

Hall D Status

E.Chudakov¹

¹Hall D Group Leader

UGBoD meeting, June 2016

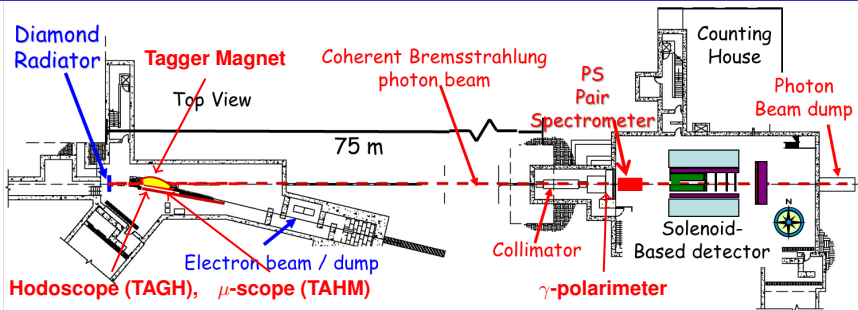


Since January 2016 ...

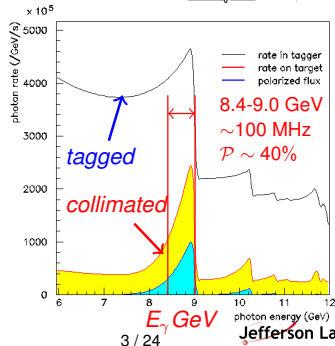
- Successful commissioning run in Feb-Apr 2016
- Collaboration meeting in May 2016
- Progress with calibration and data analysis

- 1 Hall D overview
- 2 Physics program and schedule
- 3 Collaboration and staff
- 4 Commissioning results

Hall D/GlueX 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

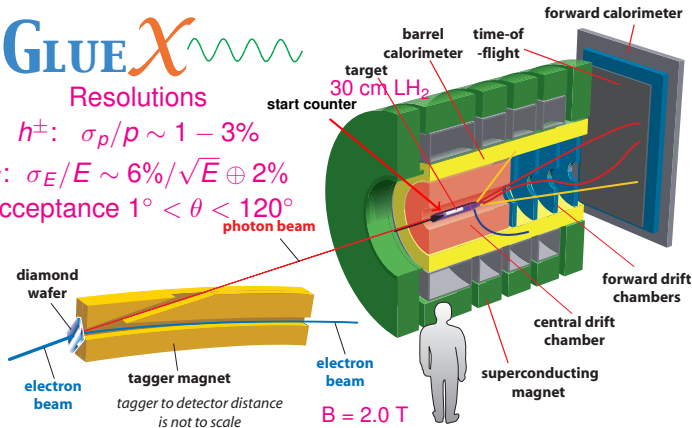
GLUEX 

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

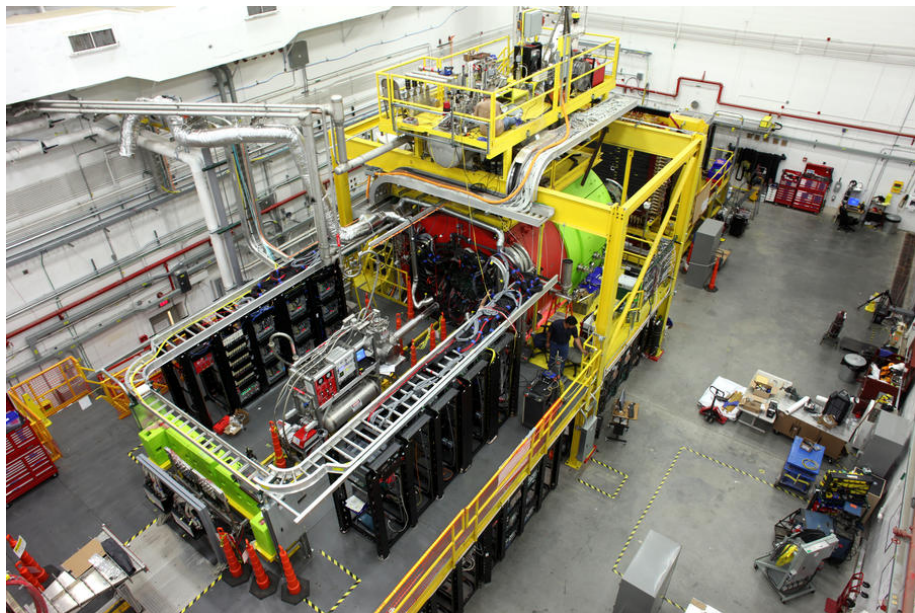
- ▶ 2017 L3
- ▶ 2018 DIRC

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

Hall D



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 eta 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(JEF) Experiment		42

Preliminary schedule

Proposal/ experiment	Sta- tus	Title	Beam days	PAC #
E12-06-102	A	Mapping Mesons early Polarized Photons 2016 Fall – 2018 Spring	120	30
E12-10-011	A-	A Precision Measurement of the eta Radiative Effect 2018 Spring – 2018 Fall ?	79	35
E12-13-003	A	An initial study of hadron decays to strange 2019 Spring ? –	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(JEF) Experiment		42

Physics Program

Proposal/ experiment	Sta- tus	Title	Beam days	PAC #
LOI12-15-001		Physics with secondary K_L^0 beam		43
LOI12-15-006		ω -production on nuclei		43
LOI12-16-001		Lepton Universality in Bethe-Heitler pro- duction of lepton pairs		44
LOI12-16-002		Probing short-range nuclear structure and dynamics		44
LOI12-16-005		Target helicity correlations in GlueX		44

Workshops on Physics Program

- 2016 Feb 1-3: [K_L Workshop](#) - about 60 participants
- 2016 Apr 28-29: [Nuclear Photoproduction with GlueX](#) - about 30 participants
- 2016 May: [GlueX Analysis](#)

The GlueX Collaboration

Arizona State, Athens, Carnegie Mellon, Catholic University, Univ. of Connecticut, Florida International, Florida State, George Washington, Glasgow, GSI, Indiana University, ITEP, Jefferson Lab, U. Mass. Amherst, MIT, MEPhi, Norfolk State, North Carolina A&T, Univ. North Carolina Wilmington, Northwestern, Santa Maria, University of Regina, and Yerevan Physics Institute.

Over 100 collaborators from 23 institutions. Others are planning to join (Wuhan Uni., China).

ENP Budget/Staff Plans for Hall D

Plans for upgrades and new equipment:

- Capital equipment ($> \$0.5M$):
 - ▶ DIRC *FY16-FY18* set
 - ▶ FCAL upgrade *FY17-FY20* planned
- Smaller projects ($< \$0.5M$):
 - ▶ L3 farm *FY16-FY17?*

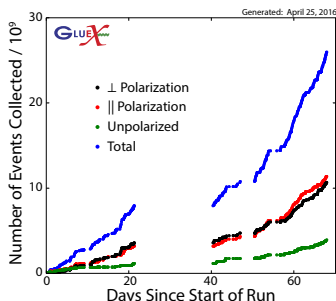
Hall D Staff:

- Scientific group: 13 staff scientists and 2 postdocs
3-rd postdoc: search in progress
Justin Stevens is leaving for W&M in Aug 2016: search started
- Technical group: 1 mechanical engineer, 1 designer and 6 techs

Hall D/GlueX Commissioning Status

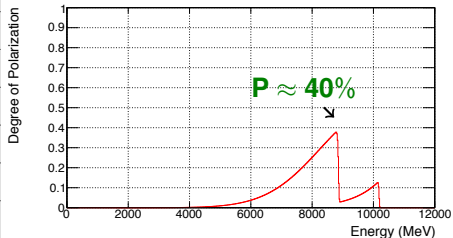
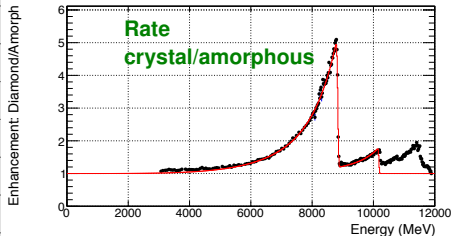
Spring 2016 run Feb 10 - Apr 25

- 12 GeV electron beam, 100-200 nA (radiator dependent)
 - Beam instrumentation commissioned (Fast Feedback)
 - Solenoid 1200 A 2.5 months
1345 A (GlueX optimum) one week
 - Diamond radiators: 50 μm - old, $\sim 30 \mu\text{m}$ - new
 - DAQ: $\sim 30 \text{ kHz}$ - sufficient for GlueX-I
Data flow $\sim 600 \text{ MB/s}$ = $\times 2$ of the initial estimate
-
- Beam studies and tuning
 - Trigger studies and tuning
 - Data for early physics results
 - GlueX commissioning completed
 - $\sim 24 \text{ G}$ events recorded



Hall D/GlueX Beam: Coherent Bremsstrahlung

Run 10492: 50 μm diamond



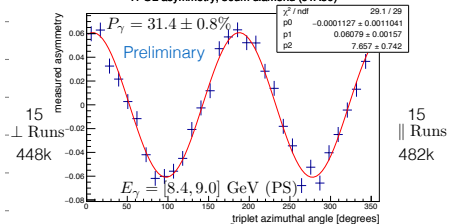
Polarization measurements

- Derived from the spectrum
- Triple polarimeter
 $\gamma e^- \rightarrow e^+ e^- e^-$
- Processes like $\gamma p \rightarrow \rho^0 p$

J1A50 (50um), 3 mm hole

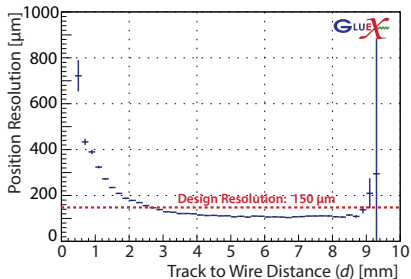
$$\frac{N(\phi)_\perp - N(\phi)_\parallel}{N(\phi)_\perp + N(\phi)_\parallel} = P_\gamma \Sigma \cos(2\phi) \quad \text{PERP/PARA}$$

TPOL asymmetry, 50um diamond (J1A50)

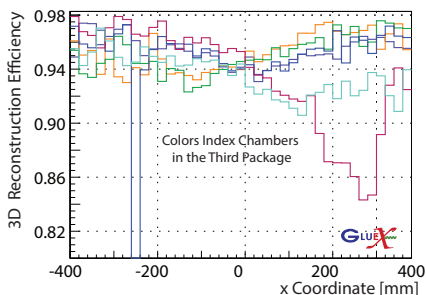
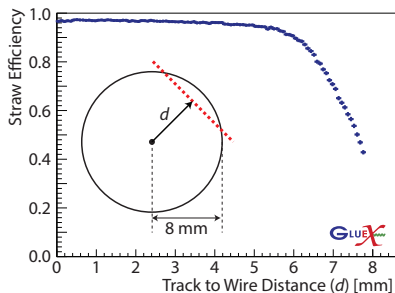
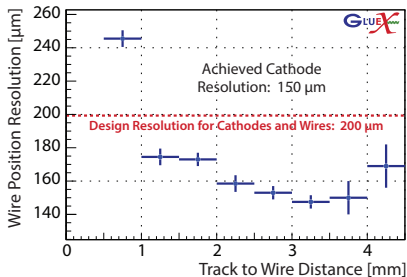


Tracking

Central Drift Chamber (CDC)

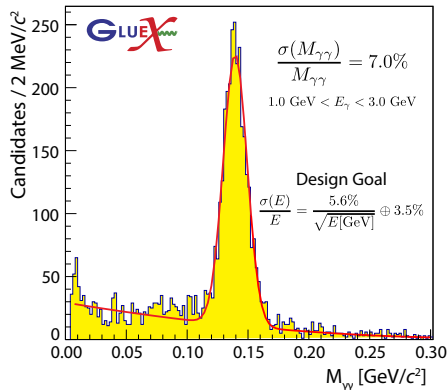


Forward Drift Chamber (FDC)

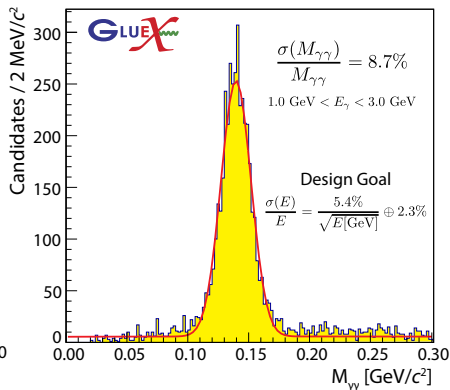


Photon Detection

Forward Lead Glass Calorimeter



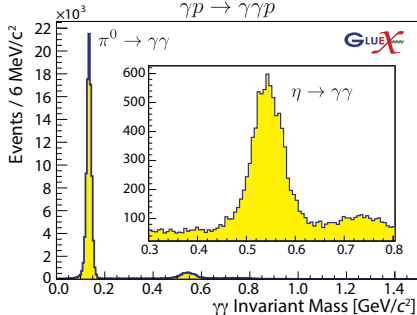
Barrel Lead-Scintillating Fiber Calorimeter



Event Reconstruction and Signals Observed

from 2015 data

$\gamma p \rightarrow \gamma \gamma p$

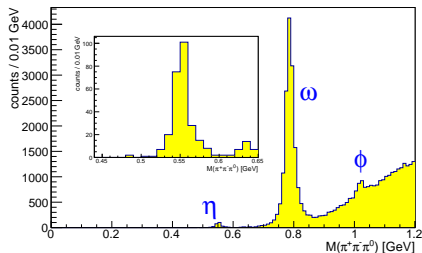


Exclusive reactions for X :

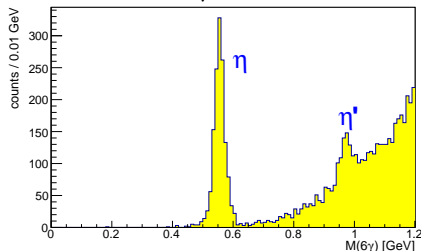
$$\gamma + p \rightarrow X + p$$

from 2016 data

$\pi^+ \pi^- \pi^0$ mass

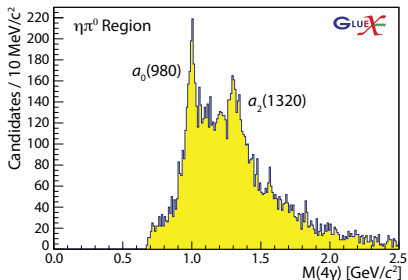
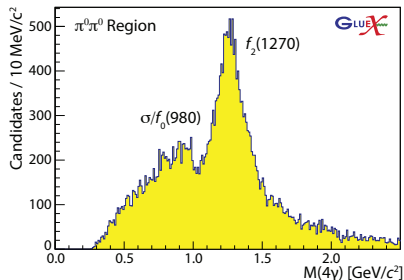
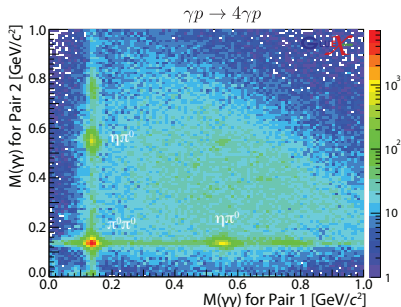


6γ mass



Event Reconstruction and Signals Observed

- Reaction $\gamma + p \rightarrow p + 4\gamma$
- Combinations $\pi^0\pi^0$ and $\eta\pi^0$

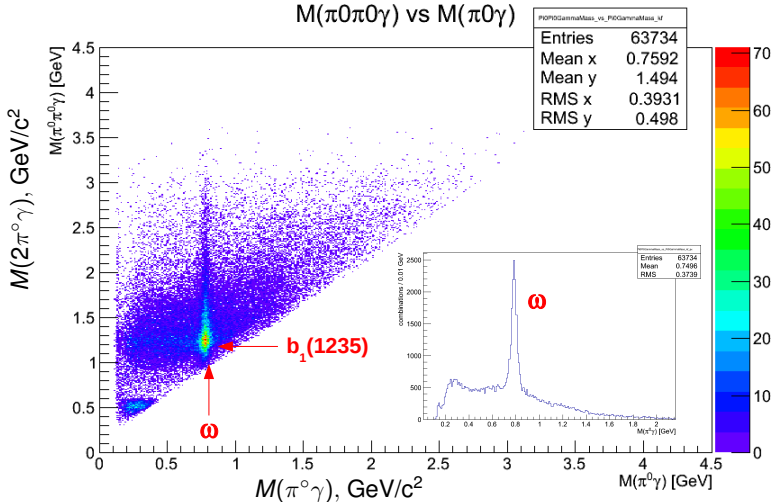


Event Reconstruction and Signals Observed

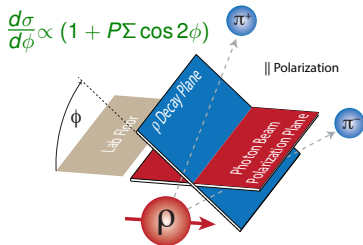
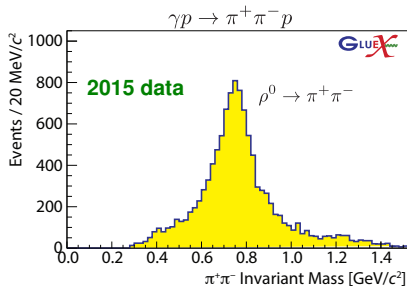
from 2016 data

$$\gamma p \rightarrow 2\pi^0 \gamma p \rightarrow 5\gamma p$$

$M(\pi^0\pi^0\gamma)$ vs $M(\pi^0\gamma)$

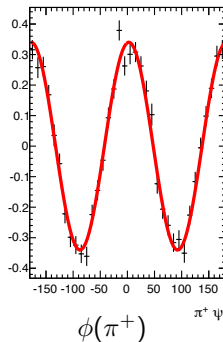


Physics With Linearly Polarized Beam



from 2016 data

- 38k (1% of total) $\gamma p \rightarrow \rho^0 p$ in $8.4 < E_\gamma < 9.0$ GeV
- 2 crystal orientations at 90°
- $\frac{N_0 - N_{90}}{N_0 + N_{90}} = P\Sigma \cos 2\phi$



$$P\Sigma = 0.341 \pm 0.007\%$$

- Spring data production: 1-st pass will be finished in 2 weeks
- Early physics: asymmetries of π^0, η
- Next pass with improved reconstruction and calibration
- Get ready for the 2016 Fall physics (GlueX-I) run
 - Test solenoid at 1350 A in August
 - Optimization of the trigger
 - UConn group continues producing diamond radiators

APPENDIX

Future Forward Kaon Identification

Present PID: TOF, dE/dx , Kinematics

Upgrade

DIRC project, ENP capital budget

- 4 of the BaBar DIRC bar boxes
- New readout system
- Allows to study:
 - Strangeonium and hybrids
 - Hyperons
- Installation planned for 2018

