

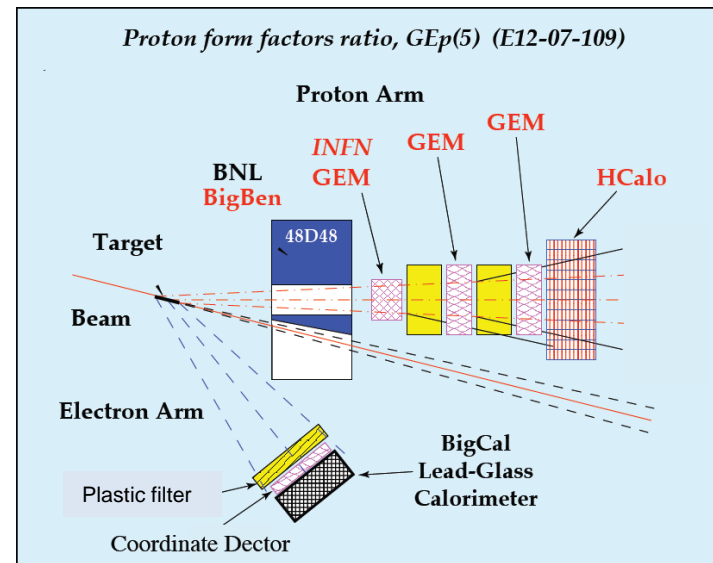
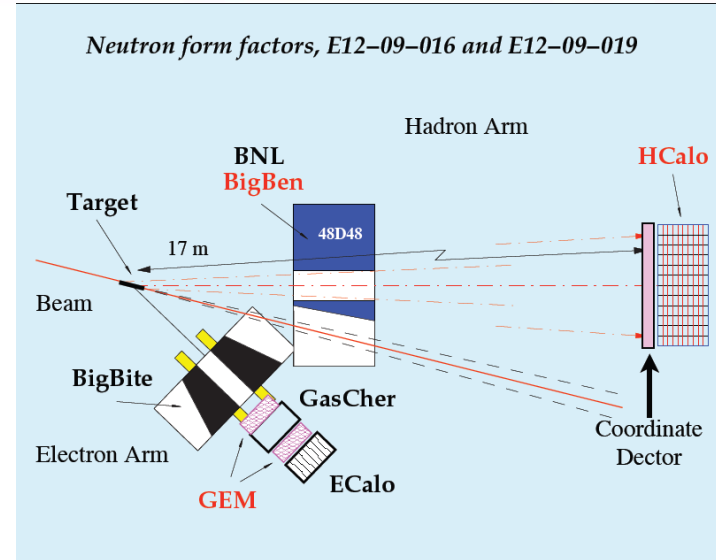


SBS Update

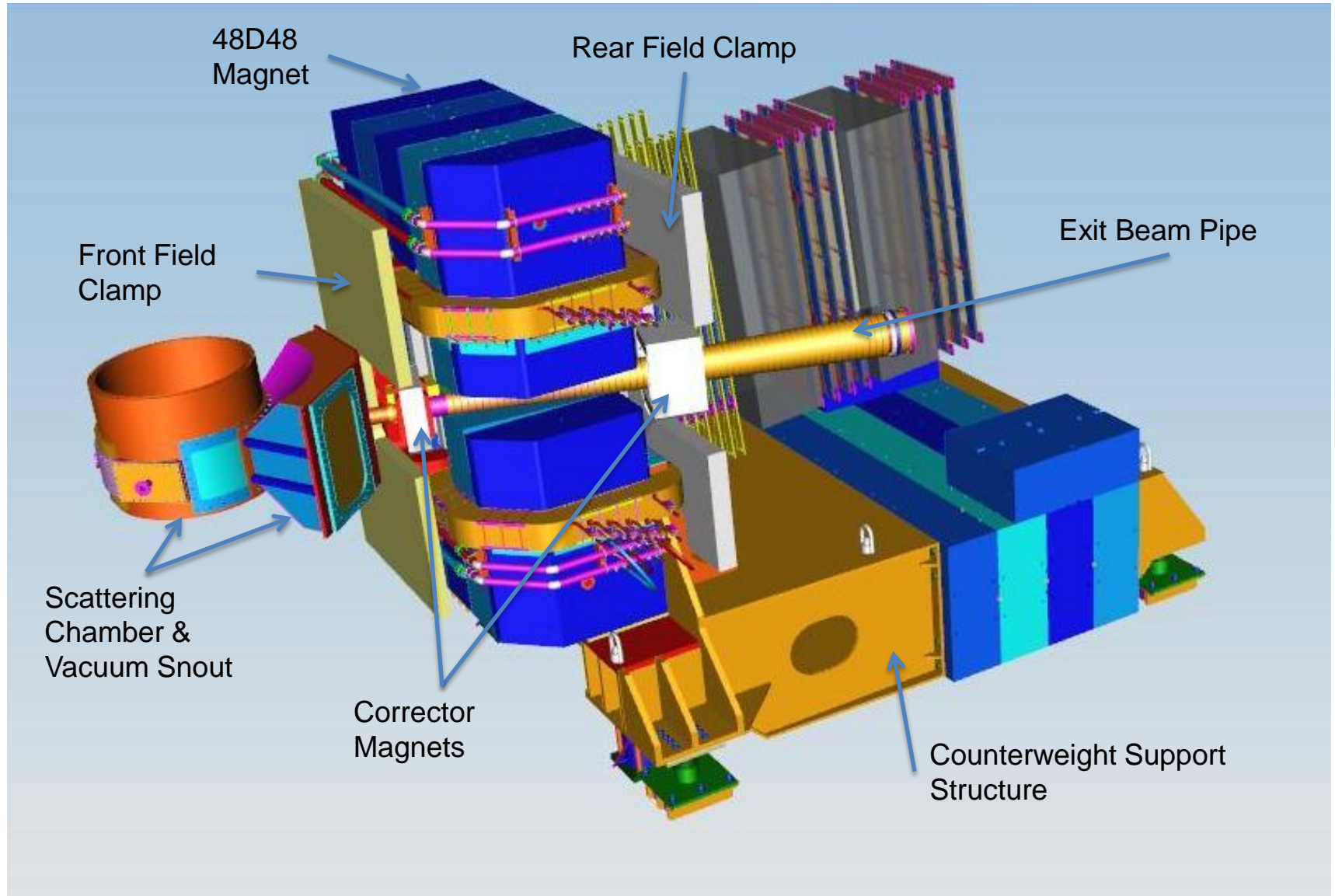
Mark Jones

SBS experiments

- Neutron G_M
 - $Q^2 = 3.5, 4.5, 6.0, 8.5, 10.0, 12.0$ and 13.5 GeV^2
 - 25 days of running
 - Extract from ratio of $d(e,e'n)/d(e,e'p)$ cross sections
- Neutron G_E
 - $Q^2 = 1.5, 3.7, 6.8$ and 10.2 GeV^2
 - 50 days of running
 - Extract from polarized ^3He asymmetry in quasi-free $^3\text{He}(e,e'n)$
- Proton G_E/G_M
 - $Q^2 = 5.0, 8.0$ and 12.0 GeV^2
 - 45 days of running
 - Extract from P_t/P_l in elastic $p(e,e'p)$
- SIDIS/Neutron Transversity
 - 3D binning in x, z and P_t
 - 60 days of running on polarized ^3He
 - Add RICH to hadron arm for PID
 - BigBite used as the electron arm



SBS



Super BigBite Magnet

- Modifications to magnet iron complete.
- Magnet assembled in TestLab and tested at 200A (10% of Max) using BNL saddle coil and new racetrack coils.
- Racetrack coils have been constructed and are at JLab.
- New saddle coil ordered and set delivery for July 2015.



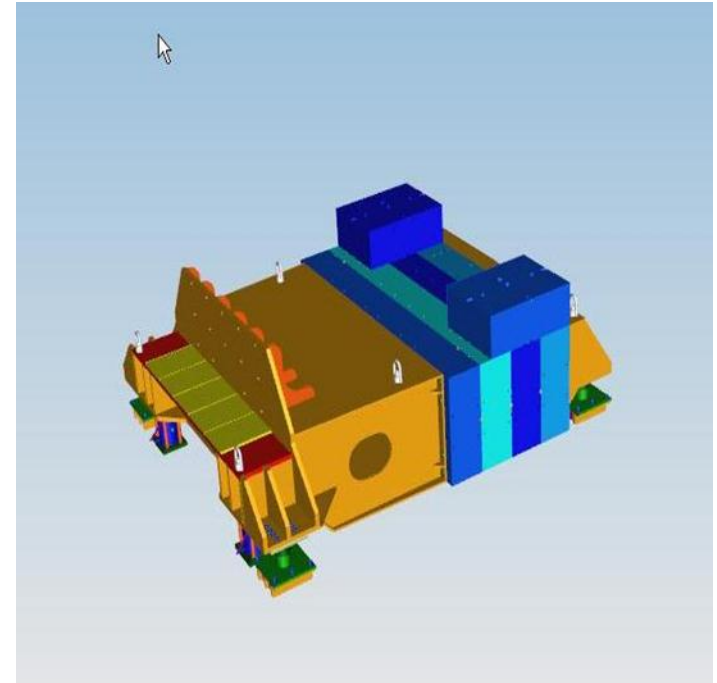
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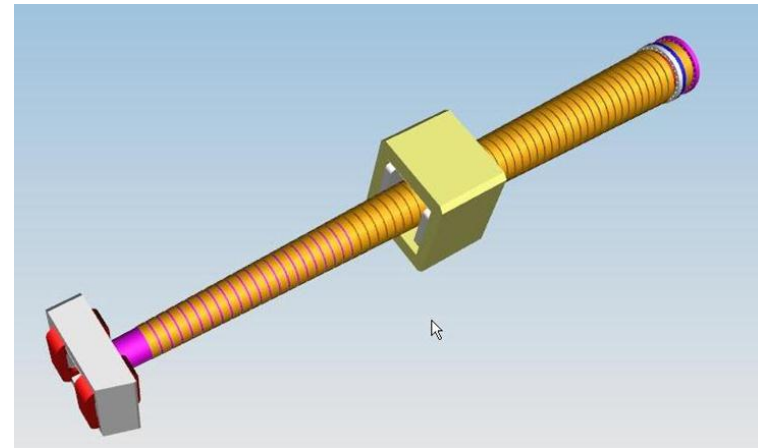
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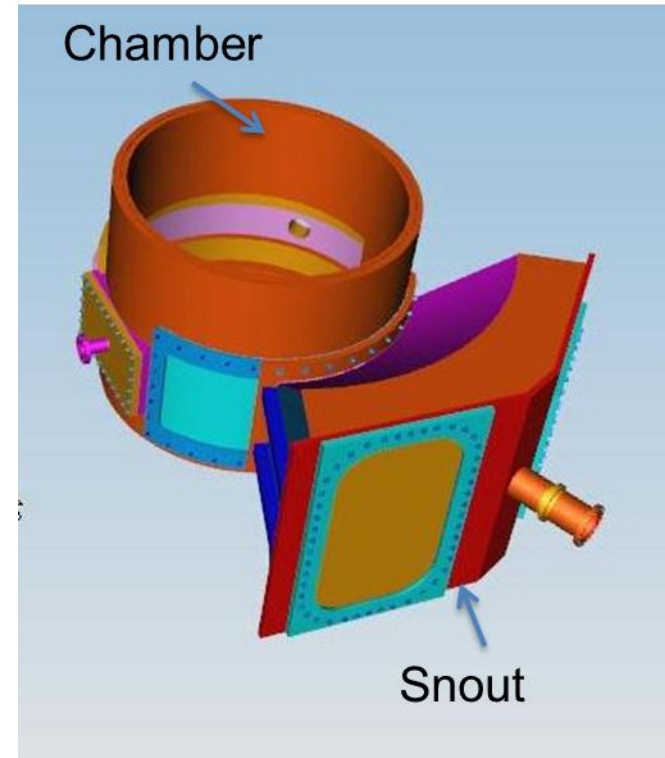
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- For G_{Ep} experiment designed extension snout to reduce background. Delivery expected in Feb 2015. Vacuum windows are designed and plan testing in March 2015.

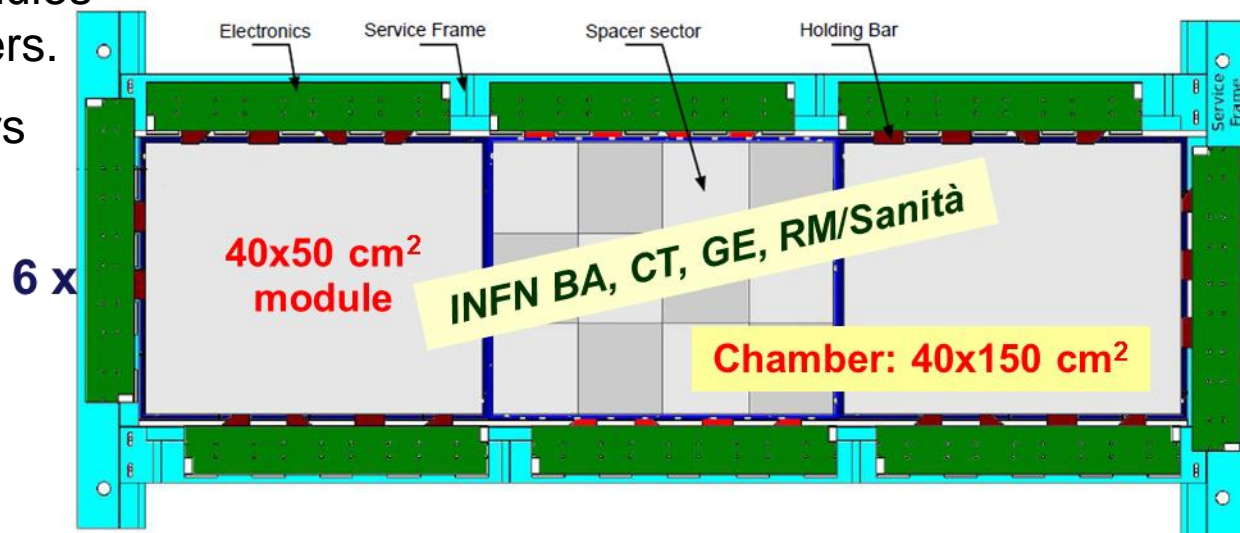
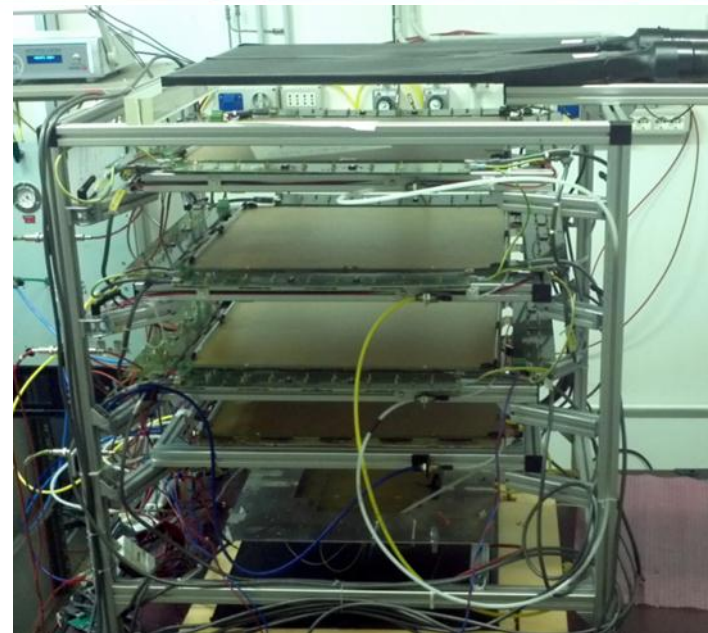


Instrumentation

Apparatus	Institutions	GMn	GEn	GEp	SIDIS
BigBite Magnet and Platform	JLab	Electron	Electron		Electron
Front Tracker GEMS	INFN-Rome/Sanita, Catania, Bari and Genoa	Electron	Electron	Hadron	Electron
Gas Cherenkov (GRINCH)	College of W&M, North Carolina A&T James Madison and Jlab	Electron	Electron		Electron
BigBite Scintillator Array	U. of Glasgow	Electron	Electron		Electron
BigBite PreShower and Shower calorimeter	exists	Electron	Electron		Electron
48D48 Magnet and platform	JLab	Hadron	Hadron	Hadron	Meson
Beamline upgrades	JLab	Hadron	Hadron	Hadron	Meson
Coordinate Detector	Idaho State U, St. Mary's, Yerevan, Jlab and Glasgow	Hadron	Hadron	Electron	
Hadron Calorimeter	Carnegie Mellon U. INFN-Catania, Yerevan and Jlab	Hadron	Hadron	Hadron	Meson
Rear GEM tracker	U of Virginia, Jlab			Hadron	Meson
GEp Electron calorimeter	Jlab, Yerevan, Stony Brook University College of W&M, Norfolk State, CNU			Electron	
Polarized ^3He target	U of Virginia JLab		Target		Transversely polarized
RICH	U of Connecticut				Meson

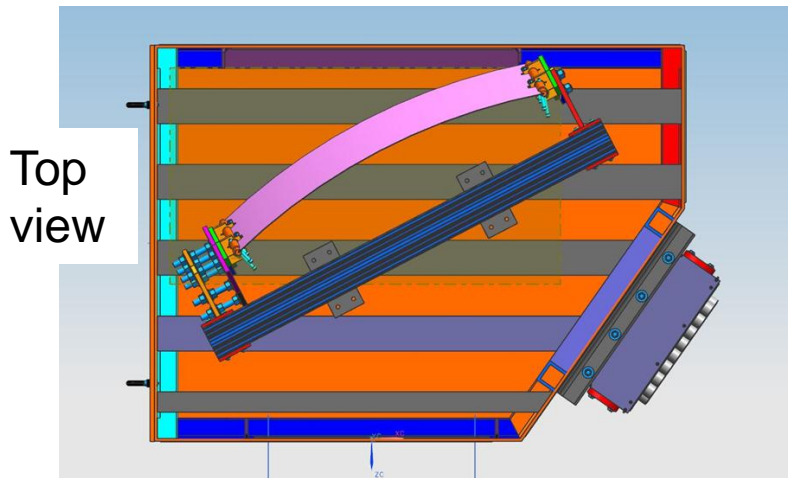
Front Tracker GEMS

- Construction of GEM modules is underway. 4 modules are at Rome and 3 are undergoing cosmic testing.
- 3 modules at various stages of construction in Catania.
- All readout electronics have been purchased and are undergoing testing.
- Plan to ship chamber with electronics to Jlab in Jan 2015.
- Construction schedule is 2 GEM modules/months. 18 modules needed for the 6 chambers.
- Completion of 6 chambers by Sept 2016

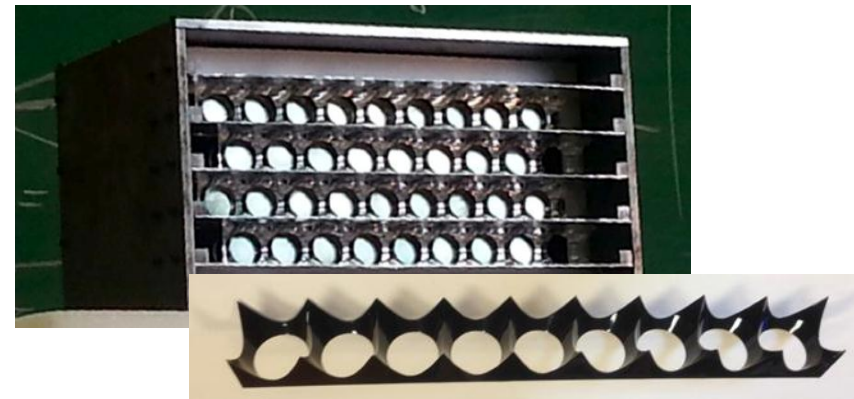


GRINCH

- Gas Cerenkov using 510 1-inch PMTs
- Mirror assembly is completed at W&M with optics tested.
- NC A&T has ordered the PMT light catcher/magnetic shield box.
- Over 600 PMTs have been characterized at a test stand at JMU.
- Preamp/Disc cards using the NINO chip have been designed by U. of Glasgow and are being manufactured.



Prototype PMT Shield box at NC A&T



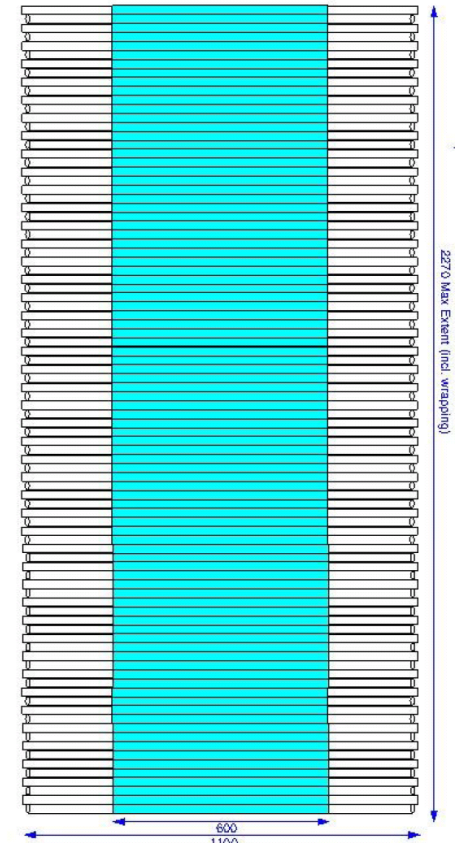
BigBite Hodoscope array

- 90 EJ200 Scintillator bars each 60 x 2.5 x 2.5 cm
- Readout at each end via light guide
- Alternate straight and bent light guide to fit PMT and housing
- ET9125 PMT for BaBar with modified base design
- Preamp/disc based on NINO chip front end card
- Timing resolution of 0.31ns limited by ET9125.
- Test done with R11265 PMT achieved 0.1ns .

BigBite Timing Hodoscope

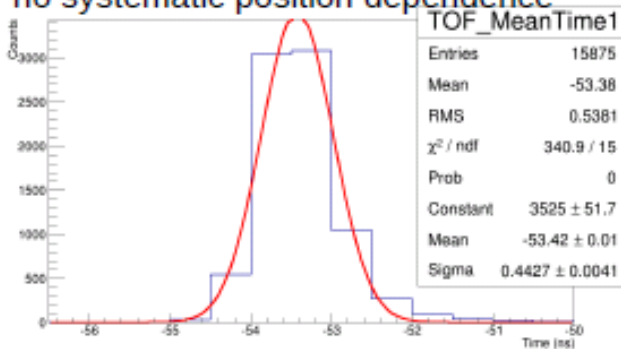
90 off 600 x 25 x 25 Plastic Scintillator
 J.R.M. Annand 16th August 2012
 Dimensions in mm

Front View of Scintillators

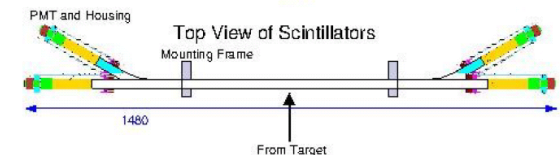
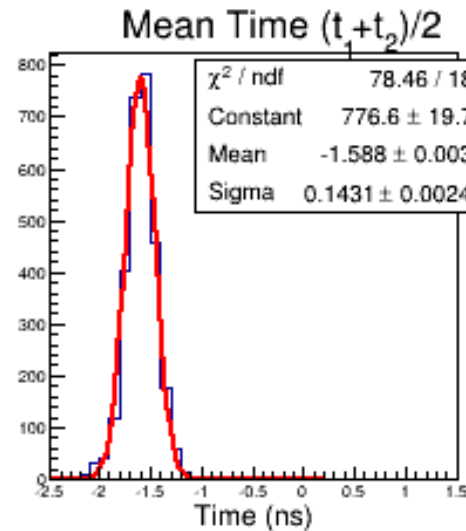


Test with ET9125

Time resolution (σ) $\sim 0.44/\sqrt{2} = 0.31$ ns
 no systematic position dependence



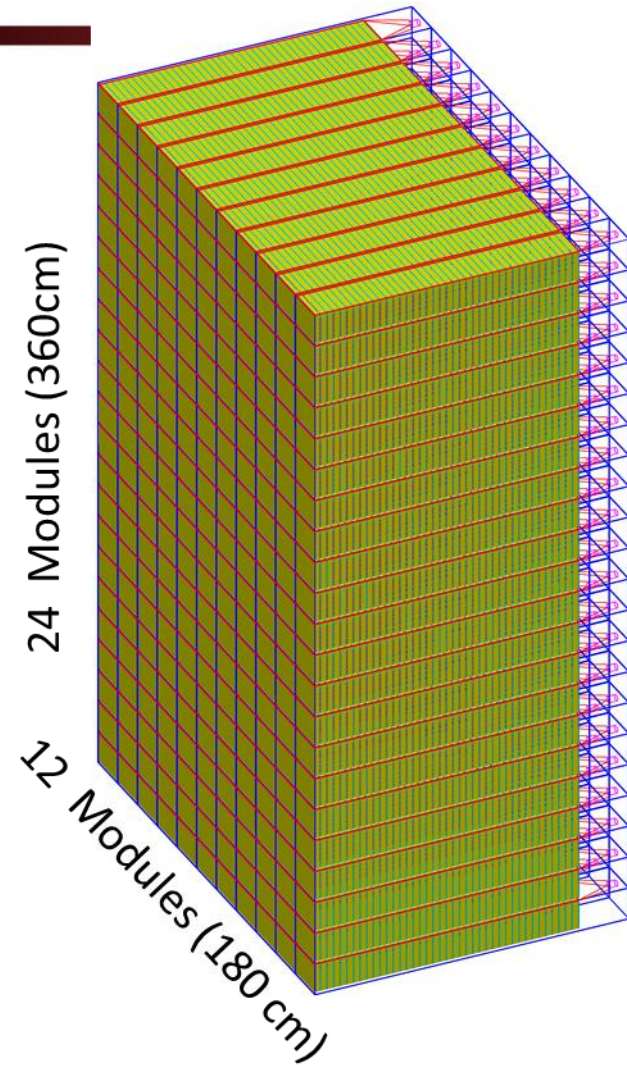
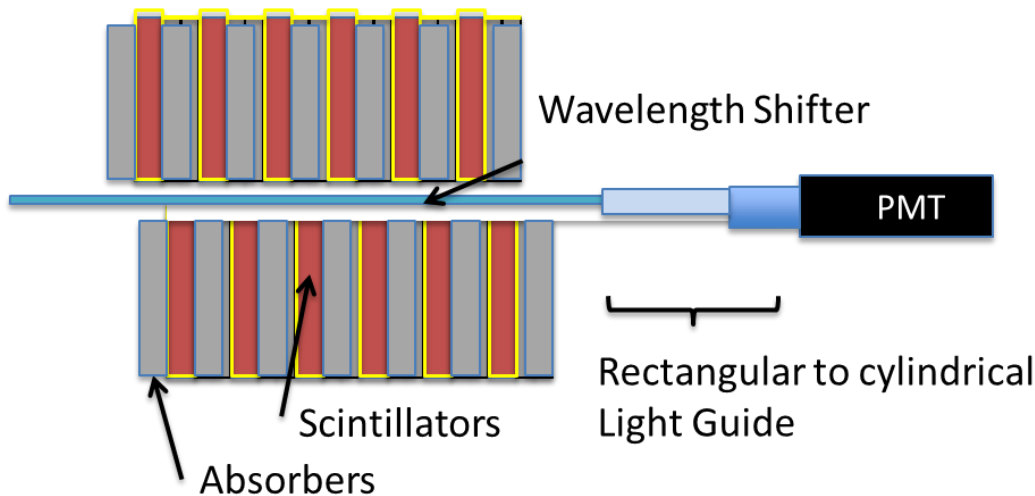
Test with R11265



HCAL

Modular Design:

- 15 cm x 15 cm x ~ 1m modules
- 40 layers scintillator and iron per module
- 288 Modules (39 tons)



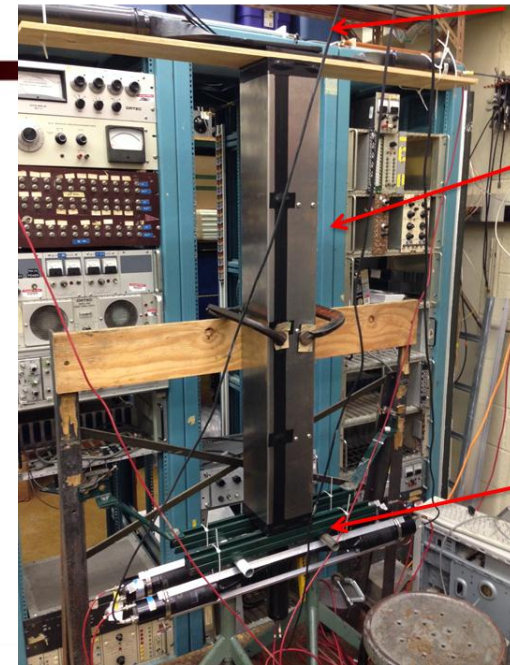
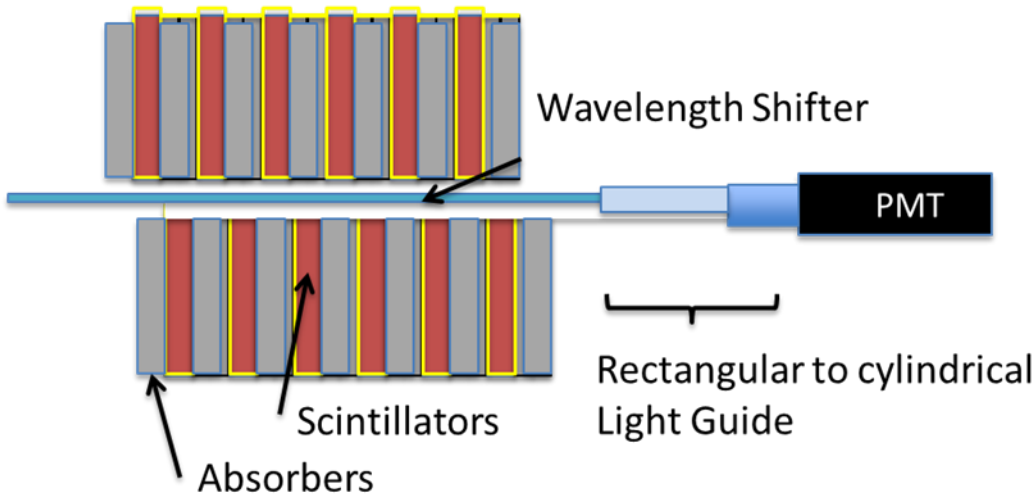
288 modules for JLab HCAL

HCal

- Prototype module tested with cosmic rays and achieved a time resolution = 350ps with suboptimal light guide.

Status

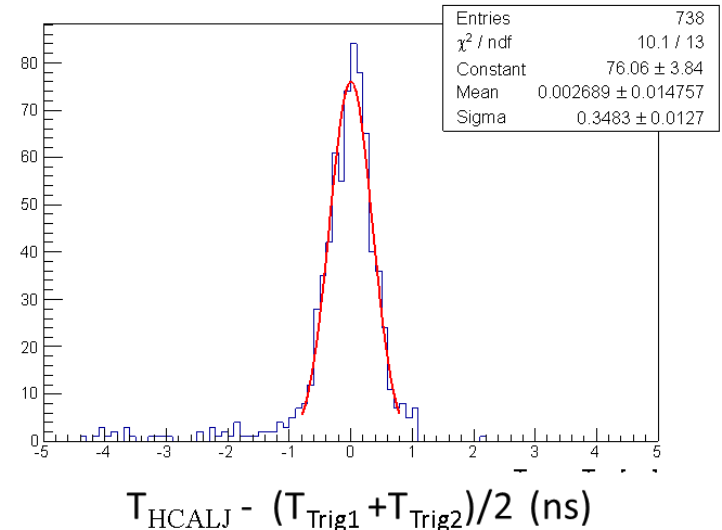
- Scintillator produced by FermiLab
- All of the 24,000 scintillator tiles have been cut.
- WLS has been delivered
- Iron absorber plates have been delivered
- Light guide design has been finalized.
- Production to start in March 2015



Trigger
Scintillators

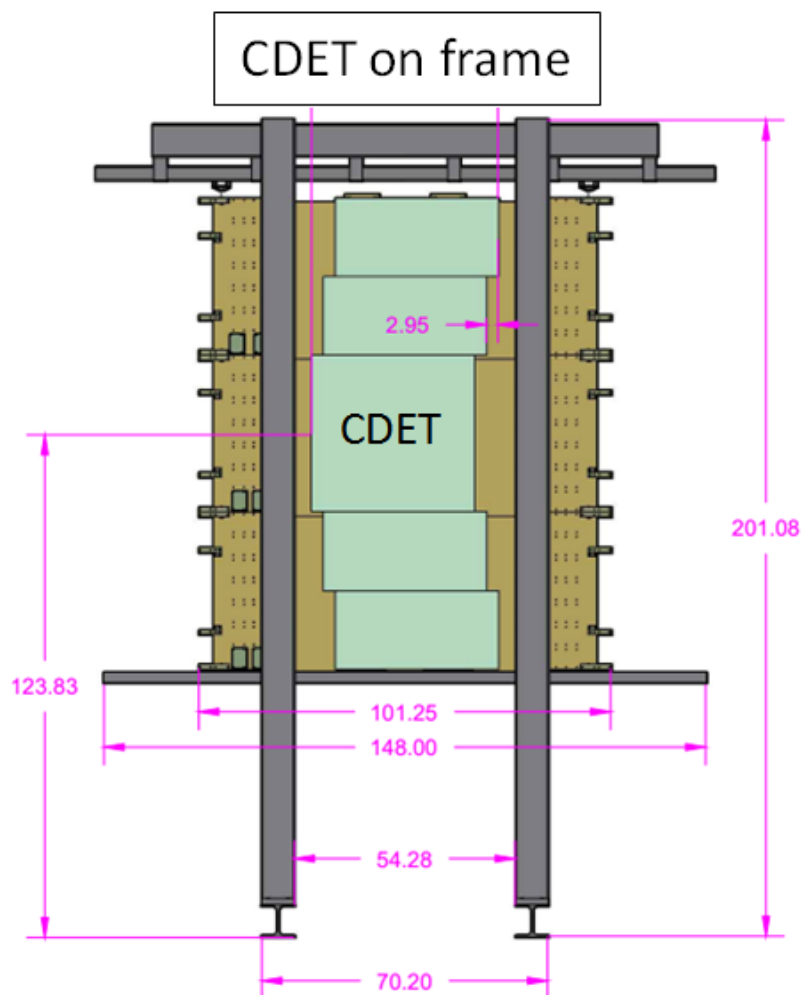
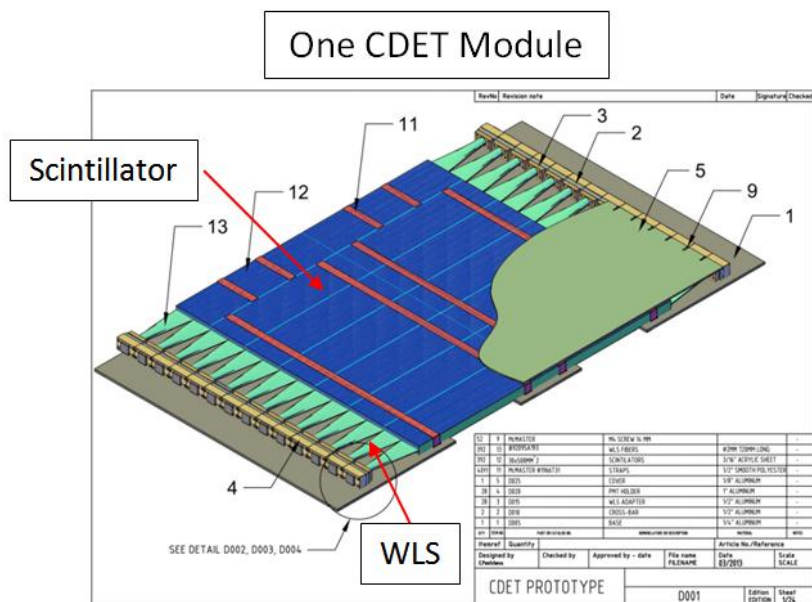
Proto 2

Trigger &
Timing
Scintillators



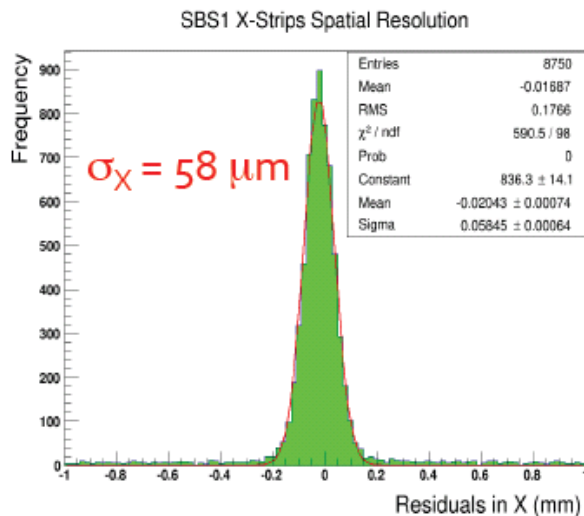
Coordinate Detector

- Two planes of scintillator cover $102 \times 294 \text{ cm}^2$
- A module will be 392 scintillator bars with volume of $0.5 \times 4 \times 51 \text{ cm}^3$
- Each plane will consist of three modules
- Light output via fast WLS fibers through a 3mm diameter hole in the scintillator bar
- WLS fibers coupled to a 16-channel maPMT.
- Production of scintillator bars at Fermilab starts in Jan 2015.



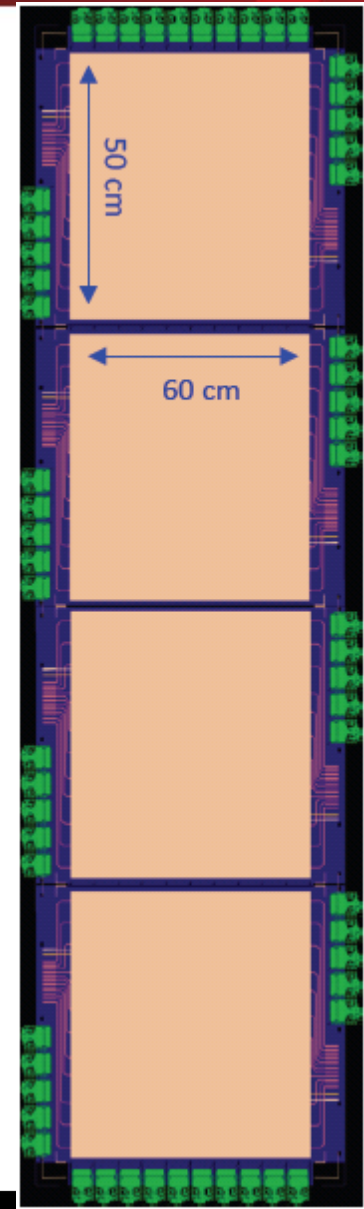
Rear GEM tracker

- Building 40 GEM modules (each with area of $50 \times 60 \text{cm}^2$) to form 10 chambers.
- Beam/cosmic/source tests with prototype chambers reveal problems with readout plane construction and chamber pressure that have been fixed and incorporated into the final design. [Article](#) on construction and prototype tests.
- Completed construction of 5 GEM modules.
- Plan to build 2 modules/month with completion by April 2016.
- Decision to use INFN readout electronics.



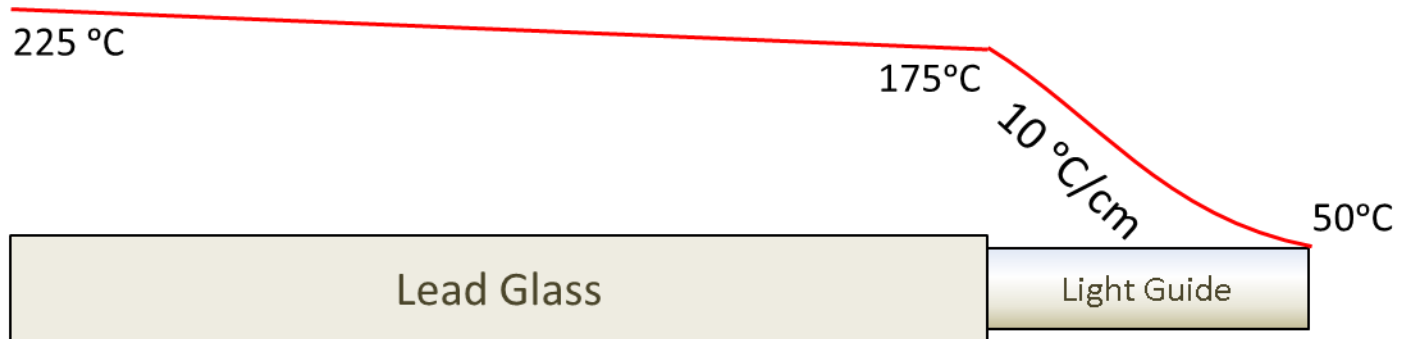
Position resolution from beam test at Fermilab. $\sigma_y = 67 \mu\text{m}$

GEM Construction at UvA



ECal

- Decision made in July 2014 to use constant thermal annealing to curing radiation damage to lead glass.

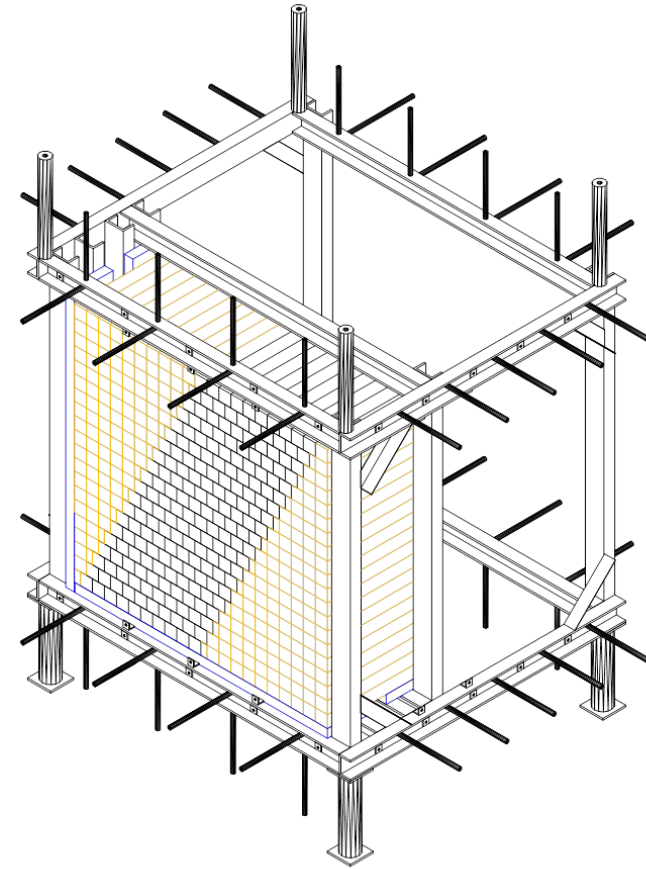


- Many tests of thermal annealing rate at different temperatures and levels of radiation damage were done in Winter/Spring 2014



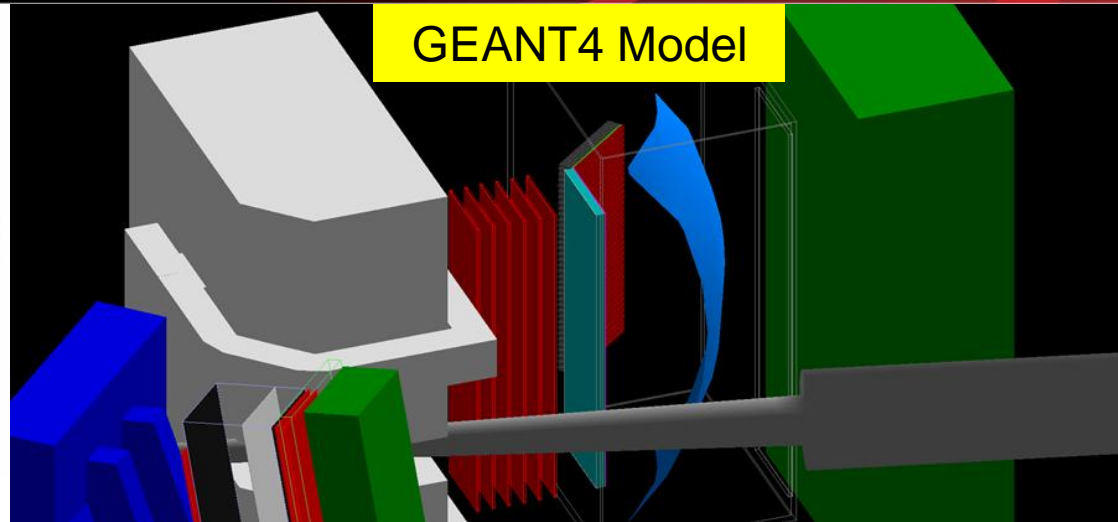
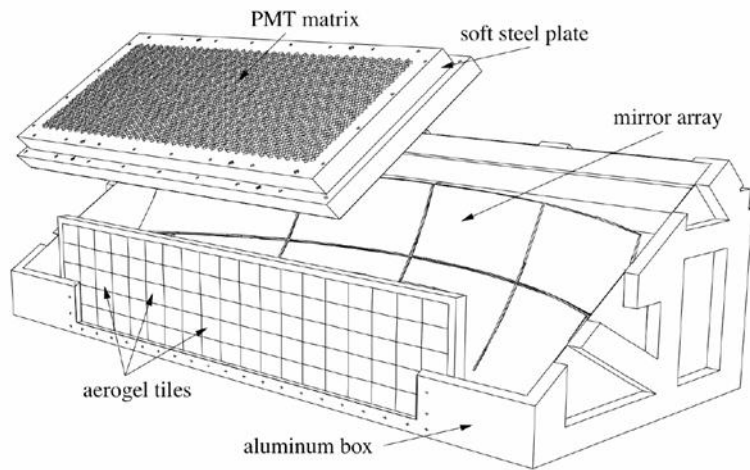
ECal

- Building a small 4x4 module prototype that could be placed in Hall A at small angle. Use ep elastic coincidence with R-HRS to study the energy resolution.
- Stony Brook University will build a large scale 200 block prototype to study mechanical assembly and cost.
- Design review milestone in July 2015.



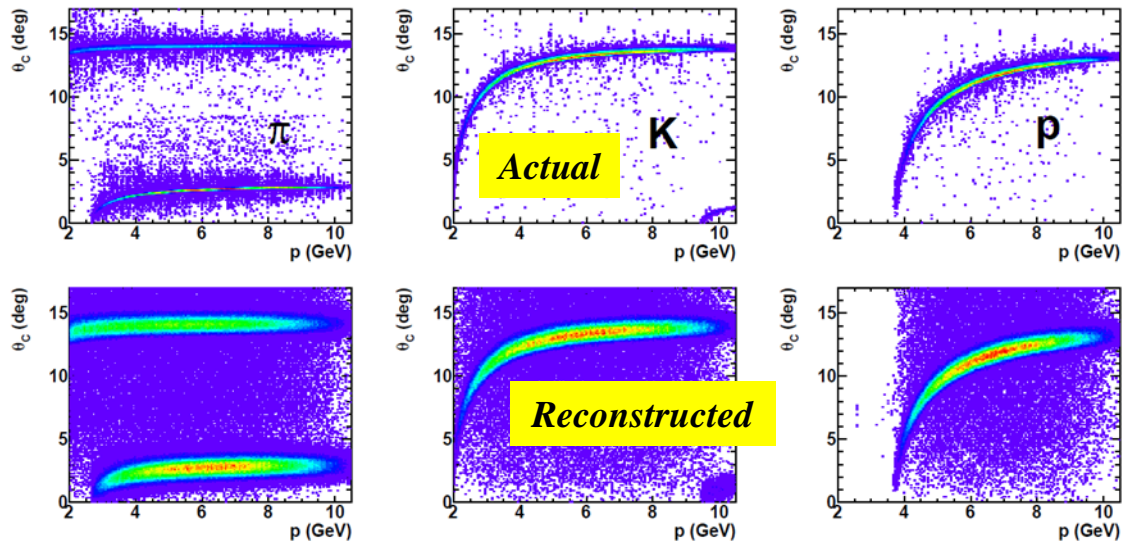
Drawing of 200 block prototype.

RICH



GEANT4 Model

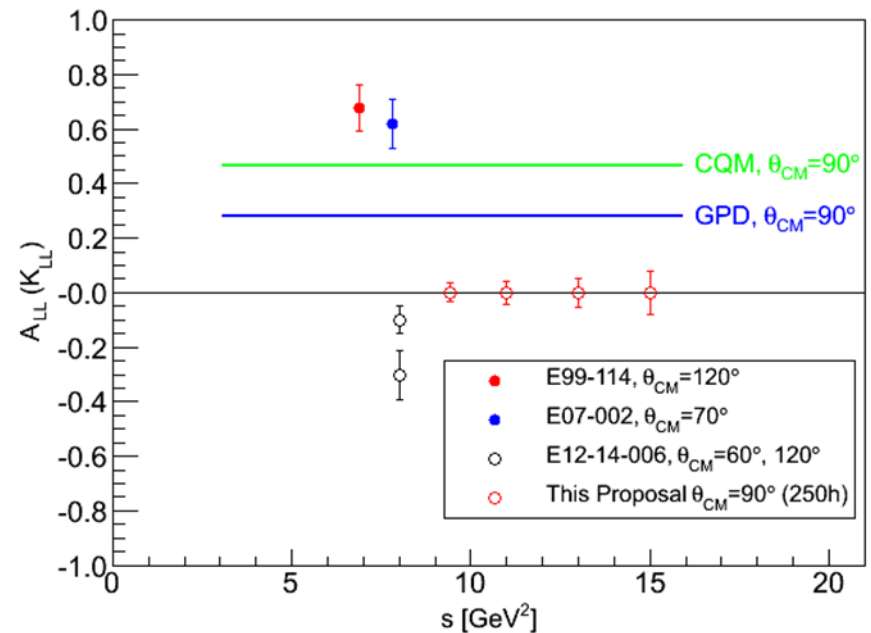
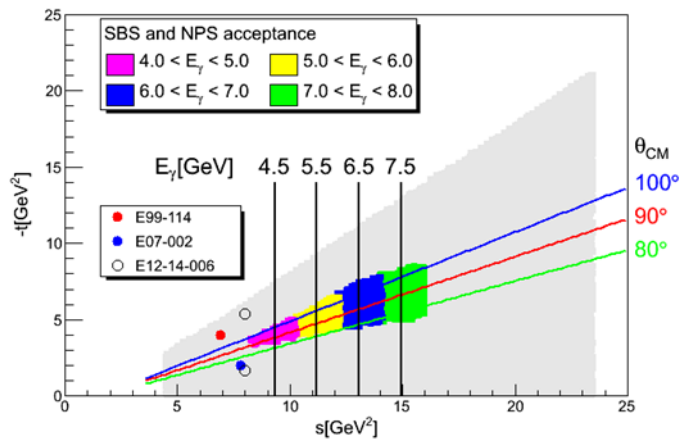
- Re-use HERMES dual-radiator RICH detector
 - Aerogel $n=1.0304$
 - C_4F_{10} gas $n=1.00137$
- [NIM A 479, 511 \(2002\)](#)
- RICH detector is at UCONN.



GEANT4 Results for θ_c

Future experiments

- Proposals at PAC42
 - PR12-14-008, "Measurements of Semi-Inclusive DIS Double-Spin Asymmetries on a Longitudinally Polarized ^3He Target" .
 - Spokespersons: X. Jiang, A. J. R. Puckett, N. Liyanage
 - Extract helicity PDFs with focus on down quarks.
 - Deferred
 - PR12-14-010, "Measurement of Tagged Deep Inelastic Scattering (TDIS)" .
 - Spokespersons: C. Keppel, P. King, D. Dutta, J. Annand, B. Wojtsekhowski, J. Zhang
 - Pion structure function
 - Deferred
- [Idea presented](#) at Neutral Meson Spectrometer meetings for wide-angle compton scattering on polarized proton target.



Conclusion

- SBS magnet has been assembled and tested at 200A.
- Most of SBS infrastructure are on-site or ordered.
- Remaining SBS infrastructure currently under design:
 - Beam line magnets and exit pipe
 - Field clamps
 - GEM and HCAL detector stands
 - Beam line lead shielding
 - Electronic hut shielding
- SBS infrastructure on schedule to be completed by Jan 2016.
- SBS detectors are in the construction phase. Shooting for completion by Sept 2016.
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Welcome more collaborators, students and postdocs.

- Detectors coming to Jlab.
- Help organizing and testing detectors and DAQ.
- GEANT simulations and software development