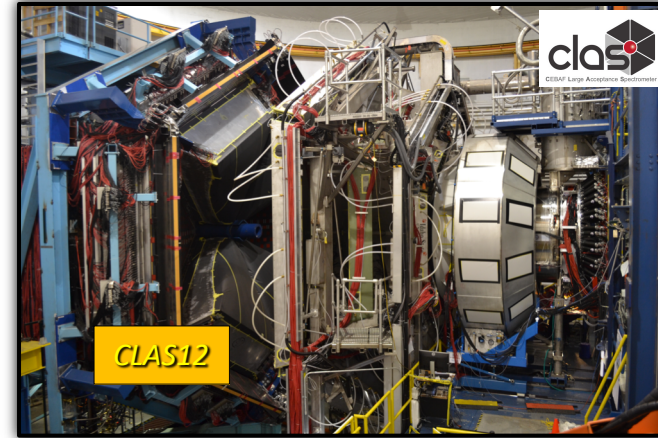
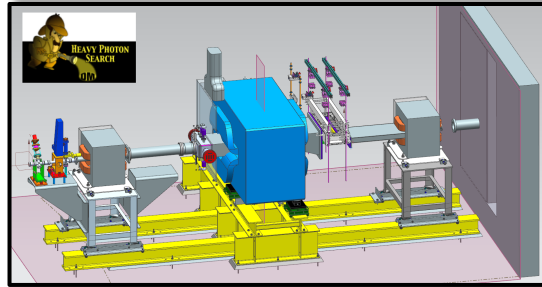
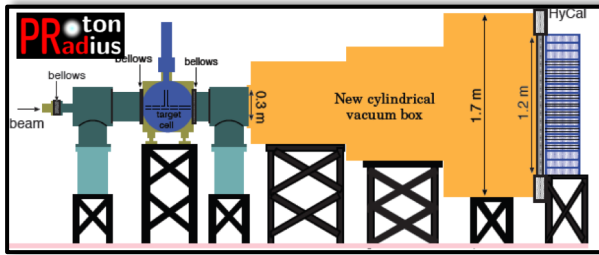




Status of Hall B

Volker D. Burkert

PAC47 meeting, 7/29 – 8/1 2019

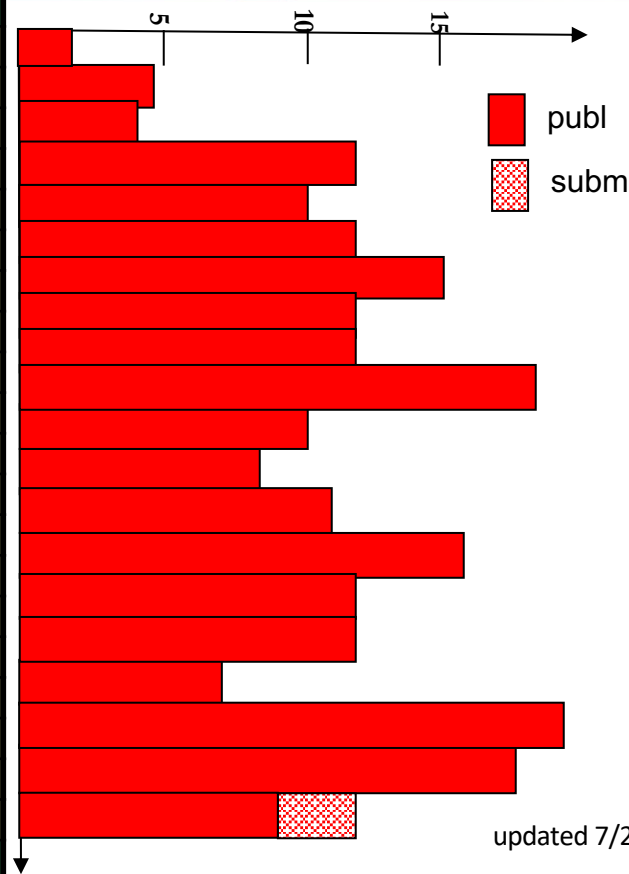
- Hall B Highlights
- Update on PRad, CLAS, HPS
- CLAS12 performance
- Physics Runs RGA, RGK, RGB
- Schedule/Upcoming events

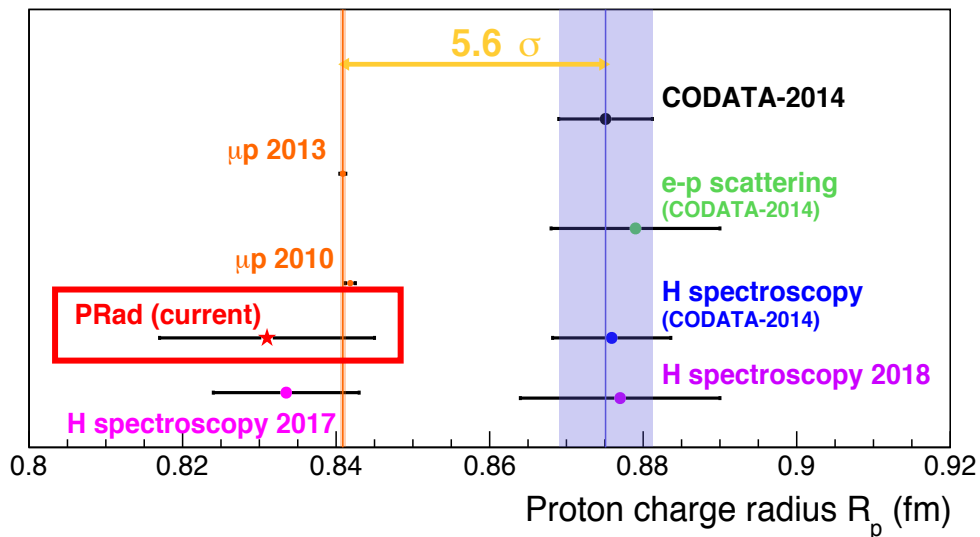
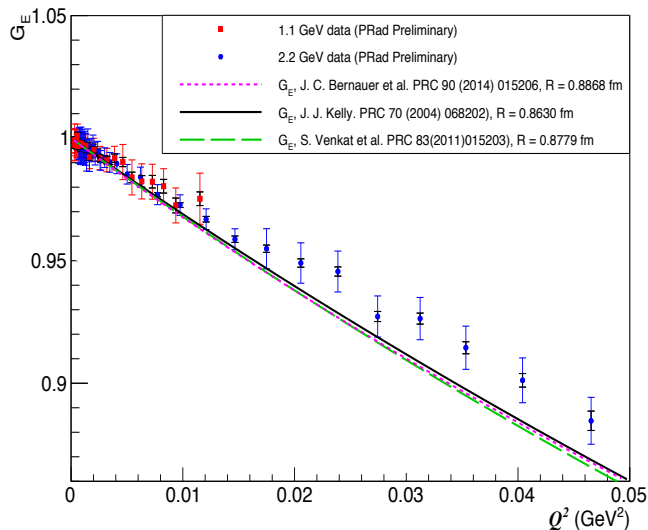
- **CLAS12 first physics runs:**
 - RG-A (13 proposals, 139 PAC days)
 - RG-K (3 proposals, 100 PAC days)
 - RG-B (7 proposals, 90 PAC days)
- **Continued flow of publications from Hall B**
 - > 225 physics papers in peer reviewed journals (> 13,000 citations)
 - 3 papers in journal **Nature**, 1 paper in journal **Science**
 - ~2,500 conference talks (~1,600 invited)
- **Specialized Hall B experiments**
 - PRIMEX experiment – PRIMEX II π^0 L.T. results in preparation , High-energy γ -e (Compton) scattering with NLO corrections submitted to **Science**
 - PRAD experiment – proton charge radius results submitted to **Nature**
 - Heavy Photon Search - Analysis of 2016 data ongoing, HPS 2019 run at 4.5 GeV underway

Refereed Physics Publications

Hall B

	Spectroscopy	Hard scattering	Nuclear	ALL
2000	-	1	1	2
2001	2	3	-	5
2002	3	-	1	4
2003	7	4	1	12
2004	3	3	4	10
2005	7	3	2	12
2006	8	4	3	15
2007	7	2	3	12
2008	4	6	2	12
2009	8	7	4	19
2010	4	2	4	10
2011	3	1	4	8
2012	6	3	2	11
2013	8	6	2	16
2014	5	6	1	12
2015	4	5	3	12
2016	7			7
2017	12	7	1	20
2018	10	6	2	18
2019	3+1	3	3+1	9+2
SUM	111+1	73	42+1	226+2



Proton Electric Form Factor G_E 

PRad R_p (current) = 0.831 ± 0.007 (stat.) ± 0.012 (syst.) fm

Submitted for publication in Nature

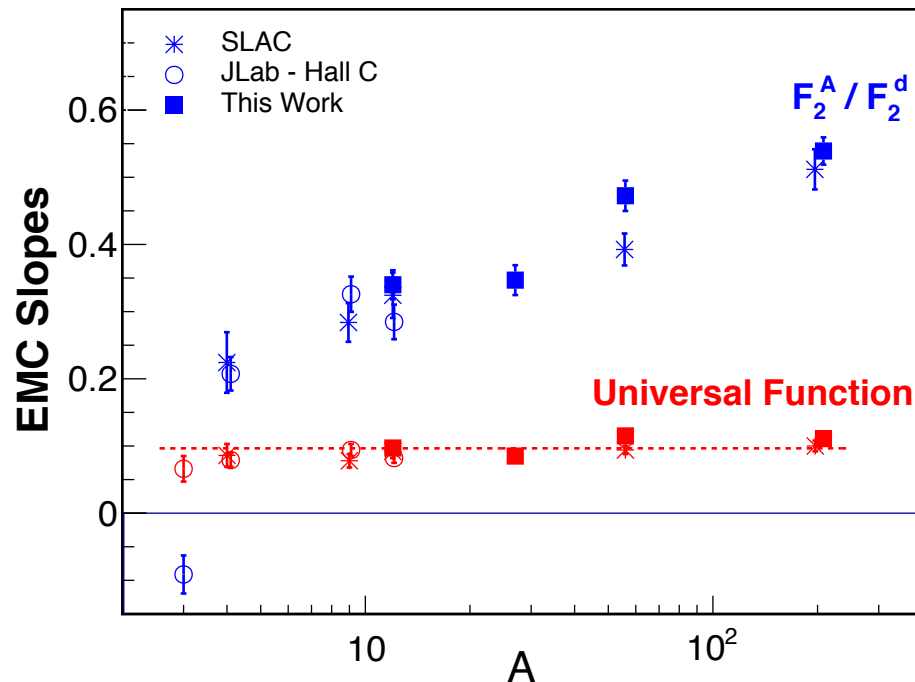
Results show that proton charge size is consistent with muonic hydrogen value
(first electron scattering result to agree with muonic hydrogen spectroscopy)

EMC effect and SRC

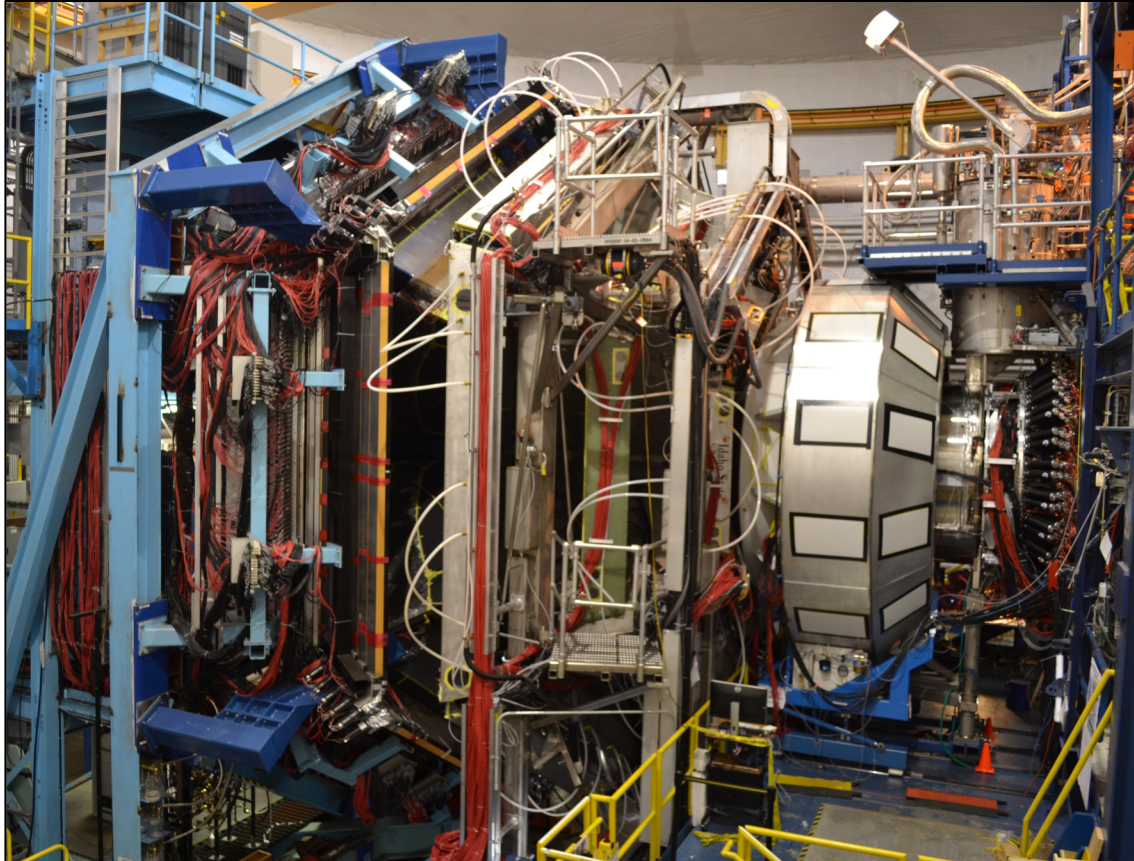
EMC data can be explained by a **universal modification of the structure of nucleons in neutron–proton SRC pairs.**

This implies that in heavier nuclei with many more neutrons than protons, each proton is more likely than each neutron to belong to an SRC pair and hence to have distorted quark structure.

Modified structure of protons and neutrons in correlated pairs

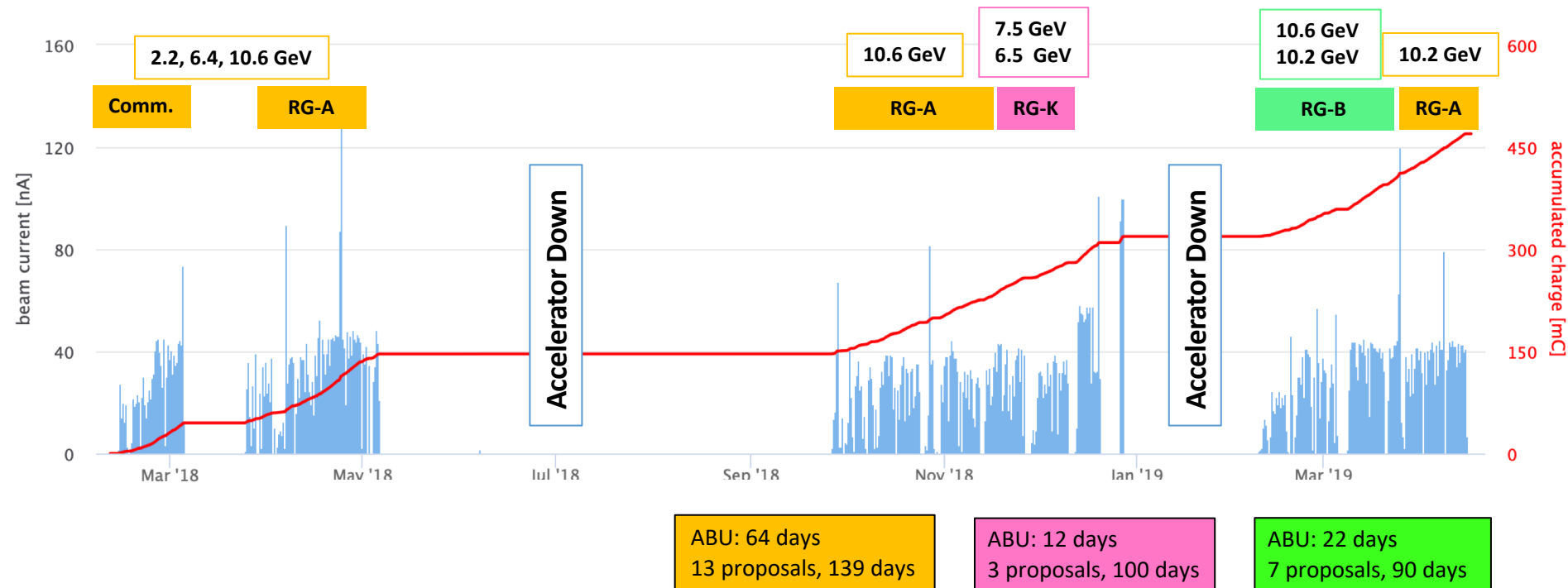


B. Schmookler et al. (CLAS), Nature 566 (2019) no.7744, 354-358



Full complement of CLAS12 detectors has been completed in 1/2018 with the installation of the RICH detector (1 sector).

Additional detector (BAND) was installed in early 2019 for the detection of backward angle neutrons in RG-B.



CLAS12 Status of RG-A & RG-K (LH₂)



RG-A: Collected charge of high luminosity running: 220mCb
 At $L = 10^{35} \text{cm}^{-2} \text{s}^{-1}$ this corresponds to: 40.1 charge days
 Low luminosity for 7 scheduled days: 3.5 charge days
 Total: 40.1 charge days + 9.6 spring = **49.7 charge days (high lumi)**

RG-K: Collected charge: 45.6mCb
 At $L = 10^{35} \text{cm}^{-2} \text{s}^{-1}$ this corresponds to: 7.1 Charge days
 In terms of ABUs this corresponds to 12.1 PAC days

Proposal	Physics	Contact	Rating	Approved days	ABU days	% ABU	Charge days	% Charge	comment
E12-06-108	Hard exclusive electro-production of π^0, η	Kubarovsky	B	80	64	80.2	49.7	62.1	
E12-06-108A	Exclusive $N^* \rightarrow KY$ Studies with CLAS12	Carman	NR	(60)	64	100.	49.7	82.8	
E12-06-108B	Transition Form Factor of the η' Meson with CLAS12	Kunkel	NR	(80)	64	80.2	49.7	62.1	
E12-06-112	Proton's quark dynamics in SIDIS pion production	Avakian	A	60	25	42	20	33	1/2 LTCC, 1 RICH
E12-06-112A	SIDIS Λ production in target fragmentation region	Mirazita	NR	(60)	25	42	20	33	1/2 LTCC, 1 RICH
E12-06-112B	Collinear nucleon structure at twist-3	Pisano	NR	(60)	25	42	20	33	1/2 LTCC, 1 RICH
E12-06-119(a)	Deeply Virtual Compton Scattering	Sabatie	A	80	64	80.2	49.7	62.1	
E12-09-003	Excitation of nucleon resonances at high Q^2	Goth	B+	40	64	100	49.7	100.	
E12-11-005	Hadron spectroscopy with forward tagger	Battaglieri	A-	119	64	54.0	53.2	44.7	
E12-11-005A	Photoproduction of the very strangest baryon	Guo	NR	(120)	64	53.5	49.7	41.4	
E12-12-001	Timelike Compton Scatt. & J/ψ production in $e+e$	Nadel-Turonski	A-	120	64	53.5	53.2	41.4	
E12-12-001A	J/ψ Photoproduction & study of LHCb pentaquarks	Stepanyan	NR	(120)	64	53.5	49.7	41.4	
E12-12-007	Exclusive ϕ meson electroproduction with CLAS12	Girod	B+	60	64	100	49.7	82.8	
RG-A completion				139			43.4	53.5	
E12-16-010	A search for Hybrid Baryons in Hall B with CLAS12	D'Angelo	A-	100	12.1	12.1	7.1	7.1	
E12-16-010A	Nucleon Resonances in exc. KY electroproduction	Carman	A-	(100)	12.1	12.1	7.1	7.1	
E12-16-010B	DVCS with CLAS12 at 6.6 and 8.8 GeV	Elouadrhiri	A-	(100)	10.0*	10.0	5.7	5.7	Correction low energy
RG-K completion				100					

RG-B: Scheduled for February 8 – March 19. 6 days were taken from RG-A and added to RG-B to compensate for poor machine operation.

RG-B collected 21.8 ABU days (= PAC approved beam days.)

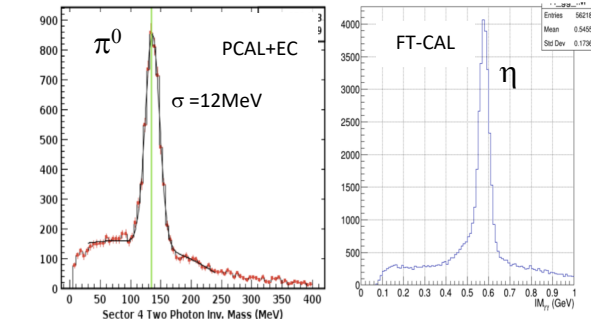
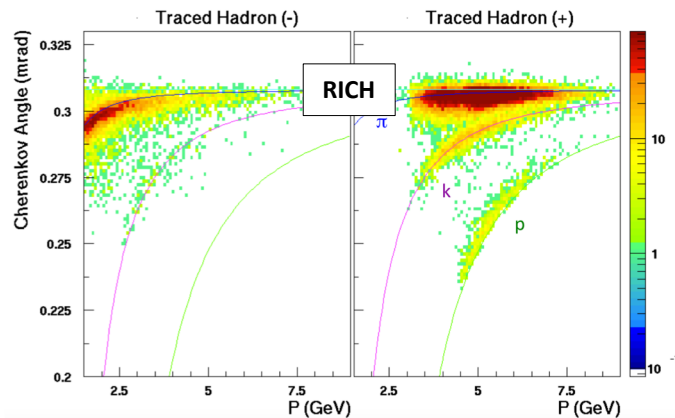
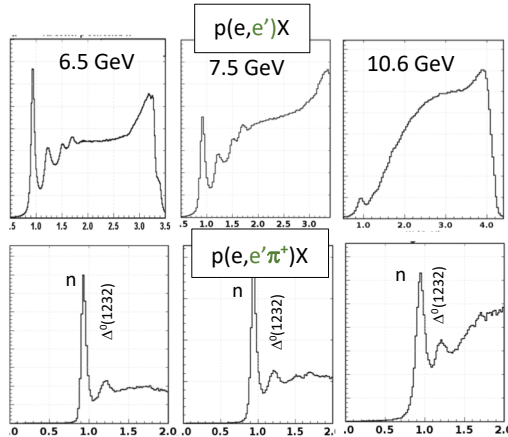
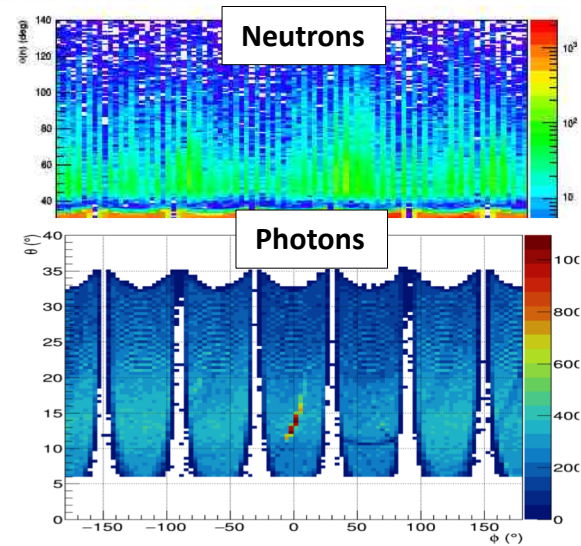
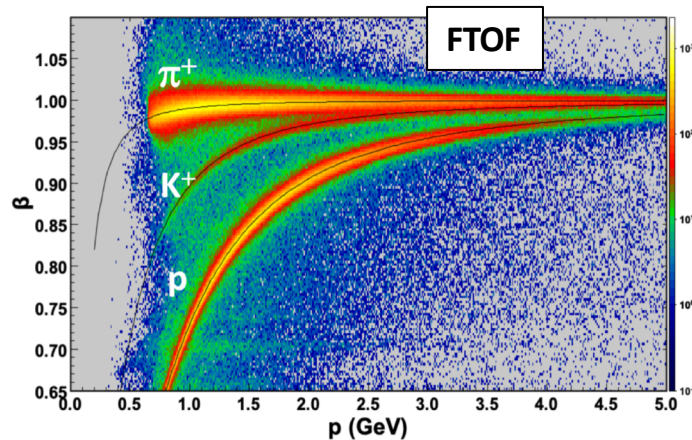
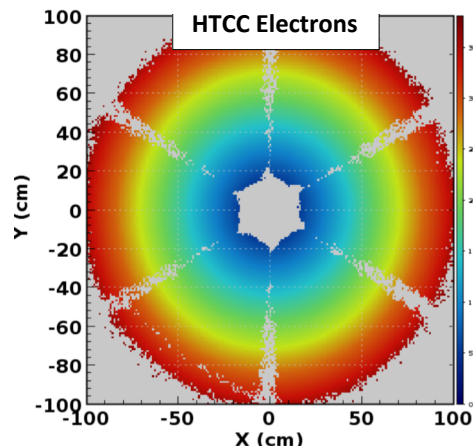
Collected charge: 150 mC

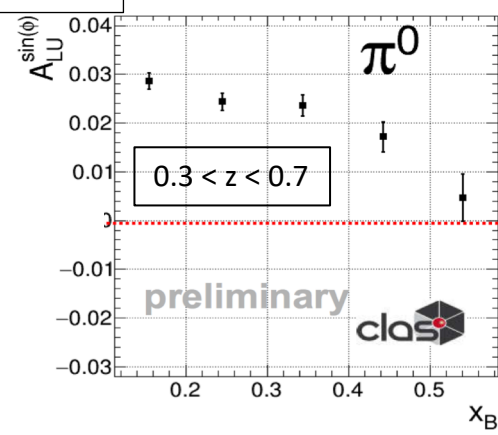
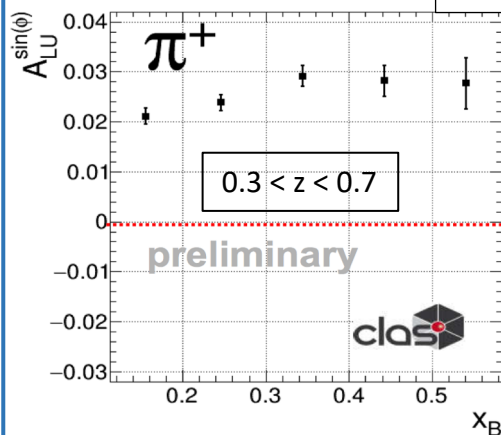
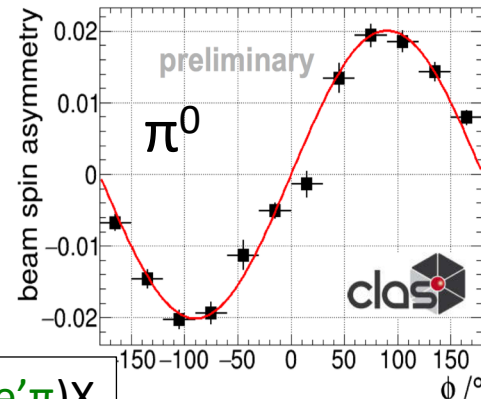
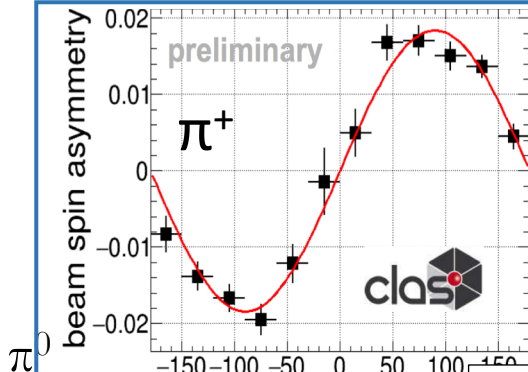
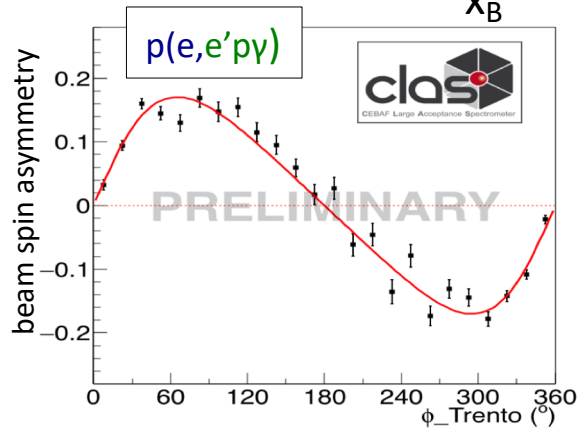
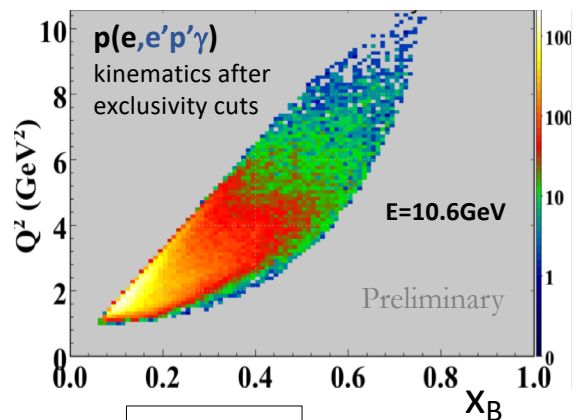
At 50nA beam current RG-B ran at hadronic luminosity of $1.6 \times 10^{35} \text{cm}^{-2}\text{s}^{-1}$.

	Physics	Contact	Rating	Days	% complete	comment
E12-07-104	Neutron magnetic form factor	Gilfoyle	A-	30	72.7	
E12-09-007(a)	Study of partonic distributions in SIDIS kaon production	Hafidi	A-	30	36.3	2 LTCC, 1 RICH
E12-09-008	Boer-Mulders asymmetry in K SIDIS w/ H and D targets	Contalbrigo	A-	30	36.3	2 LTCC, 1 RICH
E12-09-008B	Collinear nucleon structure at twist-3	Mirazita	NR	(56)	38.9	
E12-11-003	DVCS on neutron target	Niccolai	A	90	24.2	
E12-11-003A	In medium structure functions, SRC, and the EMC effect	Hen	NR	(90)	24.2	
E12-003B	J/Psi production on deuterium	Ilieva pentaquark J/Psi	NR	(80)	5.5 *) 8.3	Suffers from low energy
RG-B completion				21.8	24.2	

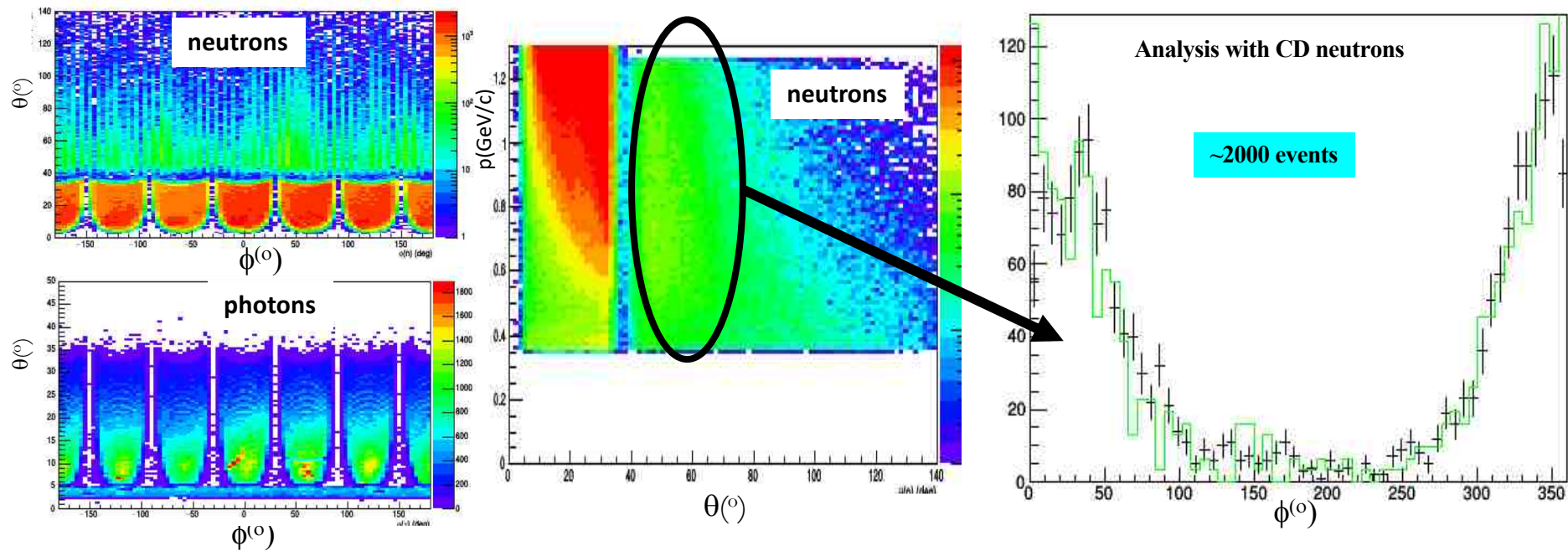
*) Entries are weighted with factor < 1 to account for reduced beam energy during part of the run.

Updated July 27, 2019

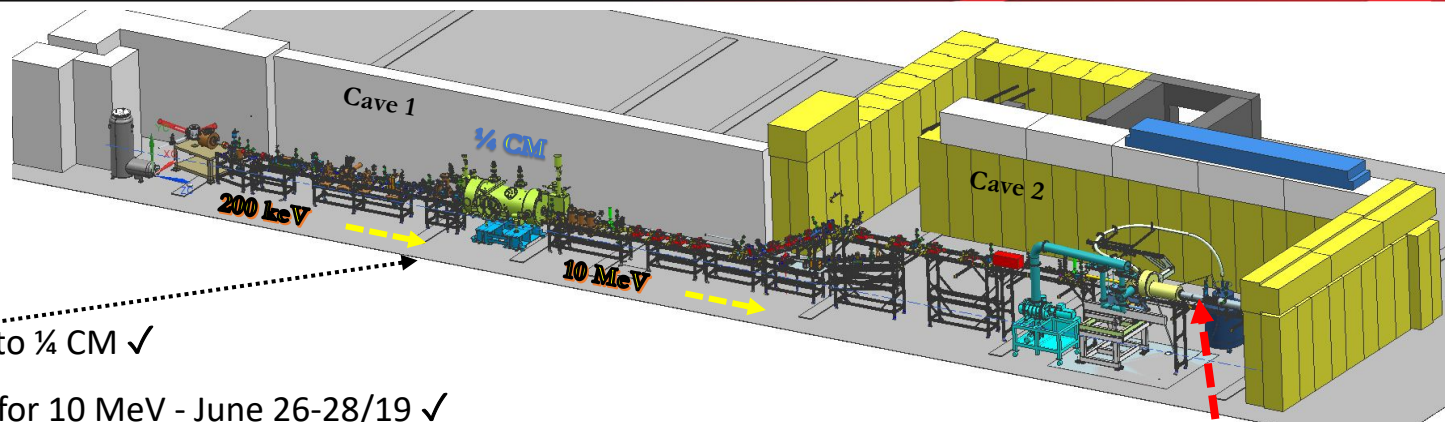




- Runs 6164, 6215, 6240, 6289, 6310, 6489, COATJAVA 5.9.0
- PID: **e**-, **γ**, **n** detected (EB)
- Kinematic cuts: $Q^2 > 1 \text{ GeV}^2$, $p(e) > 1 \text{ GeV}$, $q(e) > 5.5^\circ$, $p(n) > 0.35 \text{ GeV}$
- Preliminary « spectator » and « DVCS » cuts on $MM^2(\text{en}\gamma)$, missing energy, missing momentum, $E_g > 2 \text{ GeV}$
- nDVCS+BH simulation: GENEPI + GEMC 4.3.0 + COATJAVA 5.9.0

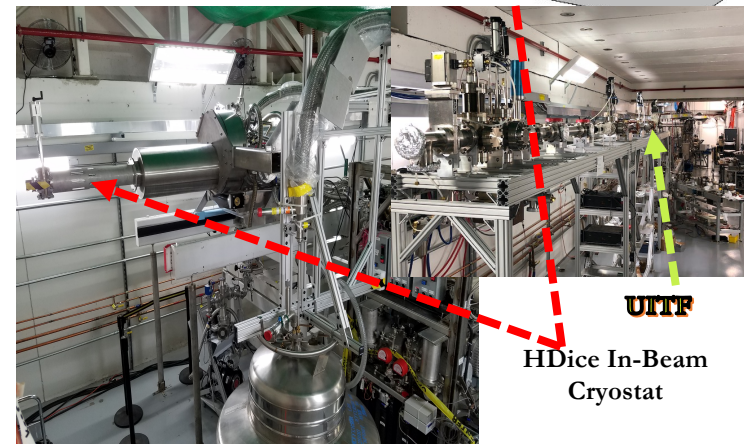


- **HPS** –currently running at 4.5 GeV with upgraded detector and trigger system
- **HD-Ice** polarized target in preparation for first test in UITF this Sep/2019
- **Run Group B** - comprises 7 individual proposals on deuterium target is scheduled to continue run in the Fall of 2019
- **BONuS12** – scheduled to run in the spring of 2020
 - high pressure gaseous target
 - a new low energy proton recoil detector based on GEM technology, will replace CLAS12 SVT
- **Dynamically polarized target for CLAS12** - on track for completion in 2020
 - 1 K refrigerator tested
 - JLab Target and Fast Electronics Group to construct up-to-date NMR Q-meter modules for target polarimeter

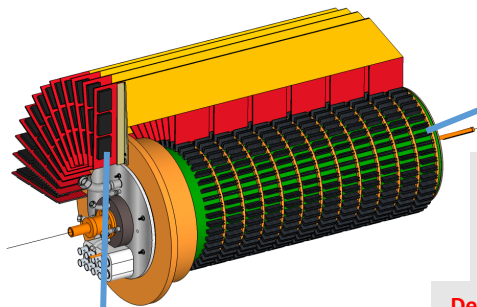


Schedule

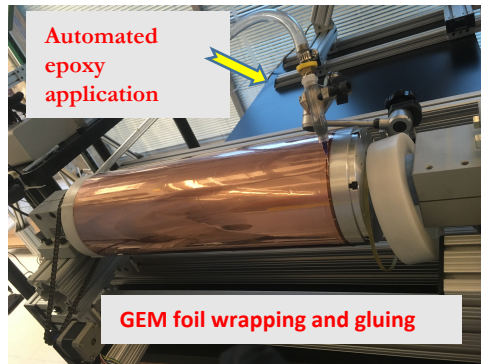
- 200 keV beam up to $\frac{1}{4}$ CM ✓
- UITF ARR (cave 1) for 10 MeV - June 26-28/19 ✓
- HDice & UITF cave-2 ERR – Sept/19
- beam periods - LHe from CTF for $\frac{1}{4}$ CM :
- 10 MeV beam through $\frac{1}{4}$ CM – Sept/19
- Beam on unpolarized HD – Nov/19
- Beam on polarized HD – Jan/20, Mar/20
- Test window ends with removal of $\frac{1}{4}$ CM for CEBAF – May 6/20



BONuS12 Detector Construction

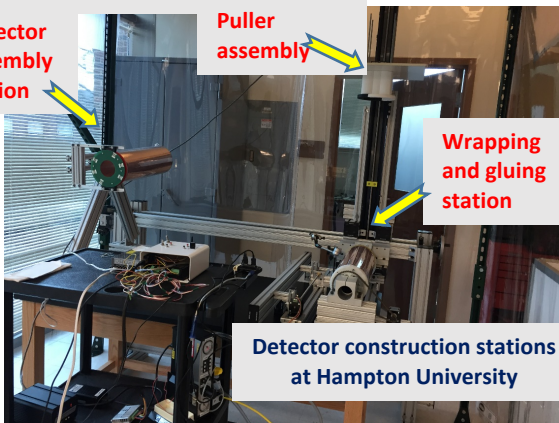


Completed outer
shell of RTPC
with readout
board



GEM foil wrapping and gluing

Detector
assembly
station

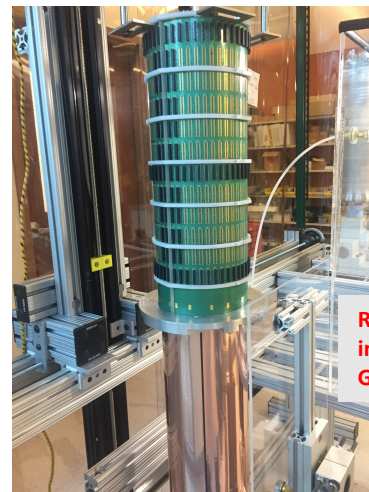


Puller
assembly

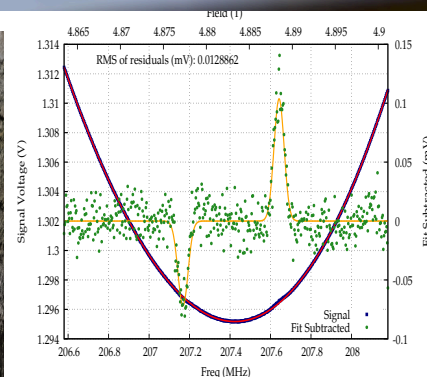
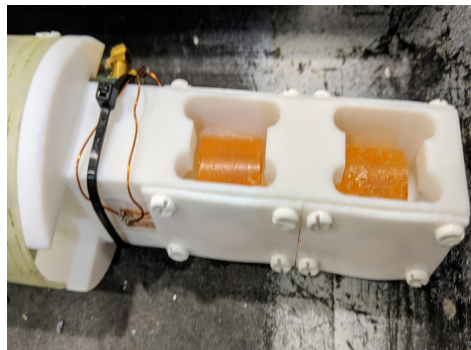
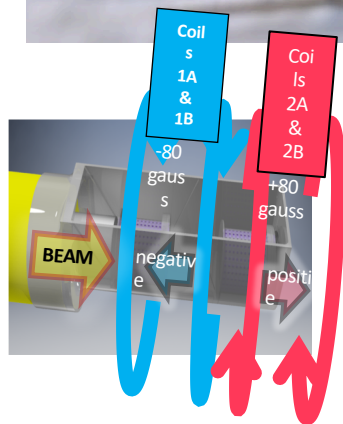
Wrapping
and gluing
station

Detector construction stations
at Hampton University

Readout adapter board
with overvoltage protection



Readout board being
installed on triple-
GEM assembly



ERR for RG-C June 17, 2019

<u>Proposals/LOIs</u>	Physics	<u>Contact</u>	<u>Days</u>
<u>PR12-19-004</u> (RGN)	Search for ϕ -N bound state	Gao	45
<u>E12-11-003C</u> (RGB)	Photoproduction of hadrons	Hauenstein	
<u>E12-07-104A</u> (RGF)	Tagged neutron DVCS with BoNuS12	Hattawy	
<u>LOI12-19-001</u>	Charged current production in Bjorken kinem.	Siddikov	
<u>LOI12-19-005</u>	Next generation Tritium experiments in CLAS12	Hen	
<u>New beam time requested for Hall B Proposals:</u>			45