Pion-LT Run Plan - Part 1

June 8, 2022

10.56 GeV Beam Plan

Initial beam activities

- Configure the spectrometers for the detector checkout prior to beam delivery:

  1. SHMS angle = 12.00 deg (from TV).
  2. SHMS momentum = -5.530 GeV/c (negative polarity and all magnets cycled).
  3. HMS angle = 12.50 deg (from TV).
  4. HMS momentum = -4.400 GeV/c (negative polarity and all magnets cycled).
  5. $z = 0$ 0.5% r.l. carbon target.
     Current Limit = 80 μA.
  6. Prescale GUI settings:

HMS singles DAQ disabled SHMS singles DAQ disabled	all PS=–1 all PS=–1
COIN DAQ:	
PS1(SHMS-3/4) PS2(SHMS-ELREAL) PS3(HMS-3/4) PS4(HMS-ELREAL) PS5(HMS-ELREAL×SHMS-3/4) PS6(HMS-3/4×SHMS-3/4)	0 –1 0 –1 –1 –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`
  including the "Carbon-hole" check to verify beam+target alignment and MCC raster size calibration. **Dave G. will need to be present to determine offsets from harp scans**

- Fix beam angle at target.
  Use the gui at: `/home/cdaq/users/gaskelld/target_bpm/target_bpm.py`
  Adjust 3H07Ax,y to remove slope while keeping 3H07Cx,y fixed
  Recheck carbon hole and iterate as necessary.

Final Pos:
3H07A: x=-0.09 y=-0.28
3H07C: x=-0.66 y=-0.46
at target: x=-0.33 y=-0.23

Encoder for Carbon Hole: 7565048

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

- BPM calibration (bulls-eye scan).
  This is not part of the typical beam checkout procedure. We want this done so that we have reliable absolute beam position information from the BPMs. Follow the procedure at: `https://hallcweb.jlab.org/wiki/index.php/Bull%27s_Eye_Scan`
  Dave G. will need to be present for this calibration.

- Energy determination with arc.
  This should be completed as soon as possible. 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.

  SK Done 12/6/12

- BCM calibrations.
  The Run Co-ordinator will coordinate the timing of this with the Program Deputy. This requires MCC's ability to reliably deliver 75-80 μA beam, so this calibration might have to wait at least a few days. The BCM calibration procedure is at `https://hallcweb.jlab.org/doc-public/ShowDocument?docid=957`. Dave Mack will analyze the data later.

- Subsequent BCM calibrations.
  Dave Mack states "the BCMs are mostly reliable, but the gains might really drift at the 1% level. E.g., during this run cycle, the outside temperature is going to drop by 40-50°F, which can affect the temperature of the RF cables and even the machine frequency, which is important for the older analog receivers." **He recommends a second BCM calibration 2 weeks after the first one, then every 2 weeks after that.** If Stephen checks the agreement of the full replay charge every few days, that will help to make educated decisions about the priority of doing more BCM calibrations.

0) Check beam spot with YAG viewer + post.

1) Beam checkout - get a good pic of Carbon Hole.

2) C-z=0 target, HMS carbon sieve @ -4400
→ Page 3

3) Detector Check. → Move Sieve out! Top of Page 3
- Focused run LDz @ -4400
- Defocused run (@ z +20%)
⇒ CALL JACOB: 443-821-8734 to COME IN.

Move Sieve IN

4) Carbon Foil ±8 cm. HMS @ -6.803 → 6.792
Page 5 SHMS @ -8.035

5) Carbon Foil (z=0) HMS @ -6.803
Page 4 SHMS @.

6) Heep coIN Trigger Checkout.
- will need to call in BRAD S.

Detector checkout (2)

Mostly already done with cosmics, probably just some checks needed.

1. For hodoscope calibration, we want defocused settings to better fill the focal plane, **so save two runs with increased Q2 by +20% current on both spectrometers compared to their nominal values. Use LD2 target for these runs. Leave rest of spectrometer settings unchanged.** Set prescales for pTRIG1 and pTRIG3 to be under 1kHz each. Start with one 5 minute run, then run for 1 hour at 100% efficiency. Ensure runs do not exceed 3 million events.

2. **Junaid should look through the root tree of the 5 minute defocused run and ensure all variables are filling correctly.** This should be done as soon as possible.

3. **If there is an issue with the single-arm trigger timing, Brad should be called in to immediately check this.** Look out for lower-than expected rates.

4. Return both Q2s to normal current values and run again for 1 hour at 100% efficiency, keeping the prescales and run lengths the same. LD2

5. PID leg checkout. Fine tune thresholds. An expert will want to change momentum and/or angle to get a good e/π ratio. Dave G.

SHMS ✓

Carbon sieve check (1)

While the spectrometers are still at negative polarity, we should quickly confirm that the optics are correct.

1. Restore the Q2 current on both spectrometers to their nominal values.

2. Insert the Carbon 0.5% r.l. target and sieve slit collimators on both SHMS and HMS. **Raster off. Current limit=40 μA.** ELREAL singles. Take 100,000 HMS and 100,000 SHMS good electron events with $-8\% < \delta < +8\%$ in HMS and $-10\% < \delta < +24\%$ in SHMS. Adjust PS2(SHMS-ELREAL) and PS4(HMS-ELREAL) as necessary to keep the deadtime at reasonable levels (below 20%).

	E_e	θ'_e	P'_e
HMS:	10560.0	12.50	-4400.0
SHMS:	10560.0	12.00	-5530.0

from e

3. Look at HMS and SHMS $x - fp$ vs $y - fp$ scatterplots. The "hourglass" should be nicely aligned vertically, indicating alignment of the beam with the HMS and SHMS optical axes. Mark Jones or Holly Szumila-Vance should be consulted if anything looks amiss.

When running carbon optics, do one 10-15 minute run to start.
Replay HMS optics using: (SHMS instructions are further down)

SCRIPTS/HMS/PRODUCTION/replay_production_hms_coin_OPTICS.C

which saves into ROOTfiles/Analysis/50k/hms_coin_replay_production_####_##.root

From the hallc_replay_lt directory, enter:

root -l ROOTfiles/Analysis/50k/hms_coin_replay_production_####_##.root

to load the file of the 10-15 minute optics run.

From here, we want to determine the rate of events into the individual sieve hol
es FOR EACH FOIL.

For the 0.5% Carbon target, this requires no extra effort.

For the Optics #2 +/- 8 cm, we need to apply some cuts.

In root, reconstruct the carbon foils by enter the following:

T->Draw("H.gtr.dp:H.gtr.y>>(100,-15,15,100,-10,10)","","colz")

and determine cuts along H.gtr.y to select one of the foils.

If unfamiliar, the format is:

T->Draw("H.gtr.dp:H.gtr.y>>(100,-15,15,100,-10,10)","H.gtr.y<HIGHCUT&&H.gtr.y>LO
WCUT","colz")

Now reconstruct the sieve collimator plane by entering the following:

T->Draw("H.gtr.x+H.gtr.th*166.032:H.gtr.y+H.gtr.ph*166.032>>(100,-10,10,100,-20,
20)","","colz")

And apply your H.gtr.y cut.

Now you should apply cuts along H.gtr.x+H.gtr.th*166.032 and H.gtr.y+H.gtr.ph*16
6.032 to select a singular hole.
Try and select a hole with lower number of events. Not on the edge of acceptance
, but not where events are hitting the most.

Root will tell you the count of events within this cut. Combined with the time o
f the run, you can get an estimate of the
rate of events into the sieve holes. Our goal is 200 counts per hole.

Once this is complete, the cuts to the sieve plane should be repeated for the ot
her foil(s).
The lowest rate should be used to determine how long to run.

Alternatively, for the SHMS:

SCRIPTS/SHMS/PRODUCTION/replay_production_shms_coin.C

(this is just the 50k replay script, but it should have all variables needed)

which saves into ROOTfiles/Analysis/50k/shms_coin_replay_production_####_##.root

From the hallc_replay_lt directory, enter:

root -l ROOTfiles/Analysis/50k/shms_coin_replay_production_####_##.root

to load the file of the 10-15 minute optics run.

From here, we want to determine the rate of events into the individual sieve holes FOR EACH FOIL.

For the 0.5% Carbon target, this requires no extra effort.

For the Optics #2 +/- 8 cm, we need to apply some cuts.

In root, reconstruct the sieve collimator enterance by enter the following:

>Draw("P.gtr.dp:P.gtr.y>>(100,-15,15,100,-20,20)","","colz")

and determine cuts along H.gtr.y to select one of the foils.

If unfamiliar, the format is:

T->Draw("P.gtr.dp:P.gtr.y>>(100,-15,15,100,-20,20)","P.gtr.y<HIGHCUT&&P.gtr.y>LOWCUT","colz")

ALSO make a delta cut. +/- should be ok

Now reconstruct the siev collimator plane by entering the following:

T->Draw("P.gtr.x+P.gtr.th*253.0:(-0.019*P.gtr.dp+0.00019*P.gtr.dp*P.gtr.dp+(138.0+75.0)*P.gtr.ph+P.gtr.y) + 40.0*(-0.00052*P.gtr.dp+0.0000052*pow(P.gtr.dp,2)+P.gtr.ph)>>(100,-10,10,100,-20,20)","","colz")

And apply your H.gtr.y cut.

ALTERATIVELY:

T->Draw("P.gtr.ph:P.gtr.th>>(100,-0.05,0.05,100,-0.05,0.05)","","colz")

w you should apply cuts along P.gtr.x+P.gtr.th*253.0 and (-0.019*P.gtr.dp+0.00019*P.gtr.dp*P.gtr.dp+(138.0+75.0)*P.gtr.ph+P.gtr.y) + 40.0*(-0.00052*P.gtr.dp+0.0000052*pow(P.gtr.dp,2)+P.gtr.ph) to select a singular hole.
Try and select a hole with lower number of events. Not on the edge of acceptance, but not where events are hitting the most.

Root will tell you the count of events within this cut. Combined with the time of the run, you can get an estimate of the rate of events into the sieve holes. Our goal is 200 counts per hole.

Once this is complete, the cuts to the sieve plane should be repeated for the other foil(s).
The lowest rate should be used to determine how long to run.

TL;DR:

Call Jacob Murphy and make him do this

Replaced by Jacob Murphy on 22/06/13

Carbon-Sieve Optics

SHMS ✓

10.549 GeV carbon-sieve optics run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}
15.00	-6.792	~~13.00~~ 10.00 gm	-8.035

1. Single Carbon Foil Optics (4)

   Set up the following configuration:

   (a) Set the SHMS magnets to –8.035 GeV/c. Magnets cycled. Done 6/17/22

   (b) SHMS angle = ~~13.00~~ 10.00 gm deg (from TV).

   (c) Set HMS magnets to –6.792 GeV/c. Magnets cycled. (X) Not done 13/6/22

   (d) **Switch HMS Optical Matrix to 6.6 GeV/c optimized matrix.** Contact Jacob Murphy with any questions. See analysis instructions

   (e) HMS angle = 15.00 deg (from TV).

   (f) Insert the Carbon 0.5% target.

   (g) Prescale GUI settings:

PS1(SHMS-3/4)	–1
PS2(SHMS-ELREAL)	0
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL×SHMS-3/4)	–1
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

   (h) HMS sieve and SHMS sieve collimators.

   (i) Stable 80 μA beam with 2×2 raster on.
   Current Limit = 80 μA.

   (j) Update *standard.kinematics* with the new settings.

   (k) **Jacob Murphy should be present for this run.** ~~Take a first run for 10 minutes~~ Analyze after 50k events & keep running (at 100% data taking efficiency) which should be immediately analyzed using Holly's carbon optics script, then continue data collection. The statistics goal is 200 electron events per sieve hole. The first run should be used to estimate how long to run.

Estimated Running Time: 1.0 hours at 100% efficiency.

2. Carbon Foil ±8 Optics (3)

Set up the following configuration:

(a) Insert Optical ±8 Carbon target. Keep spectrometer settings unchanged.

(b) Prescale GUI settings:

PS1(SHMS-3/4)	–1
PS2(SHMS-ELREAL)	0
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL×SHMS-3/4)	–1
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

17/06/22 SHMS done ✓ HMS 50% @ 15:30

(c) HMS sieve and SHMS sieve collimators.

(d) Stable 50 μA beam with 2×2 raster on.

Current Limit = 50 μA.

(e) Do not update *standard.kinematics* as the setting is unchanged. Analyze after 30k events

(f) **Jacob Murphy should be present for this run.** ~~Take a first run for 10 minutes~~ (at 100% data taking efficiency) which should be immediately analyzed using Holly's carbon optics script, then continue data collection. The statistics goal is 200 electron events per sieve hole. The first run should be used to estimate how long to run. & keep going

Estimated Running Time: 1.0 hours at 100% efficiency.

Configure the spectrometers for the trigger checkout with Heep coincidences

1. **Switch the SHMS to positive polarity** (follow the cycling procedure) and set to +5.530 GeV/c.
2. HMS momentum = -5.878 GeV/c. Follow the cycling procedure.
3. **Switch HMS Optical Matrix to standard optimized matrix.** Contact Jacob Murphy with any questions.
4. SHMS angle = 23.11 deg (from TV).
5. HMS angle = 21.67 deg (from TV).
6. 10 cm LH2 target.
7. Prescale GUI settings:

See analysis instructions
Sieve collimators out!

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

Coincidence trigger checkout - Sawatzky, Jones, Murphy

We want to set up the following configurations in the coincidence DAQ:
HMS (e^- trigger): A(ELREAL $e^- + \frac{\pi^- + K^-}{5-10}$))
SHMS (e^- trigger): A(ELREAL $e^- + \frac{\pi^- + K^-}{5-10}$)
SHMS ($\pi^\pm$ trigger): B (SCIN-3/4)
HMS A × SHMS B

- Check the single arm trigger legs.
- Check the coincidence trigger with existing HMS-ELREAL.
- Check SHMS, HMS detector fADC timing windows and thresholds.
- Check fADC pedestals. Check fADC reference times and ADC gates (widths should be 40 ns).
- Double-check SHMS timing for pions, kaons, and protons.

- Double-check SHMS+HMS coincidence timing. HMS start, SHMS stop. To limit noise/backround, narrow the gate as needed. Need to recheck and adjust timing.
  Extremely important: Look at the coincidence time plot in online analysis, and count the number of random pulses on each side of the prompt peak. The prompt peak should be centered in the distribution, with about 6 random pulses on each side. Preferably, these random pulses are of nearly equal height.
  In Kaon-LT we had a 60 ns SHMS gate, and a narrower 30 ns HMS gate with its leading edge centered in the SHMS gate `https://logbooks.jlab.org/entry/3602842`. With the lined up SHMS-3/4 overlap timing, an even narrower gate might be possible.

- The EDTM (Electronic Dead Time Monitor) needs to be set to a rate to give on the order of 10^4 accepted EDTM triggers (i.e. triggers on disk after deadtime losses) over the course of a 1 hour run. This rate is now supposed to be set automatically, but Jacob should replay a run to confirm this is the case, and post the result on hclog.

Heep-check coincidence runs

1. $p(e, e'p)$ setting for both spectrometer momenta

10.549 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$Rate_{DAQ}$	Time
21.67	-5.878	23.11	5.530	2.27 Hz	193 Hz	1.3 hr

Set up the following configuration:

(a) Set the SHMS magnets to +5.53 GeV/c (follow the magnet cycling procedure).

(b) SHMS angle = 23.11 deg (from TV).

(c) Set HMS magnets to −5.878 GeV/c.

(d) HMS angle = 21.67 deg (from TV).

(e) Prescale GUI settings:

PS1(SHMS-3/4)	0
PS2(SHMS-ELREAL)	−1
PS3(HMS-3/4)	−1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	−1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

(f) HMS large and SHMS collimators.

(g) Stable 80 μA beam with 2 × 2 raster on.

(h) Update *standard.kinematics* with the new settings.

Take two runs with a combined total of 10,000 $e + p$ elastic scattering coincidences. The first run should be 15 minutes (at 100% data taking efficiency), and should be immediately analyzed, checking E_m and p_m, while taking the second run.

Estimated Running Time: 1.3 hours at 100% efficiency.

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

Insert the "thick" dummy target (±5 cm) and **run for 10 minutes** at 40 μA (assuming 100% efficiency).
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 target).

Q^2=3.85, W=2.02, x=0.55, high ϵ data taking

Nominal Q^2=3.85 GeV$^2/c^2$, W=2.02 GeV, x=0.55 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	6.792	13.31	0.888	0.049	3.493	-21.65

1. $p(e,e'\pi^+)n$ LH2 SHMS right ($\theta = 19.65^o$) run.

   Set up the following configuration:

   (a) HMS angle = 13.31 (from TV).

   (b) HMS momentum = -6.792 GeV/c. Negative polarity. Magnets will need to be cycled.

   (c) **Switch HMS Optical Matrix to 6.6 GeV/c optimized matrix.** Contact Jacob Murphy with any questions. See analysis instructions

   (d) SHMS angle = 19.65 deg (from TV).

   (e) SHMS momentum = 3.493 GeV/c. Positive polarity.

   (f) 10 cm LH2 target.

   (g) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 430 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
35 kHz	0.6 kHz	41 kHz	12 kHz	38 kHz	195 Hz	5.6 Hz

   (h) Update *standard.kinematics* with the new settings. Use proton as the target mass. Not consistent w/ PS1 made last time!

   (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) **Take data for 1 hour (at 100% efficiency) at 80 μA to get about 81,000 $\mathbf{p(e, e'\pi^+)n}$ 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. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 19.65^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 0.2 hours (100% efficiency) at 40 μA.

3. $p(e,e'\pi^+)n$ LH2 SHMS center ($\theta = 21.65^o$) run.

   (a) Move the SHMS to 21.65 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

   (b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 319 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)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
35 kHz	0.6 kHz	17 kHz	5 kHz	20 kHz	91 Hz	5.6 Hz

   (c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (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) **Take data for 1 hour (at 100% efficiency) at 80 μA to get about 81,000 $p(e,e'\pi^+)n$ 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. $\mathrm{Al}(e,e'\pi^+)X$ Thick Dummy target SHMS center ($\theta = 21.65^o$) run.

   Now put in the "thick" 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 μA.
   DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 targets).

   Take data for 0.2 hours (100% efficiency) at 40 μA.

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 23.65^o$) run.

(a) Move the SHMS 23.65 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 338 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)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
35 kHz	0.6 kHz	7 kHz	2 kHz	10 kHz	91 Hz	5.6 Hz

needs to be corrected

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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) **Take data for approximately 1 hour (at 100% efficiency) at 80 μA to get about ~~81,000~~ p(e, e'π^+)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.

take ~45000

6. $\boxed{\mathrm{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 23.65^o$) run. done

Now put in the "thick" 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 targets).

Take data for 0.2 hours (100% efficiency) at 40 μA.

22.06.19.

Extra Settings due to HMS saturation

1) SHMS Right #2
   $\theta = 18.0°$ (otherwise as on p 9-10)
   Take 45k EVTS
   Mode-10 2min
   Dummy 10min @ 40μA

2) HMS Elastic Singles $\theta = 18.048°$
   → Set PS1 = -1
   → Adjust beam current so we can run with PS4 = 0
   → Take data ~ 30 min. (10Hz elastics).
   → Do Dummy

Q^2=2.73, W=2.63, x=0.31, high ϵ data taking

Nominal Q^2=2.73 GeV$^2/c^2$, W=2.63 GeV, x=0.31 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	5.878	12.04	0.834	0.118	4.605	-14.33

1. $p(e,e'\pi^+)n$ LH2 SHMS left ($\theta = 16.33^o$) run.

   Set up the following configuration:

   (a) HMS angle = 12.04 (from TV). **Follow the specific small angle rotation instructions on the Wiki. Beam off during the HMS movement. The Run Coordinator will need to arrange in advance which expert personnel (e.g. Amy Comer, Steve Lassiter) need to monitor remotely.**

   (b) HMS momentum = –5.878 GeV/c. Negative polarity.

   (c) **Switch HMS Optical Matrix to standard matrix.** Contact Jacob Murphy with any questions. See analysis instructions

   (d) SHMS angle = 16.33 deg (from TV).

   (e) SHMS momentum = 4.605 GeV/c. Positive polarity.

   (f) 10 cm LH2 target.

   (g) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 478 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)	10
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
79 kHz	10..7 kHz	21 kHz	8 kHz	16 kHz	220 Hz	9.9 Hz

   (h) Update *standard.kinematics* with the new settings.Use proton as the target mass.

   (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) **Take data for approximately 1 hour (at 100% efficiency) at 80 μA to get about 145,000 p(e, e'π^+)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. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 16.33^o$) run.

   Now put in the "thick" 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 μA.

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

   Take data for 0.2 hours (100% efficiency) at 40 μA.

3. $p(e,e'\pi^+)n$ LH2 SHMS center ($\theta = 14.33^o$) run.

   (a) Move the SHMS to 14.33 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. Leave the spectrometer magnet settings unchanged.

   (b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 881 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
79 kHz	10.7 kHz	63 kHz	21 kHz	37 kHz	592 Hz	9.9 Hz

   (c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (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) **Take data for 1 hour (100% efficiency) at 80 μA to get about 145,000 $d(e,e'\pi^+)n$ 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. $\mathrm{Al}(e,e'\pi^+)X$ Thick Dummy target SHMS center ($\theta = 14.33^o$) run.

   Now put in the "thick" 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 μA.
   DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 targets).

   Take data for 0.2 hours (100% efficiency) at 40 μA.

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS right ($\theta = 12.33^o$) run.

(a) Move the SHMS 12.33 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 1874 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)	10
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \text{p})$	Real coinc. $e^- \cdot \pi$
79 kHz	10.7 kHz	179 kHz	56 kHz	82 kHz	1549 Hz	9.9 Hz

(c) Update *standard.kinematics* with the new settings.Use proton as the target mass.

(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) **Take data for approximately 1 hour (at 100% efficiency) at 80 μA to get about ~~145,000~~ 80,000 p(e, e'π^+)n coincidences.** Use the physics replay to keep track of the event total. The first run should be ~ 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.

Take 80h

SK 20/6/22

SK 20/6/22

6. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 12.33^o$) run.

Now put in the "thick" dummy target (±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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 targets).

Take data for 0.2 hours (100% efficiency) at 40 μA.

Q^2=3.85, W=2.62, x=0.39, high ϵ data taking

Nominal Q^2=3.85 GeV$^2/c^2$, W=2.62 GeV, x=0.39 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	5.309	15.06	0.779	0.208	5.127	-14.28

1. $p(e,e'\pi^+)n$ LH2 SHMS right ($\theta = 12.28^o$) run.

   Set up the following configuration:

   (a) HMS angle = 15.06 (from TV).

   (b) HMS momentum = -5.309 GeV/c. Negative polarity.

   (c) SHMS angle = 12.28 deg (from TV).

   (d) SHMS momentum = 5.127 GeV/c. Positive polarity. → cycle magnet!

   (e) 10 cm LH2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 465 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
22 kHz	3.7 kHz	88 kHz	31 kHz	43 kHz	218 Hz	2.11 Hz

   (g) Update *standard.kinematics* with the new settings.Use proton as the target mass.

   (h) **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.**

   (i) **Take data for approximately 1.5 hour (at 100% efficiency) at 80 μA to get about 61,000 p(e, e'π^+)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. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 12.28^o$) run.

Now put in the "thick" dummy target (± 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 μA.

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.3 hours (100% efficiency) at 40 μA.

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

3. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS right ($\theta = 12.28^o$) run.

(a) Now put in the 10 cm LD2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 1118 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)	10
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
43 kHz	7.3 kHz	176 kHz	61 kHz	85 kHz	871 Hz	2.11 Hz

(c) Update *standard.kinematics* with the new settings.Use proton as the target mass.

(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) **Take data for approximately 1.5 hour (at 100% efficiency) at 80 μA to get about 61,000 ~~p(e,e'π^+)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.

d(e,e'π^+)nn$_{sp}$

4. $d(e,e'\pi^+)nn_{sp}$ LD2 SHMS center ($\theta = 14.28^o$) run.

(a) Move the SHMS to 14.28 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 490 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
43 kHz	7.3 kHz	55 kHz	20 kHz	34 kHz	294 Hz	2.11 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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) **Take data for 1.5 hours (100% efficiency) at 80 μA to get about 61,000 $d(e,e'\pi^+)nn_{sp}$ 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.

Replaced by Jacob Murphy
On [redacted] 22/06/21

5. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 14.28^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.3 hours (100% efficiency) at 40 μA.

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

Missing
[redacted] 22, 23 are due to different Runplan versions

[redacted] pg. 21
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Replaced by Jacob Murphy on 2022/06/22

6. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 14.28^o$) run.

   (a) Now put in the 10 cm LH2 and leave the spectrometer settings unchanged.

   (b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz. For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 270 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)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \text{p})$	Real coinc. $e^- \cdot \pi$
22 kHz	3.7 kHz	27 kHz	10 kHz	17 kHz	73 Hz	9.6 Hz

   (c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (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.** These runs do NOT need to be replayed.

   (e) **Take data for 1.5 hours (100% efficiency) at 80 μA to get about 61,000 $p(e,e'\pi^+)n$ coincidences and 432 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

   (f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

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7. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 16.28^o$) run.

(a) Move the SHMS 16.28 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 252 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	8
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
22 kHz	3.7 kHz	8 kHz	3 kHz	6 kHz	24 Hz	9.6 Hz

(c) Update *standard.kinematics* with the new settings.Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for approximately 1.5 hours (at 100% efficiency) at 80 μA to get about 61,000 p(e, e'π^+)n coincidences and 432 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

8. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 16.28^o$) run.

Now put in the "thick" dummy target (± 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 μA.

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.3 hours (100% efficiency) at 40 μA.

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

9. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS left ($\theta = 16.28^o$) run.

(a) Now put in the 10 cm LD2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 324 Hz DAQ rate overall.

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

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
43 kHz	7.3 kHz	16 kHz	6 kHz	13 kHz	96 Hz	9.6 Hz

(c) Update *standard.kinematics* with the new settings.Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for approximately 1.5 hours (at 100% efficiency) at 80 μA to get about 61,000 d(e, e'π^+)nn$_{sp}$ coincidences and 432 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

Q^2=6.00, W=2.40, x=0.55, high ϵ data taking

Nominal Q^2=6.00 GeV$^2/c^2$, W=2.40 GeV, x=0.55 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	4.752	19.92	0.711	0.531	5.512	-14.91

1. $d(e,e'\pi^+)nn_{sp}$ LD2 SHMS left ($\theta = 16.91^o$) run.
   Set up the following configuration:
   (a) HMS angle = 19.92 (from TV).
   (b) HMS momentum = −4.752 GeV/c. Negative polarity. ✓
   (c) SHMS angle = 16.91 deg (from TV).
   (d) SHMS momentum = 5.512 GeV/c. Positive polarity. ✓
   (e) 10 cm LD2 target.
   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 194 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	8
PS2(SHMS-ELREAL)	−1
PS3(HMS-3/4)	−1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	−1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
6.4 kHz	0.5 kHz	4.8 kHz	2.1 kHz	4.4 kHz	4 Hz	3.6 Hz

   (g) Update *standard.kinematics* with the new settings.Use proton as the target mass.
   (h) **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.** These runs do NOT need to be replayed.
   (i) **Take data for approximately 2 hours (at 100% efficiency) at 80 μA to get about 30,000 d(e,e'π^+)nn$_{sp}$ coincidences and 576 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(j) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 16.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.4 hours (100% efficiency) at 40 μA.

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

Q^2=3.85, W=3.07, x=0.31, high ϵ data taking

Nominal Q^2=3.85 GeV$^2/c^2$, W=3.07 GeV, x=0.31 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	3.944	17.49	0.632	0.120	6.538	-9.91

1. $d(e,e'\pi^-)pp_{sp}$ LD2 SHMS left ($\theta = 11.91^o$) run.

   Set up the following configuration:

   (a) HMS angle = 17.49 (from TV).

   (b) HMS momentum = –3.944 GeV/c. Negative polarity.

   (c) SHMS angle = 11.91 deg (from TV).

   (d) SHMS momentum = –6.538 GeV/c. Negative polarity.

   (e) 10 cm LD2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 565 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)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
20 kHz	32 kHz	194 kHz	19.1 kHz	11.8 kHz	352 Hz	5.4 Hz

   (g) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

   (h) **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.** These runs do NOT need to be replayed.

   (i) **Take data for 2.1 hours (at 100% efficiency) at 80 μA to get about ~~48,000~~ ~40,000 $d(e,e'\pi^-)pp_{sp}$ coincidences and 604.8 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

RLT (6/29/22)

(j) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\mathrm{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS left ($\theta = 11.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for ~~0.4~~ ~1 hours (100% efficiency) at ~~40~~ 25 μA.

DONE! (OWL)

RLT (6/29/22)

3. $\boxed{d(e,e'\pi^-)pp_{sp}}$ LD2 SHMS center ($\theta = 9.91^o$) run.

(a) Move the SHMS to 9.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. watch for SHMS 3/4 (pTrig 1 Scaler) rate! Keep below 600KHz

(b) **Adjust the beam current to keep the SHMS-S1X rate comfortably below 1 MHz.** We project the current for this run to be about 70 μA.

(c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **70μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 1027 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
18 kHz	28 kHz	480 kHz	70 kHz	6 kHz	797 Hz	4.7 Hz

(d) Update *standard.kinematics* with the new settings. Use neutron as the target mass. ✓

(e) **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.** These runs do NOT need to be replayed. ✓ Done 27/6/22

(f) **Take data for 2.4 hours (100% efficiency) at 70 μA to get about ~~48,000~~ 2 $d(e,e'\pi^-)nn_{sp}$ coincidences and 604.8 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** ~40,000 SJDK

(g) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay. 27/6/22

4. $\boxed{\text{Al}(e, e'\pi^-)X}$ Thick Dummy target SHMS center ($\theta = 9.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LD2 targets).

Take data for ~~0.5~~ 1 hours (100% efficiency) at ~~40~~ 25 μA.

SJDK
26/6/22

RLT
(6/24/22)

5. $\boxed{d(e,e'\pi^-)pp_{sp}}$ LD2 SHMS right ($\theta = 7.91^o$) run. Done

(a) Move the SHMS 7.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. Keep SHMS 3/4 (pTrig 2) Scaler rate below 600 kHz

(b) **Adjust the beam current to keep the SHMS-S1X rate comfortably below 1 MHz.** We project the current for this run to be about 25 μA.

(c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 25 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 584 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)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	−1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
6 kHz	10 kHz	493 kHz	98 kHz	8 kHz	306 Hz	1.7 Hz

(d) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

(e) **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.** These runs do NOT need to be replayed.

(f) **Take data for 6.5 hours (at 100% efficiency) at 25 μA to get about 46,000 d(e, e'π^-)pp$_{sp}$ coincidences and 585 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(g) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

6. $\boxed{\text{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS right ($\theta = 7.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for ~~1.3~~ hours (100% efficiency) at ~~40 μA~~.

2 hrs @ 20 MA SJDK 26/6/22

→ Got about 1:45 minutes OVG.

3. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 16.91^o$) run.

(a) Now put in the 10 cm LH2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 190 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	7
PS2(SHMS-ELREAL)	−1
PS3(HMS-3/4)	−1
PS4(HMS-ELREAL)	6
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	−1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
3.2 kHz	0.5 kHz	2.4 kHz	1.0 kHz	2.2 kHz	1 Hz	3.6 Hz

(c) Update *standard.kinematics* with the new settings.Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for approximately 2 hours (at 100% efficiency) at 80 μA to get about 30,000 p(e, e'π^+)n coincidences and 576 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

4. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 14.91^o$) run.

   (a) Move the SHMS to 14.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. Leave the spectrometer magnet settings unchanged.

   (b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 257 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	8
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	6
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
3.2 kHz	0.5 kHz	9.2 kHz	3.8 kHz	6.6 kHz	4 Hz	3.6 Hz

   (c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (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.** These runs do NOT need to be replayed.

   (e) **Take data for 2 hours (100% efficiency) at 80 μA to get about 30,000 $p(e,e'\pi^+)n$ coincidences and 576 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

   (f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

5. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 14.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.4 hours (100% efficiency) at 40 μA.

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

6. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS center ($\theta = 14.91^o$) run.

(a) Now put in the 10 cm LD2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 269 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	9
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
6.4 kHz	0.5 kHz	18.5 kHz	7.5 kHz	13.1 kHz	15 Hz	3.6 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2 hours (100% efficiency) at 80 μA to get about 30,000 $d(e,e'\pi^+)nn_{sp}$ coincidences and 576 mC charge delivered.** Use the physics replay to keep track of the event total. ~~LH2~~ **and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

After this setting, move to P66

Do NOT do the setting on the next page

02/07/22 SJK

Do not do LD2 (right) setting, go to P40 next

SJK 03/07/22

7. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS right ($\theta = 12.91^o$) run.

(a) Move the SHMS 12.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 278 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
6.4 kHz	0.5 kHz	67 kHz	26 kHz	37 kHz	50 Hz	3.6 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2 hours (at 100% efficiency) at 80 μA to get about 30,000 $\mathbf{d(e,e'\pi^+)nn_{sp}}$ coincidences and 576 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

SKIP THIS SETTING

SJDK 03/07/22

8. $\boxed{\mathrm{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 12.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.4 hours (100% efficiency) at 40 μA.

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

9. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS right ($\theta = 12.91^o$) run.

(a) Now put in the 10 cm LH2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 240 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)	6
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
3.2 kHz	0.5 kHz	33 kHz	13 kHz	18 kHz	13 Hz	3.6 Hz

(c) Update *standard.kinematics* with the new settings.Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2 hours (at 100% efficiency) at 80 μA to get about 30,000 p(e, e'π^+)n coincidences and 576 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

ONCE THIS IS DONE, MOVE TO THE SETTING on P66
& SPECTROMETER MOMENTUM AND HMS ANGLE INFO ISON P64

SJDK 03/07/22

2022/07/05 Adjusted Run Plan for Remainder of 10.549 GeV Beam Energy

We have adjusted the run plan to prioritize the settings that need the highest possible beam energy we have at this gradient. This plan should take us to the gradient change, after which we will continue our 5-pass production with the lower gradient (hence slightly lower beam energy).

Q^2=6.00, W=3.19, x=0.39, high ϵ data taking

Time estimates were made based on rates from the first 20 hours of production at the center setting. It was assumed that 43 uA at approximately 60% efficiency would be reproducible. If beam current or efficiency drop significantly, these estimates may need to be adjusted.

1. **SWING 2022/07/04**: Begin SHMS Center Setting
   (a) **Statistics Goal: 49,500 pions**
   (b) Production Charge Goal: 9158 mC
   (c) Time estimate: 129 hours total, aka 5.3 Days
      i. 106 hours total production
      ii. Note 20 hours of production were completed as of these estimates
      iii. 10.6 hours dummy target
      iv. 12 hours down for maintenance on 2022/07/06
   (d) HMS 3/4 Runs should be taken periodically, around once a day or every two days. These count as normal production runs.
   (e) Dummy Target runs should be taken periodically, not all at once. RC should advise shift crews to take advantage of beam downs to switch targets during the 5 days of data collection.
   (f) Estimated Completion Date: OWL 2022/07/10

ACTAC 49,418
9355 C

2. **OWL 2022/07/10**: Begin SHMS Left Setting

   (a) **Statistics Goal: 42,000 pions**

   (b) Production Charge Goal: ~~7776 mC~~ 11830 mC

   (c) Time estimate: 111 hours total, aka 4.6 Days

      i. 90 hours total production

      ii. 9 hours dummy target

      iii. 12 hours down for maintenance potentially during week of 2022/07/11

   (d) HMS 3/4 Runs should be taken periodically, around once a day or every two days. These count as normal production runs.

   (e) Dummy Target runs should be taken periodically, not all at once. RC should advise shift crews to take advantage of beam downs to switch targets during the 5 days of data collection.

   (f) Estimated Completion as of DAY 2022/07/11: 36/111 hours aka 32%

3. **DAY 2022/07/11 (or later TBD)**: Access SHMS Right Setting

   (a) **This setting will require a hall access to rotate the SHMS to 5.65°. The Run Co-ordinator will need to arrange in advance which expert personnel (e.g. Amy Comer, Steve Lassiter) need to be present.**

   (b) It is assumed that Monday day shift would be the best time to complete this rotation, but if there is a planned maintenance day the week of 2022/07/11, then the move to this setting from SHMS Left should be delayed to utilize the downtime. This will also adjust the dates for the Right Setting but NOT the end of the overall kinematic.

4. **SWING 2022/07/11**: Begin SHMS Right Setting

   (a) **Statistics Goal: 42,000 pions** ← (WILL NEED 11000 mC)

   (b) Production Charge Goal: ~~7776~~ 11000 mC

   (c) Time estimate: 99 hours total, aka 4.1 Days

      i. 90 hours total production

      ii. 9 hours dummy target

   (d) HMS 3/4 Runs should be taken periodically, around once a day or every two days. These count as normal production runs.

   (e) Dummy Target runs should be taken periodically, not all at once. RC should advise shift crews to take advantage of beam downs to switch targets during the 4 days of data collection.

   (f) Estimated Completion Date: SWING 2022/07/15

Ended w/ 32,000 pions & 8000 mC

5. **OWL 2022/07/16**: RESUME SHMS Left Setting

   (a) **Statistics Goal: 42,000 pions**

   (b) Production Charge Goal: ~~7776 mC~~

   (c) Time estimate: 111 hours ~~total,~~ aka 4.6 Days

      i. 90 hours total production

      ii. 9 hours dummy target

      iii. 12 hours down for maintenance potentially during week of 2022/07/11

      iv. note at least 36 hours of this setting were assumed to be taken starting OWL 2022/07/10.

   (d) HMS 3/4 Runs should be taken periodically, around once a day or every two days. These count as normal production runs.

   (e) Dummy Target runs should be taken periodically, not all at once. RC should advise shift crews to take advantage of beam downs to switch targets during the 5 days of data collection.

   (f) Estimated Completion Date: OWL 2022/07/19

Q^2=8.50, W=2.79, x=0.55, high ϵ data taking

Time estimates were made based on the estimations for $Q^2 = 6.00$ center and the initial run plan predicted rates for both settings. It was assumed that 43 uA at approximately 60% efficiency would be reproducible. If beam current or efficiency drop significantly, these estimates may need to be adjusted.

1. **DAY 2022/07/19**: Begin SHMS Center Setting

   (a) **Statistics Goal: 56,000 pions**

   (b) Production Charge Goal: 30412 mC

   (c) Time estimate: 352 hours total, aka 14.7 Days

      i. 307 hours total production

      ii. 30.7 hours dummy target

      iii. 24 hours down for maintenance assumed between the weeks of 2022/07/19 and 2022/07/26

   (d) HMS 3/4 Runs should be taken periodically, around once a day or every two days. These count as normal production runs.

   (e) Dummy Target runs should be taken periodically, not all at once. RC should advise shift crews to take advantage of beam downs to switch targets during the 14 days of data collection.

   (f) Hard-Cutoff Completion Date: OWL 2022/08/02

Q^2=6.00, W=3.19, x=0.39, high ϵ data taking

Nominal Q^2=6.00 GeV$^2/c^2$, W=3.19 GeV, x=0.39 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.59	2.398	28.18	0.398	0.214	8.035	-7.65

1. $p(e,e'\pi^+)n$ LH2 SHMS right ($\theta = 5.65^o$) run.

   Set up the following configuration:

   (a) HMS angle = 28.18 (from TV).

   (b) HMS momentum = –2.398 GeV/c. Negative polarity.

   (c) SHMS angle = 5.65 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.**

   (d) SHMS momentum = 8.035 GeV/c. Positive polarity.

   (e) 10 cm LH2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 282 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)	6
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ 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	10.6 kHz	253 kHz	117 kHz	63 kHz	81 Hz	0.44 Hz

+ (g) Update *standard.kinematics* with the new settings. Use proton as the target mass.

+ (h) **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.** These runs do NOT need to be replayed.

To Do (i) **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

DONE Wednesday July 12th [48 μA → 40 μA]

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.

(j) **Take data for 19.3 hours (at 100% efficiency) at 80 μA to get about 42k p(e, e'π^+)n coincidences and 5558.4 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(k) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. Al$(e, e'\pi^+)X$ Thick Dummy target SHMS right ($\theta = 5.65^o$) run.

Now put in the "thick" 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 μA.

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

Take data for 3.9 hours (100% efficiency) at 40 μA.

BCM Calibration (~1 hour)
Dave Mack updated 7/13/22

Instructions to Hall C shift crew:

1. Give the MCC operator a copy of this procedure.

1. Fast Raster on 2x2 (to protect stuff)

2. Target out will make life simpler. (But LH2 or LD2 is in principle OK according to operational restrictions at http://opsweb.acc.jlab.org/internal/ops/ops_webpage/restrictions/ops_restrictions.html .)

3. Ask the MCC operator to show they can stably reach the maximum desired current.

We're only interested in scalers. Check that the Unser and BCM scalers are counting on one of the xscalers screens . When the MCC calls to tell you they are ready,

4. Start a run labelled "BCM calibration".

5. Make sure the daq keeps running during the procedure until the operator calls to say it is complete. You should keep track of the progress.

6. Replay the run because I need the scalers in the ROOT file. (It may be simplest to use the standard full replay.)

Instructions to the MCC operator:

- A strip chart in the elog of Hall C current vs time would be greatly appreciated.
- Do each of the following currents, plateauing for ~1.5 minutes each. (If you get a trip, then 45 seconds is long enough. But if there's a trip too near the start of beam-on interval, then restart the 1.5 minute clock.)
- Approximate currents are fine. The Hall C Unser will determine the true beam current.
- The zeroes are as important as the beam-on periods. ~~*Close the slit for these.*~~

In units of muA:

45/20/10/5/5/45/20/10/5/5

0, "60", 0, ~~50~~ 45, 0, ~~43~~ 25, 0, 20, 0, 10, 0, 5, 0, 5

Then

0, "60", 0, ~~50~~ 45, 0, ~~43~~ 25, 0, 20, 0, 10, 0, 5, 0, 5, 0.

Let Hall C know when you're done. Thanks!

SJDK
13/7/22
45μA was highest current MCC could do

Set Spectrometer momentum as on Page 64.

HMS θ = 28.18°

3. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 7.65°$) run.

(a) Move the SHMS to 7.65 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 200 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)	6
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	−1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
0.9 kHz	10.6 kHz	48 kHz	25 kHz	18 kHz	17 Hz	0.44 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **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.

(f) **Take data for 19.3 hours (100% efficiency) at 80 μA to get about ~~53,000~~ 49.5K $p(e,e'\pi^+)n$ coincidences and 5558.4 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(g) Shift workers should keep a running total of coincidence events and charge delivered. These values are output at the end of the physics replay.

~100 kC/hr @ 40-50μA

02/07/22 So ~55 hrs here

58.0K

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 9.65^o$) run.

(a) Move the SHMS 9.65 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. ✓

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz. ✓
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 231 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	8
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	6
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ 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	10.6 kHz	8.3 kHz	4.6 kHz	4.2 kHz	3 Hz	0.44 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass. ✓

(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.** These runs do NOT need to be replayed. ✓

(e) **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.

(f) **Take data for 19.3 hours (at 100% efficiency) at 80 μA to get about ~~53,000~~ 42k p(e, e'π^+)n coincidences and 5558.4 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(g) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

6. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 9.65^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 3.9 hours (100% efficiency) at 40 μA.

Q^2=8.50, W=2.79, x=0.55, high ϵ data taking

Nominal Q^2=8.50 GeV$^2/c^2$, W=2.79 GeV, x=0.55 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	2.341	34.11	0.375	0.550	7.913	-8.67

1. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 8.67^o$) run.
   Set up the following configuration:
   (a) HMS angle = 34.11 (from TV).
   (b) HMS momentum = –2.341 GeV/c. Negative polarity.
   (c) SHMS angle = 8.67 deg (from TV).
   (d) SHMS momentum = 7.913 GeV/c. Positive polarity.
   (e) 10 cm LH2 target.
   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 198 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)	3
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
0.2 kHz	1.6 kHz	23 kHz	12 kHz	10 kHz	1 Hz	0.14 Hz

   (g) Update *standard.kinematics* with the new settings. Use proton as the target mass.
   (h) **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.** These runs do NOT need to be replayed.
   (i) **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.

(j) **Take data for 61.3 hours (at 100% efficiency) at 80 μA to get about 68,000 p(e, e$'\pi^+$)n coincidences and 17654.4 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(k) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 8.67^o$) run.

Now put in the "thick" 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 μA.

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

Take data for 12.3 hours (100% efficiency) at 40 μA.

charge goal is ~1771.2 mC on Dummy

1)

$Q^2 = 8.50$ PLAN

2207.29
GH

Currently (Run 5793) we have
17,447 mC + 9200 π^+ (after all cuts).

Desire 10k π^+ → Need $\frac{10k}{9.2k}(17,447) = 18,964$ mC

So about 1500 mC more.
→ corresponds to about 5hrs of efficient running
→ one of these should be an HMS-3/4 run.

DUMMY (p. 71).

Currently (Run 5763) we have
539 mC

Desire Q = 1771 mC
→ Need 1232 mC
- corresponds to about 6 hrs of running.

So likely ready to switch next kinematics at early DAY shift Saturday.

22.07.29
GH.

2) NEXT SETTINGS:

1) $Q^2 = 2.45$, $W = 3.20$, θ_{SHMS} 10.76°. (p.42).
LHz: 2-3 hr
Dummy: ~ ½ hr.

2) $\theta = 8.76°$. (p.44).
LHz: 2-3 hr. Check SHMS Rates!
Dummy: ~½ hr.

3) Then for this setting do FADC Dead Time (p.46)
Study, from Imax → 12 μA.
Should ~~take~~ ~12 hrs.

4). $\theta = 6.76°$. (p.47).
- This requires an expert observer but no access. [~Morning of July 31?].
- Will be RATE limited, watch SHMS rates! (3/4 600kHz)
Probably I ~ 30 μA.
LHz: ~ 3 hr
Dummy: ~½ hr

PLAN UNTIL PASS CHANGE

22.07.29

GH.

3)

5) $Q^2 = 3.87$, $W = 3.07$, both LH_2 + LD_2 ~~targets~~ (p. 49).

$\theta = 7.91°$ — LH_2 ~ 5hr; LD_2 (Watch rates!) ~ 6hr; Dummy ~ ½hr.

$\theta = 9.91°$ — LH_2 5-6hr. (p. 52); LD_2 5-6hr.; Dummy ~ ½hr.

$\theta = 11.91°$ — LH_2 5-6hr (p. 55).; LD_2 5-6hr; Dummy ~ ½hr.

→ Probably here by Aug 1 swing.

6) $Q^2 = 5.00$, $W = 2.95$ (setup on p. 58).

$\theta = 8.47°$ — LH_2 ~ 12hr. Check Rates (p. 62); Dummy ~ 1hr.

$\theta = 10.47°$ — LH_2 ~ 15hr (p. 60); Dummy ~ 1hr.

$\theta = 12.47°$ — LH_2 ~ 12hr (p. 58).; Dummy ~ 1hr.

→ Probably here by Aug 3 swing.

DO IF BEHIND SCHEDULE. ONLY WE'RE NOT

22.07.29

4)

GH

6) Then switch SHMS polarity to NEGATIVE and do:

$Q^2 = 3.85$, $W = 2.62$, LD- (p. 79).

$\theta = 12.28°$ LD2 Check RATES! ~2hr
Dummy ~20min

$\theta = 14.28°$ LD2 ~2hr (p. 81)
Dummy ~20min.

$\theta = 16.28°$ LD2 ~2hr (p. 83)
Dummy ~20min.

Maybe here by Aug 4 DAY ?
or as late as Aug 5 DAY

5) $Q^2 = 6.00$ $W = 2.40$ LD-

$\theta = 16.91°$ LD_2 ~3-4hr (p.85).
Dummy ~½hr.

$\theta = 14.91°$ LD_2 ~3-4hr (p.87).
Dummy ~½hr.

$\theta = 12.91°$ Probably skip. (p.89).
Really depends on the time.
Need to be DONE this setting by AUG 6 [redacted] Morning

6) Heap Singles [redacted] ~6-8hr. (p.77-78)
CaFe runs w/ Sieve. ~2-3hr. (p.72-76)

7) If there is time, do one LUMI run, (p.97).
or maybe go back to a Physics setting with low stats & take more data.
eg. $Q^2 = 6.00$, $W = 3.19$.

Need to be ready for pass change on Aug 8 morning

Q^2=2.45, W=3.20, x=0.21, high ϵ data taking

Nominal Q^2=2.45 GeV$^2/c^2$, W=3.20 GeV, x=0.21 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	4.256	13.41	0.679	0.048	6.265	-8.76

1. $p(e,e'\pi^+)n$ LH2 SHMS left ($\theta = 10.76^o$) run.

   Set up the following configuration:

   (a) HMS angle = 13.41 (from TV).

   (b) HMS momentum = -4.256 GeV/c. Negative polarity.

   (c) SHMS angle = 10.76 deg (from TV).

   (d) SHMS momentum = 6.265 GeV/c. Positive polarity.

   (e) 10 cm LH2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 460 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
38 kHz	70 kHz	45 kHz	19 kHz	20 kHz	268 Hz	21.7 Hz

   (g) Update *standard.kinematics* with the new settings.Use proton as the target mass.

   (h) **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.** These runs do NOT need to be replayed.

   (i) **Take data for 1 hour (at 100% efficiency) at 80 μA to get about ~~92,000~~ 35k $p(e,e'\pi^+)n$ coincidences and ~~288~~ 10 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

(j) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\mathrm{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 10.76^o$) run.

Now put in the "thick" 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 μA.

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

Take data for 0.2 hours (100% efficiency) at 40 μA.

Do Central Setting for Al dummy next
↳ Rotate to 8.76° on the SHMS
Then do LH2

SFDK
02/07/22

4

~~3.~~ $p(e,e'\pi^+)n$ LH2 SHMS center ($\theta = 8.76^o$) run.

(a) Move the SHMS to 8.76 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 1221 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)	10
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \text{p})$	Real coinc. $e^- \cdot \pi$
38 kHz	70 kHz	176 kHz	68 kHz	59 kHz	963 Hz	21.7 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed. 42K

(e) **Take data for 1 hour (100% efficiency) at 80 μA to get about ~~82,000~~ $p(e,e'\pi^+)n$ coincidences and ~~288~~ 130 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

3
4. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 8.76^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 targets).

Take data for 0.2 hours (100% efficiency) at 40 μA.

$p(e, e'\pi^+)X$ coincidences fADC deadtime study

Ensure the following configuration is unchanged:

(a) SHMS momentum = +6.265 GeV/c.

(b) SHMS angle = 8.76 deg (from TV).

(c) HMS momentum = -4.256 GeV/c.

(d) HMS angle = 13.41 deg (from TV).
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 × 2), and take coincidences at 65, 50, 30, 20, 12, 8 μA. Start at the highest current and take LH2 target data. Then go down in current and repeat. The goal is 50k prompt $p(e, e'\pi^+)X$ coincidences per setting.

10.5490 GeV $p(e, e'\pi^+)X$ fADC Deadtime Study

μA	Targets	$\frac{Rate_{SHMS}}{LHrun}$	$\frac{PS1}{SHMS}$	$\frac{Rate_{HMS}}{LHrun}$	$\frac{PS4}{HMS}$	DAQ_{SHMS}	DAQ_{HMS}	$\frac{Time}{run}$
$\theta_{SHMS} = 12.40$, $P_{HMS} = 3.738$ GeV/c, $\theta_{SHMS} = 12.30$, $P_{SHMS} = 3.260$ GeV/c								
65	LH2	303 kHz	13	114 kHz	10	1 kHz	1 kHz	0.25 hr
50	LH2	246 kHz	13	93 kHz	10	1 kHz	1 kHz	0.33 hr
40	LH2	189 kHz	13	71 kHz	9	1 kHz	1 kHz	0.3 hr
30	LH2	114 kHz	12	43 kHz	8	1 kHz	1 kHz	0.58 hr
20	LH2	76 kHz	11	28 kHz	8	1 kHz	1 kHz	0.83 hr
12	LH2	45 kHz	11	17 kHz	7	1 kHz	1 kHz	1.0 hr
8	LH2	30 kHz	10	11 kHz	7	1 kHz	1 kHz	1.0 hr
Total Time (at 100% efficiency): 6.3 hrs								

Watch SHMS 3/4 Scaler (pTrig 1) rate.
Keep below 600 kHz!

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS right ($\theta = 6.76°$) run.

   (a) Move the SHMS 6.76 deg (from TV). **Follow the specific small angle rotation instructions on the Wiki. The Run Co-ordinator will need to arrange in advance which expert personnel (e.g. Amy Comer, Steve Lassiter) need to monitor remotely.** Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

   (b) **Adjust the beam current to keep the SHMS-S1X rate comfortably below 1 MHz.** We project the current for this run to be about 40 μA.

   (c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 40 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 1050 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
19 kHz	35 kHz	326 kHz	113 kHz	76 kHz	818 Hz	11 Hz

   (d) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (e) **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.** These runs do NOT need to be replayed.

   (f) **Take data for 1 hour (at 100% efficiency) at 40 μA to get about ~~46,000~~ 25k $p(e,e'\pi^+)n$ coincidences and ~~144~~ 110 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

   (g) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

6. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 6.76^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 0.2 hours (100% efficiency) at 40 μA.

Q^2=3.85, W=3.07, x=0.31, high ϵ data taking

Nominal Q^2=3.85 GeV$^2/c^2$, W=3.07 GeV, x=0.31 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	3.944	17.49	0.632	0.120	6.538	-9.91

1. $p(e,e'\pi^+)n$ LH2 SHMS right ($\theta = 7.91^o$) run.

   Set up the following configuration:

   (a) HMS angle = 17.49 (from TV).

   (b) HMS momentum = -3.944 GeV/c. Negative polarity.

   (c) SHMS angle = 7.91 deg (from TV).

   (d) SHMS momentum = 6.538 GeV/c. Positive polarity.

   (e) 10 cm LH2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 520 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
10 kHz	16 kHz	229 kHz	90 kHz	69 kHz	318 Hz	5.4 Hz

   (g) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (h) **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.** These runs do NOT need to be replayed.

   (i) **Take data for 2.1 hours (at 100% efficiency) at 80 μA to get about ~~48,000~~ 41k p(e, e'π^+)n coincidences and ~~804.8~~ 535 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

3. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS right ($\theta = 7.91^o$) run.

Set up the following configuration:

(a) Now put in the 10 cm LD2 and leave the spectrometer settings unchanged.

(b) **Adjust the beam current to keep the SHMS-S1X rate comfortably below 1.5 MHz.** We project the current for this run to be about 60 μA.

(c) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 60 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 938 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	−1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
15 kHz	24 kHz	343 kHz	135 kHz	104 kHz	715 Hz	4.2 Hz

(d) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(e) **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.** These runs do NOT need to be replayed.

(f) **Take data for 2.7 hours (at 100% efficiency) at 60 μA to get about ~~46,000~~ 41K $d(e,e'\pi^+)nn_{sp}$ coincidences and ~~5832~~ 515 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(g) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

4. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS center ($\theta = 9.91^o$) run.

(a) Move the SHMS to 9.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 550 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)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
20 kHz	32 kHz	113 kHz	48 kHz	47 kHz	341 Hz	5.4 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2.1 hours (100% efficiency) at 80 μA to get about 48,000** $d(e,e'\pi^+)nn_{sp}$ **coincidences and 604.8 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

5. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 9.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.4 hours (100% efficiency) at 40 μA.

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

6. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 9.91°$) run.

(a) Now put in the 10 cm LH2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 294 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)	8
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
10 kHz	16 kHz	57 kHz	24 kHz	24 kHz	85 Hz	5.4 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2.1 hours (100% efficiency) at 80 μA to get about 48,000 $p(e,e'\pi^+)n$ coincidences and 604.8 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** ✓

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

7. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 11.91^o$) run.

(a) Move the SHMS 11.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 231 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	9
PS2(SHMS-ELREAL)	-1
PS3(HMS-3/4)	-1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
10 kHz	16 kHz	13.1 kHz	5.9 kHz	7.2 kHz	22 Hz	5.4 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2.1 hours (at 100% efficiency) at 80 μA to get about ~~48,000~~ 41k p(e, e'π^+)n coincidences and ~~604.8~~ 515 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

8. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 11.91^o$) run.

Now put in the "thick" dummy target (± 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 μA. .

DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2, LD2 targets).

Take data for 0.4 hours (100% efficiency) at 40 μA.

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

9. $\boxed{d(e,e'\pi^+)nn_{sp}}$ LD2 SHMS left ($\theta = 11.91^o$) run.

(a) Now put in the 10 cm LD2 and leave the spectrometer settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 296 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)	9
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
20 kHz	32 kHz	26.3 kHz	11.9 kHz	14.4 kHz	86 Hz	5.4 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 2.1 hours (at 100% efficiency) at 80 μA to get about ~~48,000~~ 41k $\mathrm{d(e,e'\pi^+)nn_{sp}}$ coincidences and ~~604.8~~ 515 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

Q^2=5.00, W=2.95, x=0.39, high ϵ data taking

Nominal Q^2=5.00 GeV$^2/c^2$, W=2.95 GeV, x=0.39 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	3.716	20.57	0.596	0.209	6.719	-10.47

1. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 12.47^o$) run.

   Set up the following configuration:

   (a) HMS angle = 20.57 (from TV).

   (b) HMS momentum = –3.716 GeV/c. Negative polarity.

   (c) SHMS angle = 12.47 deg (from TV).

   (d) SHMS momentum = 6.719 GeV/c. Positive polarity.

   (e) 10 cm LH2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 188 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	8
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
4.1 kHz	5.5 kHz	6.3 kHz	3.0 kHz	3.9 kHz	4 Hz	2.6 Hz

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   (g) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (h) **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.** These runs do NOT need to be replayed.

   (i) **Take data for 6.7 hours (at 100% efficiency) at 80 μA to get about ~~50,000~~ 1800 p(e, e'π^+)n coincidences and ~~1929.6 mC~~ charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** ok

(j) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\mathrm{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 12.47^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 1.3 hours (100% efficiency) at 40 μA.

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3. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 10.47^o$) run.

   (a) Move the SHMS to 10.47 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

   (b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 209 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)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	Real coinc. $e^- \cdot \pi$
4.1 kHz	5.5 kHz	29 kHz	13 kHz	14 kHz	18 Hz	2.6 Hz

   (c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

   (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.** These runs do NOT need to be replayed.

   (e) **Take data for 6.7 hours (100% efficiency) at 80 μA to get about 59,000 $p(e,e'\pi^+)n$ coincidences and 1929.6 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

   (f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

4. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 10.47^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LH2 targets).

Take data for 1.3 hours (100% efficiency) at 40 μA.

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS right ($\theta = 8.47^o$) run.

(a) Move the SHMS 8.47 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 260 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + \mathrm{p})$	Real coinc. $e^- \cdot \pi$
4.1 kHz	5.5 kHz	126 kHz	53 kHz	43 kHz	70 Hz	2.6 Hz

(c) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 6.7 hours (at 100% efficiency) at 80 μA to get about ~~50,000~~ 60k p(e, e'π^+)n coincidences and ~~1929.6~~ mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

6. $\boxed{\mathrm{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 8.47^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 1.3 hours (100% efficiency) at 40 μA.

Q^2=3.85, W=2.62, x=0.39, high ϵ data taking

Nominal Q^2=3.85 GeV$^2/c^2$, W=2.62 GeV, x=0.39 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	5.309	15.06	0.779	0.208	5.127	-14.28

1. $d(e,e'\pi^-)pp_{sp}$ LD2 SHMS right ($\theta = 12.28^o$) run.
   Set up the following configuration:

   (a) HMS angle = 15.06 (from TV).

   (b) HMS momentum = –5.309 GeV/c. Negative polarity.

   (c) SHMS angle = 12.28 deg (from TV).

   (d) SHMS momentum = –5.127 GeV/c. **Negative polarity. Cycle magnets.**

   (e) Now put in the 10 cm LD2.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 1033 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)	10
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
43 kHz	7.3 kHz	157 kHz	126 kHz	12 kHz	798 Hz	9.6 Hz

   (g) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

   (h) **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.** These runs do NOT need to be replayed.

   (i) **Take data for 1.5 hours (at 100% efficiency) at 80 μA to get about ~~61,000~~ 51k $d(e,e'\pi^-)pp_{sp}$ coincidences and ~~482~~ 367 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

(j) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\mathrm{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS right ($\theta = 12.28°$) run.

Now put in the "thick" 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 μA.

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

Take data for 0.3 hours (100% efficiency) at 40 μA.

3. $\boxed{d(e,e'\pi^-)pp_{sp}}$ LD2 SHMS center ($\theta = 14.28^o$) run.

(a) Move the SHMS to 14.28 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 518 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
43 kHz	7.5 kHz	72 kHz	40 kHz	4 kHz	314 Hz	9.6 Hz

(c) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 1.5 hours (100% efficiency) at 80 μA to get about 61,000 $d(e,e'\pi^-)nn_{sp}$ coincidences and 432 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

4. $\boxed{\text{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS center ($\theta = 14.28^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LD2 targets).

Take data for 0.3 hours (100% efficiency) at 40 μA.

This setting CANNOT be skipped. -6H Judge

5. $\boxed{d(e,e'\pi^-)pp_{sp}}$ LD2 SHMS left ($\theta = 16.28^o$) run.

   (a) Move the SHMS 16.28 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

   (b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 325 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)	10
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
43 kHz	7.5 kHz	32 kHz	12 kHz	6 kHz	136 Hz	9.6 Hz

   (c) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

   (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.** These runs do NOT need to be replayed.

   (e) **Take data for 1.5 hours (at 100% efficiency) at 80 μA to get about ~~61,000~~ 51K $d(e,e'\pi^-)pp_{sp}$ coincidences and ~~432~~ 561 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.** 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.

   (f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

6. $\boxed{\text{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS left ($\theta = 16.28^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 0.3 hours (100% efficiency) at 40 μA.

Q^2=6.00, W=2.40, x=0.55, high ϵ data taking

Nominal Q^2=6.00 GeV$^2/c^2$, W=2.40 GeV, x=0.55 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t\rvert$ (GeV/c)^2	p_π GeV/c	θ_q deg
10.549	4.752	19.92	0.711	0.531	5.512	-14.91

1. $d(e,e'\pi^-)pp_{sp}$ LD2 SHMS left ($\theta = 16.91^o$) run.

   Set up the following configuration:

   (a) HMS angle = 19.92 (from TV).

   (b) HMS momentum = –4.752 GeV/c. Negative polarity.

   (c) SHMS angle = 16.91 deg (from TV).

   (d) SHMS momentum = –5.512 GeV/c. Negative polarity.

   (e) 10 cm LD2 target.

   (f) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
   For **80 μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 208 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	9
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
6.4 kHz	0.5 kHz	21 kHz	3.6 kHz	0.3 kHz	10 Hz	3.6 Hz

   (g) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

   (h) **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.** These runs do NOT need to be replayed.

   (i) **Take data for 5 hours (at 100% efficiency) at 80 μA to get about ~~75,500~~ 25k ~~1440~~ 484 d(e, e'π^-)pp$_{sp}$ coincidences and ~~1440~~ mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(j) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

2. $\boxed{\text{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS left ($\theta = 16.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 1.0 hours (100% efficiency) at 40 μA.

8/7/22

Let RC
Know when you
get here (so I can
give Coffee folks heads
up) -> finish 16.9°
-Dave

3. $\boxed{d(e,e'\pi^-)pp_{sp}}$ LD2 SHMS center ($\theta = 14.91^o$) run.

(a) Move the SHMS to 14.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For **80μA beam** and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and a 260 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)	7
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	-1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
6.4 kHz	0.5 kHz	53 kHz	13.7 kHz	1.3 kHz	26 Hz	3.6 Hz

(c) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 5 hours (100% efficiency) at 80 μA to get about ~~75,000~~ 30K $d(e,e'\pi^-)nn_{sp}$ coincidences and ~~1440~~ 576 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

4. $\boxed{\text{Al}(e,e'\pi^-)X}$ Thick Dummy target SHMS center ($\theta = 14.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.
DO NOT modify *standard.kinematics* for this run (i.e. keep as for LD2 targets).

Take data for 1.0 hours (100% efficiency) at 40 μA.

Kinematic shipped SJDK 02/07/22

5. $\boxed{d(e,e'\pi^-)pp_{sp}}$ LD2 SHMS right ($\theta = 12.91^o$) run.

(a) Move the SHMS 12.91 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged.

(b) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL) target rates to 100 Hz.
For 80 μA beam and the projected rates listed below, these prescale factors should give 100 Hz HMS and SHMS singles event rates to disk, and an 259 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×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

HMS e^- rate	HMS π^- rate	SHMS e^- rate	SHMS π^- rate	SHMS $K-$ rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (e^- + \pi^- + K^-)$	Real coinc. $e^- \cdot \pi$
6.4 kHz	0.5 kHz	126 kHz	49 kHz	5 kHz	70 Hz	3.6 Hz

(c) Update *standard.kinematics* with the new settings. Use neutron as the target mass.

(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.** These runs do NOT need to be replayed.

(e) **Take data for 5 hours (at 100% efficiency) at 80 μA to get about ~~75,500~~ 25K $d(e,e'\pi^-)pp_{sp}$ coincidences and ~~1440~~ 490 mC charge delivered.** Use the physics replay to keep track of the event total. **LH2 and LD2 replays have different cuts enabled. Make sure the correct target is inputted into the physics replay.**

(f) Shift workers should keep a running total of coincidence events and charge delivered. These values are outputted at the end of the physics replay.

6. $\boxed{\text{Al}(e, e'\pi^-)X}$ Thick Dummy target SHMS right ($\theta = 12.91^o$) run.

Now put in the "thick" dummy target (± 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 μA.

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

Take data for 1.0 hours (100% efficiency) at 40 μA.

Kinematic Shimmed
02/07/22 SJDK

Calibration runs with SHMS at negative polarity (Part 1)

CaFe 2022 SHMS Optics Calibrations

This part of the CaFe experiment run plan will be taken during the PionLT run period before the accelerator pass chage on July 08, 2022. Settings for the HMS arm are for PionLT optics. **The estimated time to complete this part of the run plan is approximately 1 shift.**

A. Carbon Foil ±8 Optics at SHMS nominal setting

SHMS polarity change. Set up the following configuration:

(a) HMS angle = 12.50 (from TV).

(b) HMS momentum = –5.878 GeV/c. Negative polarity. Cycle magnets.

(c) SHMS angle = 8.30 deg (from TV).

(d) SHMS momentum = –8.55 GeV/c. **Negative polarity. Cycle magnets.**

(e) Insert the Optical ±8 Carbon target.

(f) Prescale GUI Settings:

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

(g) Insert HMS sieve and SHMS sieve collimators.

(h) Stable 50 μA beam with 2 × 2 raster on.

Current Limit = 50 μA.

(i) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(j) **Jacob Murphy should be present for this run to determine the event rate from the first 50k events.** The statistics goal is 200 electron events per sieve hole.

Estimated Running Time: 0.5 hours at 100% efficiency.

Single Carbon Foil Optics at SHMS nominal setting

Set up the following configuration:

(a) Insert the Carbon 0.5% target. Keep spectrometer settings unchanged.

(b) Prescale GUI settings:

PS1(SHMS-3/4)	–1
PS2(SHMS-ELREAL)	3
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL×SHMS-3/4)	–1
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

(c) HMS sieve and SHMS sieve collimators.

(d) Stable 80 μA beam with 2×2 raster on.
Current Limit = 80 μA.

(e) Do not update *standard.kinematics* as the setting is unchanged.

(f) **Jacob Murphy should be present for this run to determine the event rate from the first 50k events.** The statistics goal is 200 electron events per sieve hole.

Estimated Running Time: 0.5 hours at 100% efficiency.

3. Single Carbon Foil Optics for SHMS at large δ

Set up the following configuration:

(a) HMS angle = 12.50 (from TV).

(b) HMS momentum = –5.587 GeV/c. Negative polarity.

(c) SHMS angle = 6.80 deg (from TV). Expert needed -

(d) SHMS momentum = –8.55 GeV/c. **Negative polarity.**

(e) Insert the Carbon 0.5% target.

(f) Prescale GUI Settings:

Projected prescale GUI settings:	
PS1(SHMS-3/4)	–1
PS2(SHMS-ELREAL)	5
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL×SHMS-3/4)	–1
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

(g) Insert HMS sieve and SHMS sieve collimators.

(h) Stable 80 μA beam with 2×2 raster on.

Current Limit = 80 μA.

(i) Update *standard.kinematics* with the new settings. Use proton as the target mass.

(j) **Jacob Murphy should be present for this run to determine the event rate from the first 50k events.** The statistics goal is 200 electron events per sieve hole.

Estimated Running Time: 0.5 hours at 100% efficiency.

4. Carbon Foil ±8 Optics for SHMS at large δ

Set up the following configuration:

(a) Insert Optical ±8 Carbon target. Keep spectrometer settings unchanged.

(b) Prescale GUI settings:

PS1(SHMS-3/4)	–1
PS2(SHMS-ELREAL)	5
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	0
PS5(HMS-ELREAL×SHMS-3/4)	–1
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

(c) HMS sieve and SHMS sieve collimators.

(d) Stable 50 μA beam with 2×2 raster on.
Current Limit = 50 μA.

(e) Do not update *standard.kinematics* as the setting is unchanged.

(f) **Jacob Murphy should be present for this run to determine the event rate from the first 50k events.** The statistics goal is 200 electron events per sieve hole.

Estimated Running Time: 0.5 hours at 100% efficiency.

5. H(e,e')p Elastics SHMS Delta Scan

Set up the following configuration:

(a) **HMS should not be used for this section.** Use the time from this delta scan to set the HMS for the HeeP-check singles and, in particular, allow the HMS Dipole to settle and NMR to lock.

i. HMS angle = 16.05 (from TV).

ii. HMS momentum = –6.792 GeV/c. Negative polarity.

(b) SHMS momentum unchanged. See table for SHMS angle.

(c) Record all TV angle values on the run sheets and hclog.
Update *standard.kinematics* with each new setting. Use proton as the target mass.

(d) 10 cm LH2 and "thick" dummy target data should be taken with the HMS large and SHMS collimators.

(e) Stable 60 μA beam with 2×2 raster on. Contact Carlos Yero if prescaling is required due to high rates.

(f) The goal is about 1.5 million good H(e,e')p elastics singles events. Shift workers should use the HeeP singles physics replay to keep track of the event total.

CaFe H(e,e')p Elastics SHMS Delta Scan

θ_{SHMS}	P_{SHMS}	$Rate_{SHMS}$	$\frac{PS2}{SHMS}$	$\frac{Time}{LH2run}$	$\frac{Time}{ALrun}$	Good Elastic Events
6.80	-8.55	2.75 kHz	0	20 min	6 min	1500k
7.50	-8.55	1.51 kHz	0	15 min	6 min	1500k
8.30	-8.55	0.82 kHz	0	30 min	6 min	1500k
Total Time (including overhead): 2.8 hrs						

6. H(e,e')p Elastics SHMS Hodo HV Test

Set up the following configuration:

(a) Keep spectrometer and prescale settings unchanged from the previous setting (last in table).

(b) Insert the 10 cm LH2 target.

(c) **Turn OFF** SHMS Hodoscope High Voltage for planes S1X[1-6] and S2X[1-6].

(d) **Take data for 0.5 hours (at 100% efficiency) at 60 μA to get about 1.5 million good H(e,e')p elastic singles events.** Estimation is 818 Hz for elastic rates at 60 μA. Use the HeeP singles physics replay to keep track of the event total.

(e) **Turn ON** SHMS Hodoscope High Voltage for planes S1X[1-6] and S2X[1-6] after data taking is complete for this setting.

p(e,e')p Hydrogen elastic singles

Set up the following configuration:

1. HMS and SHMS angles and momenta as specified in the tables below. Both spectrometers are negative polarity
2. Record all TV angle values on run sheets and hclog. Update *standard.kinematics* with the new settings.
3. 10 cm LH2 and "thick" dummy target data should be taken with the HMS large and SHMS collimators.

LH2 target runs:
Stable 80 μA beam with 2×2 **raster on.** Set the PS2(SHMS-ELREAL) and PS4(HMS-ELREAL) target rates to 1000 Hz, all others disabled (i.e. -1). As a guide, projected rates and PS factors are given in the table below. We want at least 10,000 elastics, which typically requires at least 500,000 total electron events (times below are only a guide). The total event estimate in right-most column includes inelastics.

Thick Dummy target runs:
One run for each angle and momentum setting, taken immediately after the corresponding LH2 run. Current limit: 40 μA.

Noble Gas Cerenkov Check:
During the HeeP singles runs, an expert should ensure the noble gas Cerenkov npe Sum looks reasonable. **It is important this is examined before physics data collection begins at negative polarity following the completion of the HeeP Singles.**

HeeP Singles Analysis:
For the rates listed below, **the HMS delta cuts were widened to $-10\% < \delta < +10\%$** from the original $\pm 8\%$. The analysis scripts for these runs should be adjusted for this to ensure accurate estimates of counts. If the delta cuts are unchanged, then the 1^{st} and $5^{th} - 6^{th}$ settings will have significantly reduced HMS events, as they extend to the outer momentum acceptance of the HMS. **Make sure to restore HMS delta cuts back to original values after completing the HeeP singles.**

Delta Scans:
The HeeP singles settings include SHMS and HMS delta scans at fixed momenta of -8.035 and -6.792 GeV/c, respectively. **It is crucial that the HMS dipole NMR be stable and locked for the delta scan at -6.792 GeV/c.** Shift workers should keep a live plot of the NMR reading open in the magnet GUI. **Shift leads should take screenshots of the strip chart.** Contact Jacob Murphy with any questions.

Updated on 22/08/04
by Jacob Murphy

HMS Optical Matrix:

At the start of the HeeP singles settings, the HMS optical matrix should be switched from the standard to the 6.6 GeV version. ~~at the tenth setting, when the HMS is lowered to -5.878 GeV/c,~~ the HMS optical matrix should be switched back to the standard version. For instructions on this process, see the analysis instructions on the wiki or printed out in the run plan binder. Contact Jacob Murphy with any questions.

Single Arm Runs:

The last HeeP singles setting is divided into 2 runs. The second run is without the SHMS trigger being saved. **Make sure the prescales are updated correctly for these runs. Only the HMS events should be saved**

10.5490 GeV Heep-check singles runs

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$\frac{PS4}{HMS}$	$Rate_{SHMS}$	$\frac{PS2}{SHMS}$	$\frac{Time}{LH2run}$	$\frac{Time}{ALrun}$	$Events_{SHMS}$
				✓ * **Widen HMS delta cuts** to ±10%.						
				✓ * **Switch to HMS 6.6 GeV/c Optical Matrix**						
15.7 (-6.05 2nd time)	-6.792	12.245	-8.035	4.4 kHz	10	29.3 kHz	6/4	12 min	6 min	634k 20uA
				* Check the Noble Gas Cerenkov npe Sum						
17.735	-6.792	13.135	-8.035	0.57 kHz	0	14.8 kHz	5	24 min	6 min	1247k 60uA
19.87	-6.792	14.015	-8.035	0.04 kHz	0	3.23 kHz	2	15 min	6 min	1276k 75uA
19.87	-6.792	14.895	-8.035	0.04 kHz	0	1.36 kHz	0	15 min	6 min	964k 75uA
19.87	-6.792	15.785	-8.035	0.04 kHz	0	1.36 kHz	0	15 min	6 min	810k 70uA
				* Watch prescale GUI for single-arm runs						
19.87	-6.792	13.58	-7.913	0.04 kHz	0	0.25 kHz	0	10 min	6 min	64k 70uA
~~19.87~~	~~-6.792~~	~~13.58~~	~~-7.913~~	~~0.04 kHz~~	~~0~~	~~0 kHz~~	~~-1~~	~~20 min~~	~~0 min~~	~~0k~~
				* **Switch Back to HMS Standard Optical Matrix**						
				* **Narrow HMS delta cuts** to ±8%.						
				Total Time (including overhead): 6.6 hrs						

Setting #7 (New!)

θ_{HMS} P_{HMS}

16.05 -6.792

θ_{SHMS} P_{SHMS}

12.69 -8.035

70uA PS2 6

PS4 2

This seems very wrong

~~Do more of~~ Heep #1 and #2

Jacob used the wrong gradient to determine these settings

```
            1.00794
          37.33
          7.69
entr      0.893
ent       = 4.034
          = 0.000511
          s = 0.938272
          ty_freq = 120.0007547169
          F_Offset = 0
          _RF_Offset = -1.990
          dCoinTime_Offset = 44.089

# An example new block of information where the beam energy changed
8981 - 99999
gpbeam = 6.55
gtargmass_amu = 1.00794
htheta_lab = -37.33
otheta_lab = 7.69
hpcentral = 0.893
opcentral = 4.034
opartmass = 0.000511
hpartmass = 0.938272
helicity_freq = 120.0007547169
HMS_RF_Offset = 0
SHMS_RF_Offset = -1.990
eHadCoinTime_Offset = 44.089
```

After 50,000 events have been taken

- We run two scripts to check the detectors.
- Type *./run_coin_shms.sh* to automatically replay the most recent run and launch the online replay GUI.
- Type *./run_coin_hms.sh* to repeat the process for HMS detectors.
- For reference, all histos are saved in the HISTOGRAMS/Analysis/50k subdirectory. A copy of the scaler report is in REPORT_OUTPUT/Analysis/50k.
- Compare with the histograms in the *golden run binder*, make an elog entry if you notice any major differences
    - You should also make a log entry if you notice any consistent trends on the plots over your shift

Adjusting the HMS Optical Matrix

- For this run period, the HMS will be used at very high central momentum, well beyond the saturation point for most of the spectrometer's magents
- When running at 6.803 GeV/c central momentum in the HMS, shift workers should set the replays to point to a different optical matrix
    - From hallc_replay_lt, open the param file PARAM/HMS/GEN/hcana.param
    - Use ";" to comment out the line "h_recon_coeff_filename = 'DATFILES/hms_recon_coeff_opt2018.dat'"
    - Remove the ";" on the line "h_recon_coeff_filename = 'DATFILES/hms_newfit_6_59.dat'", or add this line in if not present
    - Ensure that the new optical matrix file is in the correct place at DATFILES/hms_newfit_6.59.dat
        - If the file is not present, contact Jacob Murphy at jmurphy@jlab.org
- When data completion at 6.59 GeV/c central HMS momentum, reverse these changes to ensure the standard optical matrix (hms_recon_coeff_opt2018.dat) is used for the rest of the run period

After the run is over

- Once the run ends you need to execute an analysis script.
- The script is - **run_pionLT.sh** located in /home/cdaq/hallc_online/hallc_replay_lt (you should be in this folder already)
- This script **requires** three arguments -
    - Run number - This **must** be a positive integer, specify the run you want to analyse
    - Run type - You must enter **one** of - Prod - Lumi - HeePSing -HeePCoin - Optics , the argument is case sensitive
    - Target You must enter **one** of - LH2 - LD2 - Dummy10cm - Carbon0p5 - Optics1 - Optics2 - CarbonHole , again, the argument is case sensitive
- The script will prompt you to re-enter the arguments if anything is not correct, **hit ctrl+c at any time to exit the script**
- Specify the run type and target as dictated by the run plan
- Depending upon the run type specified, the script will call the relevant analysis script, details on the individual scripts are provided in a separate section
    - run_pionLT.sh will print to screen the path of the script it is trying to execute
    - Generally, all of the scripts called will execute a replay, and then some subsequent analysis scripts
    - Once they complete, the script will fill the run list with relevant info, follow the onscreen prompts

SKIP THE REST.

Calibration runs with SHMS at negative polarity (Part 2)

1. Luminosity scan 1 on $z = 0$ Carbon target.

   (a) Set the HMS momentum to -5.270 GeV/c, and the SHMS momentum to -5.470 GeV/c, both negative polarity.

   (b) Rotate the HMS to 12.50 degrees, and the SHMS to 9.00 degrees. Record the TV camera angles on the runsheet to 0.005 degree accuracy.

   (c) **IMPORTANT:** For these runs we would like to take single arm scans with only on ELREAL trigger saved at a time. This means taking a one run with the prescale of -1 in one arm with 1kHz daq rate in the other.

   (d) ELREAL trigger in both arms. Set the PS2, PS4 target DAQ rates to 1 kHz, to give a total rate to disk of about 2 kHz.

   (e) Make sure the raster is on (2 × 2), and take HMS and SHMS runs at 80, 60, 40, 20, 15, 8 μA on Carbon target. Start at the highest current, then go down in current.

   (f) **Try to get runs with a minimum of beam trips (if possible).**

   (g) An expert (Jacob) should do a sanity-check of the EDTM (and any other hardware deadtime measurement system) by comparing runs over a range of detector rates but with low software deadtimes.

10.5490 GeV Luminosity Scans #1 Carbon								
μA	Targets	$\frac{Rate_{SHMS}}{LHrun}$	$\frac{PS2}{SHMS}$	$\frac{Rate_{HMS}}{LHrun}$	$\frac{PS4}{HMS}$	DAQ_{SHMS}	DAQ_{HMS}	$\frac{Time}{run}$
θ_{HMS} = 13.00, P_{HMS}=-5.270 GeV/c, θ_{SHMS} = 10.00, P_{SHMS}=-5.470 GeV/c								
80	C	613 kHz	13	85 kHz	7	1 kHz	1 kHz	10 min
80	C	0 kHz	-1	85 kHz	6	0 kHz	2 kHz	10 min
80	C	613 kHz	12	0 kHz	-1	2 kHz	0 kHz	10 min
60	C	460 kHz	12	64 kHz	6	1 kHz	1 kHz	10 min
60	C	0 kHz	-1	64 kHz	5	0 kHz	2 kHz	10 min
60	C	460 kHz	11	0 kHz	-1	2 kHz	0 kHz	10 min
40	C	306 kHz	12	42 kHz	6	1 kHz	1 kHz	10 min
40	C	0 kHz	-1	42 kHz	5	0 kHz	2 kHz	10 min
40	C	306 kHz	11	0 kHz	-1	2 kHz	0 kHz	10 min
25	C	192 kHz	11	27 kHz	5	1 kHz	1 kHz	10 min
25	C	0 kHz	-1	27 kHz	4	0 kHz	2 kHz	10 min
25	C	192 kHz	10	0 kHz	-1	2 kHz	0 kHz	10 min
15	C	115 kHz	9	16 kHz	4	1 kHz	1 kHz	10 min
15	C	0 kHz	-1	16 kHz	3	0 kHz	2 kHz	10 min
15	C	115 kHz	8	0 kHz	-1	2 kHz	0 kHz	10 min
8	C	61 kHz	9	8 kHz	3	1 kHz	1 kHz	10 min
8	C	0 kHz	-1	8 kHz	2	0 kHz	2 kHz	10 min
8	C	61 kHz	8	0 kHz	-1	2 kHz	0 kHz	10 min
Total Time (including overhead): 6.6 hrs								

2. Luminosity scan #1 on LH2 target.

   (a) Leave the spectrometer settings unchanged.

   (b) Put in LH2 Target.

   (c) **IMPORTANT:** For these runs we would like to take single arm scans with only on ELREAL trigger saved at a time. This means taking a one run with the prescale of -1 in one arm with 1kHz daq rate in the other.

   (d) Make sure the raster is on (2 × 2), and take HMS and SHMS runs at 80, 60, 40, 20, 15, 8 μA on LH2 target. Start at the highest current, then go down in current.

   (e) **Try to get runs with a minimum of beam trips (if possible).**

   (f) Take one Thick Dummy target run at 40 μA. 125,000 electrons per run, about 0.3 hour. During this run, the Target Operator should park the LH2 target and prepare for LD2 data taking.

   (g) An expert (Jacob) should do a sanity-check of the EDTM (and any other hardware deadtime measurement system) by comparing runs over a range of detector rates but with low software deadtimes.

10.5490 GeV Luminosity Scans #1 LH2								
μA	Targets	$\frac{Rate_{SHMS}}{LHrun}$	$\frac{PS2}{SHMS}$	$\frac{Rate_{HMS}}{LHrun}$	$\frac{PS4}{HMS}$	DAQ_{SHMS}	DAQ_{HMS}	$\frac{Time}{run}$
θ_{HMS} = 13.00, P_{HMS}=-5.270 GeV/c, θ_{SHMS} = 10.00, P_{SHMS}=-5.470 GeV/c								
80	LH2	0 kHz	-1	85 kHz	6	0 kHz	2 kHz	10 min
80	LH2	613 kHz	12	0 kHz	-1	2 kHz	0 kHz	10 min
60	LH2	0 kHz	-1	64 kHz	5	0 kHz	2 kHz	10 min
60	LH2	460 kHz	11	0 kHz	-1	2 kHz	0 kHz	10 min
40	LH2	0 kHz	-1	42 kHz	5	0 kHz	2 kHz	10 min
40	LH2	306 kHz	11	0 kHz	-1	2 kHz	0 kHz	10 min
25	LH2	0 kHz	-1	27 kHz	4	0 kHz	2 kHz	10 min
25	LH2	192 kHz	10	0 kHz	-1	2 kHz	0 kHz	10 min
15	LH2	0 kHz	-1	16 kHz	3	0 kHz	2 kHz	10 min
15	LH2	115 kHz	8	0 kHz	-1	2 kHz	0 kHz	10 min
8	LH2	0 kHz	-1	8 kHz	2	0 kHz	2 kHz	10 min
8	LH2	61 kHz	8	0 kHz	-1	2 kHz	0 kHz	10 min
40	Dummy	306 kHz	12	42 kHz	6	1 kHz	1 kHz	18 min
Total Time (including overhead): 5.1 hrs								

.ninosity scan #1 on LD2.

(a) Leave magnet settings unchanged.

(b) Rotate the HMS to 13.00 degrees, and the SHMS to 10.00 degrees. Record the TV camera angles on the runsheet to 0.005 degree accuracy.

(c) Put in LD2 Target.

(d) ELREAL trigger in both arms. Set the PS2, PS4 target DAQ rates to 1 kHz, to give a total rate to disk of about 2 kHz.

(e) Make sure the raster is on (2 × 2), and take HMS and SHMS runs at 80, 60, 40, 20, 15, 8 μA on LD2 target. Start at the highest current, then go down in current and repeat.

(f) **Try to get runs with a minimum of beam trips (if possible).**

(g) An expert (Jacob) should do a sanity-check of the EDTM (and any other hardware deadtime measurement system) by comparing runs over a range of detector rates but with low software deadtimes.

10.5490 GeV Luminosity Scans #1 LD2								
μA	Targets	$\frac{Rate_{SHMS}}{LDrun}$	$\frac{PS2}{SHMS}$	$\frac{Rate_{HMS}}{LDrun}$	$\frac{PS4}{HMS}$	DAQ_{SHMS}	DAQ_{HMS}	$\frac{Time}{run}$
θ_{HMS} = 13.00, P_{HMS}=-5.270 GeV/c, θ_{SHMS} = 10.00, P_{SHMS}=-5.470 GeV/c								
80	LD2	747 kHz	15	134 kHz	8	1 kHz	1 kHz	10 min
60	LD2	560 kHz	14	100 kHz	7	1 kHz	1 kHz	10 min
40	LD2	374 kHz	14	67 kHz	7	1 kHz	1 kHz	10 min
25	LD2	233 kHz	13	41 kHz	6	1 kHz	1 kHz	10 min
15	LD2	140 kHz	12	25 kHz	5	1 kHz	1 kHz	10 min
8	LD2	74 kHz	11	13 kHz	4	1 kHz	1 kHz	10 min
Total Time (including overhead): 2.3 hrs								

4. Luminosity scan #2 on LD2, LH2, and $z = 0$ Carbon targets.

   (a) If things go well, we could to do a second set of luminosity scans. In Fpi-2, this proved helpful in disentangling rate and current effects in the π^- analysis. In this scan, the rates are roughly half of the first scan, at the same current.

   (b) Move the HMS to 13.00 deg, and the SHMS to 12.00 deg (on TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision. Leave the spectrometer magnet settings unchanged. Leave the spectrometer magnet settings unchanged.

   (c) ELREAL trigger in both arms. Set the PS2, PS4 target DAQ rates to 1 kHz, to give a total rate to disk of about 2 kHz.

   (d) Make sure the raster is on (2×2), and take HMS and SHMS runs at 80, 60, 40, 25, 15, 8 μA on LD2 target. Start at the highest current, then go down in current and repeat.

   (e) **Try to get runs with a minimum of beam trips (if possible).**

   (f) Take one Thick Dummy target run at 40 μA. 125,000 electrons per run, about 0.3 hour. During this run, the Target Operator should park the LD2 target and prepare for LH2 data taking.

   (g) Repeat the scans with Carbon 0.5% r.l. and LH2 targets at 80, 60, 40, 25, 15, 8 μA. **Carbon 0.5% Current Limit = 80 μA.**

10.5490 GeV Luminosity Scans #2								
μA	Targets	$\frac{Rate_{SHMS}}{LHrun}$	$\frac{PS2}{SHMS}$	$\frac{Rate_{HMS}}{LHrun}$	$\frac{PS4}{HMS}$	DAQ_{SHMS}	DAQ_{HMS}	$\frac{Time}{run}$
$\theta_{HMS} = 13.00$, P_{HMS}=-5.270 GeV/c, $\theta_{SHMS} = 10.00$, P_{SHMS}=-5.470 GeV/c								
80	LH2, C, LD2	142 kHz	11	23 kHz	5	1 kHz	1 kHz	10 min
60	LH2, C, LD2	113 kHz	10	17 kHz	5	1 kHz	1 kHz	10 min
40	LH2, Dummy, C, LD2	75 kHz	10	11 kHz	4	1 kHz	1 kHz	10 min
25	LH2, C, LD2	47 kHz	9	7 kHz	3	1 kHz	1 kHz	10 min
15	LH2, C, LD2	28 kHz	8	4 kHz	2	1 kHz	1 kHz	10 min
8	LH2, C, LD2	15 kHz	8	2 kHz	1	1 kHz	1 kHz	10 min
Total Time (including overhead): 7.4 hrs								

To be determined in consultation with the RC: If we are waiting for the linac gradient change, go back to the $(e, e'\pi^{\pm})$ setting with the lowest statistics and take more data, or do one of the deferred calibration studies.