

Hall D Report

E.Chudakov

Hall D Group Leader

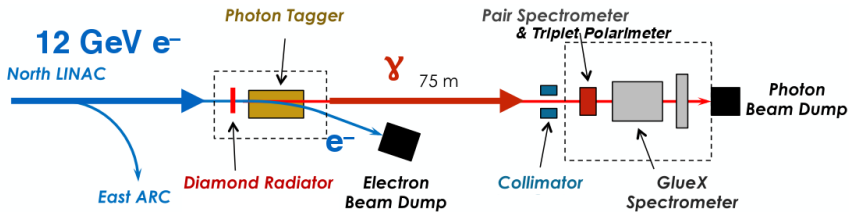
JLab PAC45, July 2017

Highlights Since July 2016 ...

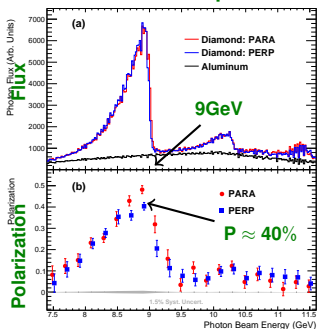
- The first GlueX physics paper published in PRC (2016 data)
- Successful GlueX-I physics run in Feb-Mar 2017
- Data analysis of the 2017 data in progress

- 1 Hall D apparatus
- 2 Collaboration and staff
- 3 Runs and first physics results
- 4 Readiness reviews
- 5 Physics program and schedule

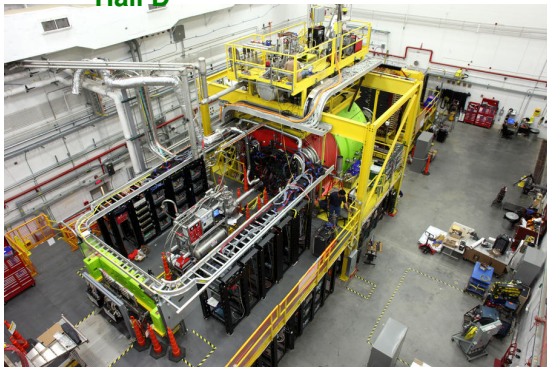
Hall D Apparatus



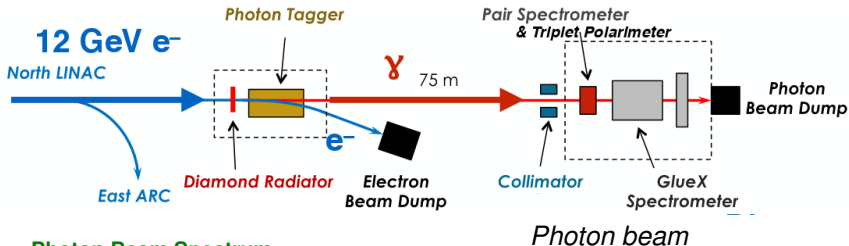
Photon Beam Spectrum



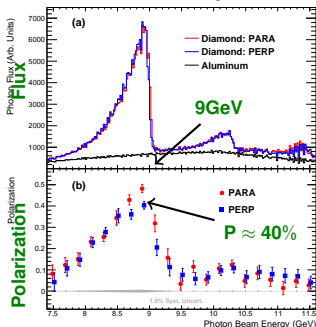
Hall D



Hall D Apparatus



Photon Beam Spectrum



- ▶ Linear polarization
- ▶ Tagging $\sigma E/E \sim 0.1\%$
- ▶ Pair Spectrometer & Triple Polarimeter

Spectrometer

- ▶ Acceptance: $1^\circ < \theta < 120^\circ$
- ▶ Resolutions: h^\pm : $\sigma_p/p \sim 1 - 3\%$
 γ : $\sigma_E/E \sim 6\%/\sqrt{E} + 2\%$
- ▶ Trigger: photoproduction at $E_{BEAM} > 7 \text{ GeV}$
in 2017: 55 kHz (signal + EM background)

The GlueX Collaboration

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

Over 120 collaborators from 25 institutions.
Others are considering to join (IHEP Beijing).

Plans for upgrades and new equipment:

- Capital equipment ($> \$0.5M$):
 - ▶ DIRC: ongoing *extended to FY19*
 - ▶ FCAL upgrade: planned *FY18-FY21*
- Smaller projects ($< \$0.5M$):
 - ▶ DAQ upgrade for high-intensity GlueX *FY16-FY18*

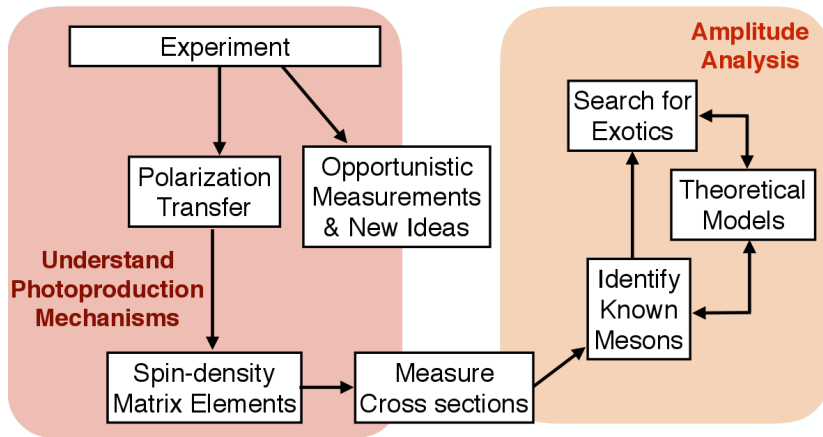
Hall D Staff:

- Scientific group: 12 staff scientists and 3 postdocs
- Technical group: 1 mechanical engineer, 1 designer and 6 techs

Hall D/GlueX Data taking Status

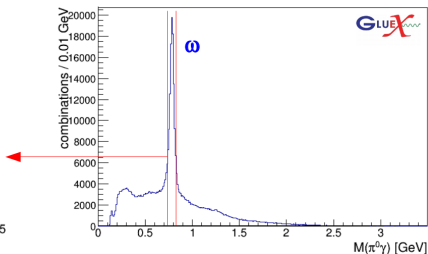
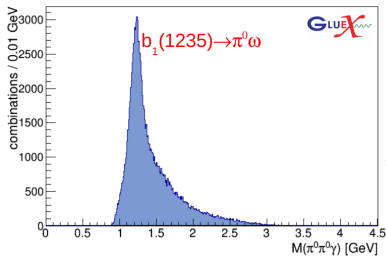
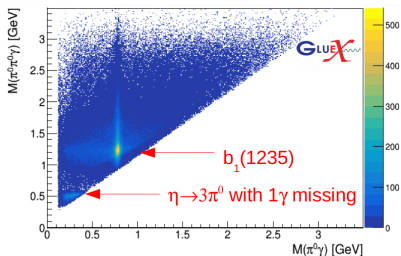
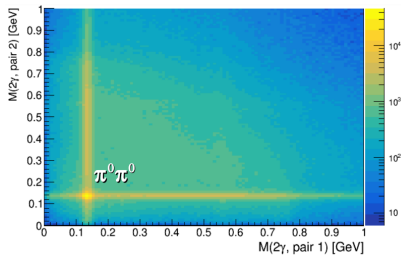
- Fall 2014 - Spring 2015: commissioning
- Spring 2016 12 GeV Engineering run
 - Commissioning is complete
 - Data for early physics results
 - ~ 22 G events recorded, 7 G events fully meet the specs
- Spring 2017 11.65 GeV GlueX physics run; ~ 40 calendar days
 - 50 G events, $\mathcal{L}_{int} \sim 20 \text{ pb}^{-1}/\text{peak}$ (20% of GlueX-I)
 - Solenoid at 1350 A; all subsystems operated as required
 - Only difference to the specs: diamond 58 μm instead of 20 μm : a few % lower polarization, compensated by a higher beam rate
 - Plans to finish the data processing by mid-August
- Next run scheduled: Fall 2017 11.65 GeV GlueX; 10 weeks total goal: provide 4 halls operations

GlueX: Analysis Strategy



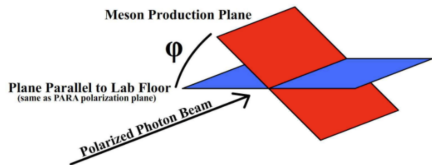
GlueX: Event Reconstruction and Signals Observed

From 2016 data: $\gamma p \rightarrow 5\gamma p$

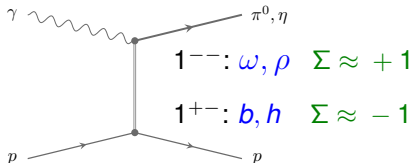


GlueX: Beam Asymmetries of π^0, η

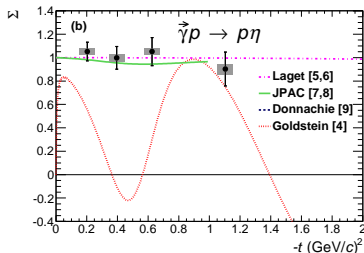
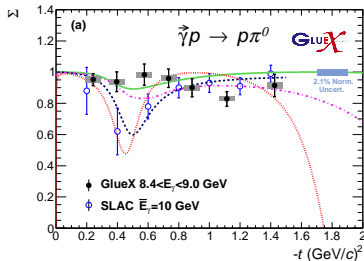
Properties of Photoproduction



$$A(\varphi) = \frac{\frac{d\sigma}{d\varphi_{\perp}} - \frac{d\sigma}{d\varphi_{\parallel}}}{\frac{d\sigma}{d\varphi_{\perp}} + \frac{d\sigma}{d\varphi_{\parallel}}} \approx P\Sigma \cos(2\varphi)$$

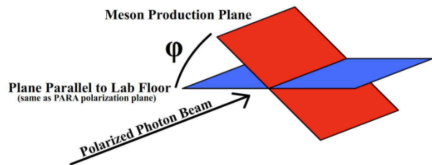


Phys.Rev. C95, 042207(R), 2017

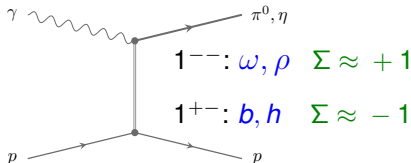


GlueX: Beam Asymmetries of π^0, η

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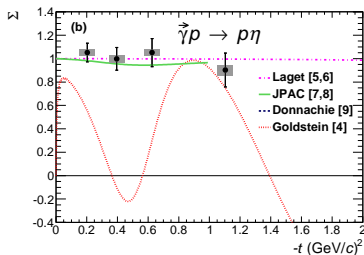
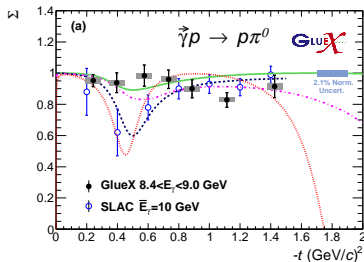


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- Vector exchange dominates
- No observed dip at $-t = 0.5 \text{ (GeV/c)}^2$

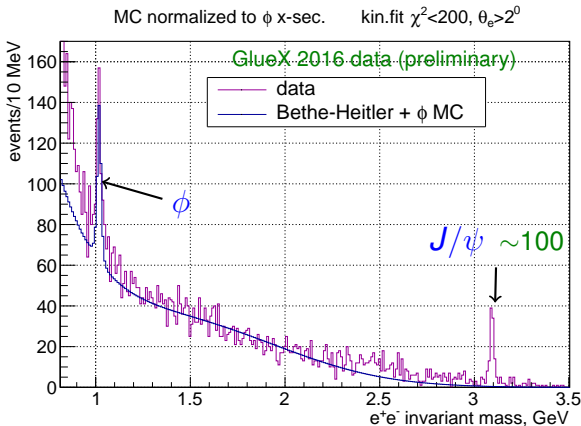
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GlueX: Photoproduction of J/ψ close to threshold

$$\gamma + p \rightarrow J/\psi + p, \quad J/\psi \rightarrow e^+ e^-$$

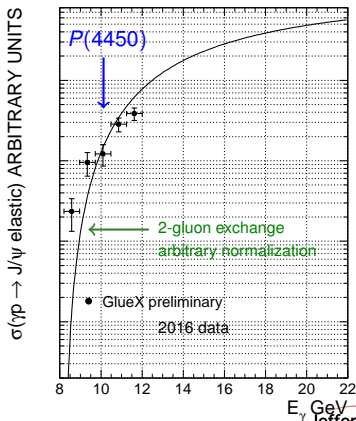
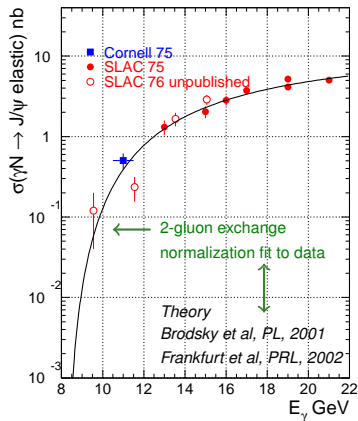
- All 2016 data: exclusive events $p + e^+ e^-$
- $e^+ e^-$ PID using the electromagnetic calorimeters BCAL and FCAL
- Kinematic fit with the beam energy from the tagger



GlueX: Photoproduction of J/ψ close to threshold

Planned measurements, after adding the 2017 Spring data:

- $\sigma(E)$ - sensitive to gluons at high x
- t-slope
- Limits on the pentaquark yield (the mass resolution $\sim 6 \text{ MeV}/c^2$)
 $\gamma p \rightarrow P(4450) \rightarrow J/\psi p$ predictions $\propto B^2(P \rightarrow J/\psi p)$



Experimental Readiness Reviews

- ENP: GlueX-2 (beam ~ 50 MHz in peak) ERR, followup mini review, May 11 2017.
 - The current scenario:
 - More selective trigger than now: < 90 kHz
 - Total data flow ~ 1.5 GB/s \Rightarrow disk \Rightarrow tape
 - No L3 is required
 - Review results: the scenario is endorsed with a number of recommendations and suggestions.
- Primex ERR, followup, June 7 2017.
 - COMCAL: on track
 - ^4He target: liquefaction successfully tested with the existing target setup
 - Review results: Passed with a number of recommendations

Physics Program and Schedule

Proposal/ experiment	Sta- tus	Title	PAC 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

Physics Program and Schedule

Established schedule

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Intention

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