Status report on Run-Group B

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DPWG, JLab, June 15 2017

CLAS12 Run-Group B

- Common features to all experiments of RG-B: **liquid deuterium** target, **11-GeV** beam
- Approved PAC days: **146**; days in the run-groups table: **90**
- 4 PAC-approved experiments, 1 high-impact experiment, 2 run-group experiments

E12-07-104	Neutron magnetic form factor	G. Gilfoyle	A-	30
E12-09-007(a)	Study of partonic distributions in SIDIS kaon production	K. Hafidi	A-	56
E12-09-008	Boer-Mulders asymmetry in K SIDIS	M. Contalbrigo	A-	56
E12-11-003	Deeply virtual Compton scattering on the neutron	S. Niccolai	A (HI)	90
E12-09-008b	Collinear nucleon structure at twist-3	M. Mirazita	--	
E12-11-003a	In medium structure functions, SRC, and the EMC effect	O. Hen	--	

RG-B: measurements of **FFs, PDFs, GPDs, and TMDs** using **deuteron as a neutron target**
→ quark-flavor separation, combining with proton results

A scheduling request for 2018 was submitted in July 2016

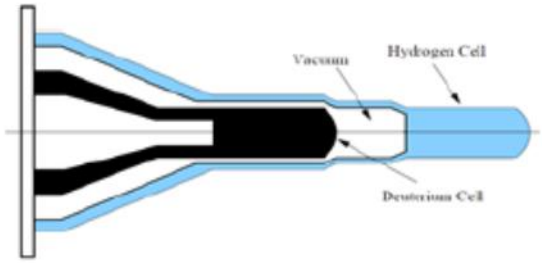
RG-preparation meetings ~ once or twice per month

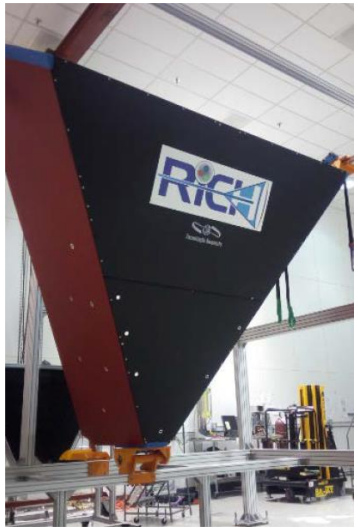
Run-Group B: running conditions

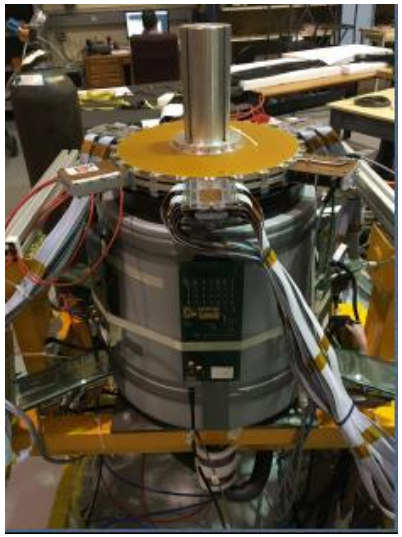
Neutron magnetic form factor	Dual target	A- 30
Study of partonic distributions in SIDIS kaon production	*Dual target*, RICH	A- 56
Boer-Mulders asymmetry in K SIDIS	*Dual target*, RICH, two field settings	A- 56
Deeply virtual Compton scattering on the neutron	Single-cell target, CND, FT	A (HI) 90
Collinear nucleon structure at twist-3	*Dual target*, RICH	--
In medium structure functions, SRC, and the EMC effect	Single-cell target, BAND	--

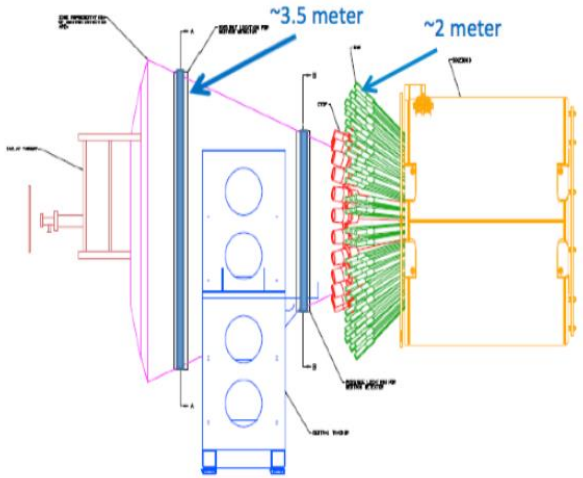
Readyness for 2018 run:

- Single-cell target, CND, RICH and FT will be already in RG A
- BAND and dual target status? New equipment requires ERR

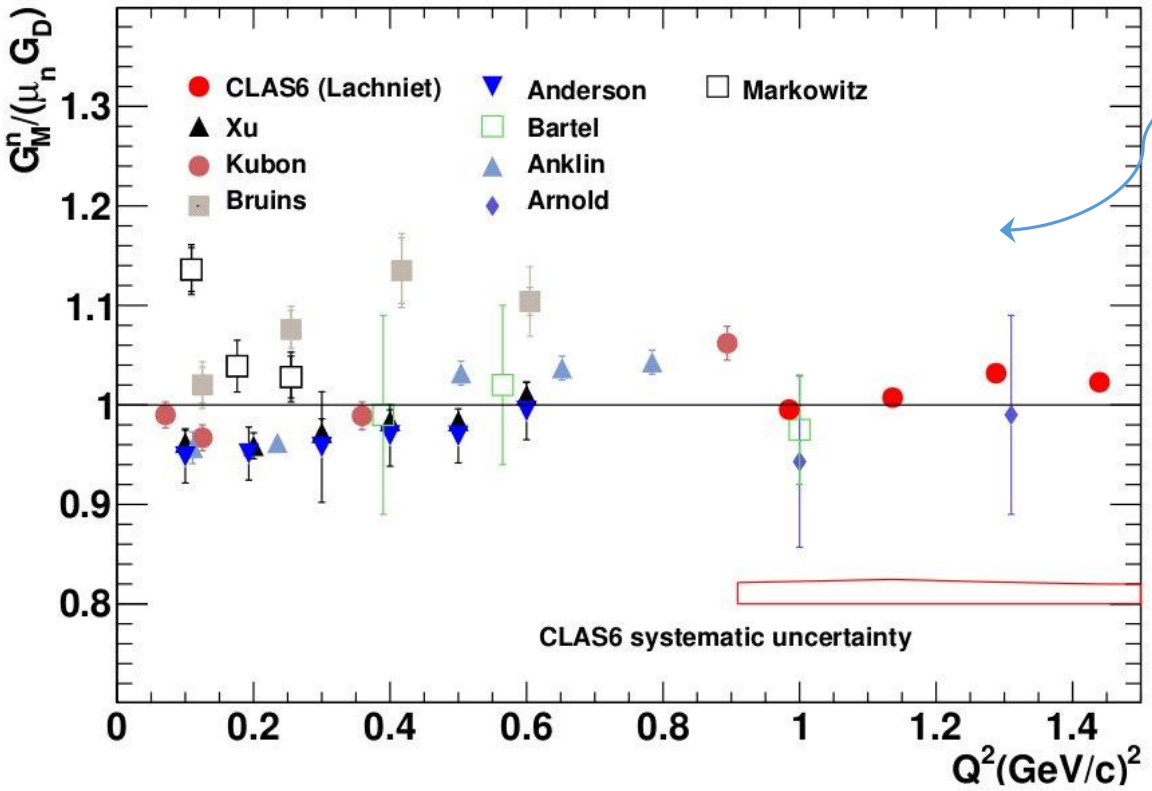








Tension in low-Q^2 G_M^n measurements



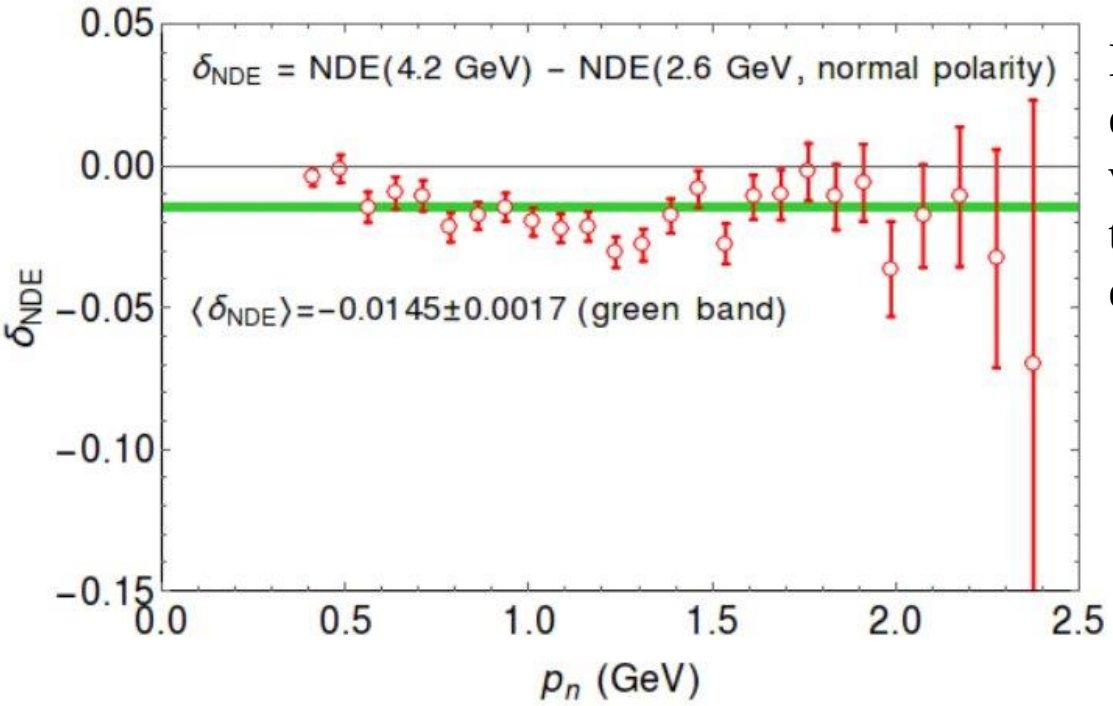
Large systematic uncertainties among neutron detection efficiency (NDE) measurements from different labs and methods.

Experiments used ratio method unless noted otherwise.

Author	Reference	NDE Method	Author	Reference	NDE Method
Lachniet	PRL 102, 192001 (2009)	^{1}H(e, e′π^+n)	Anderson[1]	PRC 75, 034003 (2007)	NA
Xu[1]	PRC 67, 012201 (2003)	NA	Bartel	NP B58, 429 (1973)	^{1}H(γ, π^+n)
Kubon	PLB 524, 26 (2002)	^{1}H(n, p)n	Anklin	PLB 336, 313 (1998)	^{1}H(n, p)n
Arnold[2]	PRL 61, 806 (1988)	NA	Anklin	PLB 426, 248 (1998)	^{1}H(n, p)n
Bruins	PRL 75, 21 (1995)	^{1}H(γ, π^+)n	Markowitz[3]	PRC 48, R5, (1993)	^{2}H(γ, np)

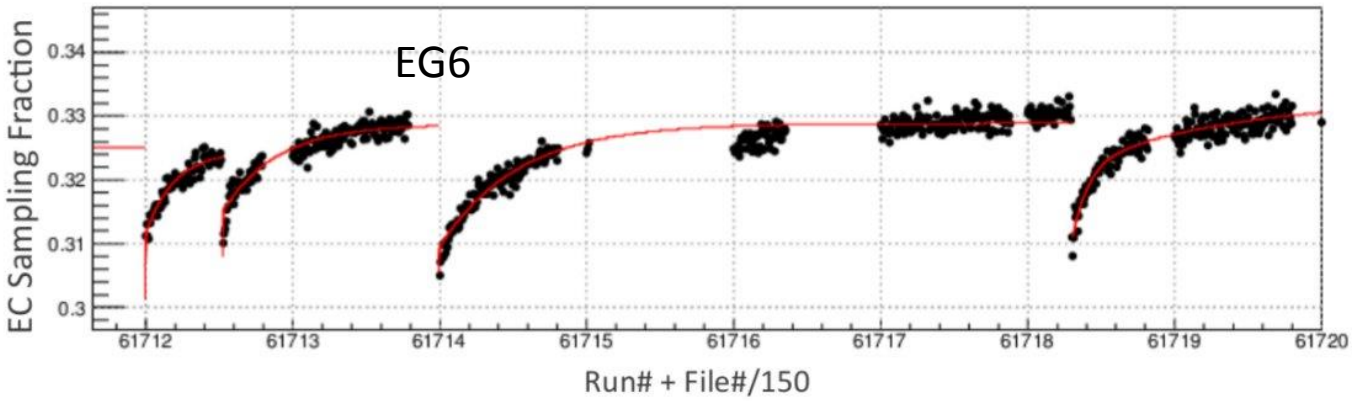
1 - $^3\vec{\text{He}}(\vec{e}, e')$ 2 - ^{2}H(e, e′) 3 - ^{2}H(e, e′n)

CLAS6 Results



Difference between E5 (CLAS6 G_M^n experiment) measurements of NDE vary by 1.5% which is about twice the expectation for the CLAS12 G_M^n experiment.

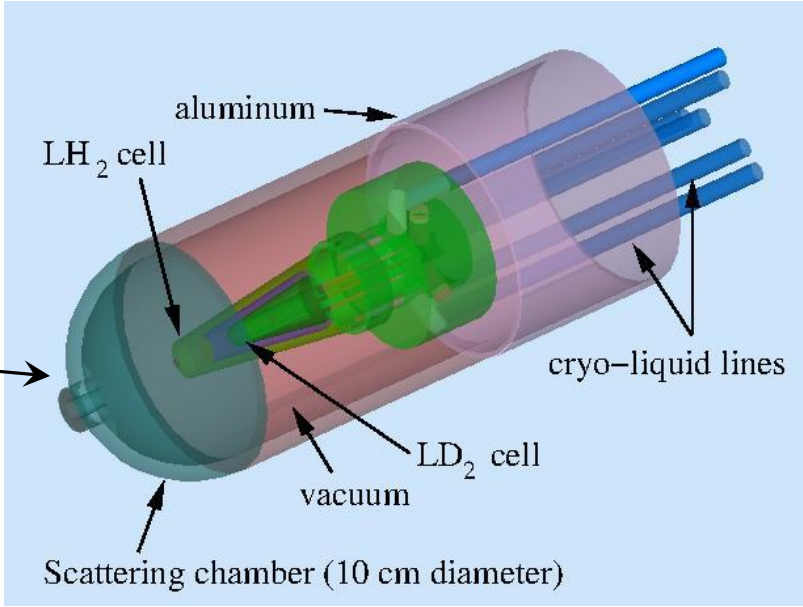
The EC is used to measure NDE. Its response to charged particles can vary significantly with time and conditions creating differences across run periods.

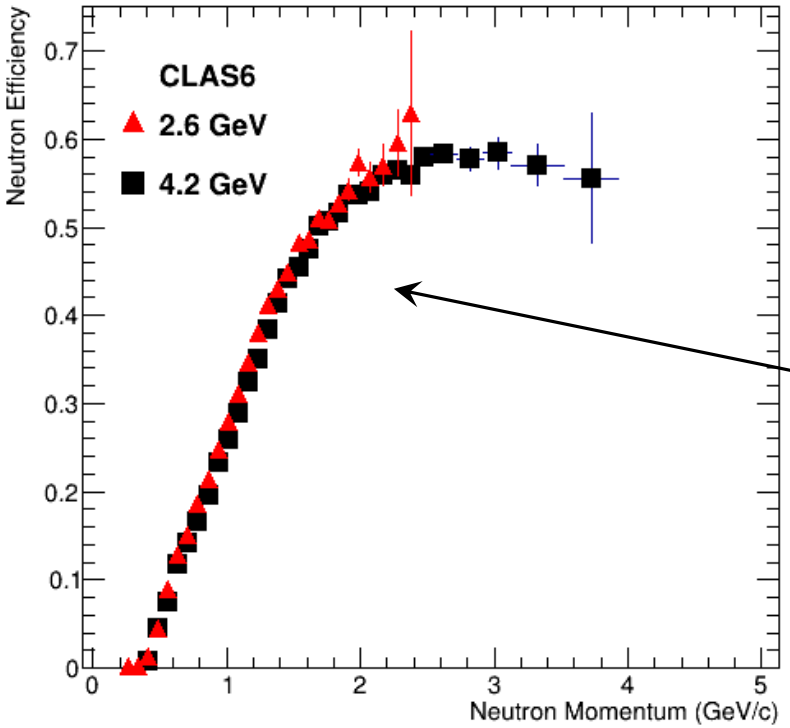


https://clasweb.jlab.org/rungroups/lowq/wiki/index.php/EG6_EC_Sampling_Fraction_Time-Dependence_Correction

CLAS12 G_M^n Target Simulation

- Modeled after E5 target used in CLAS6 G_M^n measurement.
- Dual target with two, 2-cm cells containing LH2 and LD2 separated by 1-cm gap.
- Geometry file now part of the standard gemc distribution.





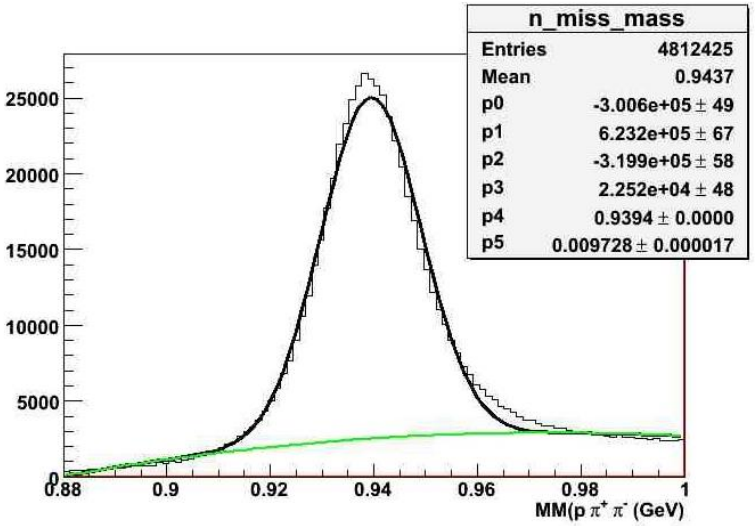
- Results of CLAS6 G_M^n neutron detection efficiency measurement for the EC.
- Two beam energies – see previous slide for comparison of values.

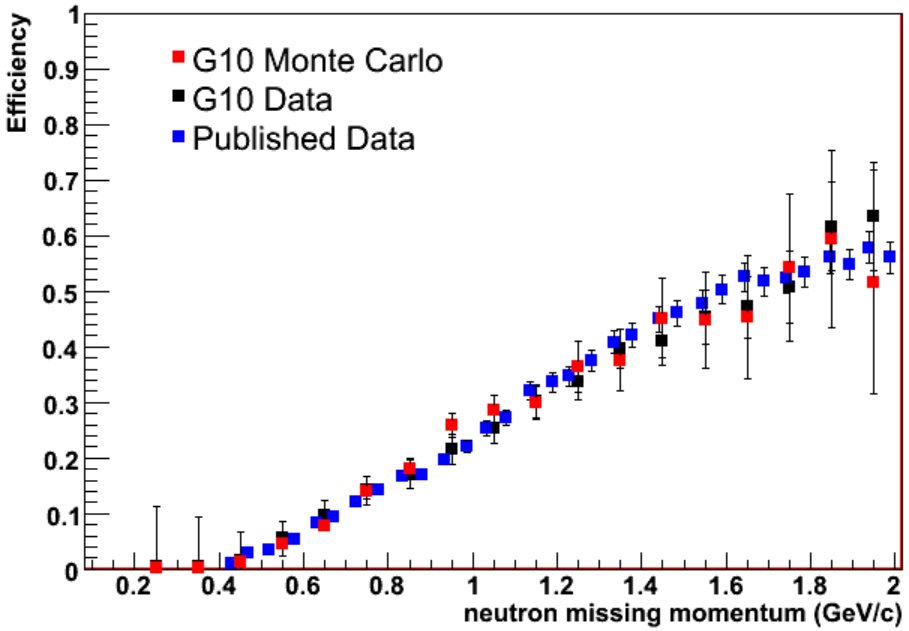
Alternative idea: using deuterium data for NDE

Work by S. A. Pereira on g10 data set.

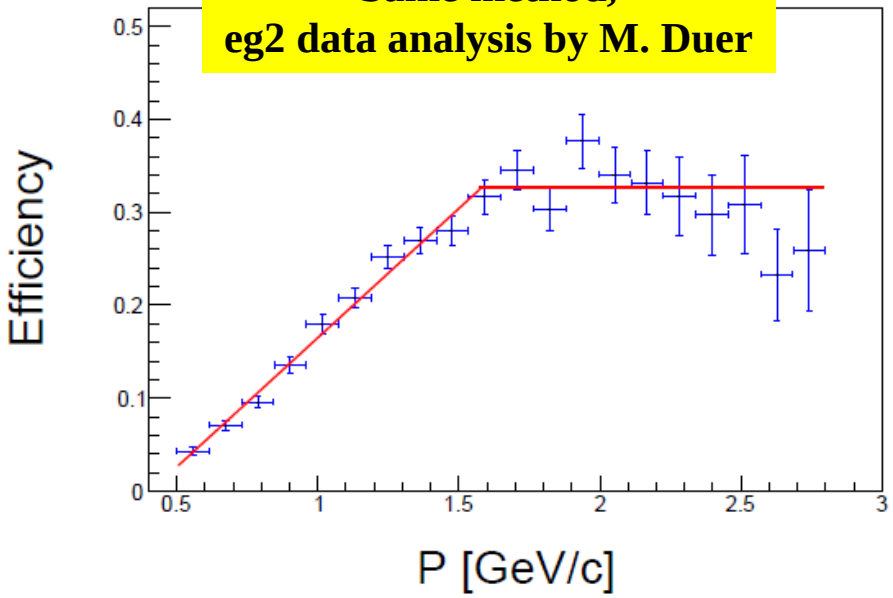
Chosen reaction $\gamma d \rightarrow p n \pi^+ \pi^-$. Exclusivity cuts:

- Missing mass of $\gamma d \rightarrow p\pi^+\pi^- X$
- Angle between the direction of expected and measured neutron
- Polar angle Θ_{miss} between 10° and 45°
- Azimuthal angle Φ_{miss} in the sector reference frame
- Background subtraction under missing mass peak





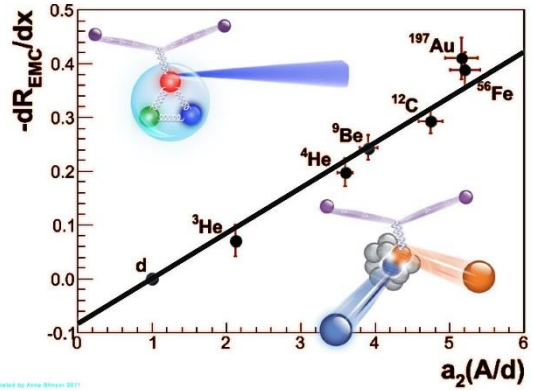
Same method,
eg2 data analysis by M. Duer

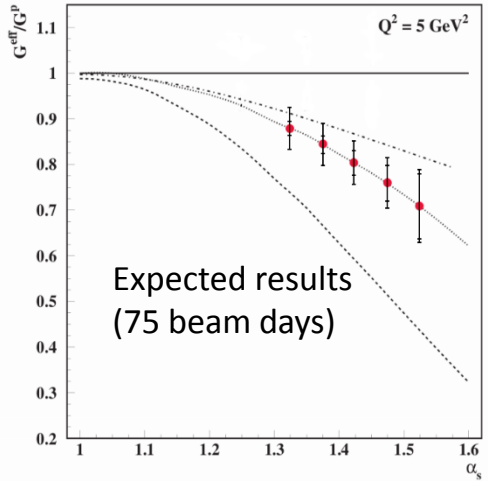


In Medium Proton Structure Functions, SRC and the EMC Effect measured with CLAS12 and the Back Angle Neutron Detector

Spokespeople: Hen, Weinstein, Hakobyan and Piasetzky

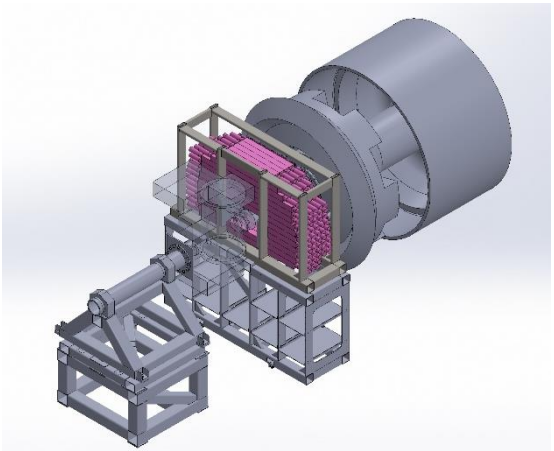
- Is the nucleon modification of the EMC-Effect due to Mean-Field nucleons or correlated pairs?
- Measure the **bound proton structure function** as a function of neutron momentum or virtuality in deuterium
  - Similar to **nucleon tagging in BoNuS**





Build new scintillator-based **back angle neutron detector**

- 160-170^o
- ~ 35% neutron detection efficiency
- ~ 7x7 cm^2 scintillators
- MRI applied for 2017



Things to do, discussion items

- We would like to **run in 2018**, as we had requested back in July 2016
- What is the status of our scheduling request?
- We are working to optimize **running conditions**:
  - ✓Can deuteron data be used to compute accurately neutron detection efficiency?
  - ✓Magnetic field settings should be studied
- **Full simulations** (GEMC+reconstruction) are in the works
- If we use dual target, ERR will be needed, the terms of which need to be clarified/understood; also, overall run time should be recomputed
- Monthly meetings are being held
- Joint meetings with RG-A should be considered as well

Possible RG Schedule (straw man)

Run Group	Days	2016	2017	2018	2019	2020	2021	2022	Remain
All Run Groups	**1036**[#)]	30	15	95	105	105	105	105	456
HPS	180*	15		35	10	10	10	10	90
PRad	15*	15							0
CLAS12 Comm			3 15						0
RG-A + RG-K (proton)	239*		10	20/15 25		35	20		114*
RG-B (deuteron)	90*				40				50*
RG-F (BoNuS)	42*				21				21
RG-C (NH_3)	120				35	25			60
RG-C-b (ND_3)	65					35			30
RG-E (Hadr.)	60						35		25
RG-H (Transv. Target)	110*						40	20	50
RG-D (CT)	60							40	20
RG-G (LiD)	55							35	20

[#)] incl. RG-H

CEBAF Large Acceptance Spectrometer