

# Pion-LT Run Plan - Part 4B

December 20, 2021

## 7.937 GeV Beam Plan

### Initial beam activities

- While waiting for beam, configure the spectrometers:

1. **Hall Access:**

- (a) Confirm that the SHMS is able to rotate to 38.00 deg, and set the limit blocks accordingly.
  - (b) Move the SHMS to 5.50 deg (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.
2. SHMS momentum = 6.538 GeV/c (positive polarity and magnets cycled).
  3. HMS angle = 15.00 deg (from TV).
  4. HMS momentum = -1.332 GeV/c (negative polarity and magnets cycled).
  5. Update *standard.kinematics* with the new settings (Reminder: all momenta should be entered as positive quantities).
  6. Prescale GUI settings:

HMS singles DAQ disabled	all PS=-1
SHMS singles DAQ disabled	all PS=-1
COIN DAQ:	
PS1(SHMS-3/4)	0
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	0
PS4(HMS-ELREAL)	-1
PS5(HMS-ELREAL×SHMS-3/4)	-1
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- Beam checkout.

Follow the notes at:

[https://hallcweb.jlab.org/wiki/index.php/Beam\\_Checkout\\_Procedures](https://hallcweb.jlab.org/wiki/index.php/Beam_Checkout_Procedures)

including the “Carbon-hole” check to verify beam+target alignment and MCC raster size calibration.

- Fix beam angle at target.  
Do this step only if MCC is unable to restore the beam positions used before the holidays.  
Use the gui at: `/home/cdaq/users/gaskellld/target_bpm/target_bpm.py`  
Adjust 3H07Ax,y to remove slope while keeping 3H07Cx,y fixed  
Recheck carbon hole and iterate as necessary.

**Items to be done as soon as possible at this energy (time determined by RC).**

- Energy determination with arc.  
The Run Co-ordinator will coordinate the timing of this with the Program Deputy. MCC will have to set up a clean dispersive tune. It is important for the Shift Leader to make a full hclog entry of the MCC data. Follow the “Hall C Beam Energy Measurement Procedure” at MCC Ops Doc: MCC-PR-06-004.  
**Our requirement is for the beam energy to be within the uncertainty of the  $7.937.6 \pm 3.4$  MeV measurement of Dec 2, hclog: 3955022.**  
Please be sure the PionLT status page is updated with the result.
- BCM calibrations.  
The Run Co-ordinator will coordinate the timing of this with the Program Deputy. This can wait until the second week of the run. The BCM calibration procedure is at <https://hallcweb.jlab.org/doc-public/ShowDocument?docid=957>. Dave Mack will analyze the data later. Please be sure the PionLT status page is updated with the run information.

**$Q^2=3.85$ ,  $W=3.07$ ,  $x=0.31$ , low  $\epsilon$  data taking – PART TWO**

Nominal $Q^2=3.85$ GeV $^2/c^2$ , $W=3.07$ GeV, $x=0.31$ Kinematics						
$E_e$	$E_{e'}$	$\theta_{e'}$	$\epsilon$	$ t $	$p_\pi$	$\theta_q$
GeV	GeV	deg		(GeV/c) $^2$	GeV/c	deg
7.937	1.332	35.12	0.288	0.120	6.538	-6.39

1.  $p(e, e'\pi^+)n$  LH2 SHMS right ( $\theta = 5.50^\circ$ ) run.

Set up the following configuration:

- (a) HMS angle = 35.12 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (b) HMS momentum = -1.332 GeV/c. Negative polarity.
- (c) SHMS angle = 5.50 deg (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (d) SHMS momentum = 6.538 GeV/c. Positive polarity.
- (e) 10 cm LH2 target.
- (f) Update *standard.kinematics* with the new settings.
- (g) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu$ A. Do not change PS5=0!
- (h) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu$ A beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 710 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	13
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
0.7 kHz	55 kHz	315 kHz	120 kHz	76 kHz	490 Hz	0.25 Hz

- (i) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**

- (j) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (k) **Take data for 11.0 hours (at 100% efficiency) at 70  $\mu\text{A}$  to get about 10,000  $\text{p}(e, e'\pi^+)\text{n}$  coincidences.** Use the physics replay to keep track of the event total.
2.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS right ( $\theta = 5.50^\circ$ ) run.
- Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LH2 run.
- If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.
- Current limit: 40  $\mu\text{A}$ .
- DO NOT modify *standard.kinematics* for this run (i.e. keep as for LD2 target).
- Take data for 1.1 hour (100% efficiency) at 40  $\mu\text{A}$ .** During this run, the Target Operator should park the LH2 target and prepare for LD2 data taking.

3.  $d(e, e'\pi^+)nn_{sp}$  LD2 SHMS right ( $\theta = 5.50^\circ$ ) run.

- (a) Put in the LD2 target. Leave the spectrometer magnet and angle settings unchanged.
- (b) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about  $45 \mu\text{A}$ . Do not change PS5=0!
- (c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For  **$45 \mu\text{A}$  beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 1000 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	14
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
0.9 kHz	70 kHz	400 kHz	155 kHz	98 kHz	810 Hz	0.16 Hz

- (d) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**
- (e) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (f) **Take data for 17 hours (100% efficiency) at  $45 \mu\text{A}$  to get about 10,000  $d(e, e'\pi^+)nn_{sp}$  coincidences.** Use the physics replay to keep track of the event total.

4.  $d(e, e'\pi^+)nn_{sp}$  LD2 SHMS center ( $\theta = 6.39^\circ$ ) run.

- (a) SHMS angle = 6.39 deg (from TV). Beam off while departing the beamline. Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (b) LD2 target. Leave the spectrometer magnet settings unchanged.
- (c) Update *standard.kinematics* with the new settings, using proton mass for the target.
- (d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu$ A. Do not change PS5=0!
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu$ A beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 1270 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	13
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	9
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
1.4 kHz	110 kHz	320 kHz	130 kHz	96 kHz	1050 Hz	0.25 Hz

- (f) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**
- (g) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (h) **Take data for 11 hours (100% efficiency) at 70  $\mu$ A to get about 10,000  $d(e, e'\pi^+)nn_{sp}$  coincidences.** Use the physics replay to keep track of the event total.

5.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS center ( $\theta = 6.39^\circ$ ) run.

Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LD2 run.

If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.

Current limit: 40  $\mu\text{A}$ .

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LD2 target).

**Take data for 1.1 hour (100% efficiency) at 40  $\mu\text{A}$ .**

During this run, the Target Operator should park the LD2 target and prepare for LH2 data taking.

6.  $p(e, e'\pi^+)n$  LH2 SHMS center ( $\theta = 6.39^\circ$ ) run.

- (a) LH2 target. Leave the spectrometer magnet and angle settings unchanged.
- (b) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about  $70 \mu\text{A}$ . Do not change PS5=0!
- (c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz. For  $70 \mu\text{A}$  beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 500 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	12
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
0.7 kHz	55 kHz	160 kHz	66 kHz	48 kHz	260 Hz	0.25 Hz

- (d) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**
- (e) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (f) **Take data for 11 hours (100% efficiency) at  $70 \mu\text{A}$  to get about 10,000  $p(e, e'\pi^+)n$  coincidences.** Use the physics replay to keep track of the event total.



7.  $p(e, e'\pi^+)n$  LH2 SHMS left ( $\theta = 8.39^\circ$ ) run.

- (a) SHMS angle = 8.39 deg (from TV). Beam off while departing the beamline. Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (b) LH2 target. Leave the spectrometer magnet settings unchanged.
- (c) Update *standard.kinematics* with the new settings, using proton mass for the target.
- (d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu$ A. Do not change PS5=0!
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu$ A beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 320 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	10
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
0.7 kHz	55 kHz	40 kHz	18 kHz	18 kHz	72 Hz	0.25 Hz

- (f) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**
- (g) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (h) **Take data for 11 hours (100% efficiency) at 70  $\mu$ A to get about 10,000  $p(e, e'\pi^+)n$  coincidences.** Use the physics replay to keep track of the event total.

8.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS left ( $\theta = 8.39^\circ$ ) run.

Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LH2 run.

If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.

Current limit: 40  $\mu\text{A}$ .

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LD2 target).

**Take data for 1.1 hour (100% efficiency) at 40  $\mu\text{A}$ .**

During this run, the Target Operator should park the LH2 target and prepare for LD2 data taking.

9.  $d(e, e'\pi^+)nn_{sp}$  LD2 SHMS left ( $\theta = 8.39^\circ$ ) run.

- (a) LD2 target. Leave the spectrometer magnet and angle settings unchanged. Keep *standard kinematics* unchanged, using proton mass for the target.
- (b) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu\text{A}$ . Do not change PS5=0!
- (c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu\text{A}$  beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 530 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	11
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	9
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
1.4 kHz	110 kHz	80 kHz	37 kHz	35 kHz	290 Hz	0.25 Hz

- (d) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button**.
- (e) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (f) **Take data for 11 hours (100% efficiency) at 70  $\mu\text{A}$  to get about 10,000  $d(e, e'\pi^+)nn_{sp}$  coincidences.** Use the physics replay to keep track of the event total.

**$Q^2=2.45$ ,  $W=3.20$ ,  $x=0.21$ , low  $\epsilon$  data taking**

Nominal $Q^2=2.45$ GeV <sup>2</sup> /c <sup>2</sup> , $W=3.20$ GeV, $x=0.21$ Kinematics						
$E_e$	$E_{e'}$	$\theta_{e'}$	$\epsilon$	$ t $	$p_\pi$	$\theta_q$
GeV	GeV	deg		(GeV/c) <sup>2</sup>	GeV/c	deg
7.937	1.644	25.02	0.372	0.048	6.265	-6.16

1.  $p(e, e'\pi^+)n$  LH2 SHMS left ( $\theta = 8.16^\circ$ ) run.

Set up the following configuration:

- (a) Set the SHMS to +6.265 GeV/c.
- (b) Move the SHMS 8.16 deg (from TV). Beam off while approaching the beam line. Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision.
- (c) HMS momentum = -1.644 GeV/c. Negative polarity. Follow the cycling procedure.
- (d) HMS angle = 25.02 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (e) 10 cm LH2 target.
- (f) Update *standard.kinematics* with the new settings.
- (g) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu$ A. Do not change PS5=0!
- (h) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu$ A beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 760 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	11
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	10
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
3.3 kHz	158 kHz	73 kHz	32 kHz	29 kHz	530 Hz	1.6 Hz

- (i) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**

(j) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 20 minute run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.

(k) **Take data for 1.8 hours (at 100% efficiency) to get about 11,600  $p(e, e'\pi^+)n$  coincidences.** Use the physics replay to keep track of the event total.

The first run should be  $\sim 20$  minutes (at 100% data taking efficiency), and should be immediately analyzed to get an indication of the pion rate. Use this to calculate how long to run to get the desired statistics.

2.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS left ( $\theta = 8.16^\circ$ ) run.

Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LH2 run.

If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.

Current limit:  $40 \mu\text{A}$ .

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

**Take data for 0.2 hour (100% efficiency) at  $40 \mu\text{A}$ .**

3.  $p(e, e'\pi^+)n$  LH2 SHMS center ( $\theta = 6.16^\circ$ ) run.

- (a) Move the SHMS to 6.16 deg (from TV). **This requires a hall access. The Run Coordinator will need to arrange in advance which expert personnel (e.g. Amy Comer, Steve Lassiter) need to be present.** Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.
- (c) Update *standard.kinematics* with the new settings.
- (d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu\text{A}$ . Do not change PS5=0!
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu\text{A}$  beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 1500 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	13
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	10
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
3.3 kHz	158 kHz	272 kHz	32 kHz	29 kHz	1330 Hz	1.6 Hz

- (f) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**
- (g) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 20 minute run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (h) **Take data for 1.8 hours (100% efficiency) at 70  $\mu\text{A}$  to get 11,600  $p(e, e'\pi^+)n$  coincidences.** Use the physics replay to keep track of the event total. The first run should be  $\sim 20$  minutes (at 100% data taking efficiency), and should be immediately analyzed to get an indication of the pion rate. Use this to calculate how long to run to get the desired statistics.

4.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS center ( $\theta = 6.16^\circ$ ) run.

Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LH2 run.

If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.

Current limit: 40  $\mu\text{A}$ .

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

**Take data for 0.2 hours (100% efficiency) at 40  $\mu\text{A}$ .**

**$Q^2=5.00$ ,  $W=2.95$ ,  $x=0.39$ , low  $\epsilon$  data taking**

Nominal $Q^2=5.00$ GeV <sup>2</sup> /c <sup>2</sup> , $W=2.40$ GeV, $x=0.55$ Kinematics						
$E_e$	$E_{e'}$	$\theta_{e'}$	$\epsilon$	$ t $	$p_\pi$	$\theta_q$
GeV	GeV	deg		(GeV/c) <sup>2</sup>	GeV/c	deg
7.937	1.104	44.37	0.225	0.209	6.719	-6.17

1.  $p(e, e'\pi^+)n$  LH2 SHMS center ( $\theta = 6.17^\circ$ ) run.

Set up the following configuration:

- (a) Move the SHMS to 6.17 deg (from TV). **This requires a hall access. The Run Coordinator will need to arrange in advance which expert personnel (e.g. Amy Comer, Steve Lassiter) need to be present.** Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (b) During the hall access, the target operator should park the LD2 target and prepare for LH2 data taking.
- (c) Set the SHMS to +6.719 GeV/c (follow the cycling procedure).
- (d) HMS momentum = -1.104 GeV/c. Negative polarity.
- (e) HMS angle = 44.37 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (f) 10 cm LH2 target.
- (g) Update *standard.kinematics* with the new settings.
- (h) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu$ A. Do not change PS5=0!
- (i) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu$ A beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 340 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	12
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS	HMS	SHMS	SHMS	SHMS	Random coinc.	Real coinc.
$e^-$ rate	$\pi^-$ rate	$\pi^+$ rate	$K$ rate	$p$ rate	$(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	$e^- \cdot \pi$
0.2 kHz	30 kHz	140 kHz	60 kHz	43 kHz	120 Hz	0.09-0.11 Hz



- (j) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button**.
  - (k) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
  - (l) **Take data for approximately 32 hours (at 100% efficiency) to get about 10,000  $p(e, e'\pi^+)$ n coincidences.** Use the physics replay to keep track of the event total.
2.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS center ( $\theta = 6.17^\circ$ ) run.
- Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LH2 run.
- If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.
- Current limit: 40  $\mu\text{A}$ .
- DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).
- Take data for 3.2 hour (100% efficiency) at 40  $\mu\text{A}$ .**

3.  $p(e, e'\pi^+)n$  LH2 SHMS left ( $\theta = 8.17^\circ$ ) run.

- (a) Move the SHMS to 8.17 deg (from TV). Beam off while departing beamline. Be sure to record and photograph the actual vernier value to 0.005 degree precision.
- (b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.
- (c) Update *standard.kinematics* with the new settings.
- (d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 70  $\mu$ A. Do not change PS5=0!
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.

For 70  $\mu$ A beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 300 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	11
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS $e^-$ rate	HMS $\pi^-$ rate	SHMS $\pi^+$ rate	SHMS $K$ rate	SHMS $p$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
0.2 kHz	30 kHz	34 kHz	60 kHz	43 kHz	68 Hz	0.09-0.11 Hz

- (f) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.**
- (g) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 1 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (h) **Take data for 32 hours (100% efficiency) at 70  $\mu$ A to get about 10,000  $p(e, e'\pi^+)n$  coincidences.** Use the physics replay to keep track of the event total.

4.  $\boxed{\text{Al}(e, e'\pi^+)X}$  Dummy target SHMS left ( $\theta = 8.17^\circ$ ) run.

Now put in the dummy target ( $\pm 5$  cm) and initially set prescale factors to the same as the LH2 run.

If the HMS and SHMS singles event rates to disk are significantly less than 100 Hz each, the PS1,4 factors can be decreased accordingly.

Current limit: 40  $\mu\text{A}$ .

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

**Take data for 3.2 hours (100% efficiency) at 40  $\mu\text{A}$ .**

## Calibration runs with SHMS at positive polarity

1.  $p(e, e'p)$  setting #1 for minimum HMS angle

7.937 GeV Heep-check coincidence run #1

$\theta_{HMS}$	$P_{HMS}$	$\theta_{SHMS}$	$P_{SHMS}$	$Rate_{HMS}$	$Rate_{DAQ}$	Time
15.45	-6.079	37.93	2.634	140 Hz	215 Hz	0.5 hr

- (a) Set HMS magnets to  $-6.079$  GeV/c. Follow the cycling procedure.
- (b) Set SHMS magnets to  $2.634$  GeV/c.
- (c) HMS angle =  $15.45$  deg (from TV). SHMS angle =  $37.93$  (from TV). Record and photograph TV values to  $0.005$  degree precision.
- (d) Update *standard.kinematics* with the new settings.
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to  $100$  Hz.  
For  $70 \mu\text{A}$  beam and the projected rates listed above, these prescale factors should give  $100$  Hz HMS and SHMS singles event rates to disk, and a  $215$  Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	4
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- (f) HMS large and SHMS collimators.
- (g) Stable  $70 \mu\text{A}$  beam with  $2 \times 2$  raster on.

**fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button**.

**Data:** Take two runs with a combined total of  $250,000$   $e + p$  elastic scattering coincidences. The first run should be  $\sim 5$  minutes (at 100% data taking efficiency), and should be immediately analyzed, checking  $E_{miss}$  and  $p_{miss}$ , while taking the second run.

**Estimated Running Time: 0.5 hour** at 100% efficiency.

2.  $\text{Al}(e, e'p)X$  Dummy target run for Heep-check #1.

Insert the dummy target ( $\pm 5$  cm) and **run for 10 minutes** at  $40 \mu\text{A}$  (assuming 100% efficiency).

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

3.  $p(e, e'p)$  setting #2 for HMS angle and both spectrometer momenta

7.937 GeV Heep-check coincidence run #2

$\theta_{HMS}$	$P_{HMS}$	$\theta_{SHMS}$	$P_{SHMS}$	$Rate_{HMS}$	$Rate_{DAQ}$	Time
19.88	-5.202	31.10	3.493	22 Hz	250 Hz	1.0 hr

- (a) Set SHMS magnets to 3.493 GeV/c. Follow the cycling procedure.
- (b) Set HMS magnets to -5.202 GeV/c.
- (c) SHMS angle = 31.10 (from TV). HMS angle = 19.88 deg (from TV). Record and photograph the TV values to 0.005 degree precision.
- (d) Update *standard.kinematics* with the new settings.
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.  
For 70  $\mu$ A beam and the projected rates listed above, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 250 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	2
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	4
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- (f) HMS large and SHMS collimators.
- (g) Stable 70  $\mu$ A beam with  $2 \times 2$  raster on.

**fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button**.

**Data:** Take two runs with a combined total of 80,000  $e+p$  elastic scattering coincidences. The first run should be  $\sim 15$  minutes (at 100% data taking efficiency), and should be immediately analyzed, checking  $E_{miss}$  and  $p_{miss}$ , while taking the second run.

**Estimated Running Time: 1.0 hour** at 100% efficiency.

4.  $Al(e, e'p)X$  Dummy target run for Heep-check #2.

Insert the dummy target ( $\pm 5$  cm) and **run for 10 minutes** at 40  $\mu$ A (assuming 100% efficiency).

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

5.  $p(e, e'p)$  setting #3 for equal HMS and SHMS angles

7.937 GeV Heep-check coincidence run #3

$\theta_{HMS}$	$P_{HMS}$	$\theta_{SHMS}$	$P_{SHMS}$	$Rate_{HMS}$	$Rate_{DAQ}$	Time
25.26	-4.388	25.26	4.388	5.7 Hz	250 Hz	2.0 hr

- (a) Set SHMS magnets to 4.388 GeV/c. Follow the cycling procedure.
- (b) Set HMS magnets to -4.388 GeV/c.
- (c) SHMS angle = 25.26 (from TV). HMS angle = 25.26 deg (from TV). Record and photograph the TV values to 0.005 degree precision.
- (d) Update *standard.kinematics* with the new settings.
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.  
For 70  $\mu$ A beam and the projected rates listed above, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 265 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	1
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- (f) HMS large and SHMS collimators.
- (g) Stable 70  $\mu$ A beam with  $2 \times 2$  raster on.

**fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button**.

**Data:** Take two runs with a combined total of 40,000  $e+p$  elastic scattering coincidences. The first run should be  $\sim 30$  minutes (at 100% data taking efficiency), and should be immediately analyzed, checking  $E_{miss}$  and  $p_{miss}$ , while taking the second run.

**Estimated Running Time: 2.0 hours** at 100% efficiency.

6.  $Al(e, e'p)X$  Dummy target run for Heep-check #3.

Insert the dummy target ( $\pm 5$  cm) and **run for 10 minutes** at 40  $\mu$ A (assuming 100% efficiency).

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

7.  $p(e, e'p)$  setting #4 for SHMS momentum

7.937 GeV Heep-check coincidence run #4

$\theta_{HMS}$	$P_{HMS}$	$\theta_{SHMS}$	$P_{SHMS}$	$Rate_{HMS}$	$Rate_{DAQ}$	Time
33.65	-3.283	19.27	5.512	1.1 Hz	125 Hz	3.0 hr

- (a) Set SHMS magnets to 5.512 GeV/c. Follow the cycling procedure.
- (b) Set HMS magnets to -3.283 GeV/c.
- (c) SHMS angle = 19.27 (from TV). HMS angle = 33.65 deg (from TV). Record and photograph the TV values to 0.005 degree precision.
- (d) Update *standard.kinematics* with the new settings.
- (e) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.  
For 70  $\mu$ A beam and the projected rates listed above, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 265 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	2
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL $\times$ SHMS-3/4)	0
PS6(HMS-3/4 $\times$ SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- (f) HMS large and SHMS collimators.
- (g) Stable 70  $\mu$ A beam with  $2 \times 2$  raster on.

**fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button**.

**Data:** Take two runs with a combined total of 11,500  $e+p$  elastic scattering coincidences. The first run should be  $\sim 30$  minutes (at 100% data taking efficiency), and should be immediately analyzed, checking  $E_{miss}$  and  $p_{miss}$ , while taking the second run.

**Estimated Running Time: 3.0 hour** at 100% efficiency.

8.  $Al(e, e'p)X$  Dummy target run for Heep-check #4.

Insert the dummy target ( $\pm 5$  cm) and **run for 15 minutes** at 40  $\mu$ A (assuming 100% efficiency).

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

9.  $p(e, e'\pi^+)n$  coincidences fADC deadtime study #1

- (a) SHMS momentum = +5.422 GeV/c.
- (b) SHMS angle = 7.23 deg (from TV). Record the actual spectrometer TV angle to 0.005 degree precision.
- (c) HMS momentum = -2.498 GeV/c.
- (d) HMS angle = 16.33 deg (from TV). Record the actual spectrometer TV angle to 0.005 degree precision.  
item10 cm LH2 target.
- (e) Projected prescale GUI settings:

HMS singles DAQ disabled	all PS=-1
SHMS singles DAQ disabled	all PS=-1
COIN DAQ:	
PS1(SHMS-3/4)	see table
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	see table
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- (f) Make sure the raster is on ( $2 \times 2$ ), and take coincidences at 65, 52, 40, 27, 15  $\mu\text{A}$ . Start at the highest current and take LH2 target data. Then go down in current and repeat.  
**The goal is 17k prompt  $p(e, e'\pi^+)n$  coincidences per setting.**
- (g) **HMS-3/4 trigger run:** For the 15  $\mu\text{A}$  setting only, take a 0.5 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the setting total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (h) **Dummy target:** Take one run at 40  $\mu\text{A}$ , for about 0.3 hour (100% efficiency).

7.937 GeV $p(e, e'\pi^+)n$ fADC Deadtime Study #1							
$Q^2=1.60 \text{ GeV}^2, W = 3.08 \text{ GeV}, \epsilon = 0.56$ central angle							
$\theta_{HMS} = 16.33, P_{HMS} = -2.498 \text{ GeV}/c, \theta_{SHMS} = 7.23, P_{SHMS} = +5.422 \text{ GeV}/c$							
$\mu\text{A}$	Targets	$\frac{\text{Rate}_{SHMS}}{\text{LHrun}}$	$\frac{PS1}{SHMS}$	$\frac{\text{Rate}_{HMS}}{\text{LHrun}}$	$\frac{PS4}{HMS}$	Rate <sub>DAQ</sub>	Time
65	LH2	621 kHz	14	255 kHz	10	5.2 kHz*	0.6 hr
* If the CODA deadtime is excessive (>20%), consider PS5=1							
52	LH2	500 kHz	14	205 kHz	10	3.4 kHz	0.8 hr
40	LH2, Dummy	380 kHz	14	155 kHz	9	2.1 kHz	1.0 hr
27	LH2	260 kHz	13	105 kHz	9	1.1 kHz	1.5 hr
15	LH2	140 kHz	12	60 kHz	8	0.5 kHz	2.6 hr
Total Time (including overhead): 9 hrs							



10.  $p(e, e'\pi^+)n$  coincidences fADC deadtime study #2

If things go well, we could do a second study. This will be helpful in setting the systematic uncertainty of any residual rate dependence we find in the analysis. In this scan, SHMS rates are roughly 1/3 of the first scan, at the same current, but the physics rate should be comparable.

- (a) Rotate SHMS to 9.23 deg (from TV). Record the actual spectrometer TV angle to 0.005 degree precision.
- (b) Keep all other spectrometer settings unchanged.  
item10 cm LH2 target.
- (c) Projected prescale GUI settings:

HMS singles DAQ disabled	all PS=-1
SHMS singles DAQ disabled	all PS=-1
COIN DAQ:	
PS1(SHMS-3/4)	see table
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	see table
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

- (d) Make sure the raster is on ( $2 \times 2$ ), and take coincidences at 70, 56, 43, 29, 15  $\mu\text{A}$ . Start at the highest current and take LH2 target data. Then go down in current and repeat.  
**The goal is 17k prompt  $p(e, e'\pi^+)n$  coincidences per setting.**
- (e) **HMS-3/4 trigger run:** For the 15  $\mu\text{A}$  setting only, take a 0.5 hour run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the setting total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate.
- (f) **Dummy target:** Take one run at 40  $\mu\text{A}$ , about 0.3 hour.

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7.937 GeV  $p(e, e'\pi^+)n$  fADC Deadtime Study #2

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$Q^2=1.60 \text{ GeV}^2, W = 3.08 \text{ GeV}, \epsilon = 0.56$  left angle

$\theta_{HMS} = 16.33, P_{HMS} = -2.498 \text{ GeV}/c, \theta_{SHMS} = 9.23, P_{SHMS} = +5.422 \text{ GeV}/c$

$\mu\text{A}$	Targets	$\frac{Rate_{SHMS}}{LHrun}$	$\frac{PS1}{SHMS}$	$\frac{Rate_{HMS}}{LHrun}$	$\frac{PS4}{HMS}$	Rate <sub>DAQ</sub>	Time
70	LH2	230 kHz	13	275 kHz	10	2.3 kHz	0.6 hr
56	LH2	185 kHz	13	220 kHz	10	1.5 kHz	0.7 hr
43	LH2, Dummy (40)	140 kHz	12	170 kHz	10	1.0 kHz	0.9 hr
29	LH2	95 kHz	12	115 kHz	9	0.6 kHz	1.4 hr
15	LH2	50 kHz	11	60 kHz	8	0.3 kHz	2.6 hr

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Total Time (including overhead): 9 hrs

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## Extra Physics Data Taking

1. **To be discussed with the Spokespersons at the RC meeting:**

If there is time remaining, go back to the  $(e, e'\pi^\pm)$  setting with the lowest statistics and take more data.

2. The below table is GH's priority order, as of Dec 18.

The most we will be able to consider are the first two, and we will have to rescale and rebalance the times downwards to optimize the statistics between them.

Candidate 7.937 GeV physics settings for more statistics				
Type	Setting	Status	Additional $Q$	Time (100% eff)
LD-	$Q^2 = 3.85, W = 3.07, \theta_{SHMS} = 8.39^\circ$	$\pi^-$ 3044/8300 (36.7%)	2550 mC	39 hr @ 18 $\mu$ A
LD-	$Q^2 = 3.85, W = 3.07, \theta_{SHMS} = 6.39^\circ$	$\pi^-$ 5168/8300 (62.3%)	1080 mC	50 hr @ 6 $\mu$ A
LD-	$Q^2 = 6.00, W = 2.40, \theta_{SHMS} = 11.12^\circ$	$\pi^-$ 12932/17000 (76.1%)	2300 mC	9 hr @ 70 $\mu$ A
LD-	$Q^2 = 6.00, W = 2.40, \theta_{SHMS} = 13.12^\circ$	$\pi^-$ 11154/17000 (65.6%)	4000 mC	15 hr @ 70 $\mu$ A
LD-	$Q^2 = 6.00, W = 2.40, \theta_{SHMS} = 9.12^\circ$	$\pi^-$ 1669/17000 (9.82%)	9800 mC	105 hr @ 26 $\mu$ A

3. For example, to achieve 6225  $\pi^-$  (75%) for the first two settings, we would need (100% eff):

8.39°: 39 hr @ 18  $\mu$ A (2550 mC), plus 2 hr Dummy.

6.39°: 23 hr @ 6  $\mu$ A (495 mC), 0.4 hr Dummy.

4. To achieve 7055  $\pi^-$  (85%) for the first two settings, we would need (100% eff):

8.39°: 49.5 hr @ 18  $\mu$ A (3210 mC), plus 2 hr Dummy.

6.39°: 41 hr @ 6  $\mu$ A (885 mC), 0.6 hr Dummy.

5. An optimum goal might be 75% for the left (8.39°) setting, and 90% for the central (6.39°)

setting, which gives the times in the table.