Hall D Update

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\textsuperscript{1}Hall D Group Leader

UGBoD meeting, January 2017
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
The GlueX Collaboration


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

<table>
<thead>
<tr>
<th>Proposal/ experiment</th>
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<th>Beam days</th>
<th>PAC #</th>
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<td>A</td>
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2016 Fall – 2018 Fall?
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<td>Physics with secondary $K_L^0$ beam $\omega$-production on nuclei</td>
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<tr>
<td>LOI12-15-006</td>
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<td>LOI12-16-001</td>
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<td>Lepton Universality in Bethe-Heitler production of lepton pairs</td>
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<td>Probing short-range nuclear structure and dynamics</td>
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<td>LOI12-16-005</td>
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<td>Target helicity correlations in GlueX</td>
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- **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 $\pi^0$ and $\eta$ photoproduction

- Prepared for PRL
- Under collaboration review

J/$\psi$ 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
$\sim 100k \quad \omega \rightarrow \pi^+\pi^-\pi^0$
Unexpected: Beam Polarization Beyond the Peak

\( \rho \) and \( \pi^0 \) asymmetries: runs 11569-11663

Still see low \( E_\gamma \) residual polarization with lower accidental rate

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

- \( \eta \)-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  \(0.05 \times 7 \times 7 \text{ mm}^3\)  **OK**
- Lower voltage for TOF (too high current in the PMTs)  **data taken**
- Polarimeter measurement at  \(E_{\text{beam}} < 6 \text{ GeV}\): \(\sim 3\sigma\) confirmation

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

- **DAQ**: a hard-to-find error in one of the FADC250 at \(> 30 \text{ kHz}\)
- **DAQ**: limitations at the data recording level (RAID etc) at \(> 50 \text{ kHz}\)
- 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

Next hardware development

- TOF - bases with amplification: Summer 2017
- DAQ for ×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
- 12 GeV $e^-$ beam 0.05 – 2.2 $\mu$A
- 20 $\mu$m diamond: coherent $< 25$ $\mu$rad
- Collimation $r < 1.8$ mm at $\sim 80$ m
- Coherent peak 8.4 – 9.0 GeV $P \sim 40$
  2.2 $\mu$A $\Rightarrow$ 100 MHz $\gamma$
- Energy/polarization measured:
  - Tagger spectrometer $\sigma_{E}/E \sim 0.1$
  - Pair spectrometer: spectrum $\Rightarrow \sigma_{P}/P \sim 5$

$\gamma$-polarimeter

Hodoscope (TAGH), $\mu$-scope (TAHM)

Collimator
Hall D/GlueX Spectrometer and DAQ

Resolutions
\[ h^\pm: \, \sigma_p/p \sim 1 - 3\% \]
\[ \gamma: \, \sigma_E/E \sim 6%/\sqrt{E} \pm 2\% \]
Acceptance \( 1^\circ < \theta < 120^\circ \)

Photoproduction \( \gamma p \) 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

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

Plans to add
- 2017 L3
- 2018 DIRC
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