Hall D Update

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[1]Hall D Group Leader

UGBoD meeting, January 2017

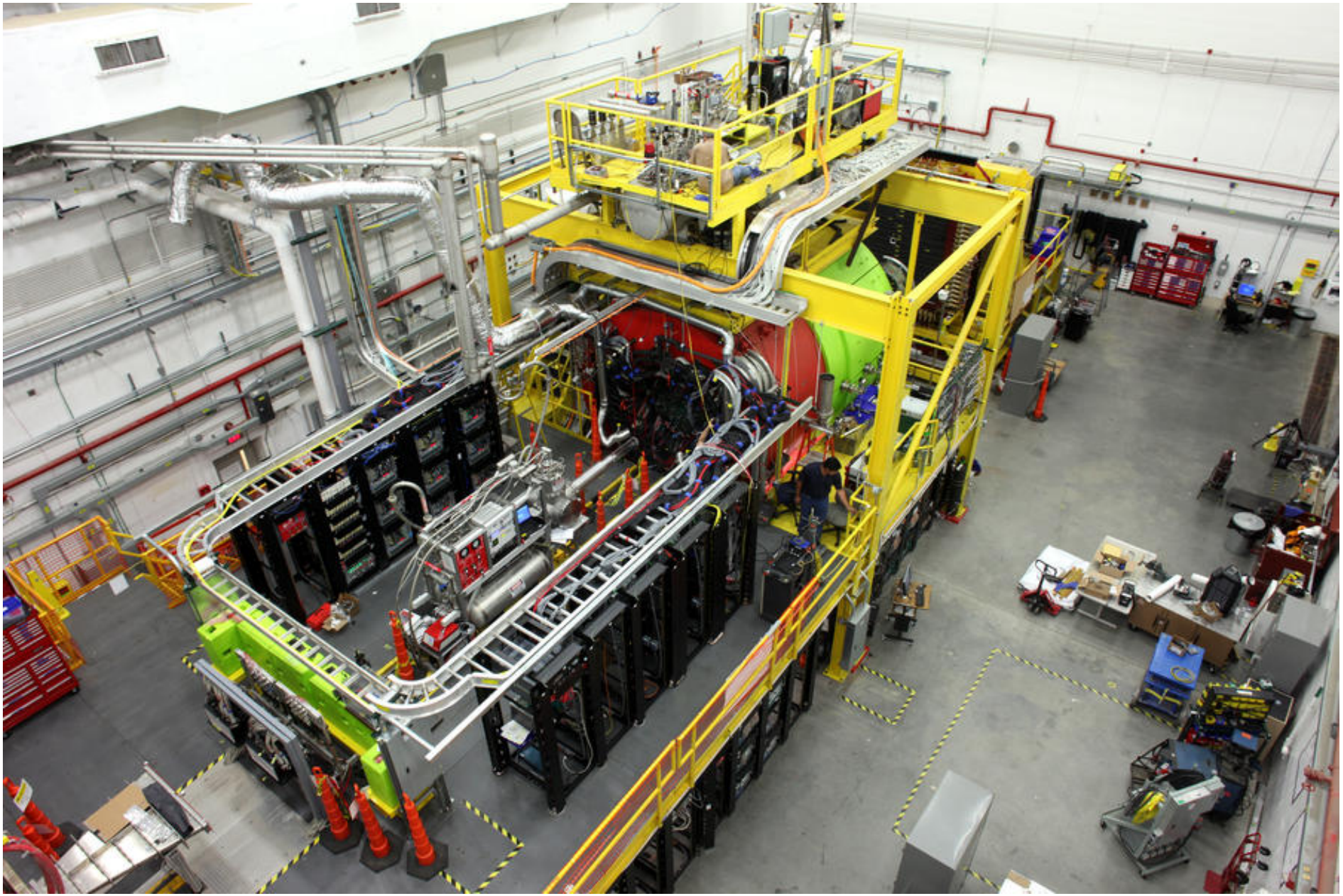
Outline

Since June 2016 ...

- Collaboration meeting in October 2016
- Spring 2016 (engineering run) results: 9 talks presented at DNP 2016 in Oct 2016
- 6-days technical run in Dec 2016 at 11.7 GeV

1. Hall D overview
2. Collaboration and staff
3. Physics program and schedule
4. Results and development

Hall D



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, W&M, Wuhan, and Yerevan Physics Institute.

Over 100 collaborators from 25 institutions.

ENP Budget/Staff Plans for Hall D

Plans for upgrades and new equipment:

- Capital equipment ($> \$0.5M$):
  - DIRC *FY16 - extended to FY19*
  - FCAL upgrade *FY18-FY21* planned
- Smaller projects ($<$\$0.5M):
  - L3 farm *FY16-FY18?*

Hall D Staff:

- Scientific group: 12 staff scientists and 3 postdocs
  Replacing Justin Stevens: put on hold by the management
- Technical group: 1 mechanical engineer, 1 designer and 6 techs

Physics Program

Proposal/ experiment	Status	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

Physics Program

Established schedule

Proposal/ experiment	Sta- tus	Title	Beam days	PAC #
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2016 Fall – 2018 Fall?

Physics Program

Established schedule

Intention

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2016 Fall – 2018 Fall?

2018 Fall –

2019 Spring –

2019 Fall –

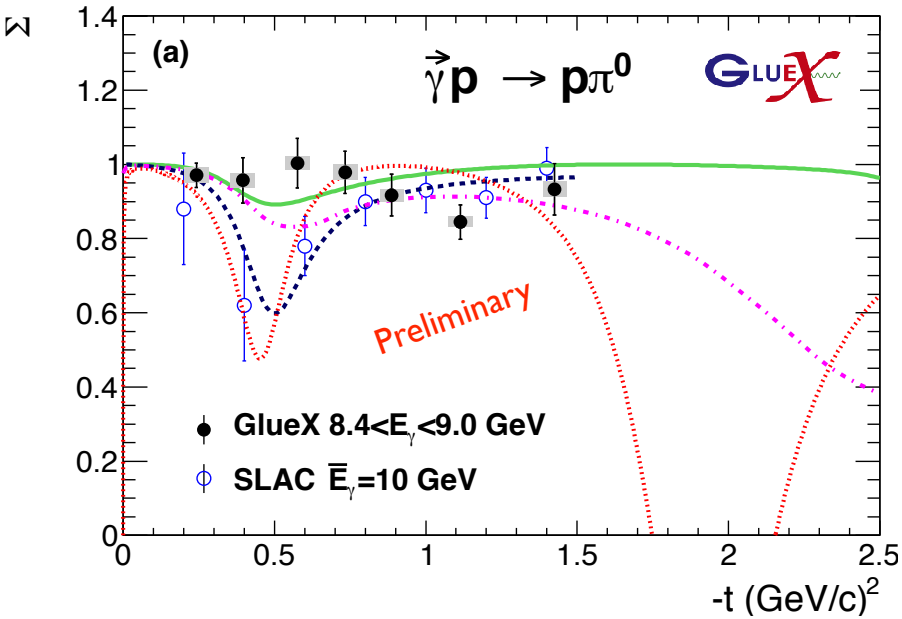
Physics Program

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

- LOI12-15-001 Activities: K_L Workshop 2016 Feb 1-3 - 60 participants; YSTAR-2016 2016 Nov 16-17
- LOI12-15-006 Workshop: Nuclear Photoproduction with GlueX 2016 Apr 28-29 - 30 participants
- LOI12-16-001 PAC: encouragement to submit a proposal
- LOI12-16-002 PAC: requirement for the accuracy evaluation, GlueX coll. vetting
- LOI12-16-005 PAC: recommendation to wait a few years

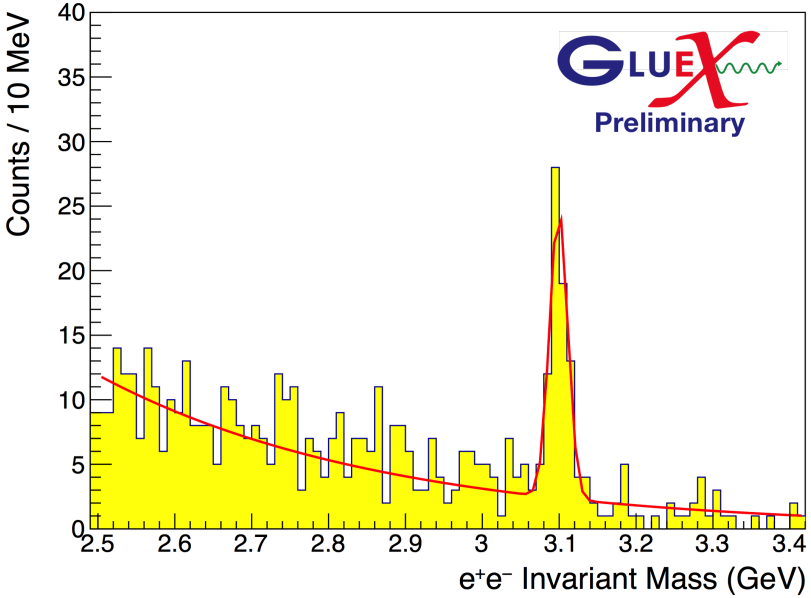
Selected Results from the Engineering Run

Beam asymmetry of π^0 and η photoproduction



- Prepared for PRL
- Under collaboration review

J/Ψ Production



Luminosity and statistics

$\sim$7 days of running at 10 MHz in the peak

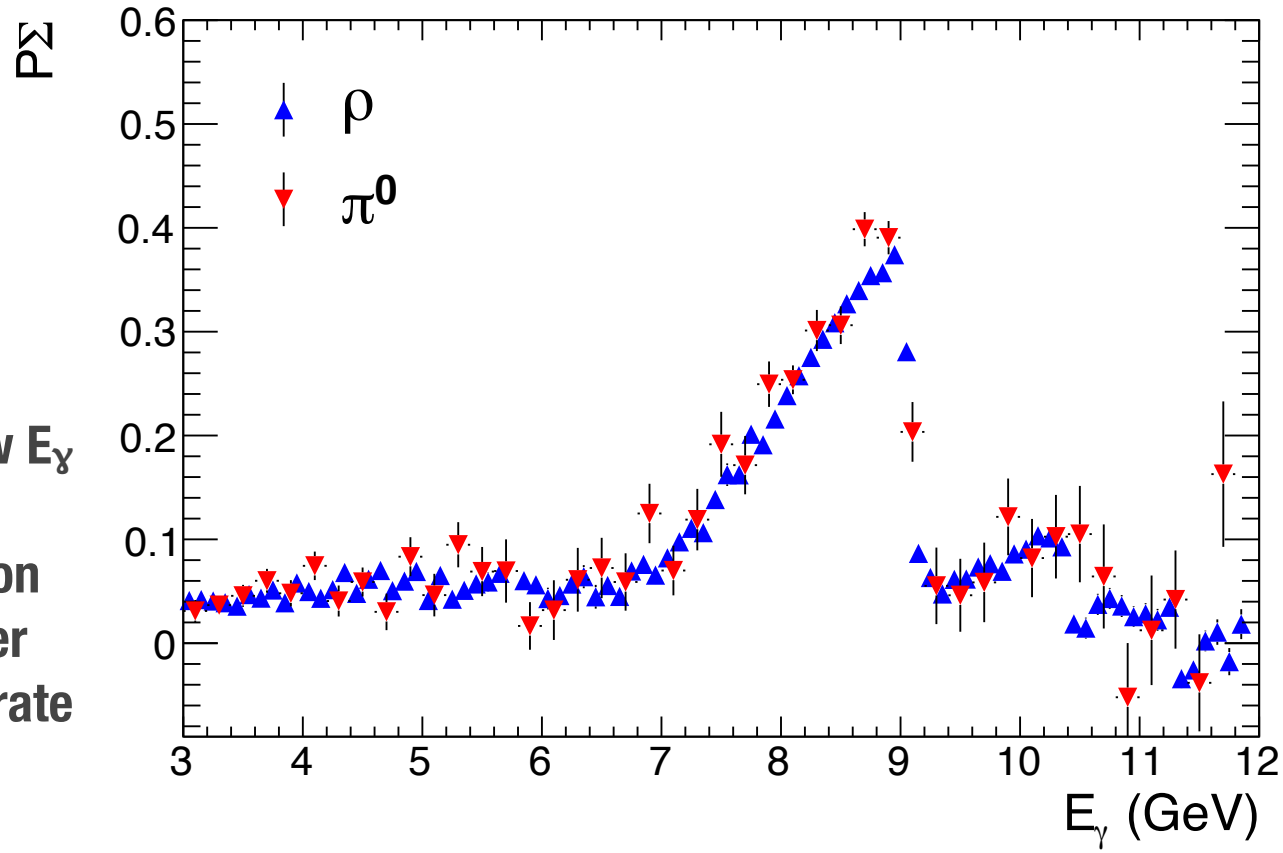
$1 \cdot 10^{12}$ tagged photons in peak on target

$\sim$ 100k $\quad \omega \rightarrow \pi^+\pi^-\pi^0$

Progress with the algorithms and calibration: higher efficiencies and better

Unexpected: Beam Polarization Beyond the Peak

ρ and π^0 asymmetries: runs 11569-11663



Still see low E_γ residual polarization with lower accidental rate

Conditions: 50 um diamond, 5.0 mm collimator, 2 ns bunch spacing

Reviews

- η-PrimeX Readiness Review for running in 2018 Spring, Jul 20.
  Not passed - have to come later for running in 2016 Fall
  Main issues:
  - Uncertainty in the plans to build the ComCAL
  - Target group has no time/resources before 2018 to develop and build a Helium target to the new specs

  Since the review: progress on the ComCAL plans; working on the target specifications

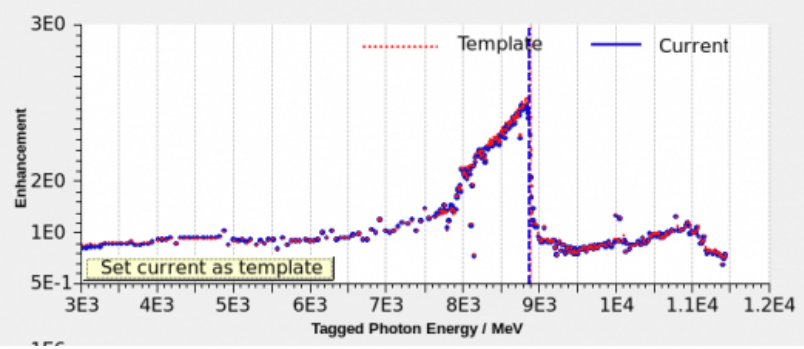
- L3 for GlueX-III - high intensity, mini-review on Jul 22.
  Not passed, Main issues and progress in solving them:
  - Considerable growth of the event size due to the accidentals
  - Too high data rate for the VME bus from many crates

  Since the review: a considerable progress done in reduction of the projected trigger rate and the event size;
  Tests done during the December 2016 run

- Software Review, Nov 10-11. Passed

December 2017 Run: 6 days for various tests

- DAQ: New firmware for the front-ends and trigger modules; new online configurations **OK**
- DAQ: testing performance at higher rates 50 kHz **OK**
- New diamond radiator $0.05 \times 7 \times 7$ mm^3 **OK**
- Lower voltage for TOF (too high current in the PMTs) data taken
- Polarimeter measurement at $E_{beam} < 6\ GeV$: $\sim 3\sigma$ confirmation



Problems found and will be addressed before the Spring 2017 run:

- DAQ: a hard-to-find error in one of the FADC250 at $>$ 30 kHz
- DAQ: limitations at the data recording level (RAID etc) at $>$ 50 kHz
- Solenoid trips at ramping up caused by voltage spikes in coil 2 - mitigated by lower ramp rates

Outlook

Next runs - schedule updated

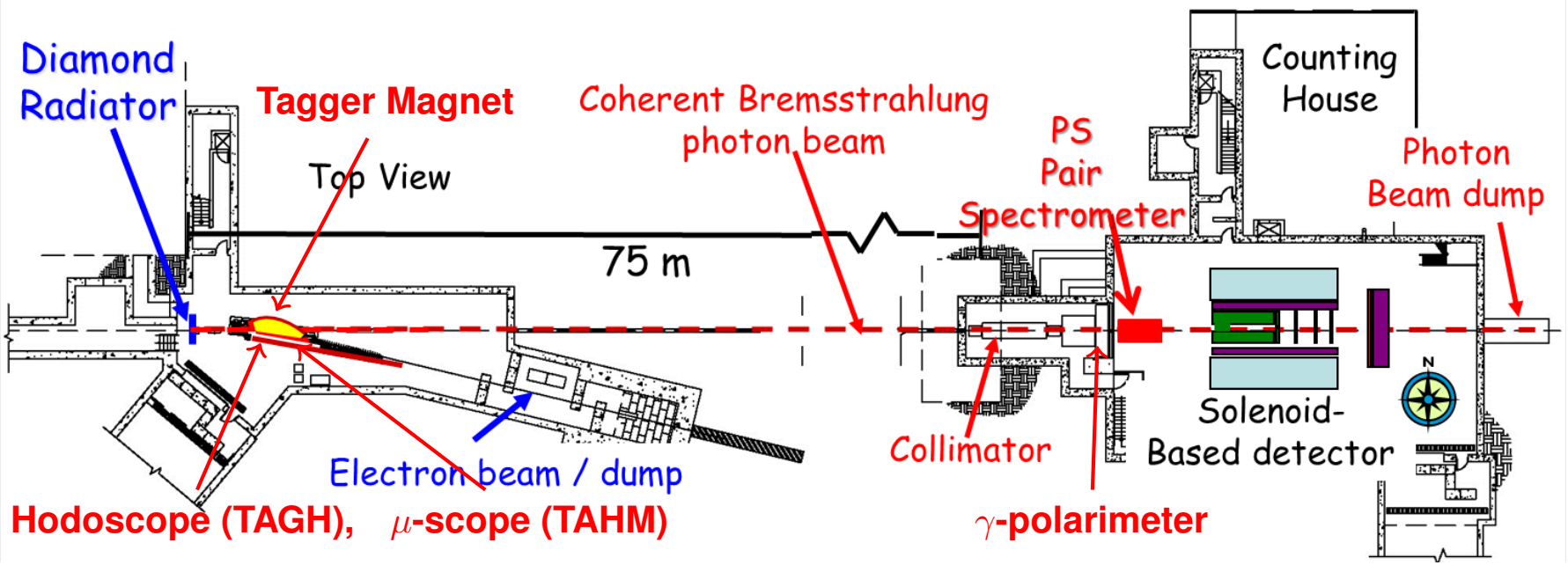
- 2017 Jan,30 - Mar,22 GlueX-I physics
- 2017 Oct,2 - Dec,20 GlueX-I physics (132 days in CY 2017)

Next hardware development

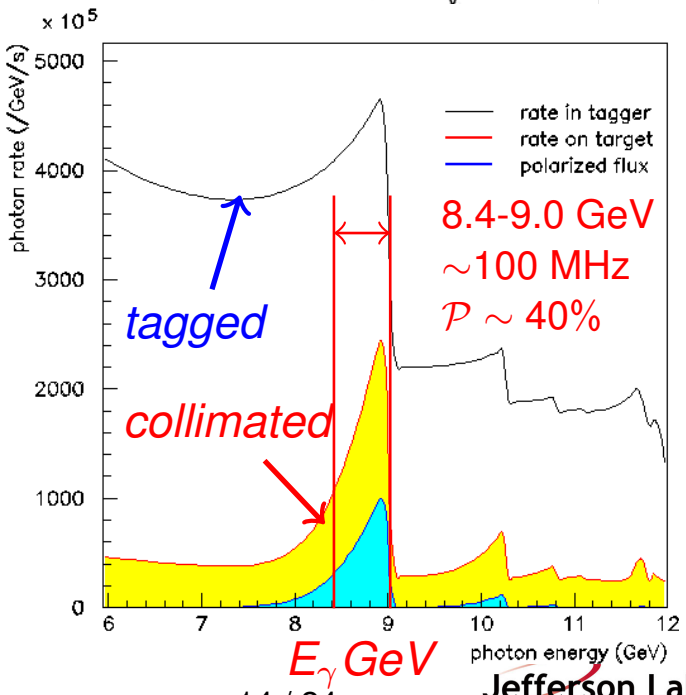
- TOF - bases with amplification: Summer 2017
- DAQ for $\times 5$ beam intensity: L3, links, RAID: 2017-2018
- DIRC: frame (IU), optical boxes (MIT) 2017-2018
- ComCal for PRIMEX (100 PbWO crystals) 2018
- Helium target for PRIMEX: conceptual design 2017

APPENDIX

Hall D/GlueX Beamline



- 12 GeV e^- beam $0.05 - 2.2\ \mu$A
- 20 μm diamond: coherent $<$25 μrad
- Collimation $r <$1.8 mm at $\sim$ 80 m
- Coherent peak $8.4 - 9.0$ GeV $\quad \mathcal{P} \sim 40\%$
  $2.2\ \mu$A $\Rightarrow$ 100 MHz γ
- Energy/polarization measured:
  - Tagger spectrometer $\sigma_E/E \sim$0.1%
  - Pair spectrometer: spectrum $\Rightarrow \sigma_{\mathcal{P}}/\mathcal{P} \sim$5%



Jefferson Lab

Hall D/GlueX Spectrometer and DAQ

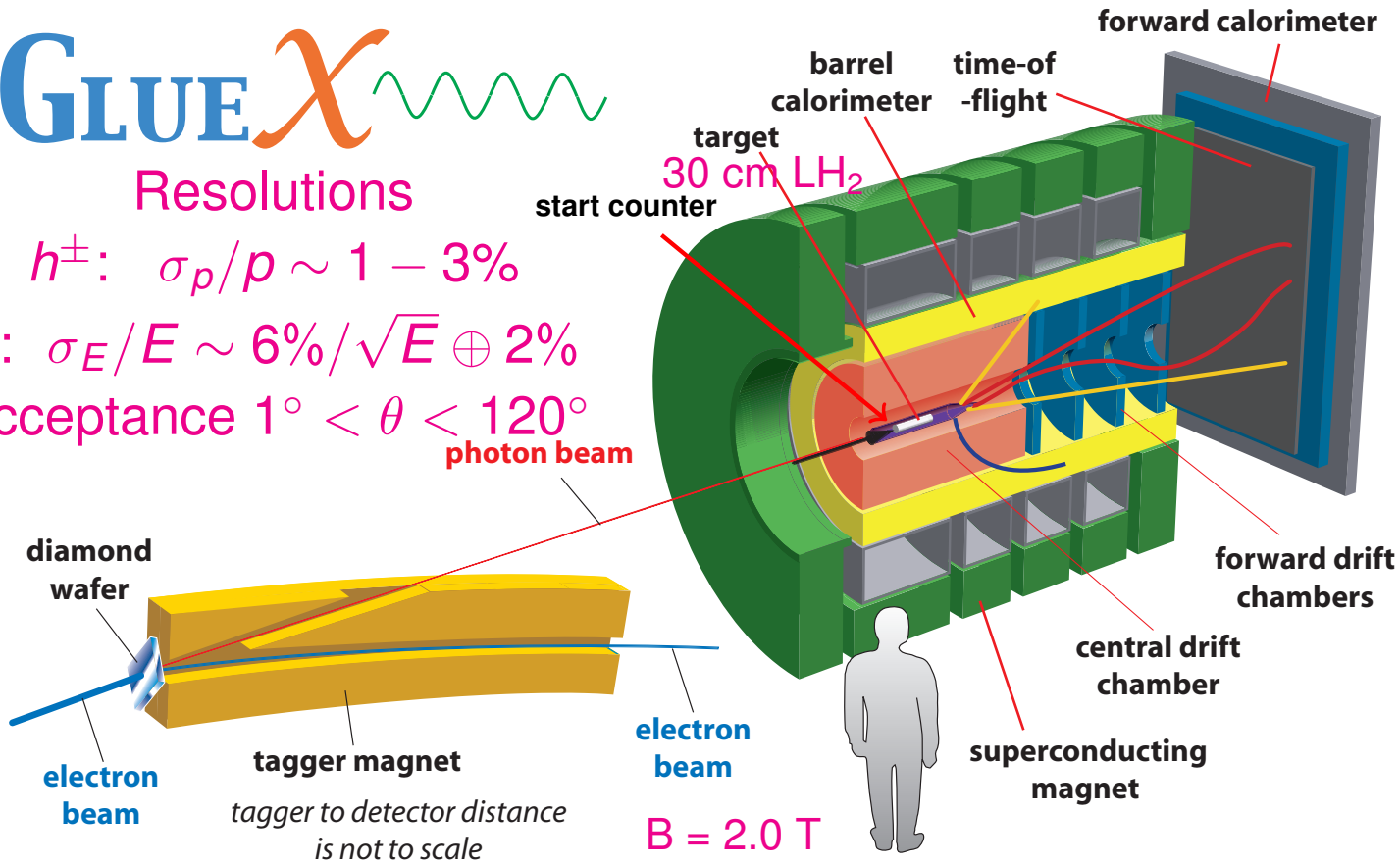
GlueX

Resolutions

$h^{\pm}$: $\sigma_p/p \sim 1-3\%$

γ: $\sigma_E/E \sim 6\%/\sqrt{E} \oplus 2\%$

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

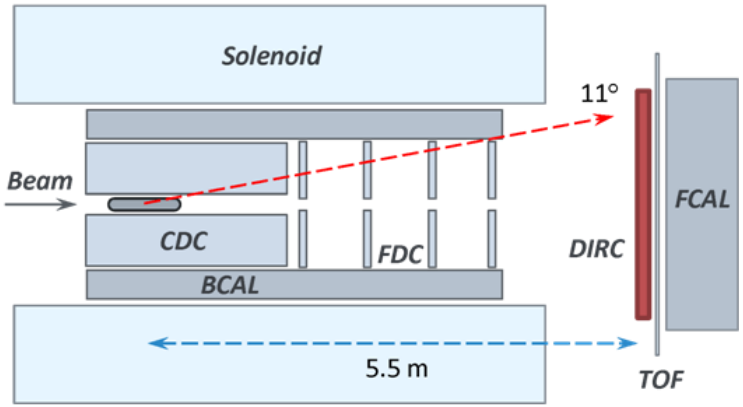
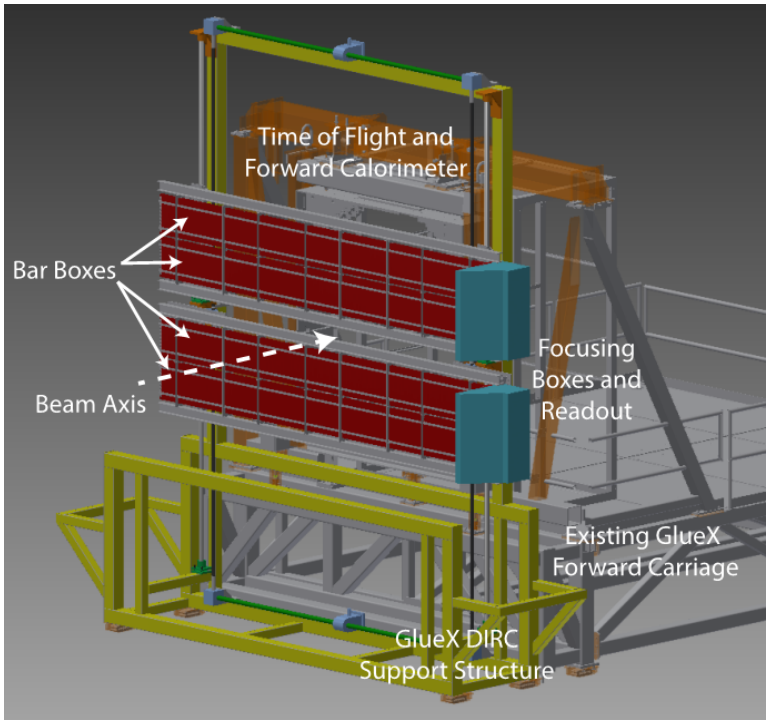
Beam 10 MHz/GeV: inclusive trigger 20 kHz $\Rightarrow$ DAQ $\Rightarrow$ tape

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

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