

Hall D Report

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PAC43, July 2015

- 1 Physics program
- 2 Collaboration and staff
- 3 Apparatus and main specifications
- 4 Status of commissioning with beam

Physics Program

Proposal/ experiment	Sta- tus	Title	Beam days	PAC #
E12-06-102	A	Mapping the Spectrum of Light Quark Mesons and Gluonic Excitations with Linearly Polarized Photons	120	30
E12-10-011	A-	A Precision Measurement of the η Radiative Decay Width via the Primakoff Effect	79	35
E12-13-003	A	An initial study of hadron decays to strange final states with GlueX in Hall D	200	40
E12-13-008	A-	Measuring the Charged Pion Polarizability in the $\gamma\gamma \rightarrow \pi^+\pi^-$ Reaction	25	40
C12-12-002	A	A study of meson and baryon decays to strange final states with GlueX in Hall D	220	42
C12-14-004	C2	Eta Decays with Emphasis on Rare Neutral Modes: The JLab Eta Factory Experiment (JEF) <i>partly concurrent with GlueX ($\eta \rightarrow 3\pi$)</i>	(130)	42
LOI12-15-001		Physics with secondary K_L° beam		43
LOI12-15-006		ω -production on nuclei		43

The Hall D/GlueX collaboration

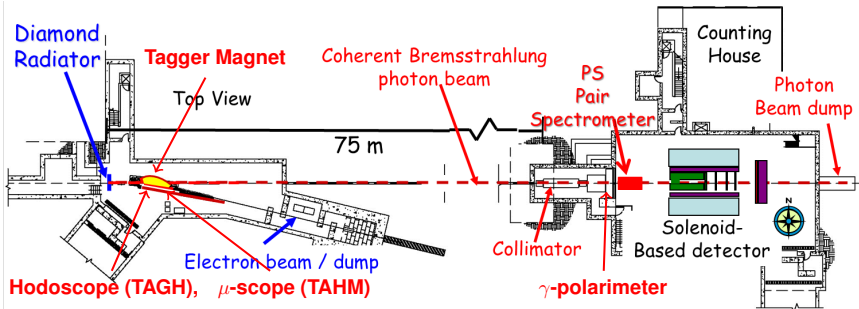
GlueX Collaboration: 21 institutions; about 110 scientists

Hall D Scientific Staff: 13 staff scientist, 1 postdoc fellow

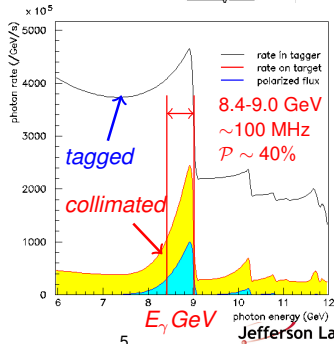
Applied recently to joining GlueX:

- George Washington University
- Mississippi State University
- GSI

Beamline



- 12 GeV e^- beam 0.05 – 2.2 μ A
- 20 μ m diamond: coherent $< 25 \mu$ rad
- Collimation $r < 1.8$ mm at ~ 80 m
- Coherent peak 8.4 – 9.0 GeV $P \sim 40\%$
2.2 μ A \Rightarrow 100 MHz γ
- Energy/polarization measured:
 - Tagger spectrometer $\sigma E/E \sim 0.1\%$
 - Pair spectrometer: spectrum $\Rightarrow \sigma P/P \sim 5\%$



Hall D/GlueX Spectrometer and DAQ

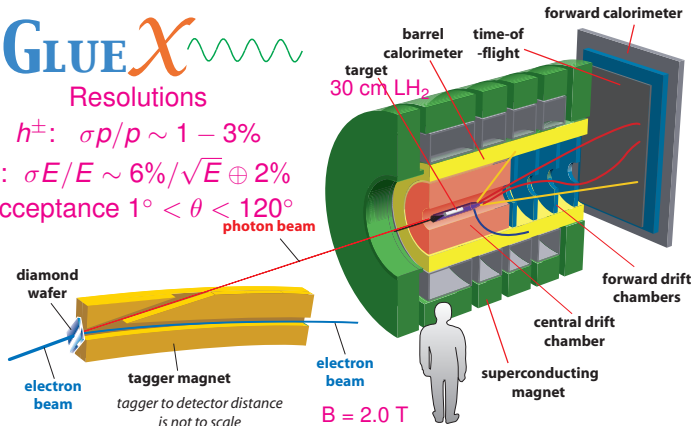
GLUEX 

Resolutions

$$h^\pm: \sigma p/p \sim 1 - 3\%$$

$$\gamma: \sigma E/E \sim 6\%/\sqrt{E} \oplus 2\%$$

$$\text{Acceptance } 1^\circ < \theta < 120^\circ$$



Detectors

- ▶ CDC, FDC
- ▶ BCAL, FCAL
- ▶ TOF, ST

Plans to add

- ▶ 2017 L3
- ▶ 2018 Cherenkov

Photoproduction γp 15 kHz for a 100 MHz beam

Beam 10 MHz/GeV: inclusive trigger 20 kHz \Rightarrow DAQ \Rightarrow tape

Beam 100 MHz/GeV: inclusive trigger 200 kHz \Rightarrow DAQ \Rightarrow L3 farm \Rightarrow tape

Commissioning Status

Runs with beam:

- ▶ Fall 2014 10.0 GeV beam: beam commissioning and detector checkout
- ▶ Spring 2015 5.5 GeV beam: 1 week - commissioning continued

All equipment for GlueX-I has been commissioned at some level!

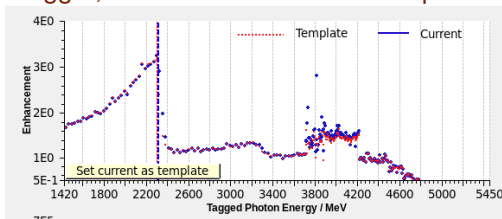
Still to be installed/replaced/commissioned:

- Solenoid: optimize the running current. Solenoid worked for ~ 3 weeks at 1200 A, but quenched after 1 day of running at 1300A. The issue will be addressed by a review on Jul 14.
- Tagger microscope: about 30% of the fibers have low efficiency - they will be replaced in 2015.
- Thin diamond radiators for the physics running (20 μm thick) still to be manufactured and installed (50 μm thick sample used).

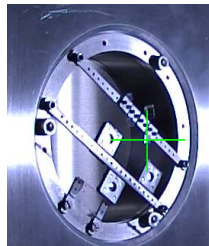
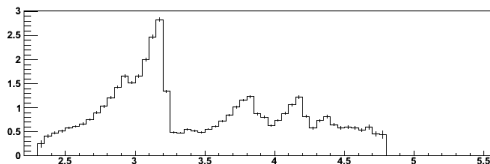
Coherent Bremsstrahlung

- “Old” diamonds 50 and 100 μm thick
- Both diamonds were aligned and produced coherent radiation!

Tagger, normalized to incoherent spectra

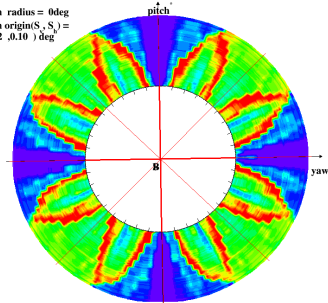


Pair Spectrometer



../data/RadScanIndex0_ID7_STONE_26_04_15:16_34.txt

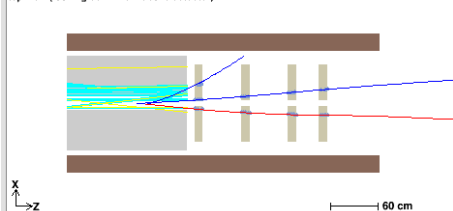
Scan radius = 0deg
Scan origin(S_x, S_y) =
(0.42, 0.10) deg



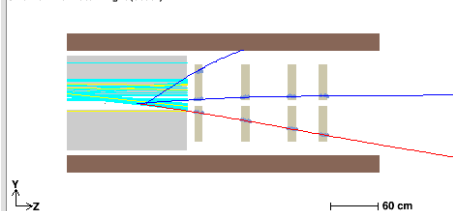
Beam(SB)=(S_B, S_B)=(0.000, 0.000) deg, $\phi_0 = -0.0$ deg
Beam to Crystal vector BC = -(S+SB) = (-0.417, -0.096) deg

Event Display

top view (looking down from above detector)

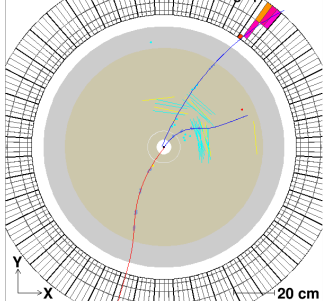


side view from beam right (south)

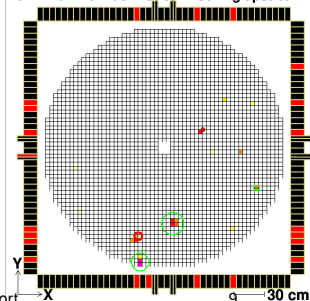


- 2 positive tracks
- 1 negative track
- Hits in FDC, CDC, BCAL, FCAL.
TOF

BCAL view from downstream looking upstream



FCAL view from downstream looking upstream



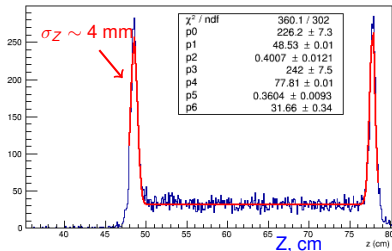
Track Reconstruction in Drift Chambers

Alignment, calibration: in progress

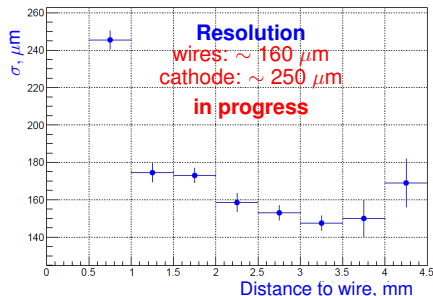
Field-off alignment

- FDC - tracks from the target
- CDC - cosmics

Empty LH₂ Target: thin windows

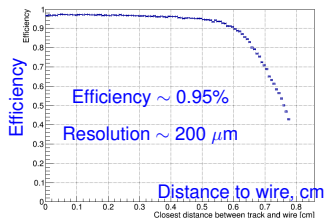


FDC: Resolution



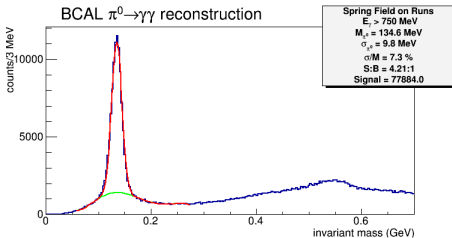
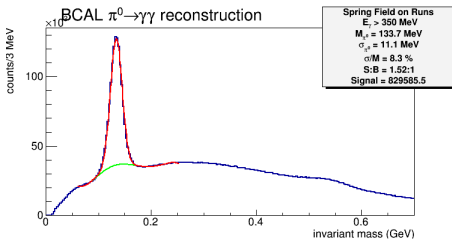
CDC efficiency

CDC Per Straw Efficiency Vs. DOCA



EM calorimetry: Calibration using π^0 mass

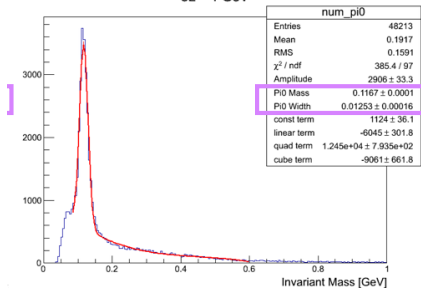
BCAL



Calibration with π^0 well advanced;
 π^0 width is $\sim \times 1.15$ of the specs

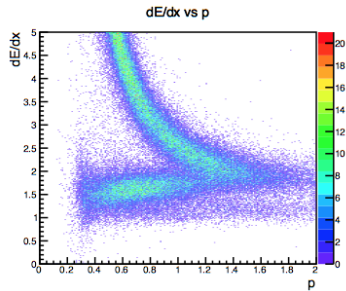
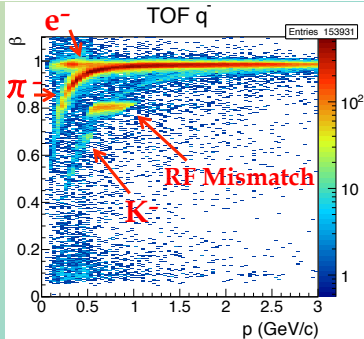
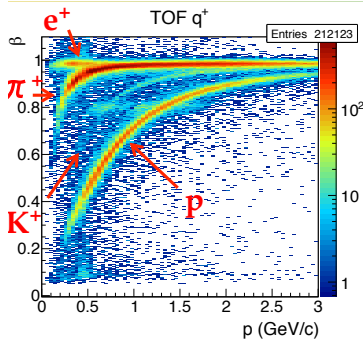
FCAL

eL > 1 GeV



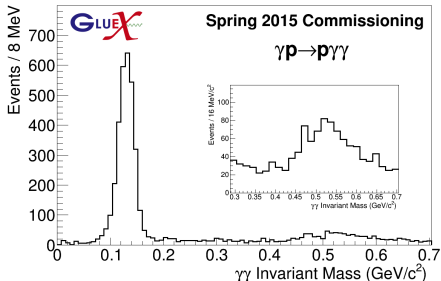
$\approx 18,000 \pi^0$

$\times 10$ more statistics needed
 π^0 width is $\sim \times 1.5$ of the specs
Data analysis - work in progress
Issues with a few % of the CW bases

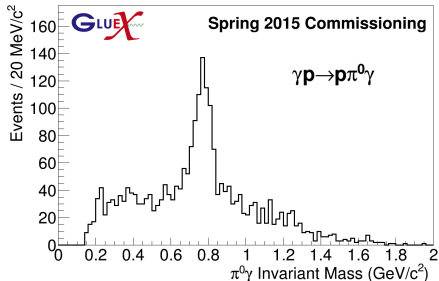


Event Reconstruction and Signals Observed

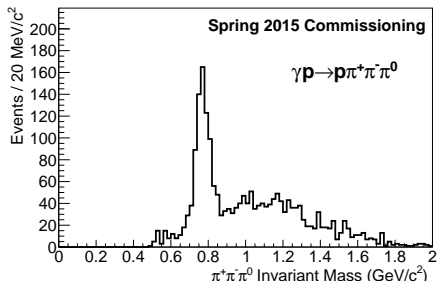
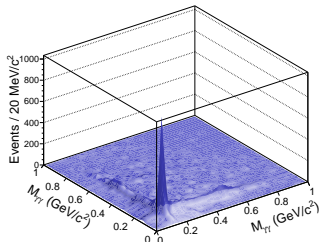
$$\gamma p \rightarrow p \pi^0$$



$$\gamma p \rightarrow p \omega^0$$

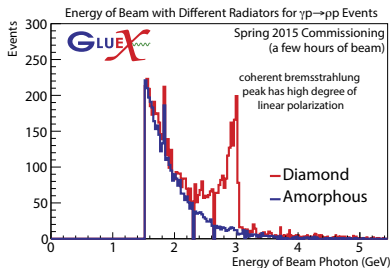
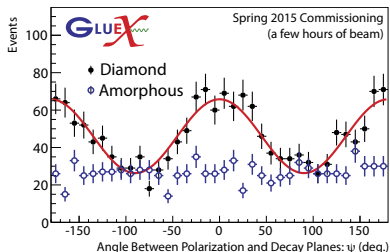


$$\gamma p \rightarrow p \pi^0 \pi^0$$



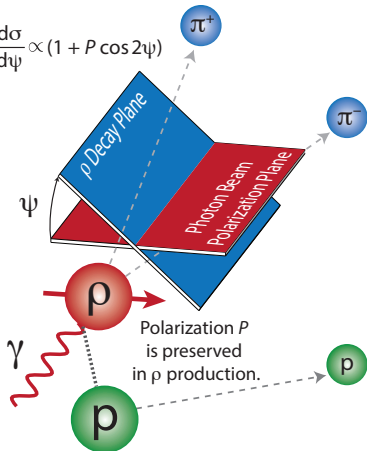
Physics With Linearly Polarized Beam

Polarized ρ Production with the Hall D Photon Beam



$$\gamma p \rightarrow \rho^0 p \rightarrow \pi^+ \pi^- p$$

$$\frac{d\sigma}{d\psi} \propto (1 + P \cos 2\psi)$$



Program for the next run (12 GeV?)

- Find a “safe” current for the solenoid
- More data for calorimeter calibration
- Build and install 20 μm -thick diamonds
- Stable beam position - commissioning of the Fast Feedback system (accelerator)
- Commissioning of the triple polarimeter and total absorption counter
- DAQ: aim at $\sim 5\text{-}10$ kHz with small dead time
- Trigger: continue tuning and optimization

Backup

- *Specs:*

- ▶ GlueX-I: DAQ 20 kHz 300 MB/s \Rightarrow tape
- ▶ GlueX-II: DAQ 100 kHz 1500 MB/s \Rightarrow L3 20 kHz \Rightarrow tape

- *Many issues solved, still a way to go:*

- ▶ CODA: hard to start, networking issues
- ▶ Firmware: FADC-125MHz, TDC CAEN
block/buffer level > 1 - First version came in 2015 - not yet stable
- ▶ Long events (low thresholds, noise issues)

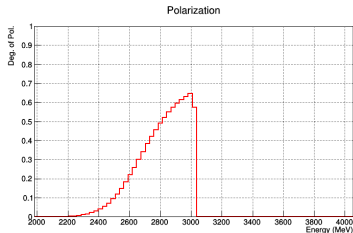
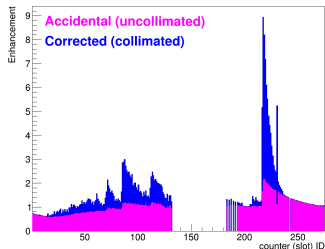
- *Spring 2015 status:*

- ▶ Stable at buffer/block level=1 \Rightarrow 3 kHz at 50% live time, 200 MB/s
- ▶ Tests at buffer=4/block=40 \Rightarrow 30 kHz at 97% live time, 600 MB/s
still unstable, crashes in a minute

Work in progress

Coherent Bremsstrahlung and Beam Polarization

Photon spectrum \Rightarrow calculated polarization



Triple Polarimetry: First results

