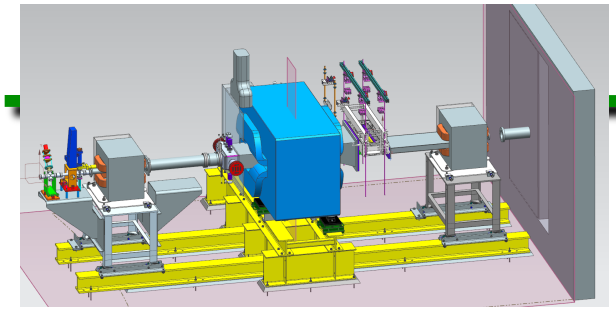
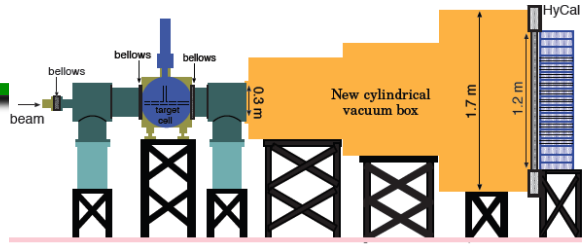
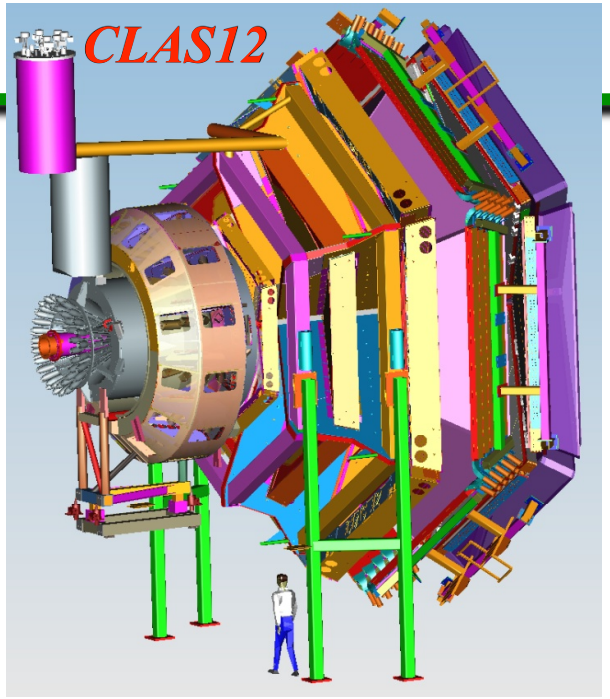






Status of Hall B

Volker D. Burkert

CLAS Collaboration Meeting
March 28 - 31 , 2017

Jefferson Lab
Exploring the Nature of Matter

clas
CEBAF Large Acceptance Spectrometer

Hall B Overview

- **12 GeV upgrade project nearly complete, CD4B Review May 10/11.**
  - All base detector construction, readout & slow controls - developed
  - Torus assembly complete – magnet is superconducting and ramped up to 3800 A (I_{Design}=3770 A).
  - Solenoid magnet in final assembly at ETI – shipping to JLab scheduled for May'17
- **Successful CLAS12 run 2/3-2/5 demonstrating the DOE Key Performance Parameter**
  - Event reconstruction, calibration/commissioning effort making excellent progress using data from KPP and cosmic rays for detector calibration
- **CLAS12 upgrades with collaboration driven equipment**
  - Central Neutron Detector, Forward Tagger addressing ERR, MM & RICH in final assembly stage
- **Solid flow of PhD theses, publications in refereed journals and conference talks**
  - **168** PhD theses completed on CLAS results (**33** in progress)
  - **184** science papers + **39** technical papers published in refereed journals
  - Many entrances in recent RPP (PDG) editions are based on CLAS data (e.g. N*'s)
  - **>2,050** talks at conference (>1150 invited)
- **Non-CLAS experiments**
  - **Proton Radius experiment** – 2016 completed (>100% of goal) – analysis underway
  - **Heavy Photon Search** – 2015/16 data – awaiting first results from low energy run
- **CLAS12 engineering & physics runs** scheduled for October –December 2017

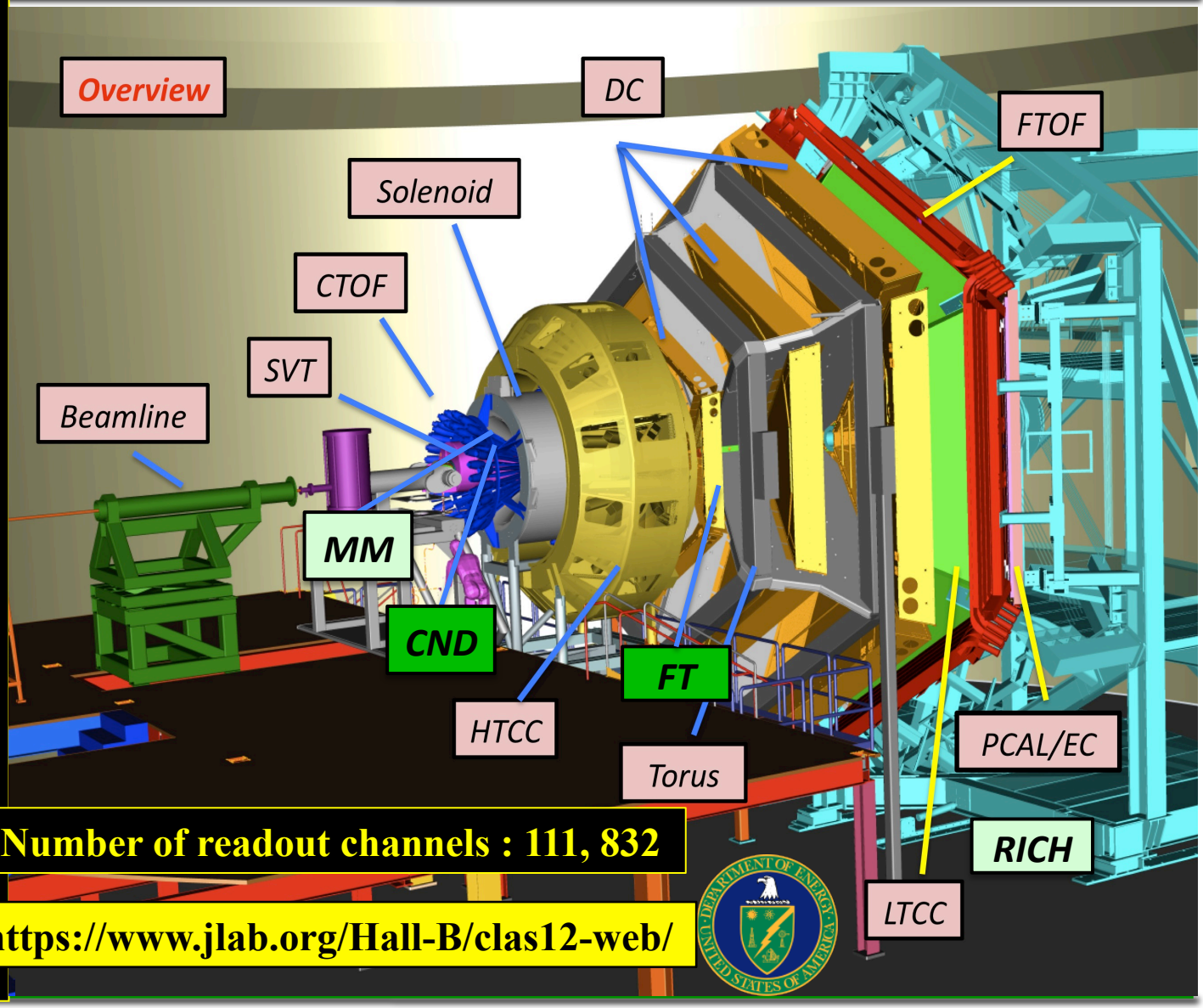
CLAS12 Technical Scope

HALL B

Forward Detector (FD)
- TORUS magnet
- HT Cherenkov Counter
- Drift chamber system
- LT Cherenkov Counter
- Forward ToF System
- Pre-shower calorimeter
- E.M. calorimeter
- Forward Tagger
- RICH detector

Central Detector (CD)
- Solenoid magnet (1)
- Silicon Vertex Tracker
- Central Time-of-Flight
- Central Neutron Det.
- MicroMegas

Beamline
- Photon Tagger
- Shielding
- Cryo Target
- Moller polarimeter
- Polarized Targets



Number of readout channels : 111, 832

https://www.jlab.org/Hall-B/clas12-web/

Torus Magnet

The CLAS12 Toroid is based on six super-conducting coils around the beam line to produce a field primary in the azimuthal (ϕ) direction. The choice of this configuration leads to an approximate toroidal field distribution around the beam axis. The Torus design was driven by the following physics requirements:

- Large acceptance for forward going particles (50% particle acceptance in detectors at 5 degrees from beam axis)
- Good momentum resolution
- 6 fold symmetry around the beam axis
- Large bore to allow passage of scattered primary beam

TECHNICAL PARAMETERS

PARAMETER	DESIGN VALUE
Magnet Type	Toroidal Field Geometry
Number of Coils	6
Coil structure	Double pancake potted in Aluminum Case
Warm bore ∅ (mm)	124
Total weight (Kg)	25,500
Number of turns per pancake	117
Number of turns per coil	234
Conductor	SSC outer dipole cable soldered in 20 mm x 2.5 mm Cu channel
Turn to Turn Insulation	0.003" E-Glass Tape ½ Lap
Nominal current (A)	3770
Ampere turns (-)	882,000
Peak Field (T)	3.58
Peak Field Location	Inner turn near warm bore adjacent to cooling tube
B-Symmetry	Yes
∫Bdl @ nominal current (Tm)	2.78 @ 5 degree , 0.54 @ 40 degree
Inductance (H)	2.00
Stored Energy (MJ)	14.2
Quench Protection/Dump Resistor	Hard wired quench detector / 0.124 Ω dump resistor
Coil Cooling	Conduction Cooled by Supercritical Helium
Supply temperature (K)	4.6
Temperature margin (K)	Min 1.52 (@5.3 K) to Generation temperature 6.82
Heat Shield Cooling	LN2 Thermo-Siphon

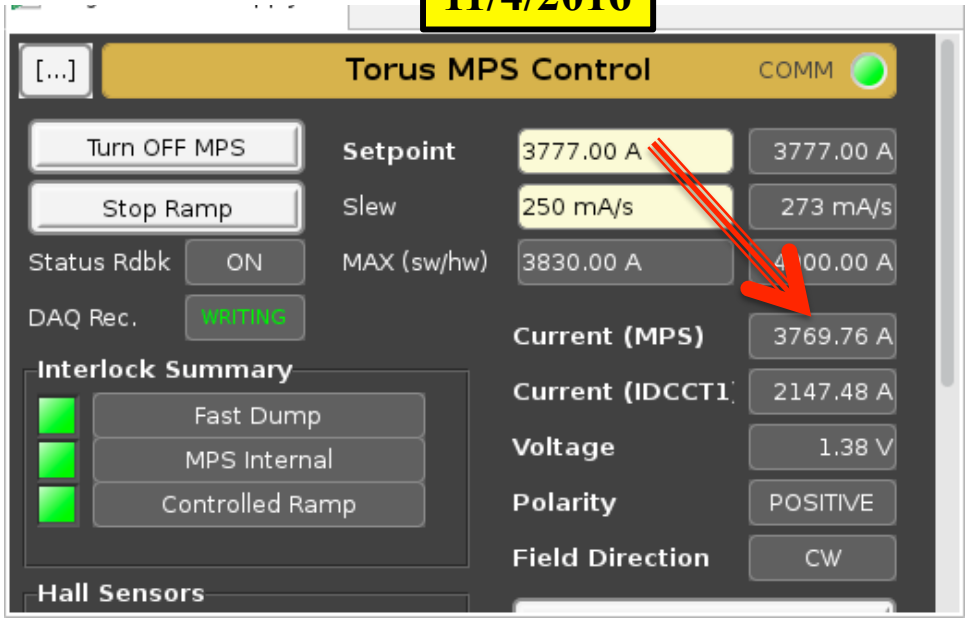
- **Construction Strategy:**
  - ❑ JLab lead the design effort
  - ❑ JLab procured the soldered conductor
  - ❑ FNAL manufactured 8 coils and potted them in the coil cases (CCMs)
  - ❑ JLab assembled each coil into cryostats in an on-site factory
  - ❑ All 8 coils tested at 80K
  - ❑ The six coil torus assembled and tested as a magnet in Hall B

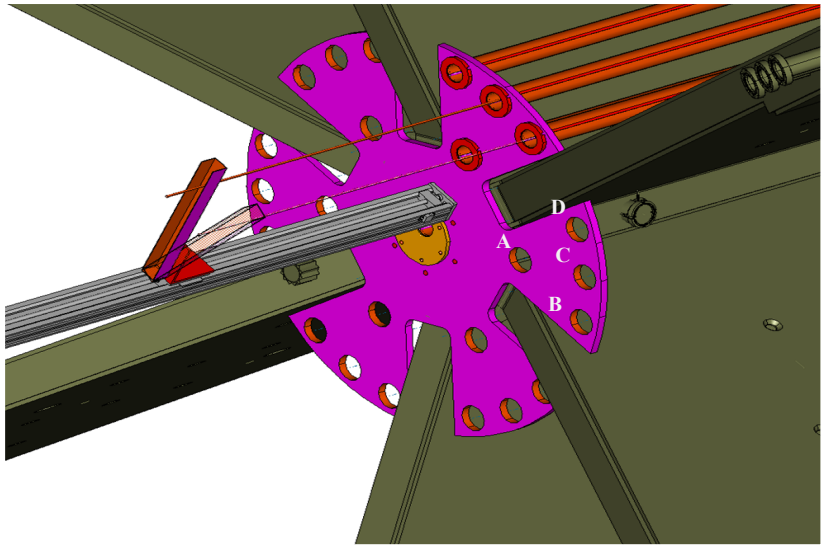
- **Significant Dates:**
  - ❑ August 1, 2013 - 7 conductor spools soldered
  - ❑ December 1, 2013 - Practice coil delivery to JLab
  - ❑ January 2, 2014 - Prototype coil fabrication start
  - ❑ Oct 17, 2014 - Begin erection of the Torus assembly tooling in Hall B
  - ❑ Nov 1, 2014 - Complete coil fabrication process (Practice CCM001)
  - ❑ Nov, 2014 - First CCM delivered to JLab for Cryostating
  - ❑ February 6, 2015 - First coil delivered to Hall B
  - ❑ May 11, 2015 - 4th Coil installed on Installation Spit
  - ❑ June, 2015 - Last CCM delivery to JLab
  - ❑ June, 2015 - 6th Coil installed on Torus
  - ❑ January, 2016 - Magnet Assembled and off the Assembly Spit
  - ❑ August 2016 - Cooldown Starts
  - ❑ September 2016 - Torus at 4 Kelvin
  - ❑ November 2016 - Torus commissioned and field mapped in Hall B

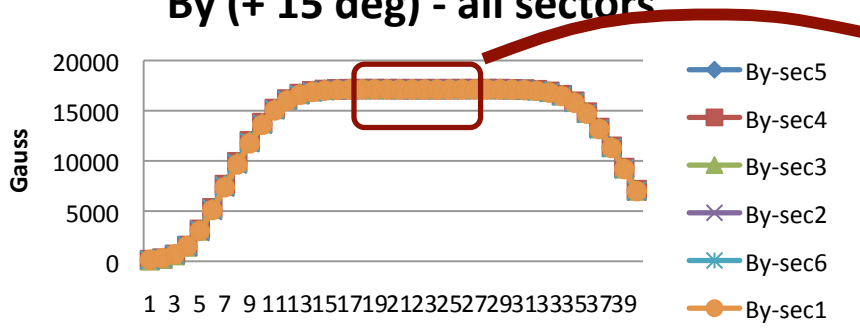
- **Project Status 3/15/2017**
  - ❑ Magnet achieved full field
  - ❑ Small internal helium leak is not effecting performance
  - ❑ Lower vacuum pump system will have Turbo Pump moved to low field region

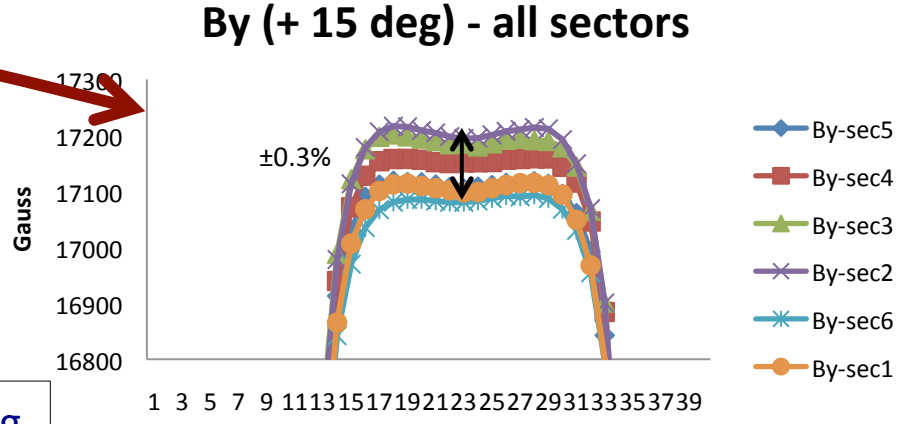
Torus magnet operational

11/4/2016



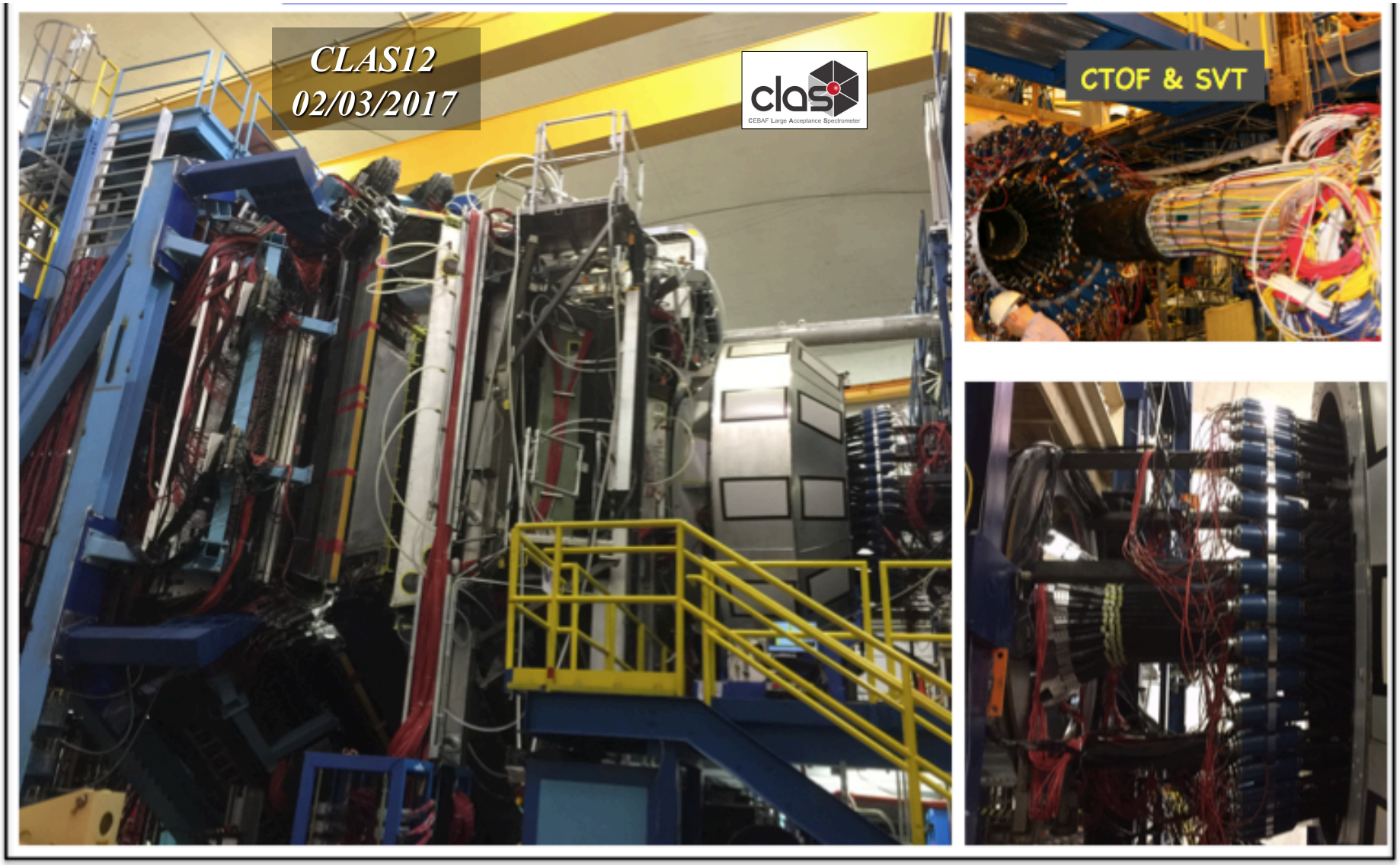






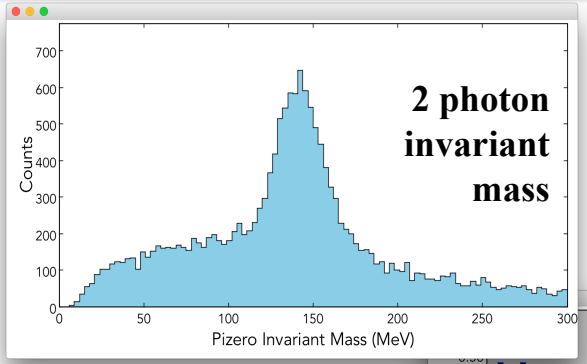
Analysis of magnetic field measurements ongoing

Equipment for KPP

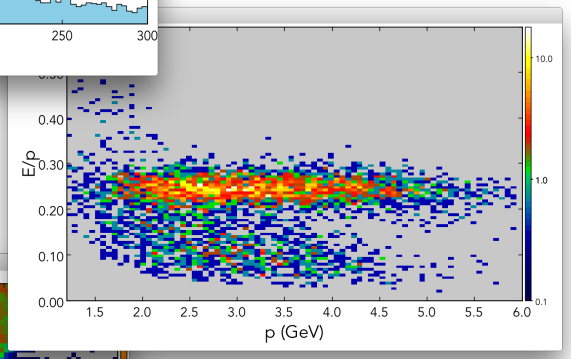


CLAS12 Calibration of KPP data

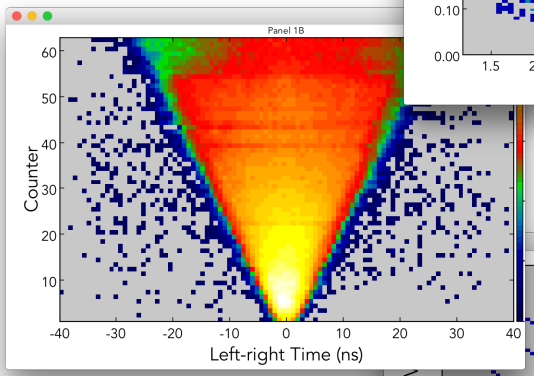
- Focus on forward detectors: **ECAL, FTOF, DC**
  - **ECAL** (PCAL+EC): energy calibration) based on pions
  - **FTOF**: gain, attenuation length, effective velocity, left-right timing offsets **completed**, first iteration of time walk, paddle-to-paddle **in progress**
  - **DC**: first iteration of T0 and time-to-distance calibration
- Great opportunity to test procedures, identify issues & improve algorithms
- Limitations due to single sector DC
- Alternative procedure to calibrate detectors in all sectors being developed



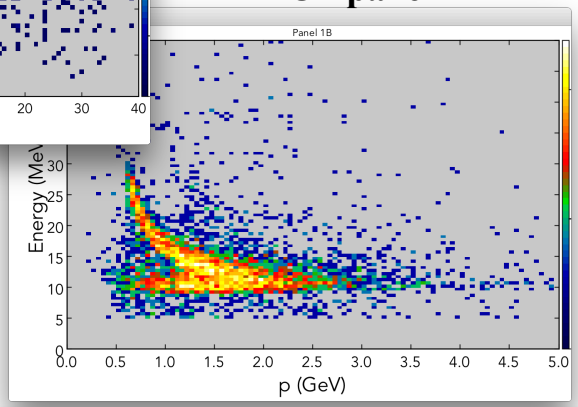
ECAL sampling fraction



FTOF panel 1B

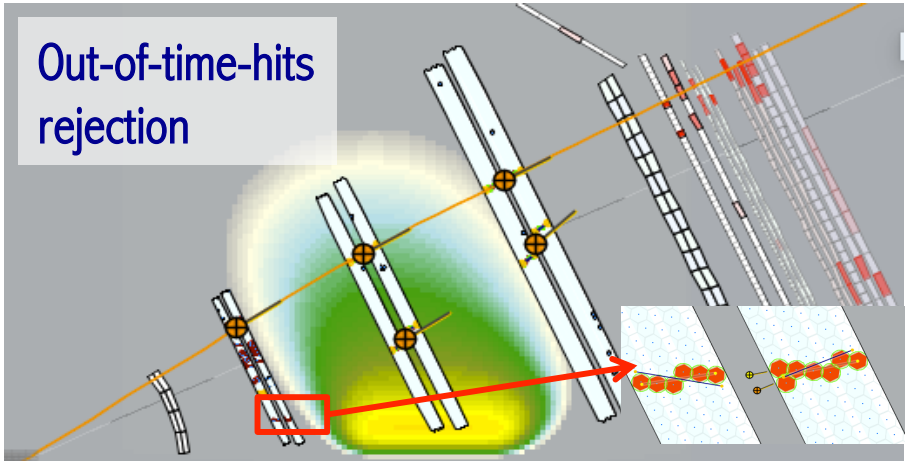


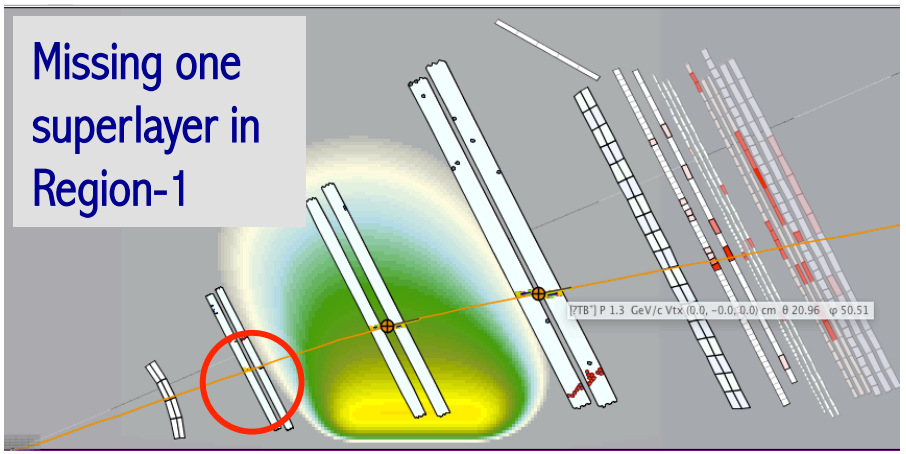
FTOF panel 1B

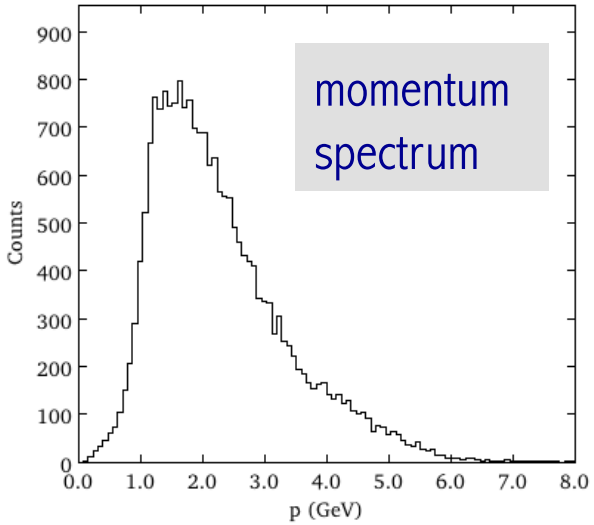


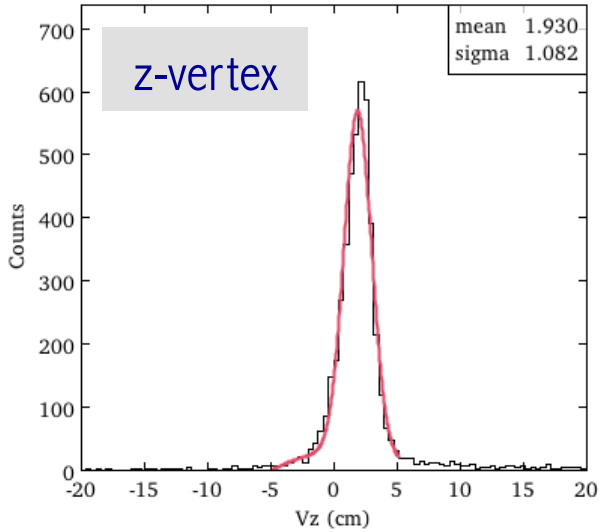
CLAS12 Tracking in Forward Detector

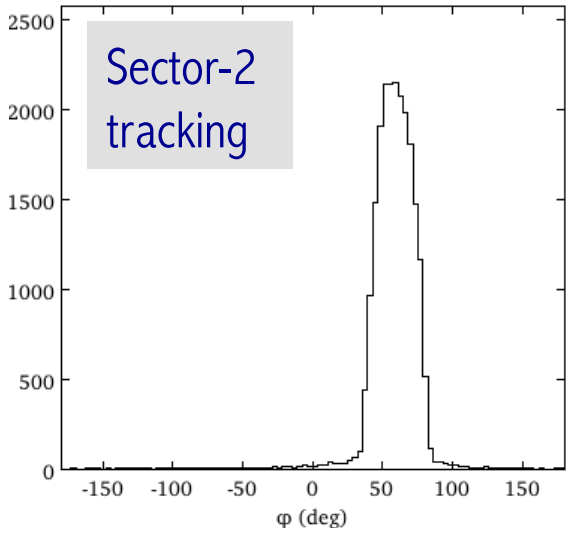
E_e=6.4 GeV, calorimeter trigger in S2 only, negative tracks outbending, no solenoid field



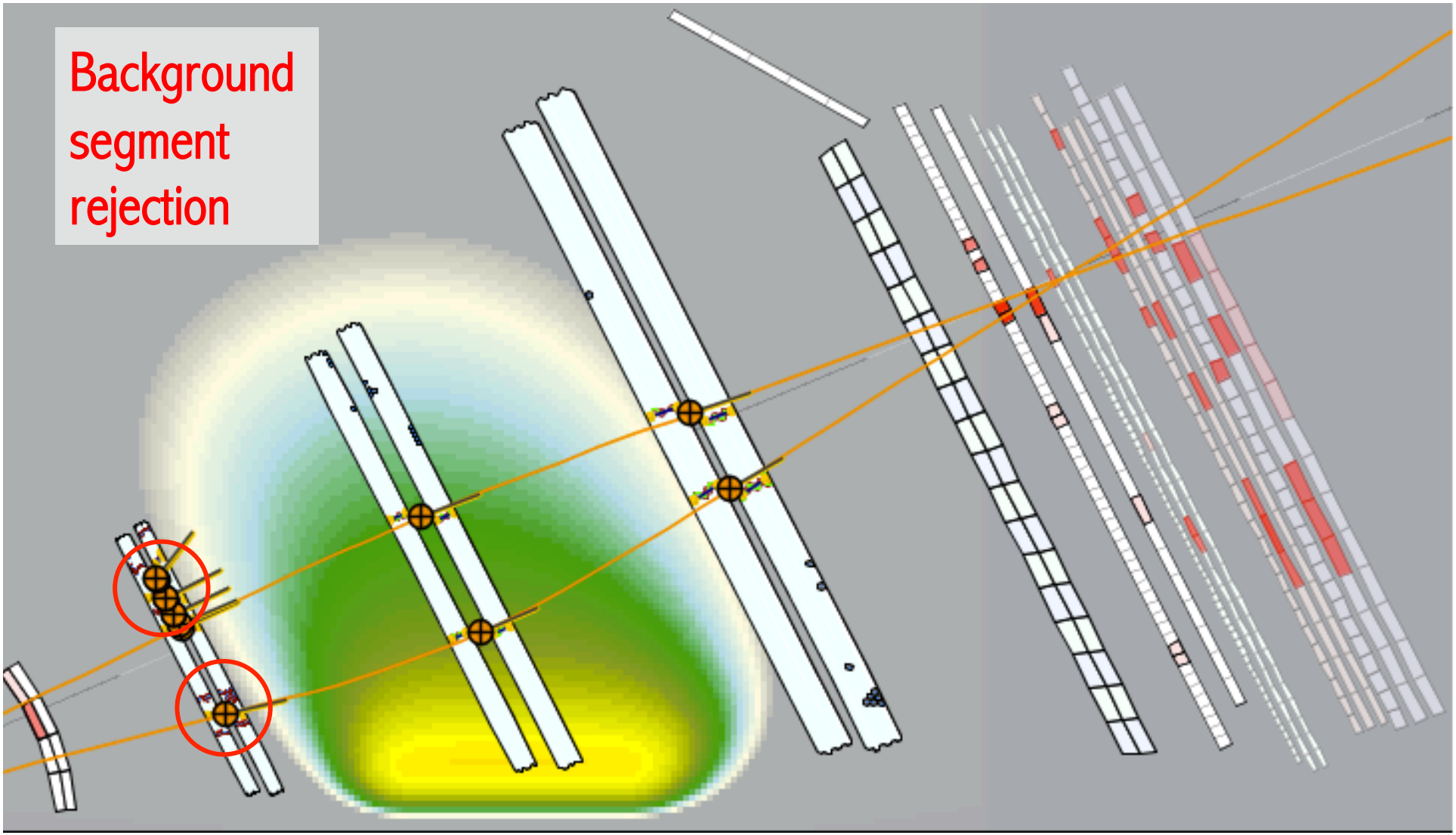








CLAS12 Tracking in Forward Detector



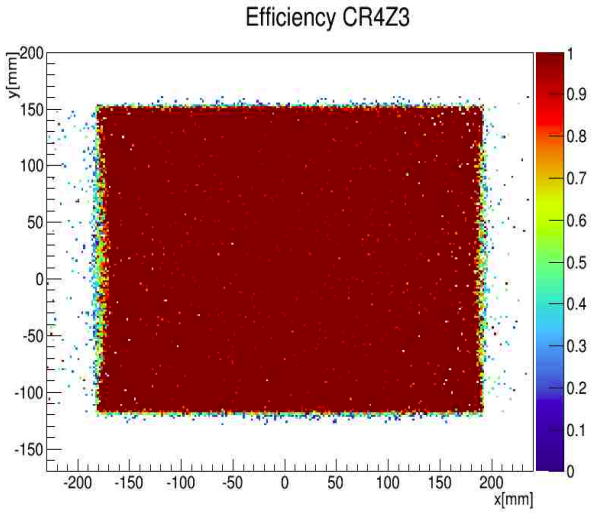
Micromegas Vertex Tracker

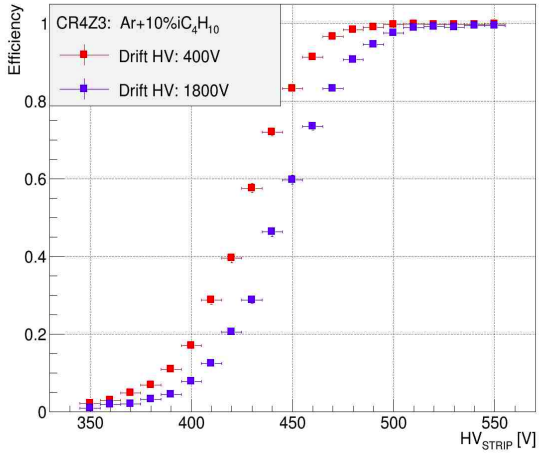
Mechanical structure for the B6 configuration is ready.

75% of tiles constructed and are being tested.

Detectors will be delivered and **integrated with SVT in early June**.

MVT B6 structure with CR6





Efficiency test for an inner tile of MVT

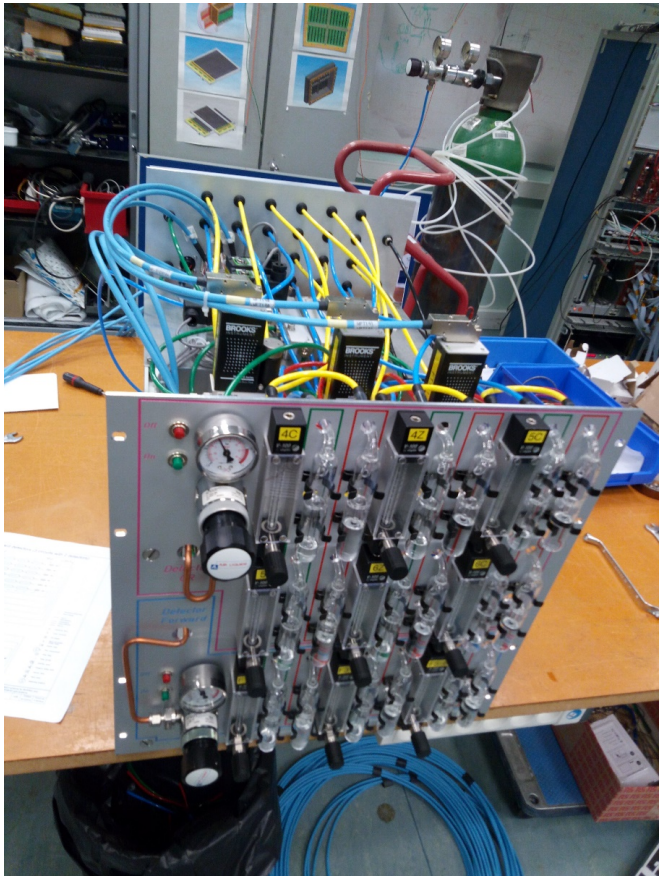
Micromegas Gas System

Gas distribution rack done and tested.

The control rack with PLC is being tested with the distribution gas .

In June, everything will be ready to receive the gas.

MVT barrel and forward gas control rack

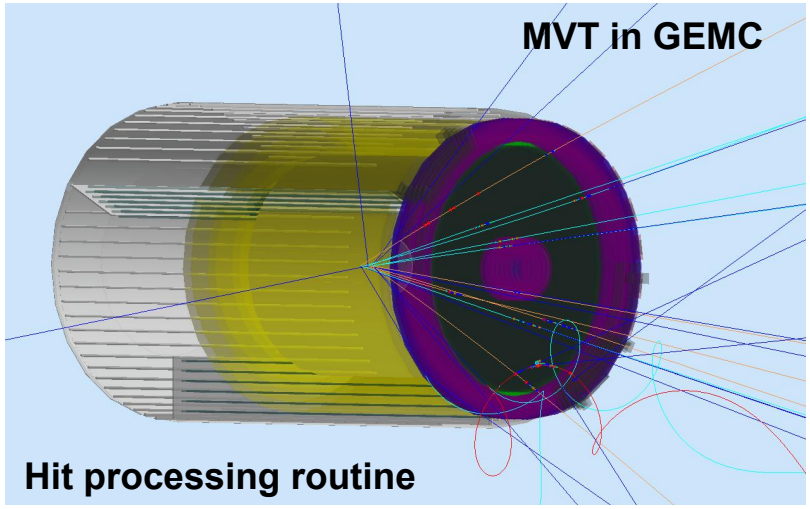


MVT distribution gas rack under test

CALIBRATION SYSTEM + GEMC

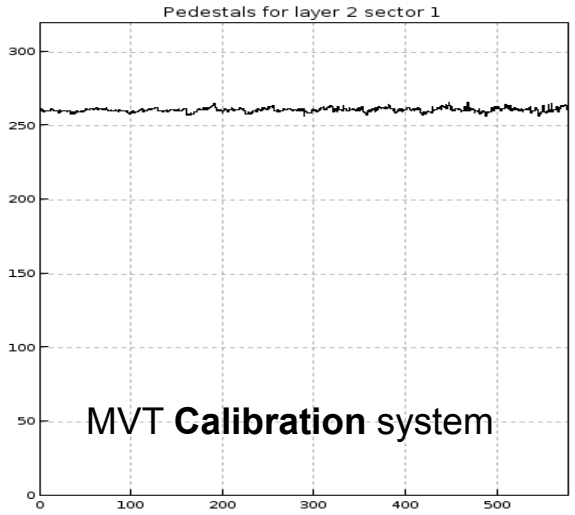
Calibration code nearly complete.

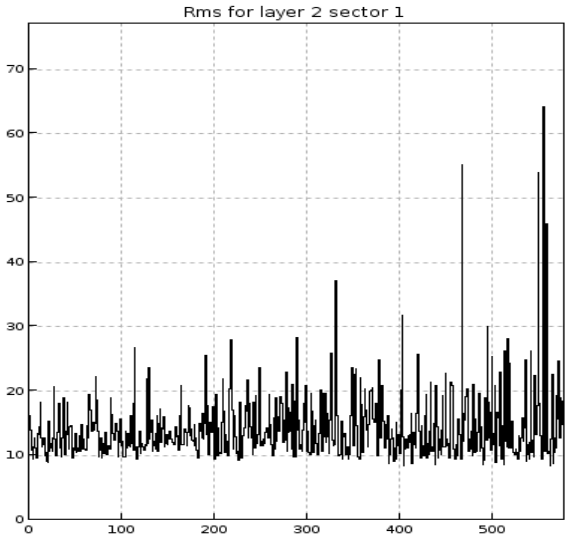
Monitoring and calibration code will be merged to coatjava in April.



Hit process routines improved for micromegas (FTT and MVT) in GEMC

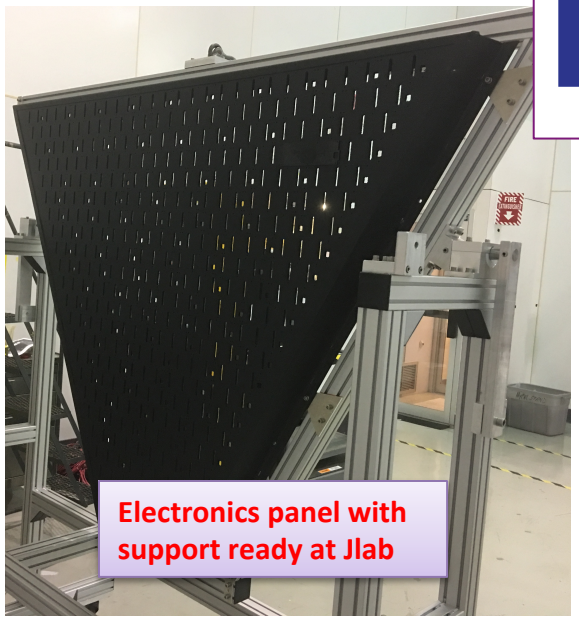
Next step: Implement B6 configuration





RICH

clas



Electronics panel with support ready at Jlab

Mechanical structure

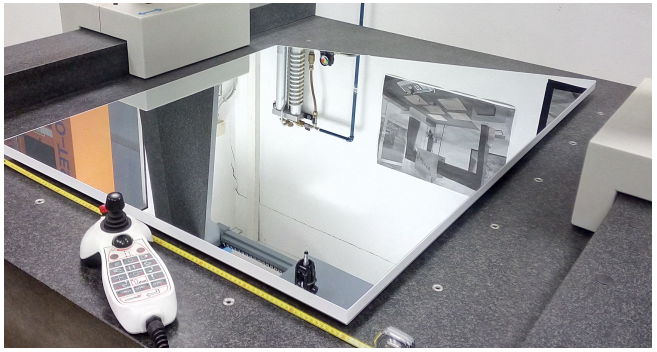
- Assembling at JLab ongoing with help of DSG
- Support structure for the electronics panel arrived to Jlab

Spherical mirrors:

- All 10 mirrors received and accepted
- Back to vendor to build support and alignment structure

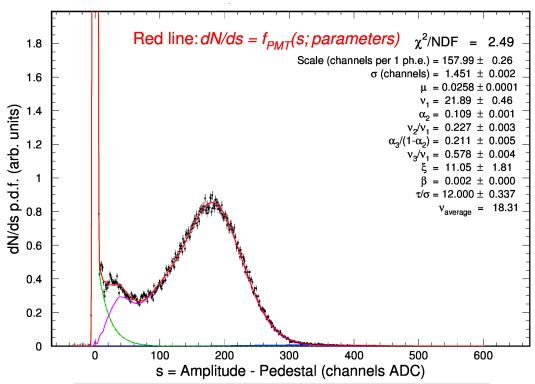
Planar mirrors:

- 3/5 lateral mirrors accepted
- 2 front mirrors in production



RICH structure assembled at Jlab!

CLAS12 RICH



One photoelectron spectrum taken with new front-end

Aerogel:

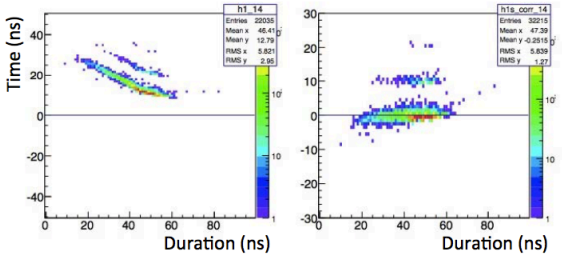
-Received over 75% of the minimum required quantity of 3cm tiles

- 2cm layer production started

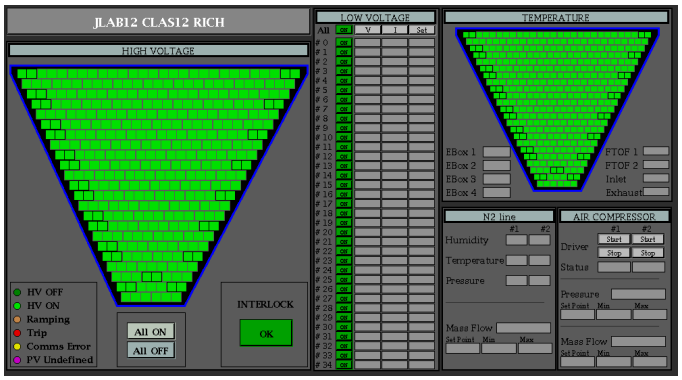
Electronics:

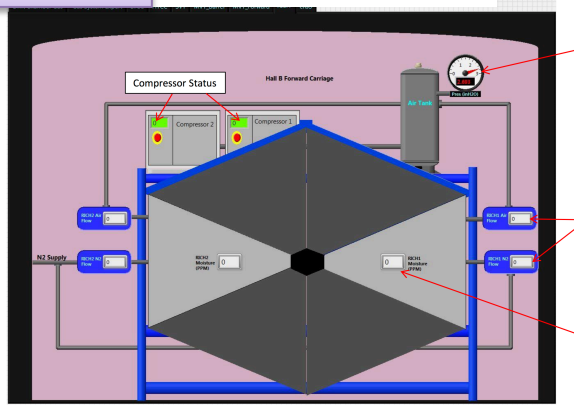
- All electronics front-end boards are at JLab
- Acceptance tests done at the company
- Electronics boards characterization ongoing
- σ(ped)/1phe ~ 1%

Digital time walk correction



Slow Control design ongoing





On schedule for the installation in Hall B in September 2017

CLAS12 Central Neutron Detector

IPN ORSAY

Recent achievements:

- Construction completed
- Detector at JLab (ESB building) since 6/2015
- HV calibrations of PMTs completed
- Cosmic data analysis: σ_t ~150 ps for all blocks
- Assembly in mechanical structure done in Orsay
- Cosmic rays tests at JLab using CLAS12 electronics, confirmed Orsay results for time resolution
- June 2016: Ancillary Equipment ERR
- Calibration, monitoring, simulation and reconstruction software 90% complete
- v_{eff}, time offsets calibrations demonstrated at calibration challenge (12/2016), ADC calibration and attenuation length near completion
- GEMC digitization undergoing improvements

Plan for 2017:

- Installation in the CD after solenoid magnet commissioning (09 '17)

CLAS12 Forward Tagger (FT)

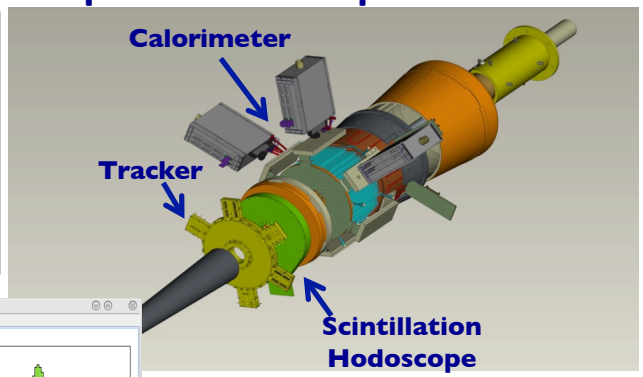
HALL B

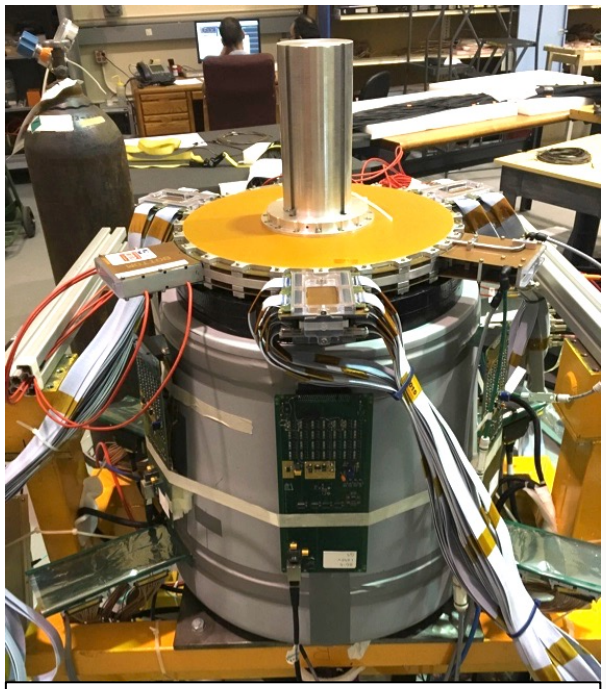
Detect electrons at small angle to perform quasi-real photo-production experiments.

Calorimeter: electron energy/momentum
Photon energy (ν=E-E'), Polarization $\varepsilon^{-1} \approx 1 + \nu^2/2EE'$
$PbWO_4$ crystals with APD/SiPM readout

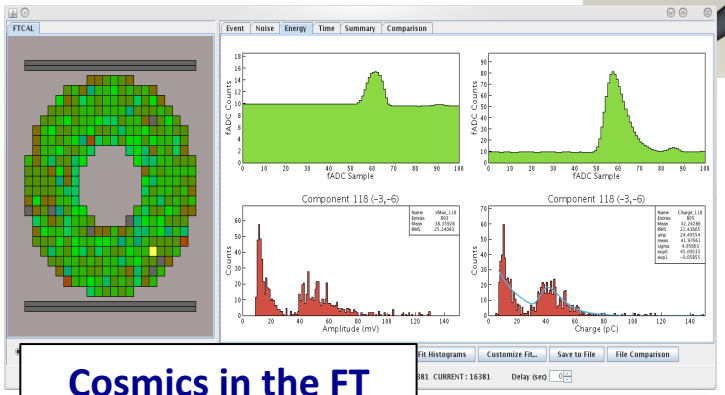
Scintillation Hodoscope: veto for photons, Scintillator tiles with WLS

Tracker: electron angles, polarization plane, MicroMegas detectors

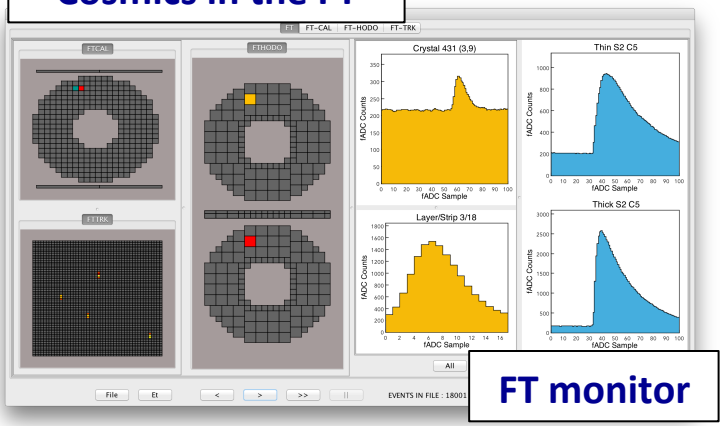




FT-Cal+FT-Hodo+FT-Trck cosmic test at JLab



Cosmics in the FT

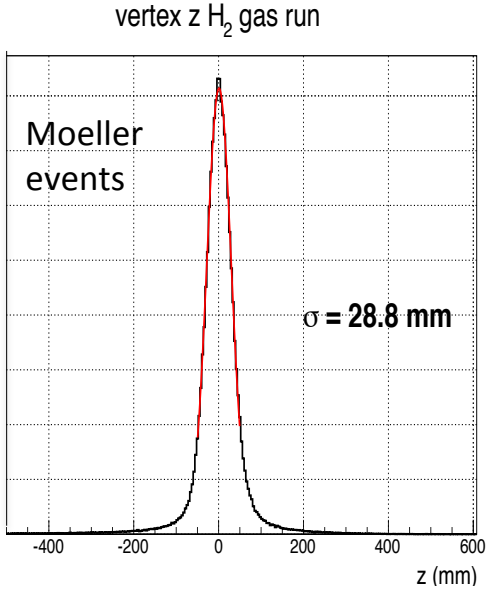


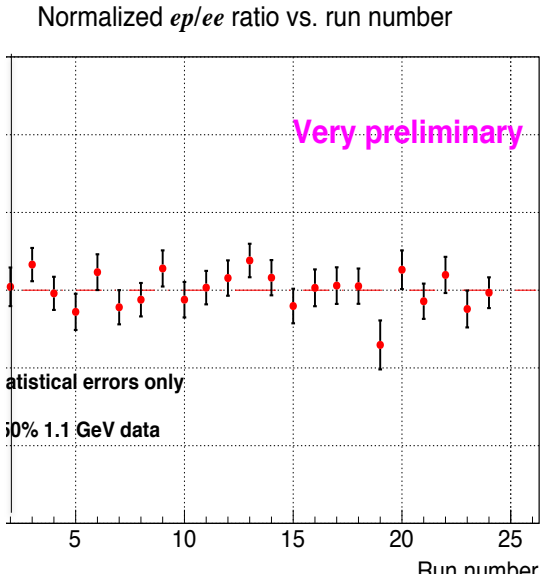
FT monitor

- First calibration w/ cosmics
- Hardware interlocks in preparation by DSG
- FT-Cal final assembly in May
- FT checkout in June (in EEL)
- Installation in CLAS12 in July
- Implementation of R/O in CLAS12 DAQ in summer
- FT-Cal + FT-Hodo reconstruction implemented in COATJAVA3.0.
- FT-Trck in progress

PRad Analysis Status

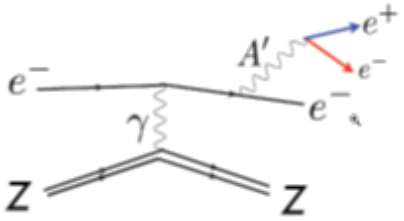
- Development of a GEANT4 based simulation code, including detectors realistic geometry, resolutions and beam line elements, has been finalized.
- Physics analysis in progress:
  - ✓ z-vertex reconstruction is finalized for both ep --> ep and ee --> ee from ^{12}C and H_2 targets;
  - ✓ normalized experimental yields for ep --> ep and ee --> ee are extracted for the ~50% of 1.1 GeV runs;
  - ✓ the ratio shows good stability vs. run number for physics runs;

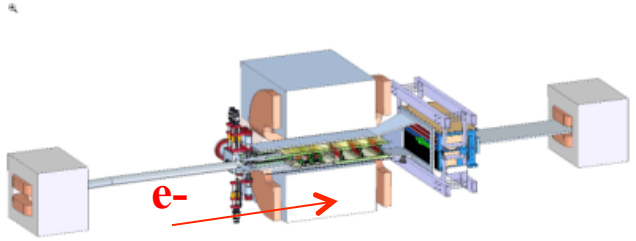




HPS Physics Results

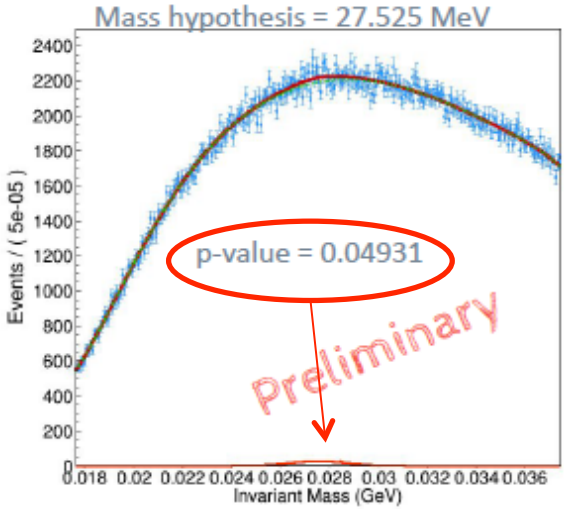
HALL B

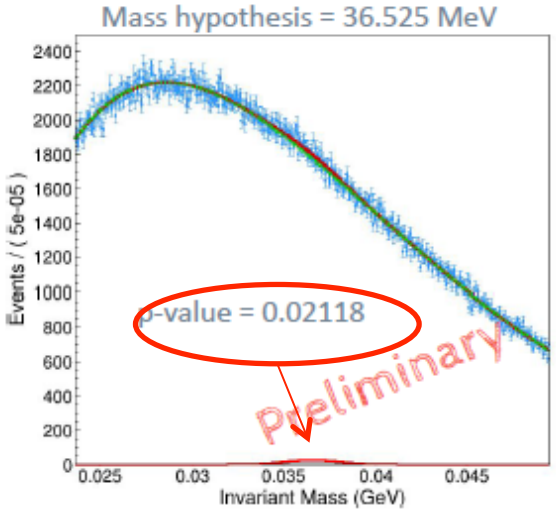




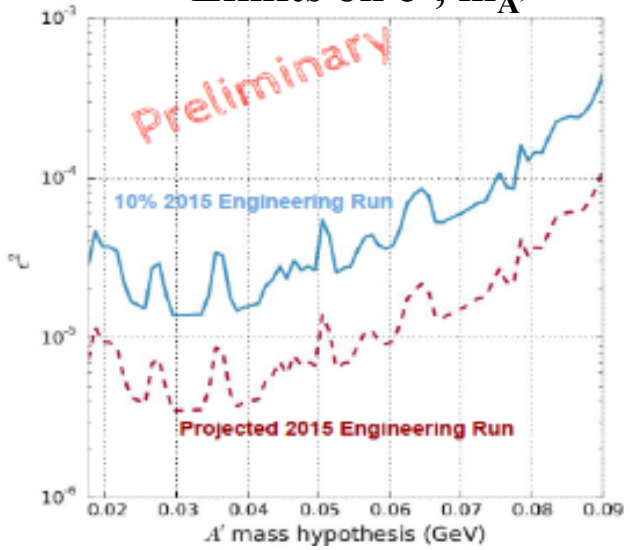
Physics

- If DM is light and produced in the Big Bang, Nature needs a new force, e.g. a heavy photon (A′)
- A's could mediate dark matter annihilations and its interactions with *our* matter
- HPS looks for an electro-produced A' decaying to e^+e^-
- HPS identifies A's with invariant mass and separated vertices
- **First Limits are based on the unblinded 10% of 2015 data**
  - * Ready to unblind the full data set in ~1-2 weeks
  - * HPS can deliver physics





Limits on ε^2, $m_{A'}$



talk by N. Baltzell

Hall B – Run Groups

HALL B

Proposal	Physics	Contact	Rating	Days	Group	New equipment	Energy	Run Group	Target
E12-06-108	Hard exclusive electro-production of π^0, η	Stoler	B	80	139	RICH (1 sector) Forward tagger	11	A F. Sabatié	liquid H_2
E12-06-108A	Exclusive N*->KY Studies with CLAS12	Carman		(60)					
E12-06-108B	Transition Form Factor of the η' Meson with CLAS12	Kunkel		(80)					
E12-06-112	Proton's quark dynamics in SIDIS pion production	Avakian	A	60					
E12-06-112A	Semi-inclusive Λ productiuon in target fragmentation region	Mirazita		(60)					
E12-06-112B	Colinear nucleon structure at twist-3	Pisano		(60)					
E12-06-119(a)	Deeply Virtual Compton Scattering	Sabatie	A	80					
E12-09-003	Excitation of nucleon resonances at high Q^2	Gothe	B+	40					
E12-11-005	Hadron spectroscopy with forward tagger	Battaglieri	A-	119					
E12-11-005A	Photoproduction of the very strangest baryon	Guo		(120)					
E12-12-001	Timelike Compton Scatt. & J/ψ production in e+e-	Nadel-Turonski	A-	120					
E12-12-007	Exclusive φ meson electroproduction with CLAS12	Stoler, Weiss	B+	60					
E12-07-104	Neutron magnetic form factor	Gilfoyle	A-	30	90	Neutron detector RICH (1 sector) Forward tagger	11	B K. Hafidi	liquid D_2 target
E12-09-007(a)	Study of partonic distributions in SIDIS kaon production	Hafidi	A-	30					
E12-09-008	Boer-Mulders asymmetry in K SIDIS w/ H and D targets	Contalbrigo	A-	56					
E12-09-008A	Hadron production in target fragmentation region	Mirazita		(60)					
E12-09-008B	Colinear nucleon structuer at twist-3	Pisano		(60)					
E12-11-003	DVCS on neutron target	Niccolai	A	90					
E12-11-003A	In medium structure functions, SRC, and the EMC effect	Hen		(90)					
Beam time partial sum				**765 (1355)**	**229**				

Experiment ending with A or B are run group experiments approved by the CLAS collaboration. They are running parallel to the experiments with same experiment number. Experiments ending with (a) and (b) take data with both run groups.

Hall B – Run Groups

HALL B

E12-06-109	Longitudinal Spin Structure of the Nucleon	Kuhn	A	80	185	Polarized target RICH (1 sector) Forward tagger	11	C S. Kuhn	NH_3 ND_3
E12-06-109A	DVCS on the neutron with polarized deuterium target	Niccolai		(60)					
E12-06- 119(b)	DVCS on longitudinally polarized proton target	Sabatie	A	120					
E12-07-107	Spin-Orbit Correl. with Longitudinally polarized target	Avakian	A-	103					
E12-09-007(b)	Study of partonic distributions using SIDIS K production	Hafidi	A-	80					
E12-09-009	Spin-Orbit correlations in K production w/ pol. targets	Avakian	B+	103					
E12-06-106	Color transparency in exclusive vector meson production	Hafidi	B+	60	60		11	D	
E12-06-117	Quark propagation and hadron formation	Brooks	A-	60	60		11	E	Nuclear
E12-06-113	Free Neutron structure at large x	Bueltman	A	42	42	Radial TPC	11	F	Gas D_2
E12-14-001	EMC effect in spin structure functions	Brooks	B+	55	55	Pol. LiH target	11	G	LiH
TOTAL CLAS12 run time (approved experiments)				**1466 (2118)**	**631**				

Proposal	Physics	Contact	Rating	Days	Group	Equipment	Energy	Group	Target
C12-11-111	SIDIS on transverse polarized target	Contalbrigo	A	110	110	Transverse target	11	H	HD
C12-12-009	Transversity w/ di-hadron on transvere target	Avakian	A	110					
C12-12-010	DVCS with transverse polarized target in CLAS12	Elouadrhriri	A	110					
All CLAS12 transverse target proposals				330	110				
E12-11-006	Heavy Photon Search at Jefferson Lab (HPS)	Jaros	A	180	180	Setup in alcove	2.2, 6.6	I	Nuclear
E12-11-106	High Precision Measurement of the Proton Charge Radius	Gasparian	A	15	15	Primex	1.1, 2.2	J	H2 gas
Beam time request from CLAS12 C1 experiments + non-CLAS12 experiments				**525**	**305**				
Beam time from approved CLAS12 experiments (from previous table)				**1466 (2118)**	**631**				
Beam time for Hall B experiments table 1 + table 2 (incl. 110 days of C1 approved exp.)				**1991 (2643)**	**936**				

Hall B – Run Groups

HALL B

Proposal	Physics	Contact	Rating	Days	Group	Equipment	Energy	Group	Target
E12-16-010	A search for Hybrid Baryons in Hall B with CLAS12	D'Angelo	A-	(100)	100	Forward Tagger	6.6, 8.8	K Confinement & Strong QCD	IH2
E12-16-010A	Nucleon Resonances in exc. KY electroproduction	Carman	A-	(100)					
E12-16-010B	DVCS with CLAS12 at 6.6 and 8.8 GeV	Elouadrhiri	A-	(100)					
Total Beam time of Run Group K				**100 (300)**	**100**				
Beam time of approved & C1 approved CLAS12 experiments from table 1 + table 2				**1991 (2643)**	**936**				
Beam time for Hall B experiments table 1 + table 2 + table 3				**2091 (2943)**	**1036**				

Proposal Count	Experiment Days	Run Groups	RG days	Compression
37	**2943**	**11**	**1036**	**0.35**

In the BOAW we expect experiment schedule:

- 35 weeks per year ≈ 35/2 = 17.5 PAC weeks = 122.5 PAC days
- With 0.8 Hall multiplicity => 122.5 x 0.8 = 98 PAC days

- To run 2943 PAC days of individual experiments = **30 years**
- Run 2943 PAC days as run groups = 1036/98 = **10.5 years**

Scheduling considerations

HALL B

Assuming all ERR reviews have been passed and beam time requested

- Experiment with hydrogen target to run first to understand detector responses, calibrations
- Provide all Run Groups with significant amount of data during first 5 years

  => schedule ~50% of total approved Run Group days
- Scientific ratings by the PAC
- Schedule ***High Impact*** experiments early (PAC41)
- Compatibility with energies used in other Halls
- Benefit to collaboration
- Operating luminosity
- Jeopardy process
- Final scheduling done in NPES committee

PAC41 - High Impact Experiments

Hall B High Impact (H.I.) experiments: 195 PAC days

PRad: 15
HPS: 39

BONUS: 21 (*)
HDIce: 110
TMD(p): 10
DVCS(d): 90 (**)

(*) : 42 if it runs before ^{3}H/^{3}He

(**) : H.I. if HDIce delayed

PAC Days
Boldface = days designated High Impact
Parentheses = days not counting toward High Impact total

PAC41 "High Impact" Selection

Row Color
Yellow = High Impact
Green = backup expt

Exp#	Exp name	Hall	Run Group/ Days	PAC Days	PAC grade	Comments
	TOPIC 1 : SPECTROSCOPY					
E12-06-102	**GlueX** : Mapping the Spectrum of Light Quark Mesons and Gluonic Excitations with Linearly Polarized Photons	D		(120) approved ★90	A	GlueX - assumed half commissioning/half physics ★plus (30) commissioning days
	TOPIC 2 : FORM FACTORS					
E12-06-101	Measurement of the Charged **Pion Form Factor** to High Q2	C		52	A	Requires fully commissioned SHMS
E12-07-109	**GEp/GMp** : Large Acceptance Proton Form Factor Ratio Meas's at 13 and 15 (GeV/c)2 Using Recoil Polarization Method	A		45	A-	Requires SBS and high power cryo target
E12-11-106	High Precision Measurement of the **Proton Charge Radius**	B		15	A	Non-CLAS12 experiment, Prad
	TOPIC 3 : PDFs					
E12-06-113	**BONuS** : The Structure of the Free Neutron at Large x-Bjorken	B	F/40	(40) approved ★21 ↓	A	Requires BONuS Radial TPC upgrade ★42 days High Impact for the experiment
E12-10-103	**MARATHON** : Measurement of the F2n/F2p, d/u Ratios and A=3 EMC Effect in DIS off the Tritium and Helium Mirror Nuclei	A	Tritium target group/61	↑ ★21 (42) approved	A	that runs first; experiments are equally important & both are essential
E12-06-110	**A1n HallC-3He** : Meas of Neutron Spin Asymmetry A1n in the Valence Quark Region Using an 11 GeV Beam and a Polarized 3He Target in Hall C	C		36	A	Requires high luminosity 3He
	TOPIC 4T : TMDs					
C12-11-111	**TMD CLAS-HDIce** : SIDIS on Transverse polarized target	B	G/110	110 concurrent	A	Requires transversely polarized HDIce with electron beam
C12-12-009	**Dihadron CLAS-HDIce** : Measurement of transversity with dihadron production in SIDIS with transversely polarized target	B	G/110	(110) concurrent	A	Requires transversely polarized HDIce with electron beam C1 Proposal
E12-06-112	**TMD CLAS-H(Unpol)** : Probing the Proton's Quark Dynamics in Semi-Inclusive Pion Production at 12 GeV	B	A/139	(60) approved ★10	A	Hall B commissioning + 10 days ★plus (50) commissioning days
	TOPIC 4G : GPDs					
E12-06-114	**DVCS HallA-H(UU,LU)** : Measurements of Electron-Helicity Dependent Cross Sections of DVCS with CEBAF at 12 GeV	A	Early: DVCS & GMp/62	(100) approved ★70	A	Hall A commissioning
C12-12-010	**DVCS CLAS-HDIce** : DVCS at 11 GeV with transversely polarized target using the CLAS12 Detector	B	G/110	(110) concurrent	A	Requires transversely polarized HDIce with electron beam C1 Proposal
E12-11-003	**DVCS CLAS-D(UU,LU)** : DVCS on the Neutron with CLAS12 at 11 GeV	B	B/90	(90) approved	A	Requires D target; central neutron detector ready in 2016 ★Backup GPD-E meas if HDIce delayed
	TOPIC 5 : NUCLEAR					
E12-13-005	**Bubble Chamber** : Measurement of 16O(^{3},±)12C with a bubblechamber and a bremsstrahlung beam	INJ		14	A-	Our guess: 2017
E12-11-101	**PREx-II** : Precision Parity-Violating Measurement of the Neutron Skin of Lead	A		35	A	Requires septum, Pb target, 1% Moller polarimetry
E12-06-105	**SRC-hiX** : Inclusive Scattering from Nuclei at $x > 1$ in the quasielastic and deeply inelastic regimes	C		32	A-	
E12-11-112	**SRC-Tritium** : Precision measurement of the isospin dependence in the 2N and 3N short range correlation region	A	Tritium target group/61	19	A-	
	TOPIC 6 : FUNDAMENTAL SYMMETRIES					
E12-11-006	**HPS** : Status of the Heavy Photon Search Experiment at Jefferson Laboratory (Update on PR12_11_006)	B	H/180	(155) approved ★39	A	non-CLAS12 experiment, HPS ★25 pre-CLAS engr + 14 physics @ 4.4 GeV
E12-10-009	**APEX** : Search for new Vector Boson A1 Decaying to e+e-	A		34	A	Requires new septum and target system

<<< SUMMARY of "HIGH IMPACT" DAYS >>>

by Topic	1	2	3	4GT	5	6	total post-commissioning
	90	112	78	190	100	73	643
by Hall		**A**	**B**	**C**	**D**	**INJ**	
		224	195	120	90	14	643

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

Summary

- CLAS data continue to deliver important science in many areas.
- HPS experiment successfully took data at 2.3 GeV: first results presented. PRad experiment to measure proton radius completed, analysis underway.
- CLAS12 base detectors and beam line equipment used in successful KPP run.
- Data from KPP run currently employed for detector calibration & event reconstruction.
- Superconducting Torus magnet ramped up to 3800 A (design 3770A) without quench.
- Delivery of Solenoid magnet expected early May 2017.
- Ancillary detector construction finished or well advanced – on track for use in engineering run.
- Preparations for the fall run are well underway

The KPP run was a big accomplishment of CLAS12

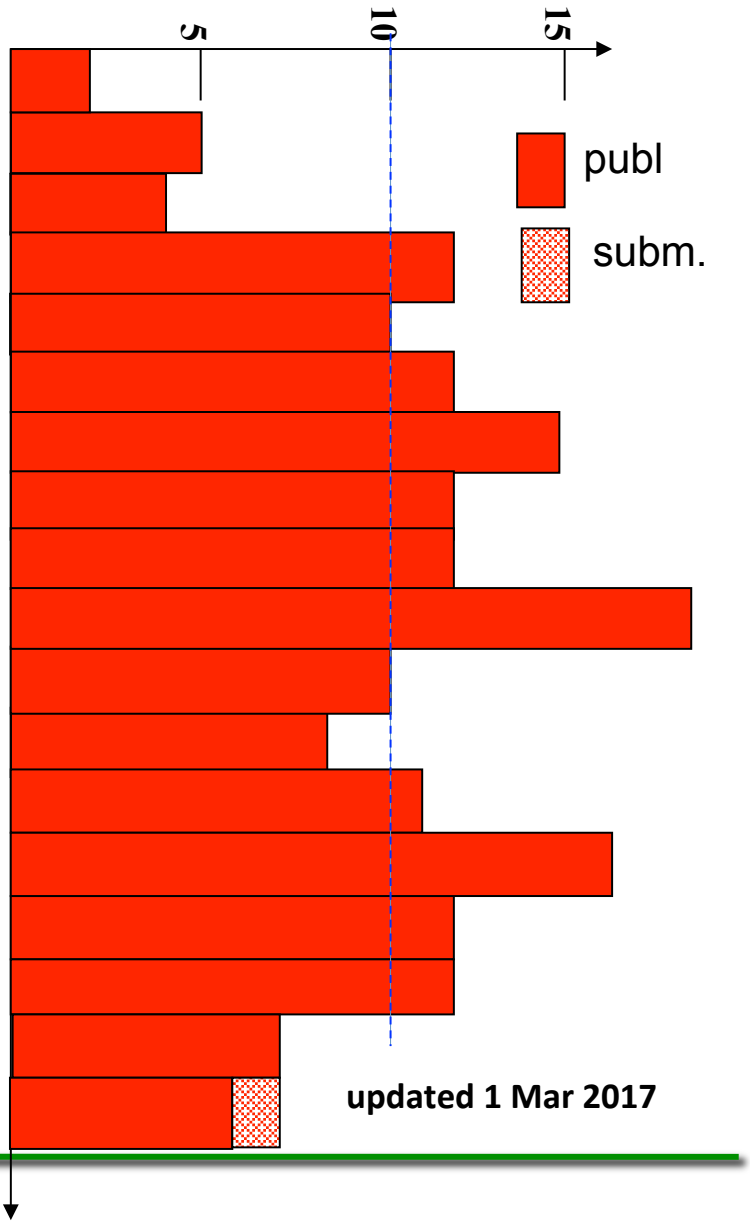
Now we need to channel the energy to be ready for science

The effort of the entire collaboration is needed!

Additional slides

Hall B Physics Publications in refereed Journals

	HSWG	DPWG	NPWG	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	1+1	5		6+1
SUM	87+1	61	37	184+1



Physics Publications by Run Groups

• e1(a – f)	26
• e1-6	12
• e2	8
• e1-dvcs	7
• e5	1
• e6	3
• e8-Bonus	2
• eg1	14
• eg1-dvcs	6
• eg2	4
• eg3	1
• eg4	1
• eg5-TPE	2
• eg6	
TOTAL:	**88**

• g1	14
• g2	5
• g3	4
• g5	2
• g6	3
• g7	3
• g8	2+1
• g9	2
• g10	7
• g11	23
• g12	
• g13	1
• g14	
• PRIMEX	1
TOTAL:	**67**+1

Total: 184+1

Advanced Analysis

• E1-E8	9
• EG1	6
• EG2	2
• E1-DVCS	3
• EG1-DVCS	1
• G1-G11	8
TOTAL:	**29**

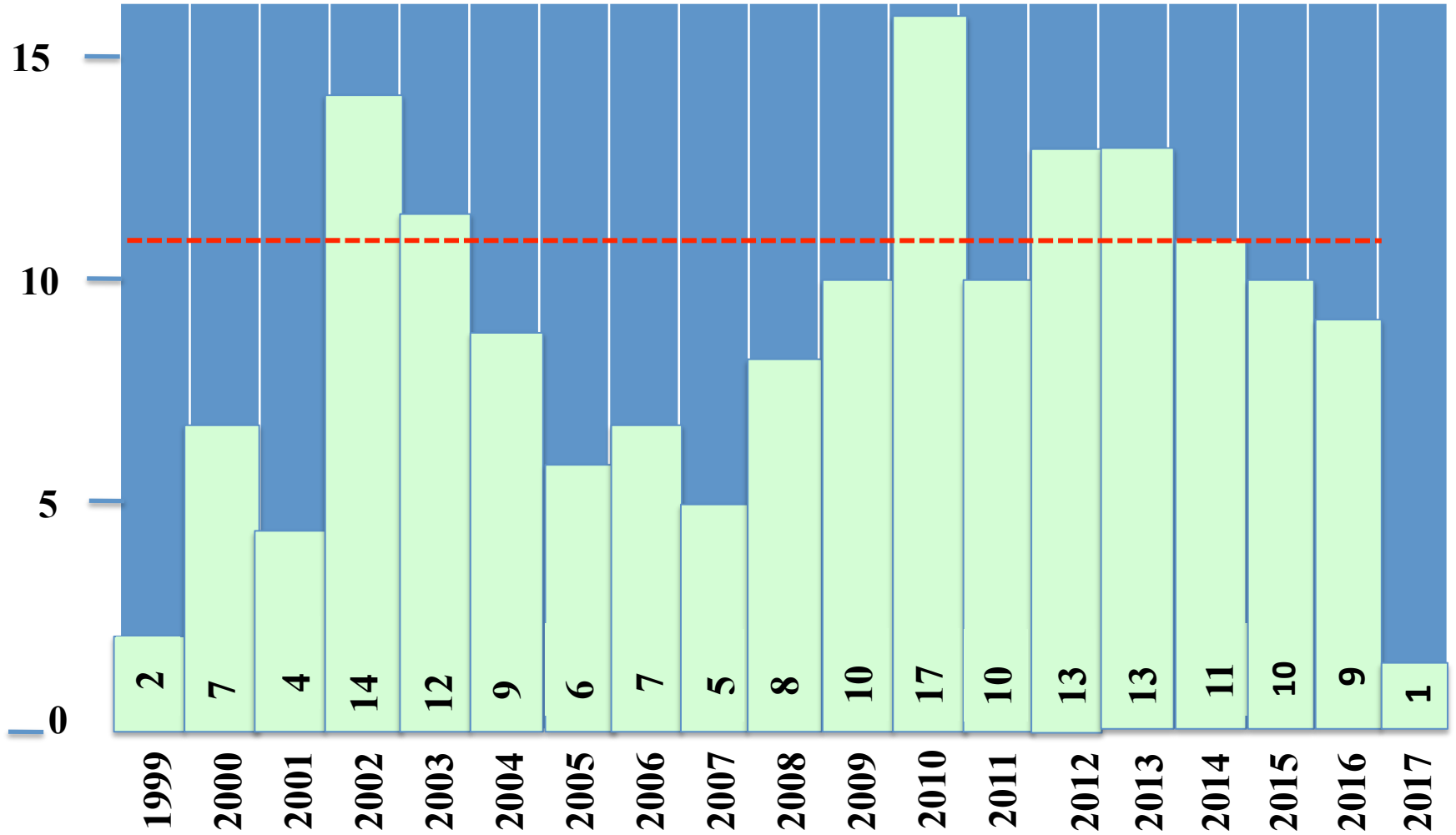
updated 1 Mar 2017

CLAS PhD Theses

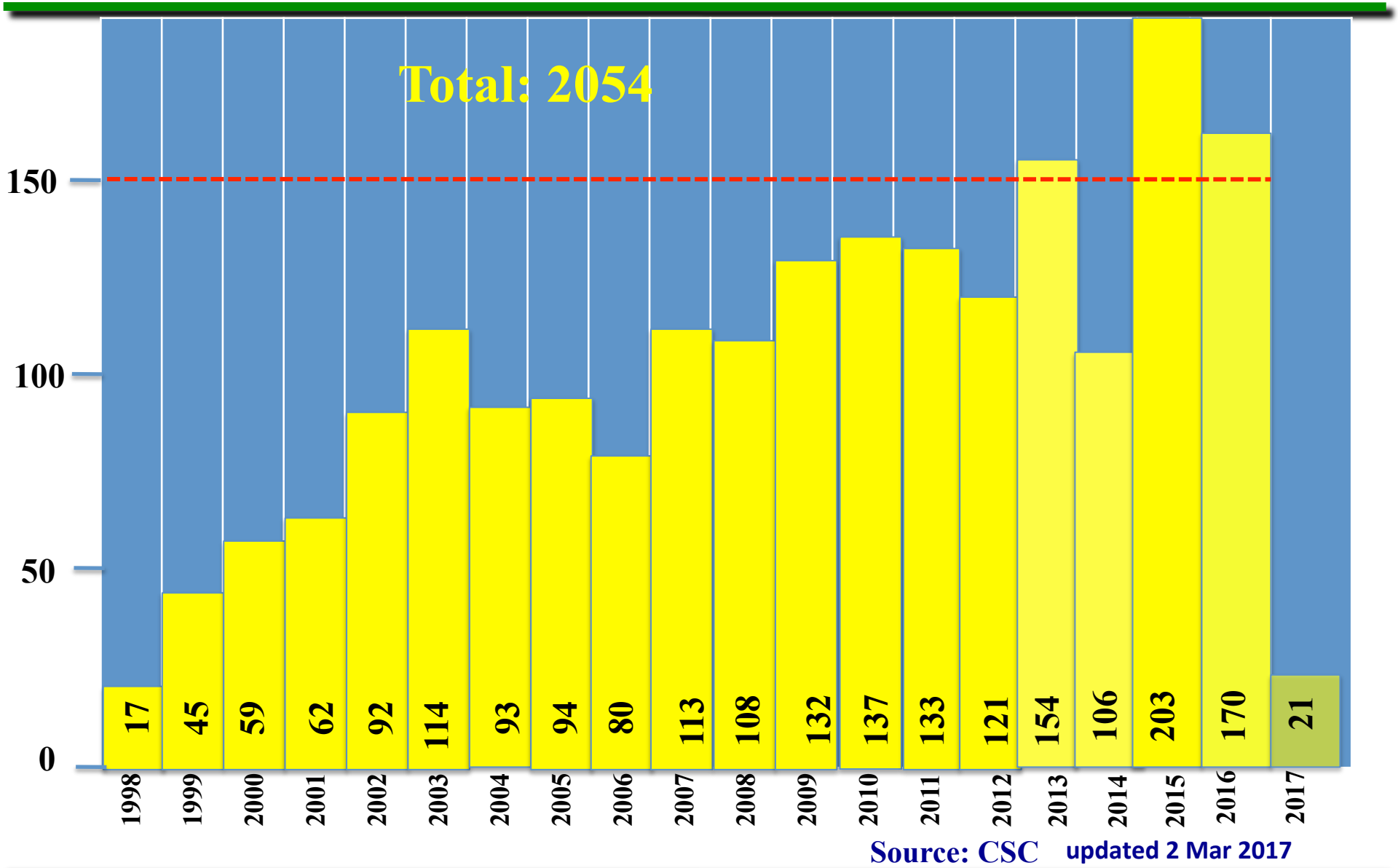
CEBAF Large Acceptance Spectrometer

Completed: 168 In progress: 33

updated 12 Dec 2016



Conference Presentations



International Collaboration

Armenia:
- Yerevan Physics Institute, Yerevan

Chile:
- Universidad Tecnica Federico Santa Maria, Valparaiso

France:
- Orsay University, IN2P3, Paris
- CEA Saclay, IRFU, Paris

Germany:
- Institut f. Kernphysik, Jülich
- Justus-Liebig-University Giessen, Giessen

Italy:
- INFN - LNF, Frascati, Roma
- Università di Genova,INFN, Genova
- Università di Ferrara, Ferrara
- INFN - Pavia, Universita di Pavia
- INFN - University di Roma Tor Vergata, Roma
- INFN - Sezione.di Torino, University di Torino

Republic of Korea:
- Kyungpook National University, Daegu

Russian Federation:
- MSU, Skobeltsin Institute for Nuclear Physics, Moscow
- Lomonsov Moscow State University, Moscow
- Institute for Theoretical and Experimental Physics, Moscow

Spain:
- University of the Basque Country, Bilbao

United Kingdom:
- Edinburgh University, Edinburgh
- Glasgow University, Glasgow

United States of America:
- Argonne National Laboratory, Argonne, Il
- California State University, Dominguez Hills, CA
- Canisius College, Buffalo, New York
- Carnegie Mellon University, PIttsburgh, PA
- Catholic University of America, Washington, DC
- College of William and Mary, Williamsburg, VA
- Christopher Newport University, Newport News, VA
- Duquesne University, Pittsburgh, PA
- Fairfield University, Fairfield, CT
- Florida International University, Miami, FL
- Florida State University, Tallahassee, FL
- George Washington University, Washington, DC
- Idaho State University, Pocatella, ID
- James Madison University, Harrisionburg, VA
- Mississippi State University, Starkville, MS
- Norfolk State University, Norfolk, VA
- Ohio University, Athens, OH
- Old Dominion University, Norfolk, VA
- Rensselaer Polytechnic Institute, Troy, NY
- Stony Brook University,
- Temple University, Philadelphia, PA
- Thomas Jefferson National Facility, Newport News, VA
- University of Connecticut, Storrs, CT
- University of New Hampshire, Durham, NH
- University, of Richmond, Richmond, VA
- University of South Carolina, Columbia, SC
- University of Virginia, Charlottesville, VA
- Virginia Polytechnic Institute and State University, Blacksburg, VA

47 Institutions, 03/2017

CLAS12 Solenoid Magnet

HALL B

The CLAS12 Solenoid is a self-shielded (actively shielded) super-conducting magnet around the beam line to produce a field primary in the beam direction. It has been driven by the following physics requirements:

- Provide field for magnetic field for tracking of central particles.
- Moeller electron shield.
- Uniform field ($\Delta B/B < 10^{-4}$ in ϕ2.5x4 cm cylinder) for polarized target operation.

Solenoid - TECHNICAL PARAMETERS

PARAMETER	DESIGN VALUE
Magnet Type	Solenoid
Number of Coils	5
Coil structure	Layer wound
Number of turns in main coils	3704 (2 x 840 + 2 x 1012)
Number of turns in shield coil	1392
S.C. cable	SSC 36 strands
Nominal current (A)	2416
Central field (T)	5.0
Peak Field (T)	6.56
Field homogeneity in ϕ2.5x4 cm cylinder	1×10^{-4}
Peak Field Location	Inner turn near warm
B-Symmetry	Yes
$\int$Bdl @ nominal current (T-m)	7.0
Inductance (H)	5.89
Stored Energy (MJ)	< 20MJ
Warm bore ∅ (mm)	780
Total weight (KG)	18800
Cooling mode	Conduction cooled
Supply temperature (K)	4.2
Temperature margin	Min 1.5
Conductor Used	SSC outer dipole w 17 mmx2.5mm copper channel
Turn to Turn Insulation	0.004" Glass Tape ½ Lap

- **Construction Strategy and Project Leadership**
  - Solenoid magnet SOTR: John Hogan
  - Construction strategy:
    - Magnet has been designed and is being fabricated by Everson Tesla Inc. (ETI). ETI is responsible for electromagnetic, thermal, mechanical designs and quench analysis. In addition, ETI shall provide all QA/QC associated with the manufacturing and assembly of the cryostat.
    - ETI will have an active role in start-up and commissioning the magnet at JLAB.
    - JLAB responsibilities:
      - Provide the SSC cable soldered in Cu Stabilizer to ETI.
      - Design the instrumentation, power and control system for the magnet.
      - Shipping and delivery of the solenoid magnet to Hall B.
      - Install and commission the magnet in Hall B.
      - Design & fabrication of cryogenic supply/return system - SST(solenoid-service-tower) for the magnet.
- **Significant Dates**
  - Mar. 2014: FDR at ETI
  - Dec. 2014: MRR (Coil) at ETI
  - Jun. 2015: Inner Coils Wound & Potted
  - Dec 2015: MRR of Cold Mass Assembly
  - Jan. 2016: Intermediate Coils Wound & Potted
  - Jun. 2016: Shield Coil Wound & Potted
  - Dec. 2016: Cold Mass assembly complete
  - Jan. 2017: SST delivered to Hall B for pre-installation
  - Apr. 2017: Factory testing
  - May. 2017: Shipment to Jefferson Lab
- **Project Status**
  - Final Design Review complete.
  - New power supply in delivered onsite and positioned in Hall-B.
  - All Coils: Winding & potting complete.
  - All Manufacturing Readiness Reviews (MRR's) complete.
  - Solenoid cold mass assembly complete.
  - SST complete and delivered to Hall B
  - Cryogenic & Control systems installed and being tested