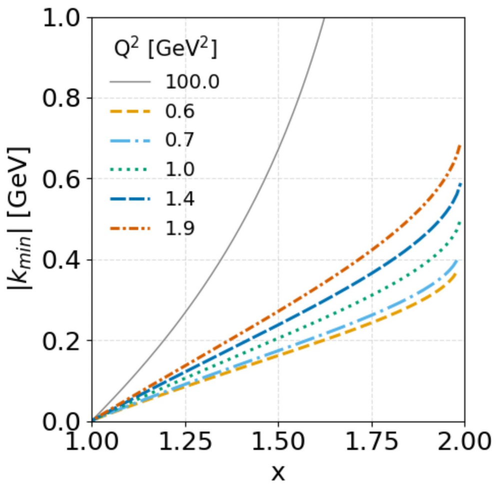
min(p_1) := $k_{min} > k_F + k_{CM}/2$

heavier nuclei

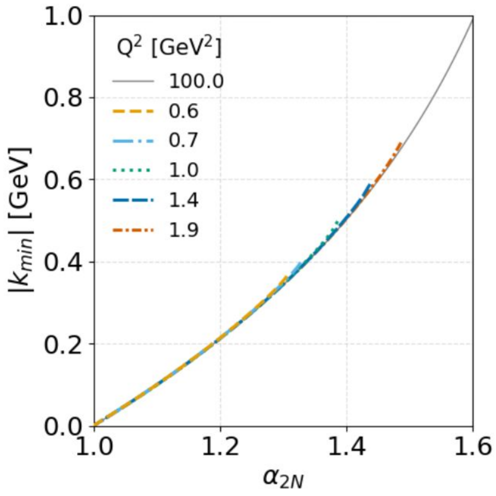
→ larger $\mathbf{k_F}$ and $\mathbf{k_{CM}}$

→ larger **threshold α (or Q^2)** for scaling onset

- **Large x and Q^2 ⇒ large k_{min}**



- **Large α ⇒ large k_{min}**

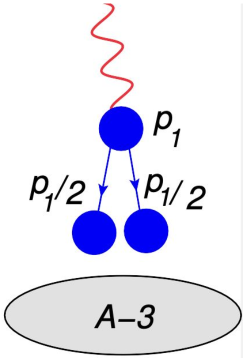


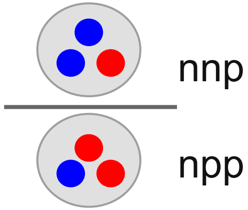
3N-SRC Scaling Search in 12 GeV Era

Two complementary efforts to isolate 3N-SRC above the kinematic threshold:

- **A>3 :** tests nuclear systematics, universality of 3N-SRC, and A-dependence at higher α at x>2 (higher Q^2)

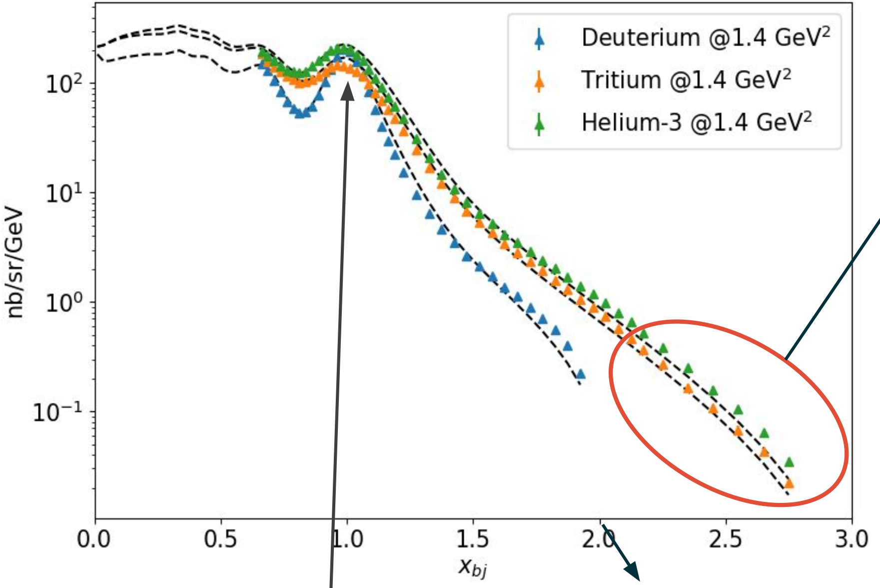
- **A=3:** a **clean** benchmark to
  - Search or confirm 3N-SRC scaling at mid α and Q^2
    - **Scaling-violating** effects such as nuclear effects, final-state interactions, and other competing processes largely **cancelled** in mirror nuclei comparisons.
    - Small Fermi motion → mean field contribution drops fast
  - Provide a baseline for 3N quantitative interpretation
    - Clean **nnp** or **npp** configuration. Can construct the isoscalar average for A/3
    - No COM, momentum balance remains in the A=3 system
    - Sensitive to the leading nucleon isospin in 3N





Our Approach: 3N SRC with A=3 Mirror Nuclei

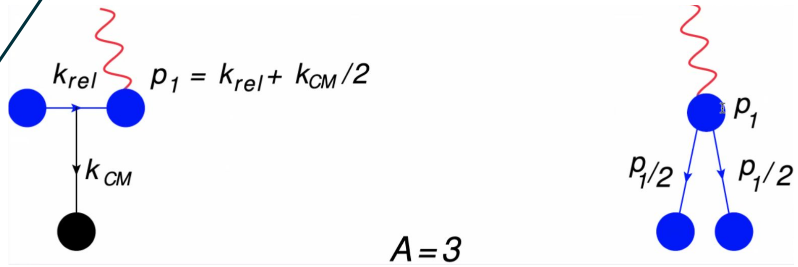
(e,e') cross section from E12-11-112@Hall A, 2018



x=2: Limit of static 2N-SRC pair e.g. deuteron

$$\sigma_A = \sigma_{QE} + a_2(A)\sigma_2 + a_3(A)\sigma_3 + \ldots$$

x>2: 2N-SRC with COM or 3N-SRC?



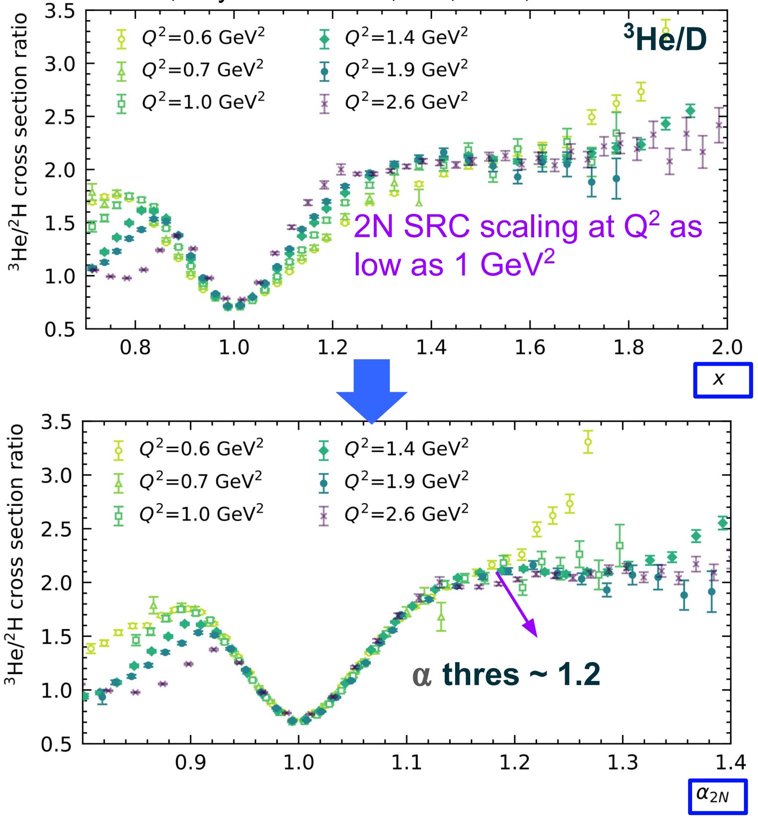
Easier to find 3N above mean-field in A=3:

- Smaller $\mathbf{k_F}$:
  - <100 MeV/c in A=3
  - ~250 MeV/c in A>=12
- smaller COM for 2N SRC
- No COM for 3N SRC

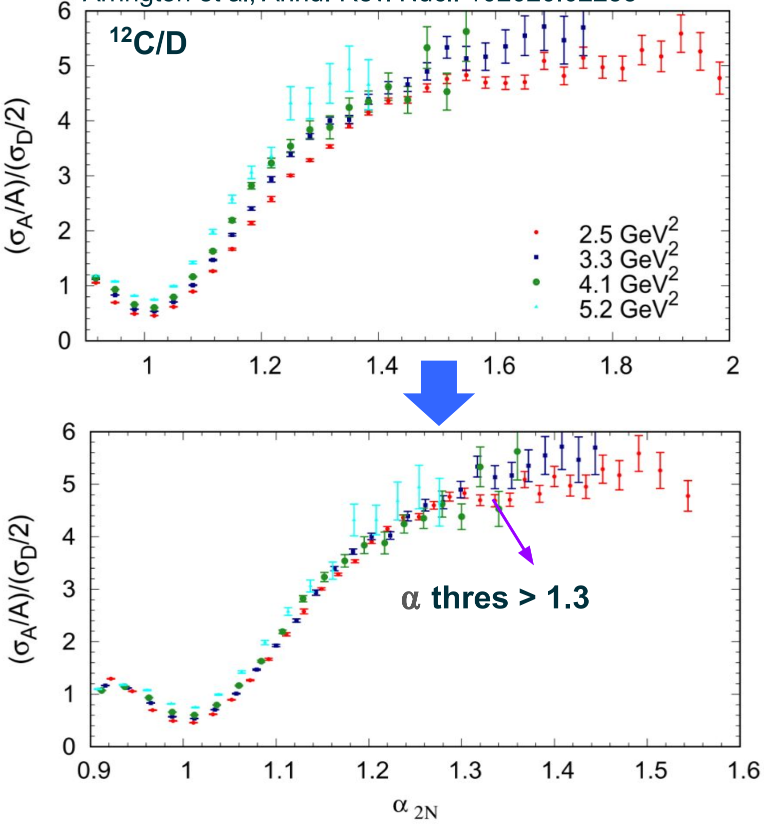
⇒ isolate 3N-SRC → scaling at lower threshold α and Q²

Hint: 2N Scaling Onset vs. A

SL et al, Physics Letters B, 868, 2025,139734



Arrington et al, Annu. Rev. Nucl. 102020.02253



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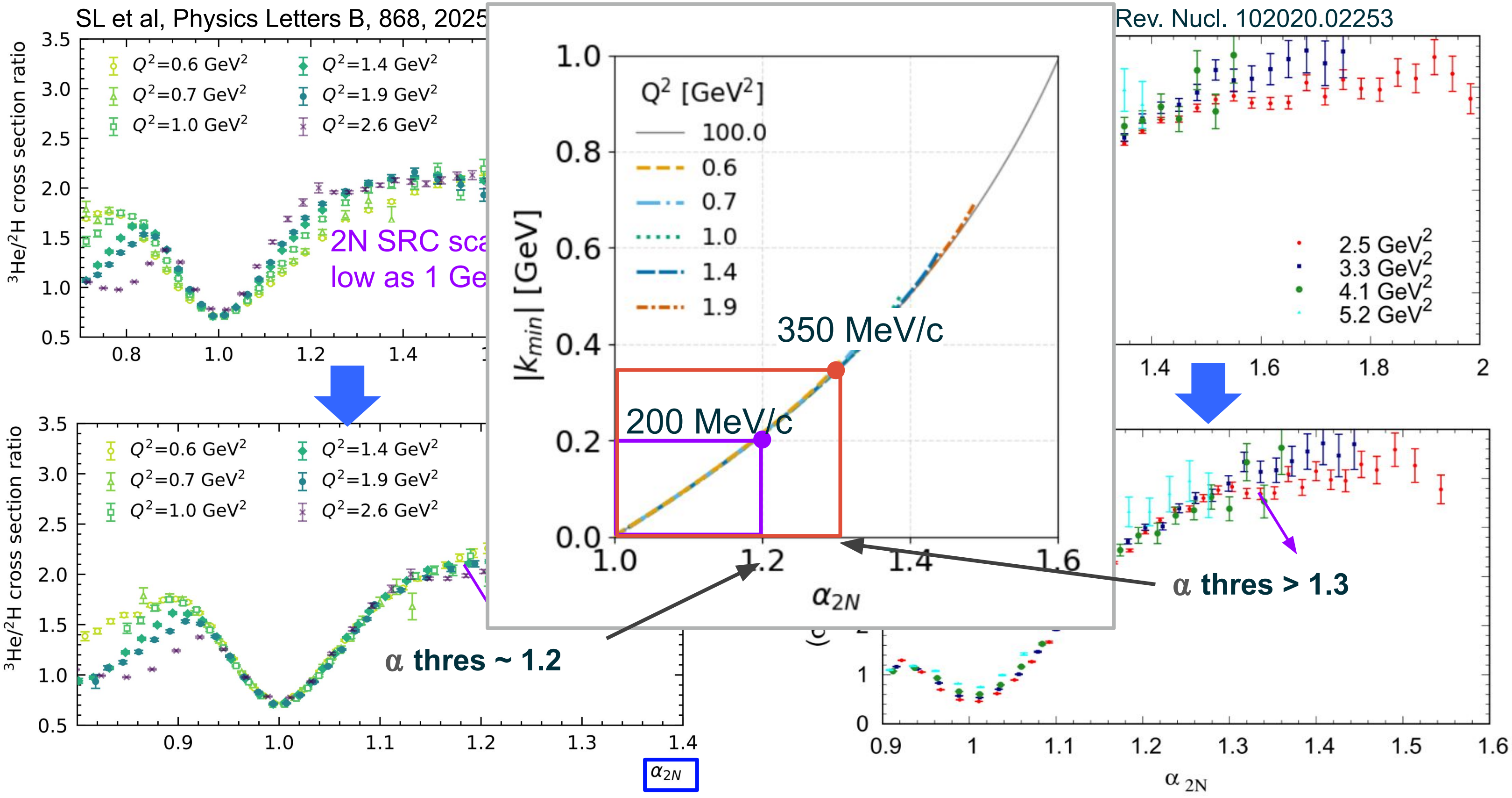
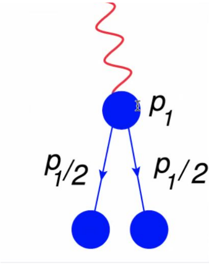


Hint: 3N Scaling in A=3?

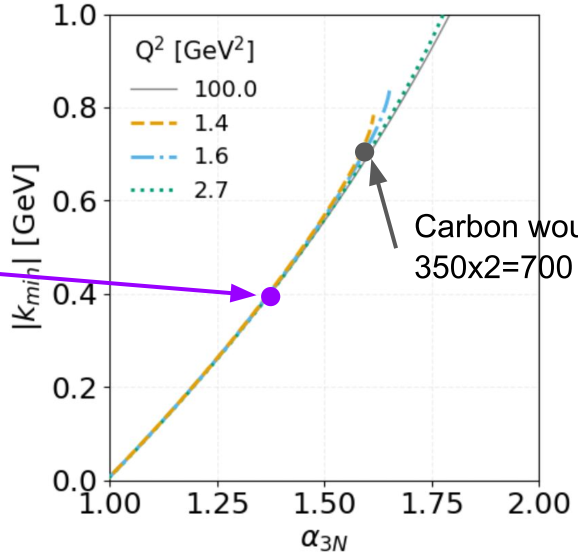


For A=3:
lowest energy configuration in (e,e’) to ensure all 3N are above mean-field:

p1=400, p2 = p3 = 200 MeV/c

For the leading nucleon:

α=1.4 ⇒ k_{min}=400 MeV/c



Carbon would require
350x2=700 MeV/c ⇒ α=1.6

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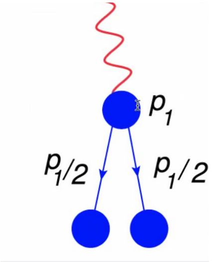

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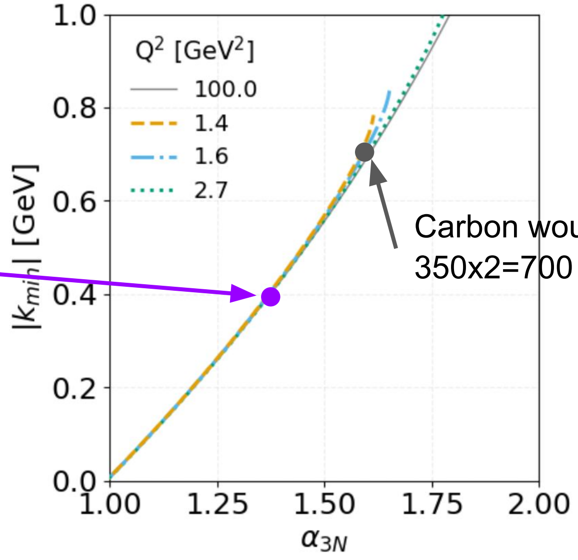

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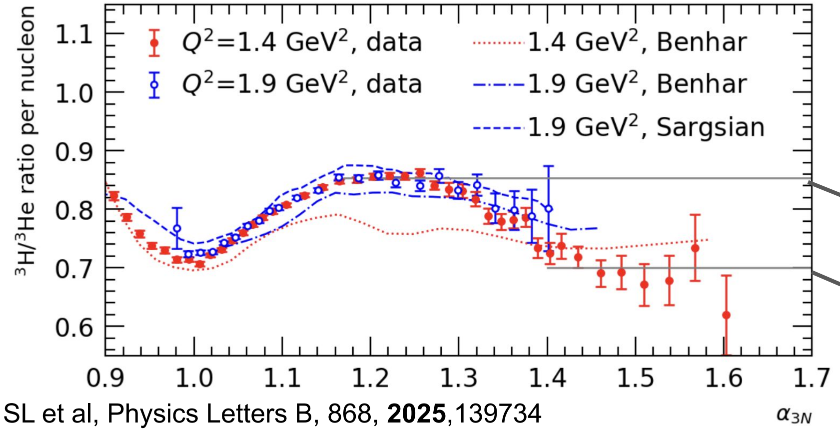
Observation from 2018 A=3 data

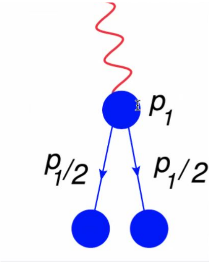


SL et al, Physics Letters B, 868, **2025**,139734

2N SRC scaling onset at α=1.2

Possible 3N scaling onset at α=1.4 ?

Hint: 3N Scaling in A=3?



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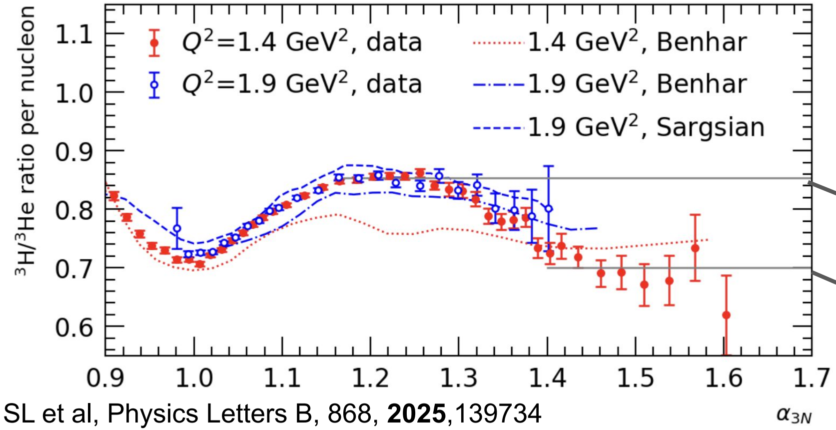
Already have:
- A=3 data up to α of 1.6
- 2N SRC scaling at lower Q^2 , and calculations that describe the shape
- Possible **onset** of 3N SRC scaling with limited precision

Still missing:
- Statistical significance to claim a plateau
- Multiple Q^2 settings to confirm scaling

Goals of the new proposal

Observation from 2018 A=3 data



SL et al, Physics Letters B, 868, **2025**,139734

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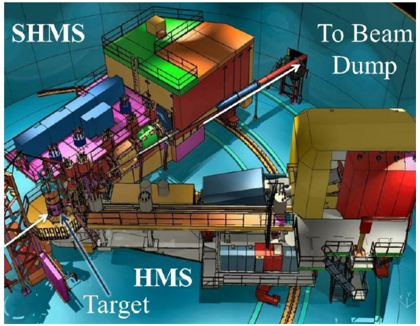
New Proposal: Kinematics



SHMS in standard configuration to detect scattered electrons

- Good momentum resolution (v.s. Hall B CLAS12)
- Higher central momentum, smaller angle (v.s. Hall A) → higher rates → can afford higher Q^2
- Large momentum acceptance → one single setting to cover x from 1 to 3

	E12-11-112	This Proposal	
Kinematics	**L17**	**kin1**	**kin2**
Beam Energy	4.3 GeV	11 GeV	8.8 GeV
Spectrometer	HRS@Hall A	SHMS@Hall C	SHMS@Hall C
Angle	17.0	8.5	8.5
Central momentum	3.54 - 3.94 GeV	9.8 GeV	8.2 GeV
Q^2	1.4	2.7	1.6

New Proposal: Target System

Same target system design from the 2018 tritium program:

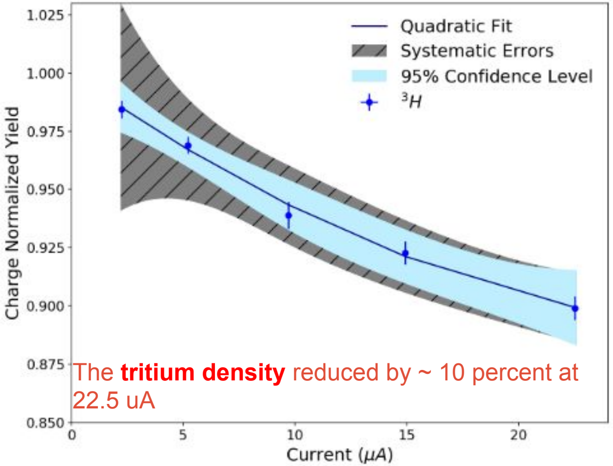
- 25cm long sealed Alloy cell
  - Large block of aluminum for heat sink
  - hold **1000 Ci** tritium gas at 10 atm
  - Will use identical cells for deuterium, helium-3, as well as an empty cell for calibration

- Well-understood target properties:
  - Beam-induced density fluctuation at 10% level
  - Tritium decay correction

- Similar **safety** protocols:
  - beam current limit (22.5uA)
  - Raster size 2x2mm
  - Beam-on temperature <150 K

(Some engineered safety mitigations will have to be different for Hall C)

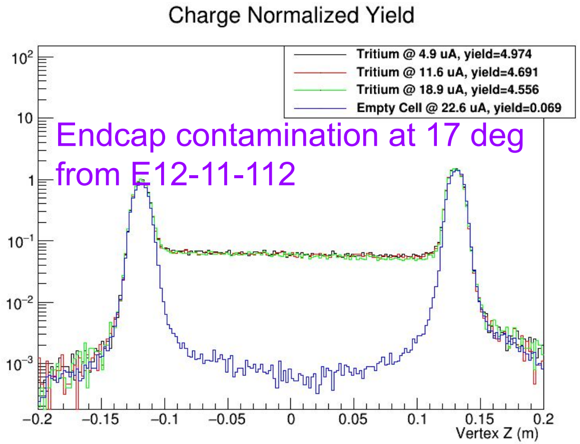
S. Santiesteban et al. , https://doi.org/10.1016/J.NIMA.2019.06.025



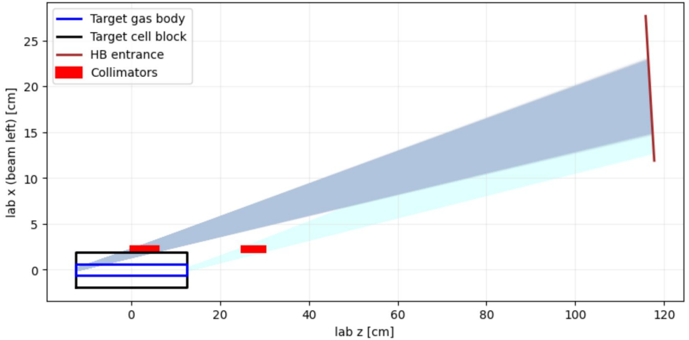
New Proposal: Target System

Additional target collimators (tungsten blocks):

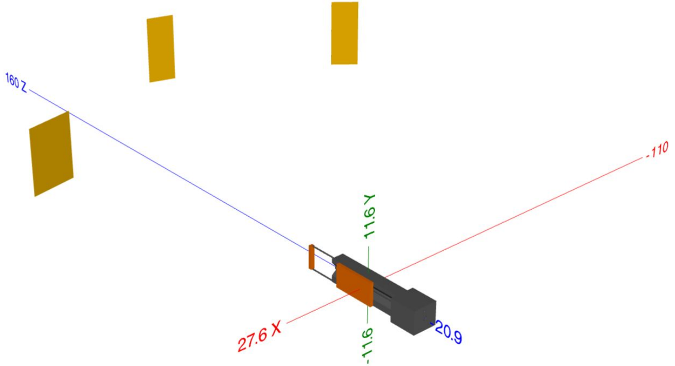
- Without collimator:
  - Apply vertex z cut e.g. +-8cm to remove endcap window peaks → rely on reconstruction resolution
  - Subtract residuals with empty cell
- **With collimator:**
  - Most of endcap events won't reach detector plane. Also reduce the rates
  - Empty cell runs for double check
  - Feasibility tested with SIMC (acceptance) and GEANT4 (background)



- Endcap events projections from SIMC



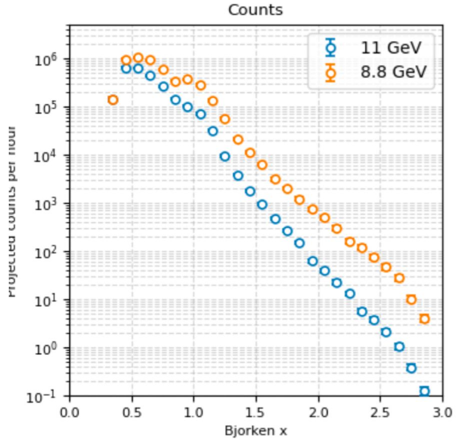
- Target cell, collimators, and spectrometer entrance in GEANT4



New Proposal: Run Plan

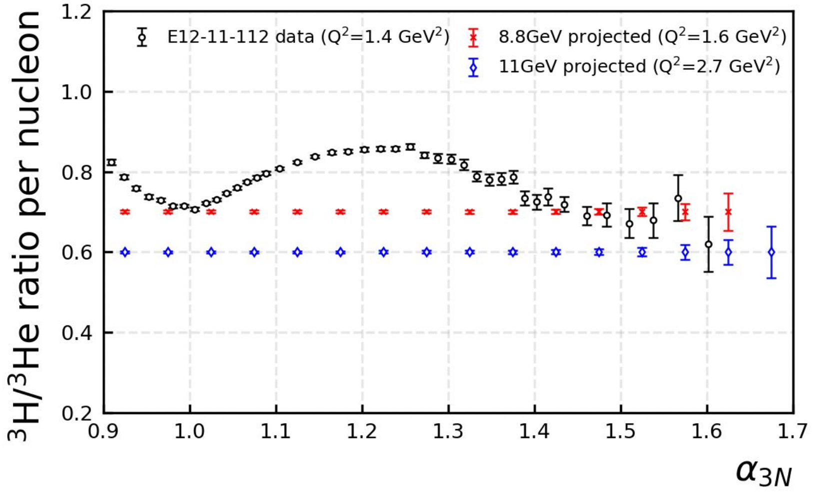
	Beam Energy (GeV)	Beam Current (μA)	Beam Requirements	Target Material	Material Thickness (mg/cm^2)	Beamtime (days)
	6.6	22.5	Unpolarized	^{1}H	71	0.1
Calibration	6.6	22.5	Unpolarized	^{2}H	142	0.2
	6.6	22.5	Unpolarized	^{3}H	85	0.8
	6.6	22.5	Unpolarized	^{3}He	64	0.7
	6.6	22.5	Unpolarized	^{27}Al	350	0.2
Production	8.8	22.5	Unpolarized	^{1}H	71	1.0
	8.8	22.5	Unpolarized	^{2}H	142	1.5
	8.8	22.5	Unpolarized	^{3}H	85	5.5
	8.8	22.5	Unpolarized	^{3}He	64	5.0
	8.8	22.5	Unpolarized	^{27}Al	350	1.0
	11.0	22.5	Unpolarized	^{1}H	71	2.5
Production	11.0	22.5	Unpolarized	^{2}H	142	3.0
	11.0	22.5	Unpolarized	^{3}H	85	16
	11.0	22.5	Unpolarized	^{3}He	64	15
	11.0	22.5	Unpolarized	^{27}Al	350	4.5
	Total Beam Time					57 days
	Configuration Change					3 days
	Total Time					60 days

(+4 days if assuming 53mg/cm^2 for ^{3}He instead of 64mg/cm^2)



- 60 PAC days including calibrations to reach <3% statistical uncertainties up to α=1.7
- 1.2% systematic uncertainties in ratios at x>2 + 1.2% normalization mainly from target density
- Run in parallel with PR12-26-011 (HMS)

New Proposal: Projected Results



❖ Bin size is chosen to be at least 3 times the detector resolution

Precise ratios and cross sections to compare to *ab initio* calculations

- Test high-momentum components in precise *ab initio* few-body calculations
- Intrinsic sensitivity to isoscalar structure of highest-momentum nucleons (next slide)

Quantitative 3N-SRC scaling test in A=3:

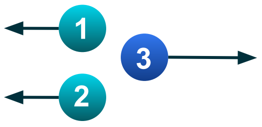
- Extend precision and α range for α > 1.4
- Compare two Q^2 values higher than Hall A data
- Precision sufficient to set 5% limit on variation above α>1.4

If 3N-SRC dominance confirmed, extract SRC information

- Ratio provides constraint on isospin structure of leading nucleons
- Baseline for A/3He measurement…
- Provide guidance on structure and cross sections needed for exclusive measurements

New Proposal: Projected Results

A clean A=3 benchmark: known nnp and npp configurations with 0 center-of-mass motion to constrain the isospin of the leading (highest momentum) nucleon at large $\mathbf{k}_{min}$



"Line" configuration

$p_3 = p_1 + p_2$

$R(^3H/^3He) \approx \sigma_p/\sigma_n \approx 2.5$

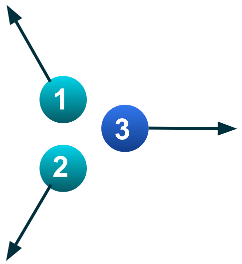
if nucleon #3 favors p in (nnp) and n in (npp)

$R(^3H/^3He) \approx \sigma_n/\sigma_p \approx 0.4$

if nucleon #3 is favors n in (nnp) and p in (npp)

$R(^3H/^3He) \approx 0.7$

if the chance to probe highest momentum nucleon is isospin-independent



"Star" configuration

$p_1 = p_2 = p_3$

Requires high E_{miss}, no sensitivity in (e,e')

Summary

- **A definitive A=3 scaling test:**
  - A=3 inclusive cross section measurement to test the possible 3N-SRC scaling observed in the 2018 data
  - α up to 1.7
  - Q^2 at 1.6 and 2.7 GeV^2 with enough precision to support a plateau claim

- **A clean A=3 benchmark:**
  - Pin down the minimal kinematic requirement for scaling
  - Decouple center-of-mass motion, isoscalar corrections, scale-violating processes from 3N-SRC measurement
  - Benchmark 3N-SRC structure against theories

- **The Hall C tritium run group:**
  - Use Hall A 2018 tritium target design with SHMS-side collimators
  - This unique combination of beam, A=3 target, and high momentum spectrometer is only possible at JLab

Thank you!

Justification

Timely: x>2 ratio from 2025, A/3 proposal this year, theory engagement, white paper this year, does not dependent on A/3 results

A controlled technical path: Hall A cell design, SHMS standard configuration, added endcap collimation, empty/dummy/optics calibrations.

High Impact: A=3 provides the baseline for 3N-SRC studies

Connections:

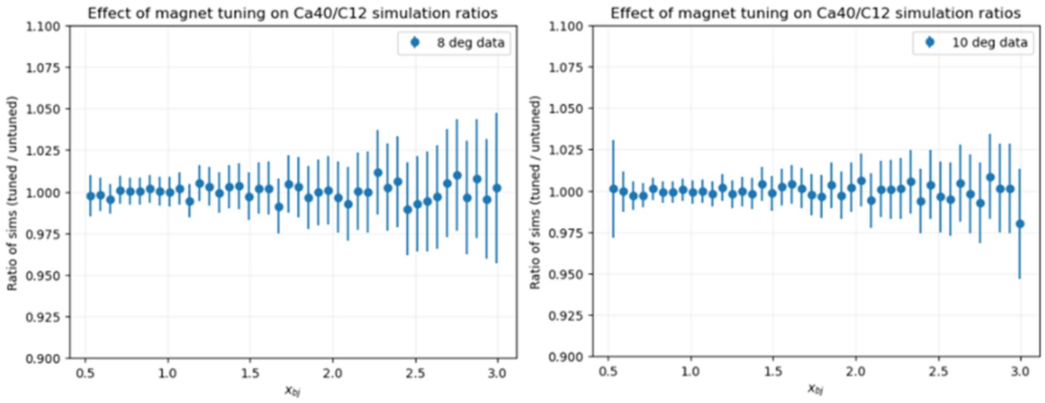
repulsive core v.s. 3N

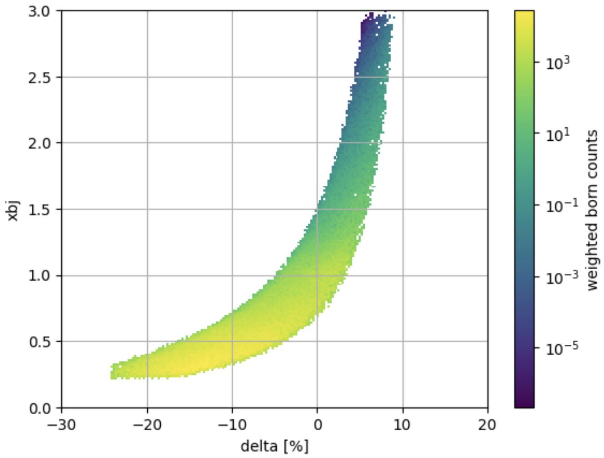
3N → 3 body force
2BB xs is << 3N SRC
3N force need exclusive measurement with large Emiss but only after the 3N factorization/scaling is established

Optics Calibration

- Take sieve data with optics target at exact kinematics
- Take delta scan at lower momentum/energy, and extrapolate based on our knowledge of field map
    - Saturation has limited impact on ratio
    - Constrain delta range to <10% to limit delta distortion

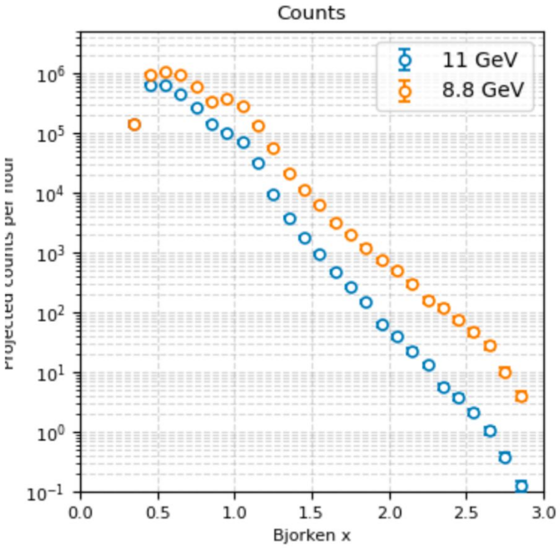
Optics study from XEM2 (courtesy of Jordan O'Kronley)

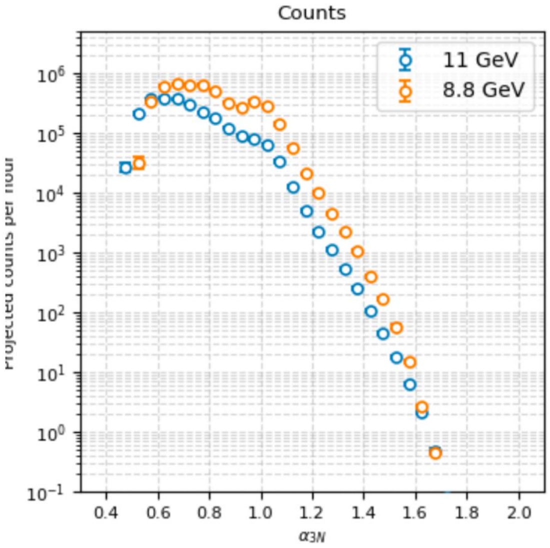




New Proposal: Rate

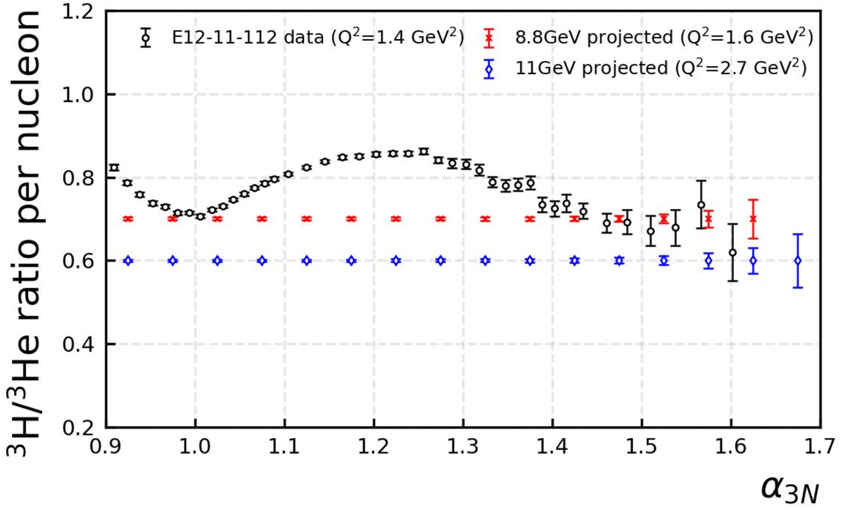
Hall C Single-arm simulation package
Cross section model: F1F209 + QE fitted to 2018 A=3 data

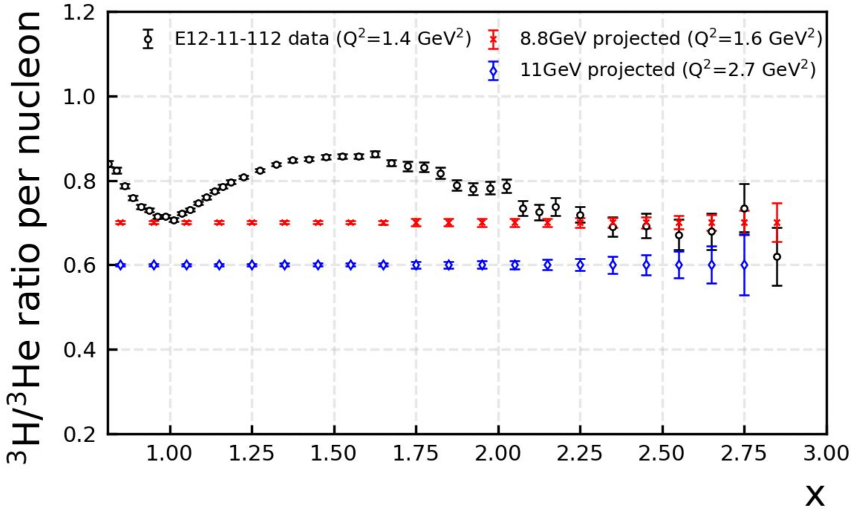




Ebeam (GeV)	P_0 (GeV/c)	Angle (degrees)	Total DAQ Rate (Hz)	$1.55 < \alpha_{3N} < 1.6$		
				counts/hour	$Q^2(\mathrm{GeV}^2)$	x
8.8	8.2	8.5	3108	15	1.6	2.55
11.0	9.8	8.5	1561	6.25	2.7	2.24

New Proposal: Sensitivity





Fit the plateau:

1. Linear fit **y=A + Bx**. for projected data, force the data central value of 0.7
2. If the fitted B is consistent with a flat line, then we further check the end-to-end variation:

   delta = [y(x=1.4) - y(x=1.6)]/y0

   where 1.4 and 1.6 are the alpha values at end points. y0=0.7 for projected data

For 1.6 and 2.7 GeV^2 projected result, consider a fit between 1.4 and 1.6 of alpha, the stats plus the 1.2% point-to-point systematics can support the claim of:

*B is consistent with 0 +-0.2, and the end-to-end fluctuation i.e. the uncertainty on delta is less than **4%** ⇒ is the fluctuation within the alpha range of 1.4 to 1.7 will be less than **8% with 95% C.I.***

This is a lot stronger than what we can claim with the 2018 data which has either:

- B is consistent with 0 but uncertainties are large. 95% C.I. width > 18% for delta. (if fit at alpha>1.45)
- B is clearly not 0 from the linear (if fit at alpha>1.4)

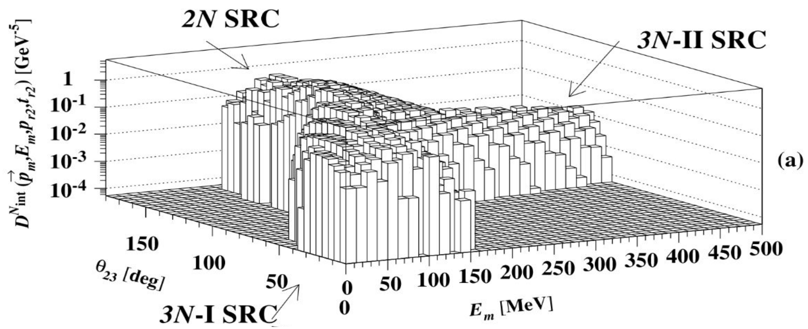
	Error on the slope (alpha>1.4)
5 pass projected:	0+/-0.111
4 pass projected:	0+/-0.188
Combined	0+/-0.096
Hall A:	-0.40+/-0.19

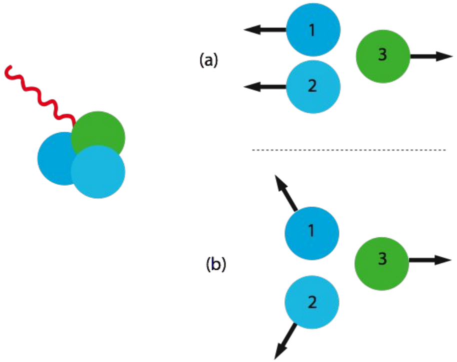
My Perspective of 3N SRC Search

- Does it exist?
  - x>2 scaling with A=3 and A>12
  - Coincident detection at identified scaling region

- Universality?
  - A/3 ratios

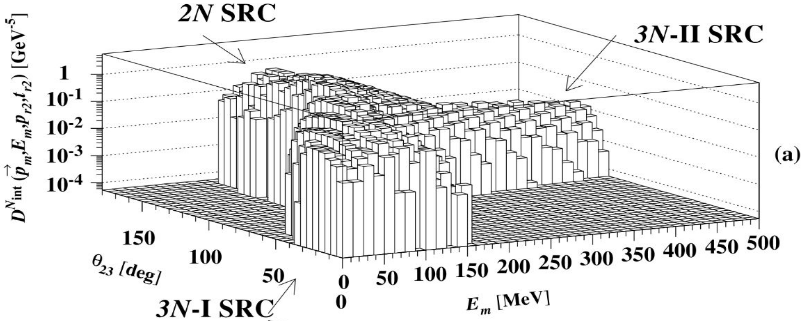
- What configuration?
  - A=3 electrodisintegration
  - A=3 (e,e’) ratio

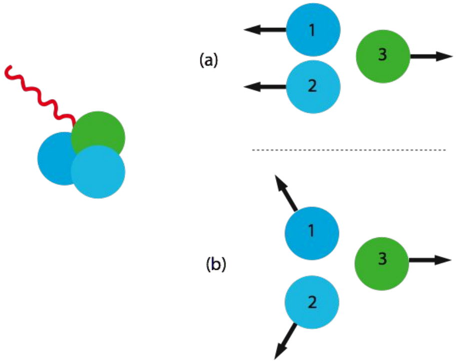




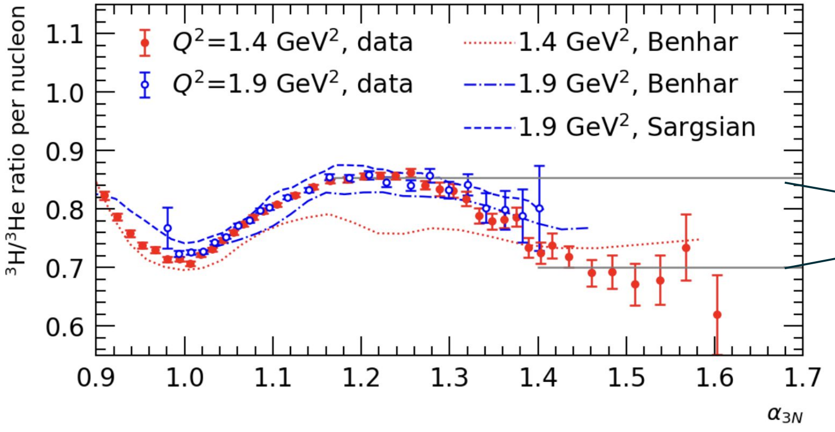
My Perspective of 3N SRC Search

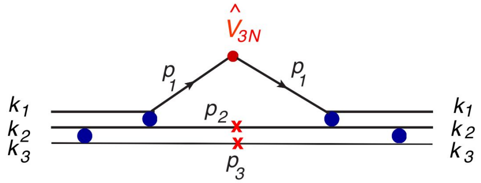
- **Why tritium (e,e')?**
  - Still high-x but less expensive:
    - Lower Q^2 comparing to heavier nuclei
  - Provide baseline for other measurements and calculations (know your denominator)
  - Mirror nuclei
    - Control scale-violation processes
    - Zero center of mass motion, two clean nnp or npp configuration → remove ambiguities in interpretation





What We Talk About When We Talk About 3N SRC

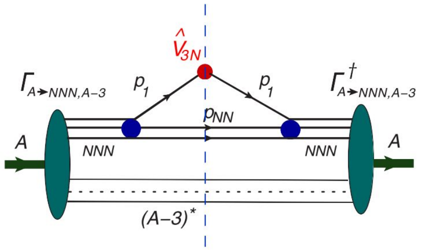




Convolution of 2N SRCs?

$$R(^3H/^3He)_{3N} \approx [R(^3H/^3He)_{2N}]^2$$
$$= 0.854^2$$
$$\approx 0.7$$

- Seems to be consistent with data
- Favors the line configuration
- Still tensor force?



Irreducible 3N SRC:

- ❖ Involves inelastic transition
- ❖ High Emiss
- ❖ 3-body force?

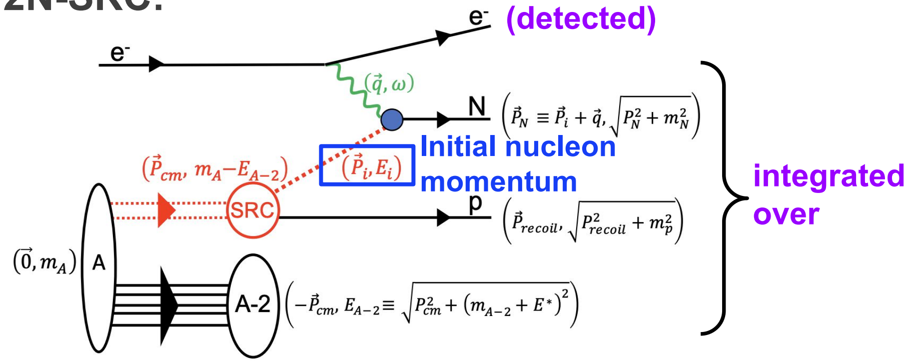
If scales but not at ratio=0.7:

- Contribution from nn and pp:
  - p+p → p+n ⇒ 3N SRC
  - n+n → n+p ⇒ 3N SRC
- N+N ⇒ 2N repulsive core → require large COM

Scaling violation in 2N

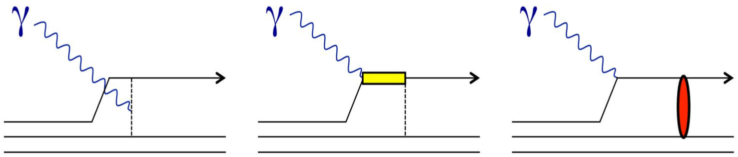
- Electron knocks out nucleon quasi-elastically
- “Inclusive”: detect e’ only, integrate over final state

2N-SRC:



Competing processes:

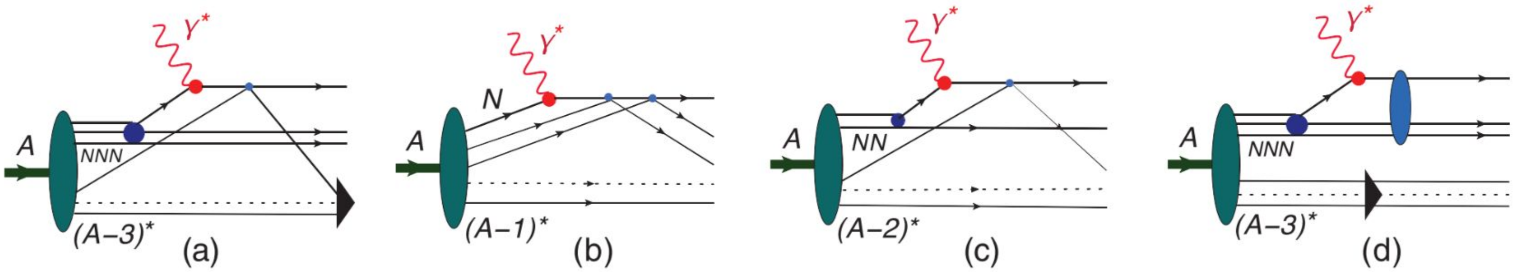
- Meson-exchange current (MEC):
  - $1/Q^2$ suppression
- Isobar Current (IC):
  - $1/Q^2$ and x>1 suppression
- Final State Interactions (FSI):
  - contained within the SRC pair at large Q^2



a) MEC b) IC c) FSI

Scaling violation in 3N

TOWARD OBSERVATION OF THREE-NUCLEON … PHYSICAL REVIEW C **107**, 014319 (2023)



Long-range FSI does not exist in A=3

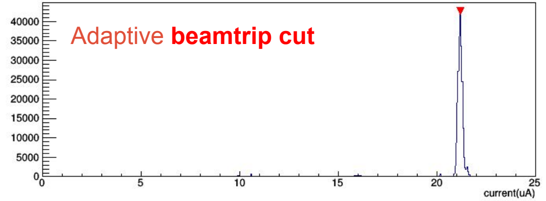
Double-rescattering is suppressed at forward angle

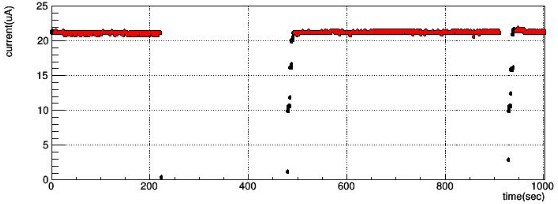
2N-SRC+FSI is minimized in A=3, can smear the transition region

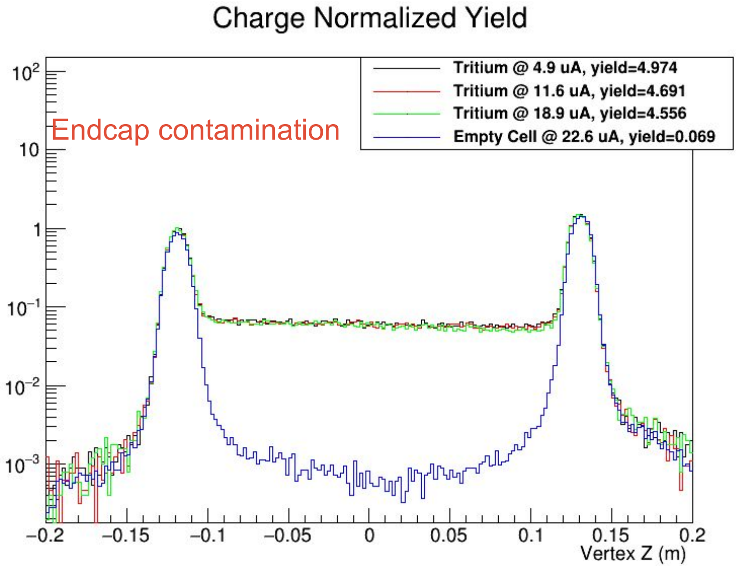
FSI within 3N won't modify alpha

2018 Tritium Gas Target Analysis

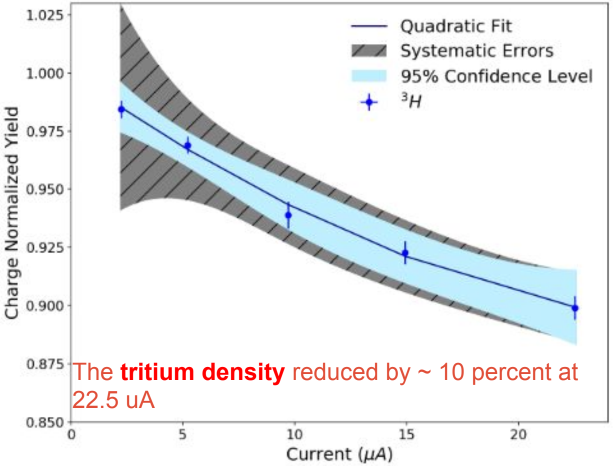
- Maximum current = 22.5 uA on gas cells to minimize the risk of gas leak.
- Endcap (75mg/cm2 Aluminum) being mis-reconstructed into thin gas body (77mg/cm2 Tritium)
- “Boiling”: gas density change along beam path
- Tritium decay correction
- Hydrogen contamination.



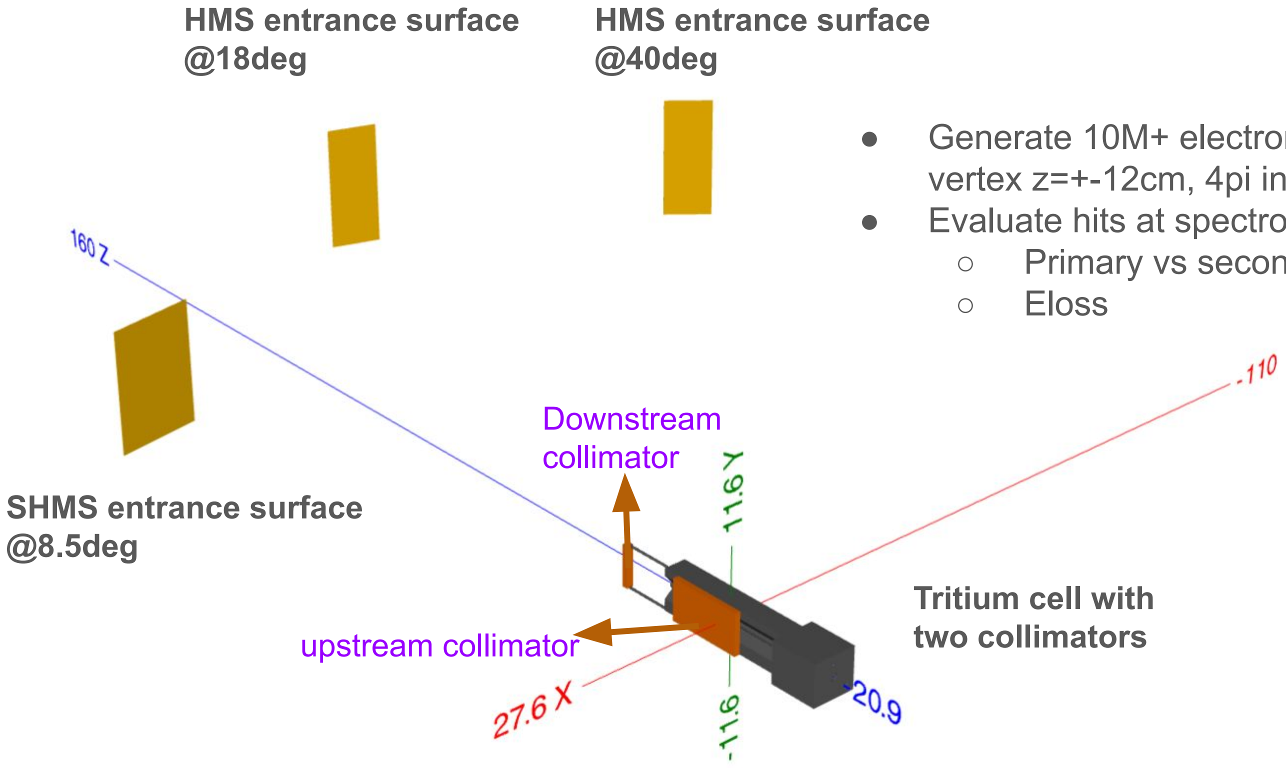




S. Santiesteban et al. , https://doi.org/10.1016/J.NIMA.2019.06.025

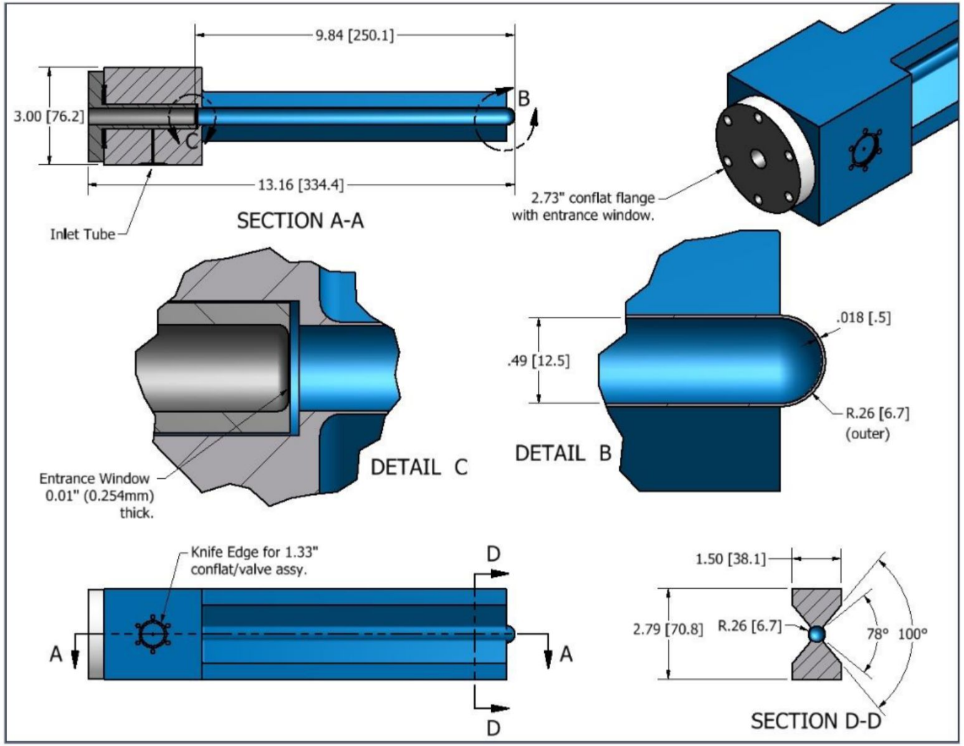


GEANT4 Simulation for Collimator Impact



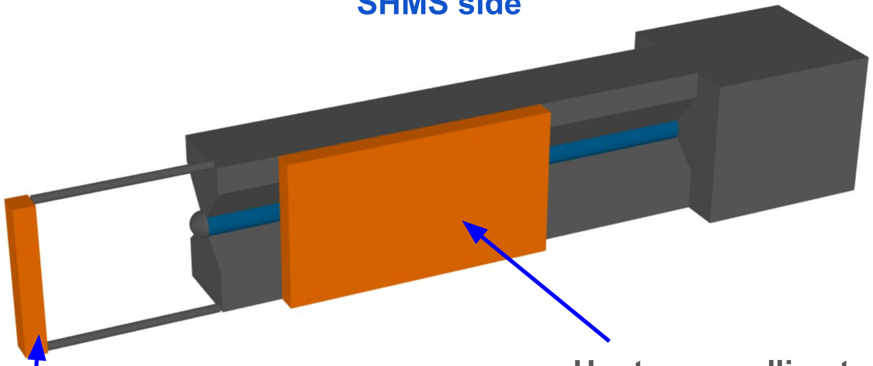
- Generate 10M+ electrons at 2-11GeV, vertex z=+-12cm, 4pi in theta and phi
- Evaluate hits at spectrometer entrance
  - Primary vs secondary
  - Eloss

Tritium Cell Dimension

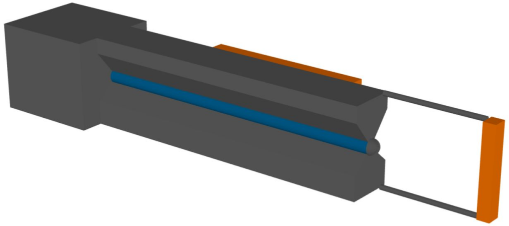


Collimators

SHMS side



HMS side: no collimation



Upstream collimator 1cm thick tungsten plate mounted to the target heat sink body to block scattered electrons from the entrance window

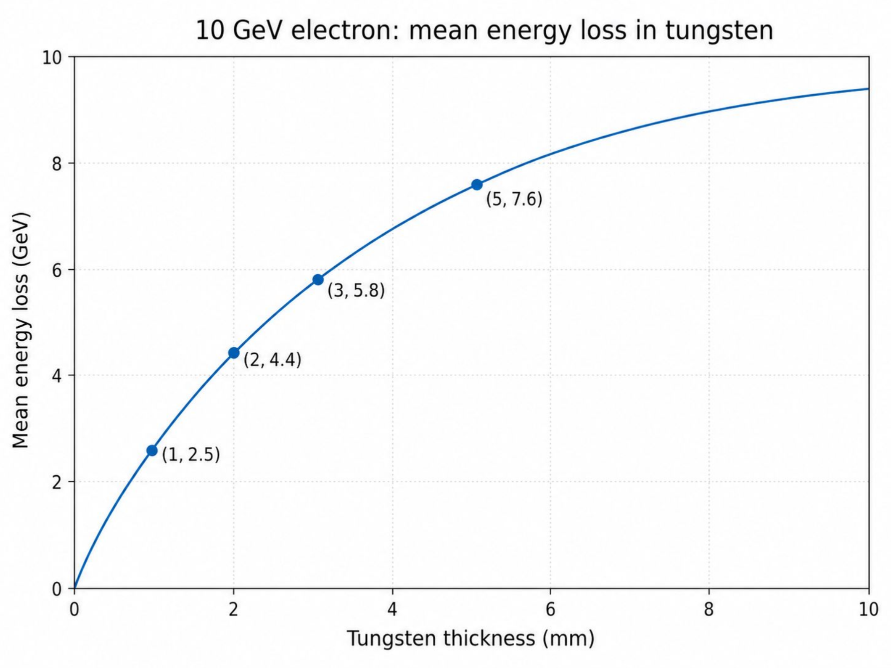
Downstream collimator

- a 1cm thick tungsten plate at z=20cm to block electrons scattered off the downstream window while allow enough clearance to avoid interference with beamline.
- Mounted to the cell body by two 2mm thick aluminum bolts.

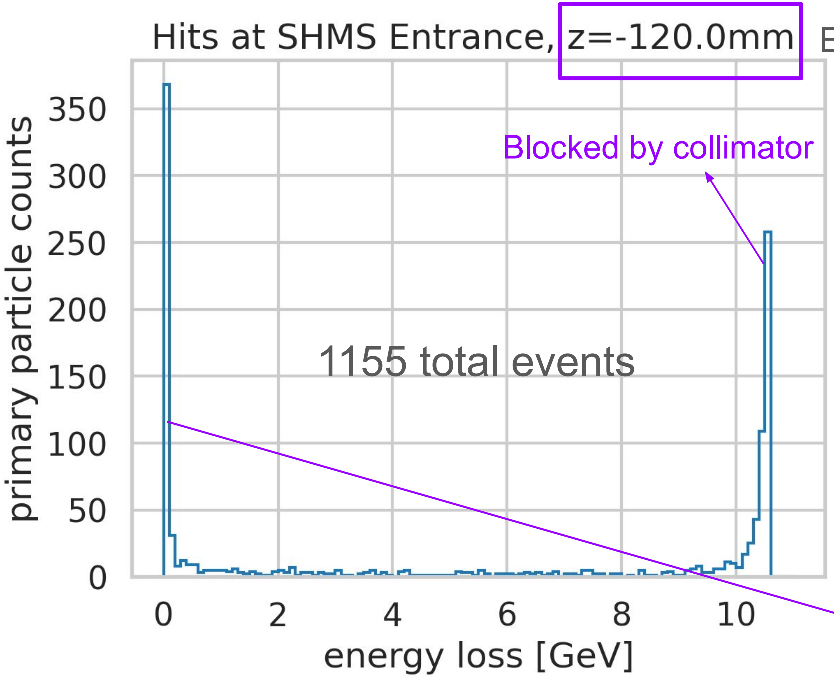
Energy Loss of Primary Electrons

Aluminum wall: ~0.4mm thickness → < 5% radiation length → included in cross section model with the equivalent radiator method (Mo & Tsai, `SLAC-PUB-848`)

Tungsten collimator: X0=3.5mm. 1cm is enough to shield 10 GeV electrons.

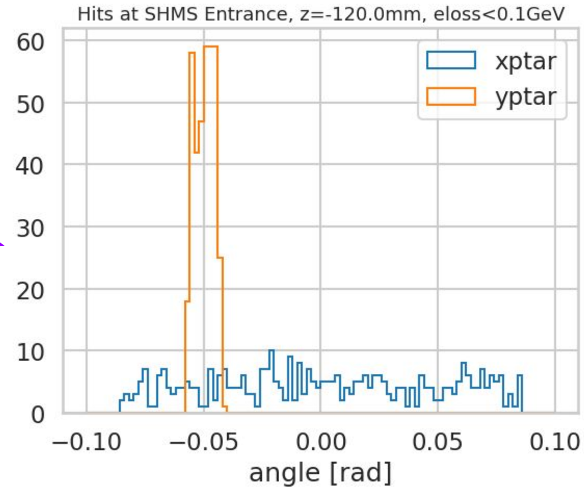


Energy Loss of Primary Electrons



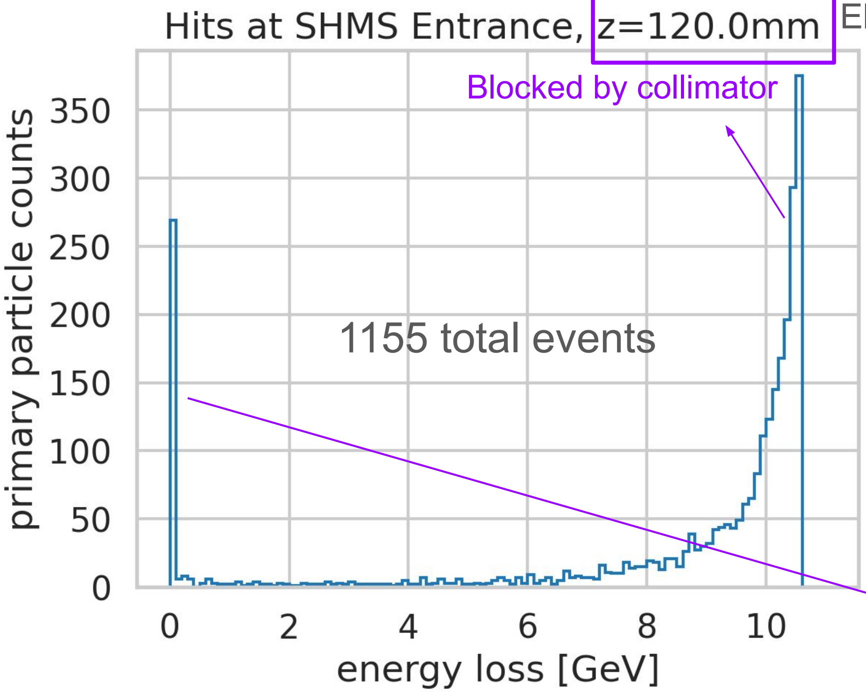
Electrons from **upstream** window

258 events with eloss<0.1 GeV: they didn’t hit collimator but the horizontal incident angle at SHMS entrance is out of SHMS acceptance thus won’t reach detector plane.

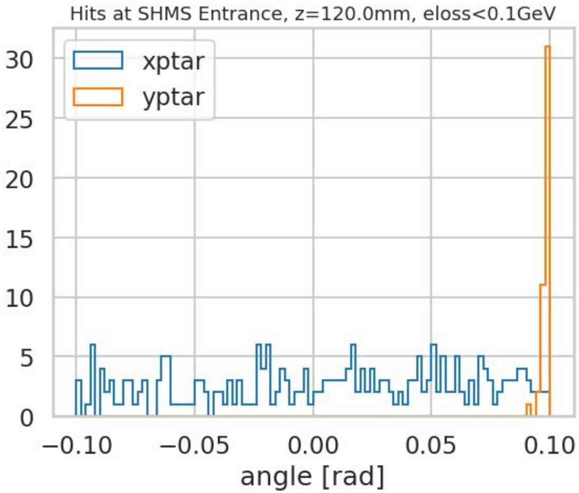


Energy Loss of Primary Electrons

Electrons from **downstream** window

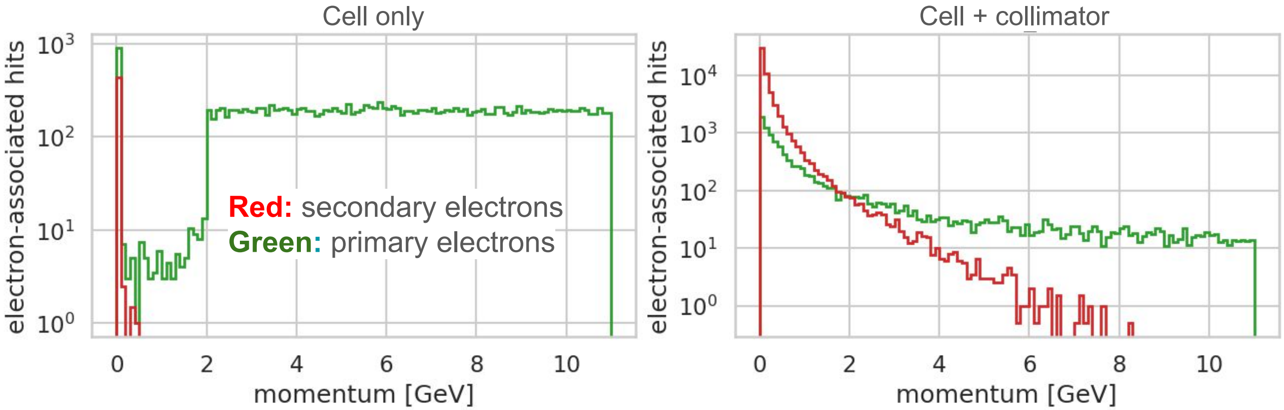


371 events with eloss<0.1 GeV: they didn't hit collimator but the horizontal incident angle at SHMS entrance is out of SHMS acceptance thus won't reach detector plane.

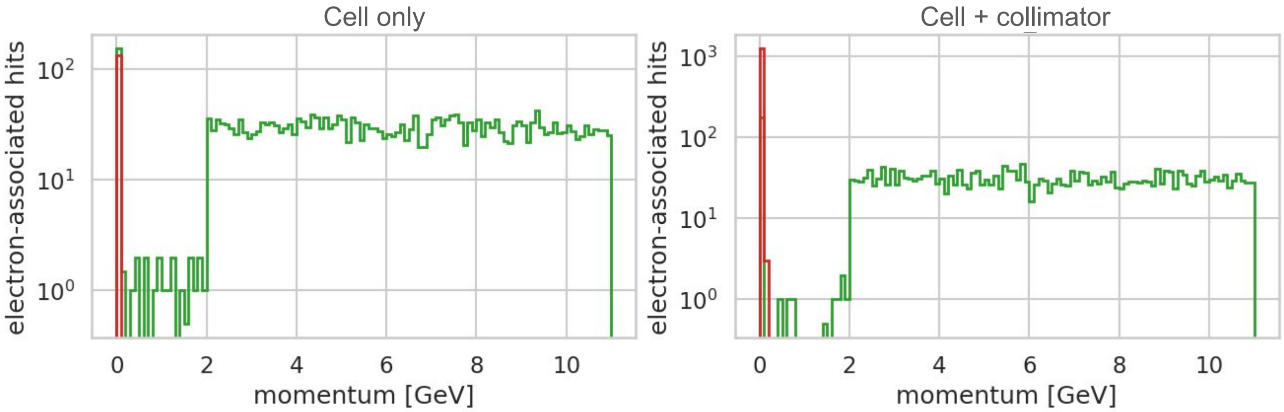


Secondary Electron Contaminations

Electrons from downstream window to SHMS entrance



HMS entrance 18 deg, z=120 mm

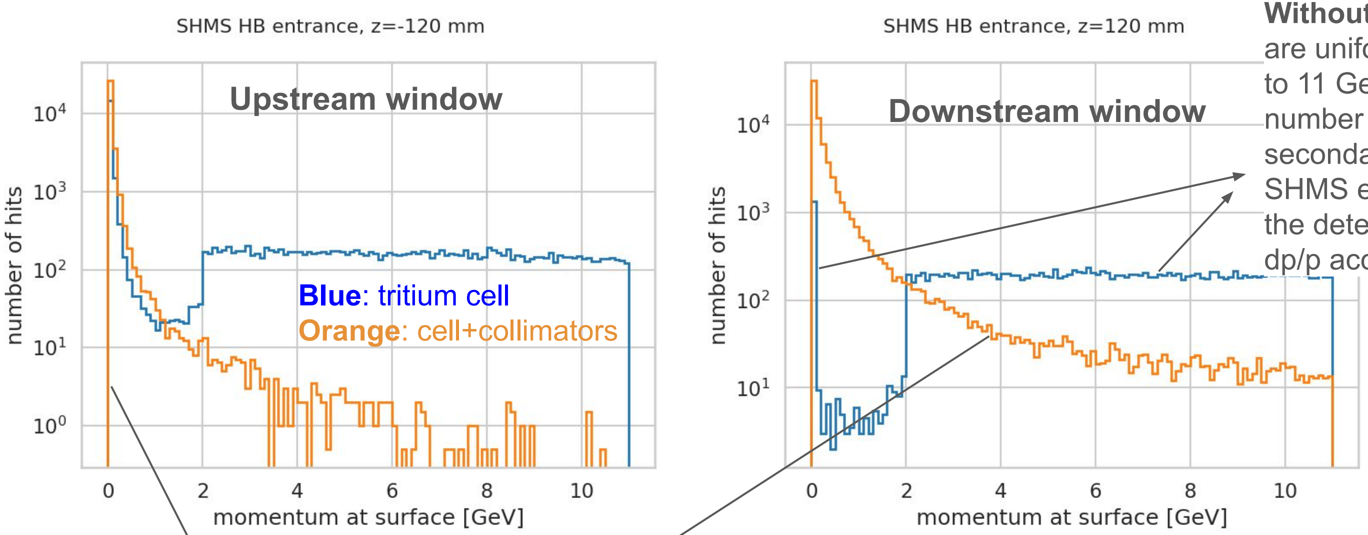


SHMS: collimator generated many low-momentum secondaries. It also completely blocked primary electrons or shifted them to much lower energies

HMS: collimator generated many low-momentum secondaries. None of those are within our momentum settings therefore won’t contaminate the HMS measurements.

HMS at 40 deg, and similar plots at z=-120mm show the same behavior: no contaminations from secondaries within acceptance

SHMS Hits with/without Collimators



Without collimator: electrons are uniformly distributed from 2 to 11 GeV as generated. A small number of low-momentum secondary electrons reached SHMS entrance but won't reach the detector plane due to the dp/p acceptance.

With collimator: Collimator reduced the amount of high-momentum electrons reaching SHMS entrance by a factor of 10+ within the momentum range of the SRC configurations. The remained electron contaminations are further suppressed by the shape of QE cross section at x>1 which decreases very quickly with momentum,

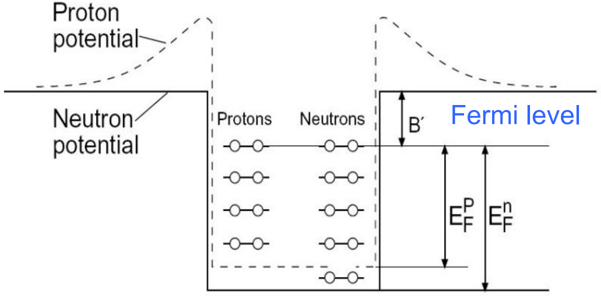
How nucleons move in nuclei and interact with each other?

Schrödinger equation:

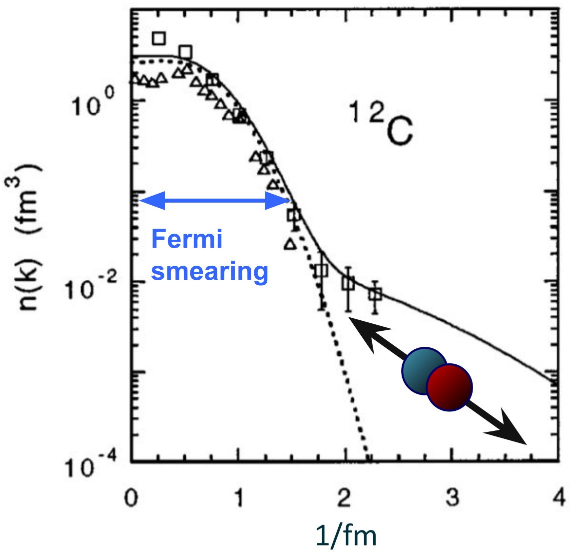
$$[\sum_i -\frac{\hbar^2}{2m_N}\nabla_i^2 + \sum_{i<j} v_2(\boldsymbol{x}_i,\boldsymbol{x}_j) + \sum_{i<j<k} v_3(\boldsymbol{x}_i,\boldsymbol{x}_j,\boldsymbol{x}_k) + ...]\Psi_A = E_A\Psi_A$$

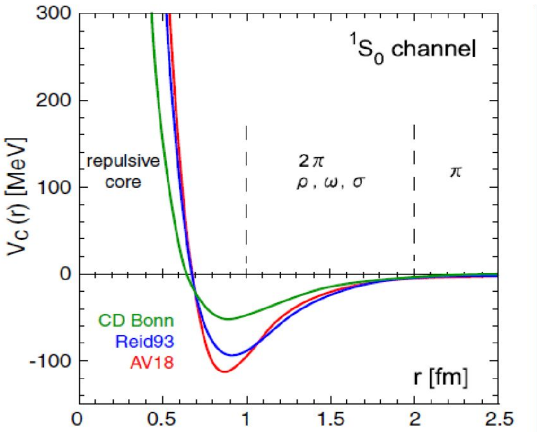
- **Independent particle shell model ("Mean field"):**

$$[-\frac{\hbar^2}{2m_N}\nabla_i^2 + U(\boldsymbol{x})]\phi_\alpha(\boldsymbol{x}_i) = \epsilon_\alpha\phi_\alpha(\boldsymbol{x}_i)$$



Cioffi Degli Atti, et al. PRC53, 1689 (1996)



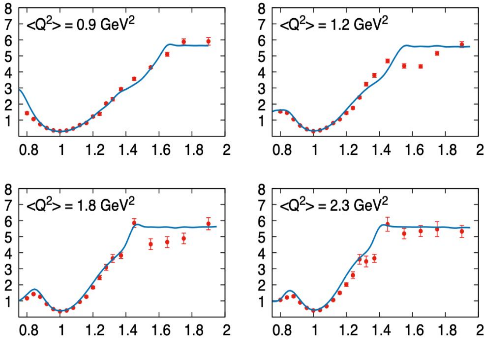


"The main effects of NN correlations is to generate high momentum and high removal energy components"

Decades of 2-nucleon Short-Range Correlation studies

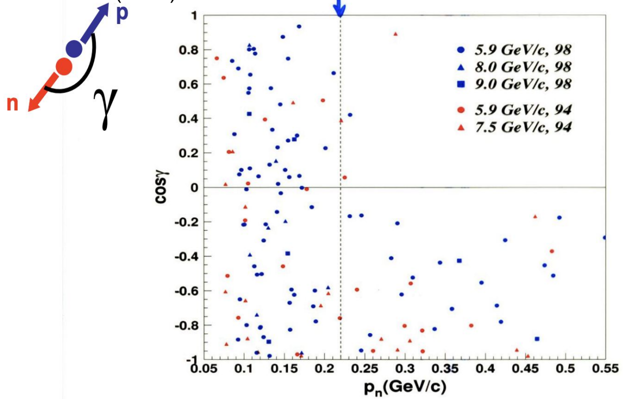
Fe/D (e,e') @SLAC

L. Frankfurt et al, Phys. Rev. C 48:2451 (**1993**)



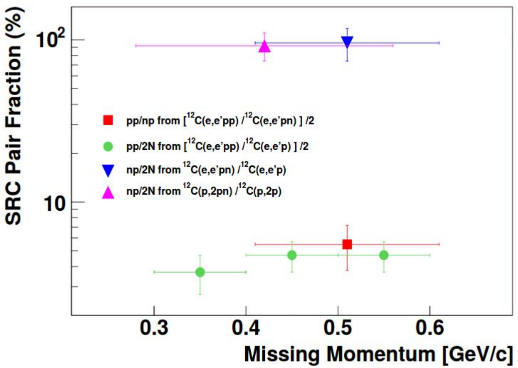
^{12}C(p,p'pn)X@BNL

E. Piasetzky et al., PRL 97, 162504 (**2006**)



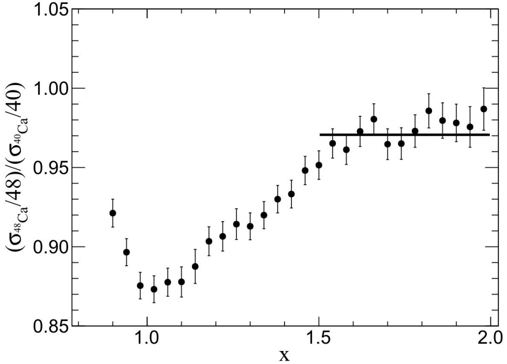
^{12}C(e,e'pN)@JLab

Subedi et al, Science 320, 1476 (2008)



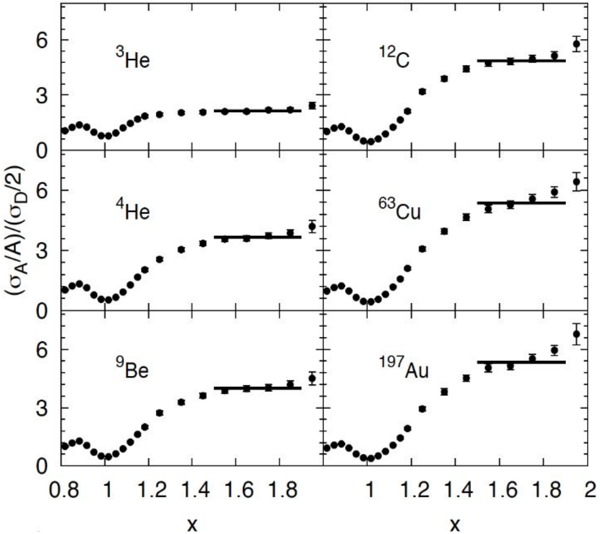
^{48}Ca/^{40}Ca (e,e') @JLab

D. Nguyen *et al.* Phys. Rev. C **102**, 064004



A/D (e,e') @JLab

N. Fomin, et al., PRL 108 (**2012**) 092052



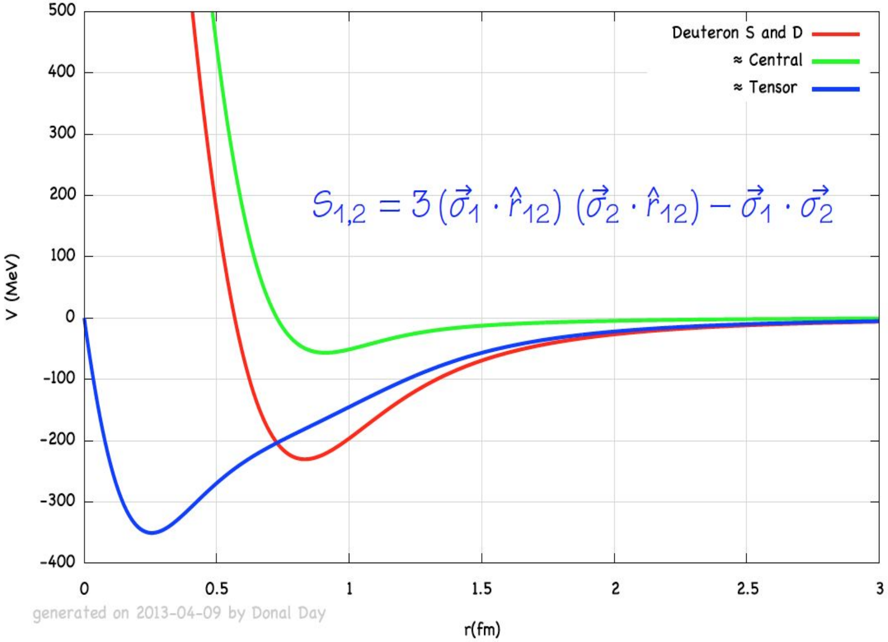
- NN pairs with **large back-to-back** momentum and total → 0
- Up to **20%** of nucleons
- Isospin **T=0 deuteron-like np** pair dominate due to tensor force.

Nucleon-Nucleon Potentials

Free nucleon-nucleon potential = **Repulsive core** **+** **attractive tensor force**

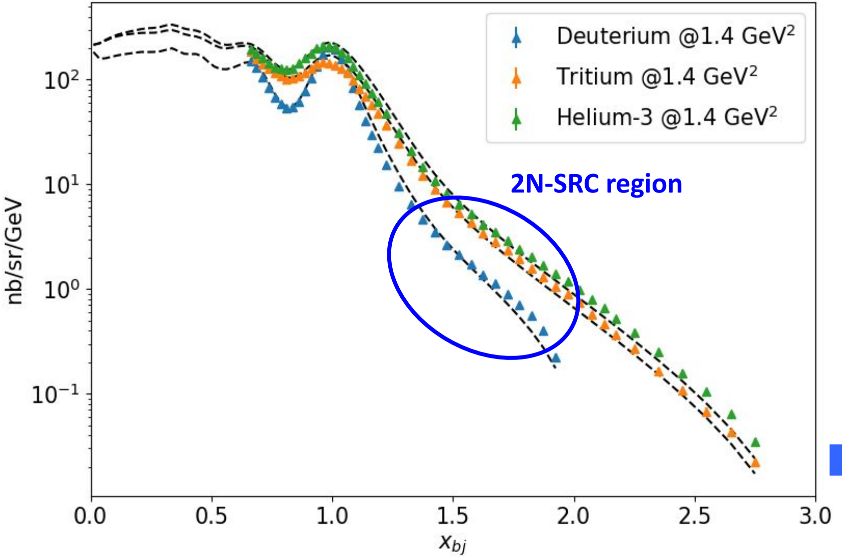
S (spin) = 0, T (isospin) = 1: np, pp, nn pairs. The **tensor operator** $S_{1,2} = 0$, no attractive tensor force

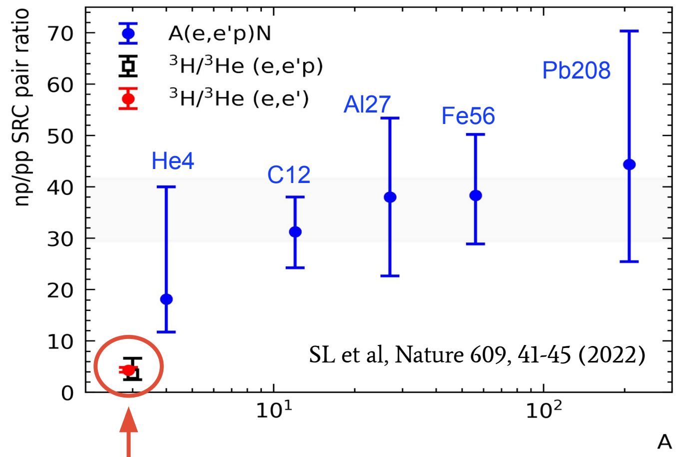
S (spin) =1, T (isospin) = 0: Deuteron-like np pair.

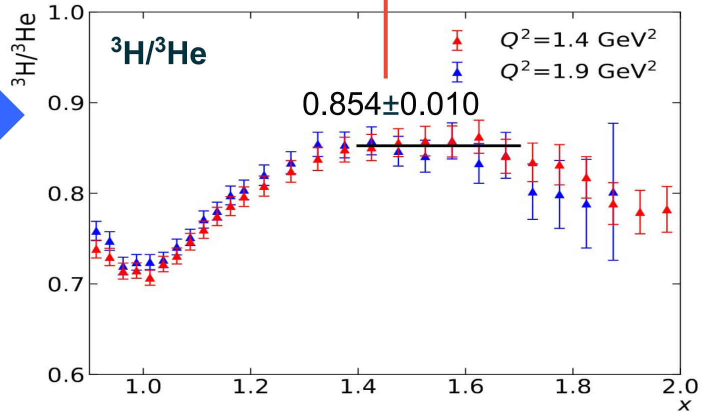


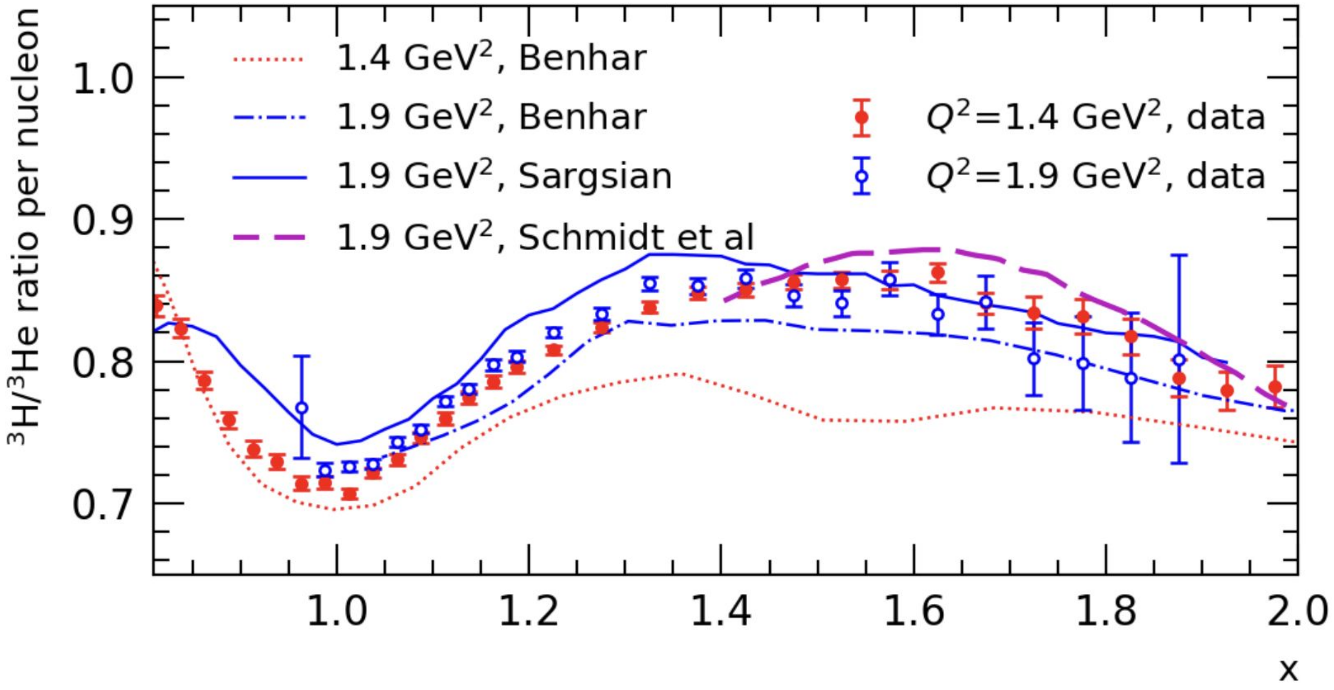
E12-11-112: Study 2N SRC isospin with A=3

(e,e') cross section from E12-11-112@Hall A








1.4 GeV^2, Benhar
1.9 GeV^2, Benhar
1.9 GeV^2, Sargsian
1.9 GeV^2, Schmidt et al
Q^2=1.4 GeV^2, data
Q^2=1.9 GeV^2, data
^{3}H/^{3}He ratio per nucleon
1.0
0.9
0.8
0.7
1.0
1.2
1.4
1.6
1.8
2.0
x