JEFFERSON LAB ELECTRONIC LOGBOOK

Saturday update - GH.

<<Prev Index Next>>

Approximate time plan through to next pass change

Lognumber 4027584. Submitted by huberg on Thu, 08/11/2022 - 14:43.

Logbooks: HCLOG

Below is my updated time projection for the next settings through to the change to 3-pass next Tuesday. As usual, it depends entirely on linac and hall performance, storms, etc.

Thu swing, Fri owl - resume Q2=3.85 data taking
Fri day - energy measurement, continue Q2=3.85
~~Fri swing~~ - finish Q2=3.85 → now Sun owl, around 04:00
Sat owl - go back to Q2=2.45-Left and take more data → Sun owl
Sat day - Heep Coin → Sunday day + swing
Sat swing - SHMS polarity change to negative → Sunday swing
Sat swing - Heep singles → Monday owl.
Sun owl - continue Heep singles

Probably we will have time for both sets of Lumi scans on Sunday through Monday owl. This means we would not need to do any at 6.4GeV, giving us some needed buffer to the planned end on Sept 9.

Mon day - access for aerogel change
Mon swing - Q2=2.12
Tue owl - continue Q2=2.12, including the FADC DT scan
Tue day - change to 3-pass

Try to do some of this after Q2=2.12 runs. But can guarantee we can't do everything!

Looking further ahead (for Stephen):
- The second aerogel change would then be on Wednesday. I understand that Vladimir won't be available until noon that day, so that gives a bit of buffer assuming the start up after pass change is slow.
- Another access to rotate the SHMS to 5.50deg could occur on Aug 21 day (a Sunday). If we are behind schedule by that point (likely), this would be actually on Monday.

Subject: Update on runplan 8.5 GeV
From: Muhammad Junaid <junaid7.net@gmail.com>
Date: 07/08/2022, 14.40
To: Garth Huber <huberg@uregina.ca>, Dave Gaskell <gaskelld@jlab.org>

Hi,
As the pass change will be on Tuesday then the possibility ofÂ changing the aerogelÂ tray will be on August 12 (Day - shift) if everythingÂ goes smooth.Â

Time period for settings (50% efficiency and beam current 80uA)

HEEP Single Settings: 8.1 hours
HEEP Coin Settings: 9.07 hours
Q2 = 2.45 (theta_shms = 8.93 & 6.93): 8.2 hours (Angle change requires expert)
Q2 = 2.45 & 3.85 (theta_shms = 5.50): 16.5 +/- 2 hours (Angle change requires hall access)
Q2 = 3.85 (theta_shms = 7.47 & 9.47): 20.6 +/- 1 hours
Q2 = 2.12 Physics Setting: 7.3 hours (doing on aerogel tray n=1.015)
fADC Study at Q2 = 2.12: 3.33 hours
Lumi scan # 1: 12.6 hours
Lumi scan #2: 11.5 hours
Aerogel change from n=1.011 to n=1.015: 6 hours
August 11 will be maintenance day. (Day - shift)

Â

Plan

1---Assuming, we will get CW beamÂ around 12pm during the dayÂ shift on August 9th, 2022Â (expected). Then we will quickly do the beam checkouts (at positive polarity).
Â
3----Â HEEP coin settings will take 9.07 hours and it will almost cover Aug 09 swing shift.
(If we get beam late due to RF recovery or some other issue, Move HEEP coins settings after step 6 as shown in Plan B otherwise we will follow Plan A)
Â
2------Then we will move to Q2=2.45Â physics settingÂ and start taking dataÂ atÂ theta_shms=8.93Â andÂ shms_theta=6.93Â (RC needs to talk with Steve Lassiter so that he can keep an eye during SHMS rotation).
It will take around 8.2 +/-1Â hoursÂ andÂ cover AugÂ 10-Â owl shift.
Â
4------Â ThenÂ during theÂ day shift (AugustÂ 10), we will move the theta_shms= 5.50deg with hall accessÂ and RC needs to talk with Steve Lassiter in advance.
Â Then weÂ willÂ start taking data Q2=2.45Â physics dataÂ and itÂ willÂ take almost 4.1Â +/- 2 hours.Â (Expected time for angle change will be between 08:00 am to 10:00 pm).
It will cover almost the Aug 10 day shift.
Â
5------Then we will continue taking data for Q2=3.85 at theta_shms =5.50deg, theta_shms=7.47deg and theta_shms=9.47deg.
This will take almost 32.04 +/-1Â hours.
It will cover AugÂ 10Â â€“Â Swing shift and AugÂ 11- owlÂ shift
But August 11 is maintenance day (as mentioned on MCC whiteboard).
So, this setting will cover Aug swing and Aug 12 owl shift.
Â

6------ThenÂ at the start ofÂ the August 12Â - Day shift, we will change the aerogel tray.
(Expected time for aerogel change will be between 08:00 am to 02:00 pm)
After that we willÂ start taking physicsÂ data at Q2= 2.12Â physics settingÂ which will take 7.3 hoursÂ andÂ fADCÂ data at Q2=2.12Â will take 3.33 hours.Â It will cover Aug 12 - day and swing shifts.
Â
Here we have to do the polarity change.
7-------we will move towardsÂ HEEP singles. ItÂ will take almostÂ 8.1Â hours. (It will cover almost AugÂ 13Â â€“Â owlÂ shift.
Â
8------After that, we will move toward theÂ Lumi settingsÂ

--
Best Regards
Muhammad Junaid
Ph.D. ResearchÂ Scholar
Experimental Nuclear-Particle Physics Group
Department of Physics
UniversityÂ of Regina, Canada.

Pion-LT Run Plan - Part 2

August 8, 2022

8.487 GeV Beam Plan

Initial beam activities

- While waiting for beam, configure the spectrometers for beam checkout:

  1. **Change HMS and SHMS polarity.** Carefully follow the magnet cycling procedure.
  2. SHMS angle = ~~12.00~~ 6.93 deg (from TV).
  3. SHMS momentum = ~~+2.688~~ +6.265 GeV/c (positive polarity and magnets cycled).
  4. HMS angle = ~~14.55~~ 20.90 deg (from TV).
  5. HMS momentum = ~~-6.579~~ -2.193 GeV/c (negative polarity and magnets cycled).
  6. Update *standard.kinematics* with the new settings (Reminder: all momenta should be entered as positive quantities).
  7. z= 0 0.5% r.l. carbon target
     Current Limit = 80μA
  8. Prescale GUI settings:

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

- Beam checkout.
  Follow the notes at:
  `https://hallcweb.jlab.org/wiki/index.php/Beam_Checkout_Procedures`
  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.
  Do this step only if MCC is unable to restore the beam positions used at the previous energy.
  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.

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.
  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.

- BCM calibrations.
  The Run Co-ordinator will coordinate the timing of this with the Program Deputy. This requires MCC's ability to reliably deliver 70 - 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.

Q^2=2.45, W=3.20, x=0.21, middle 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
8.487	2.193	20.90	0.461	0.048	6.265	-6.93

1. $p(e,e'\pi^+)n$ LH2 SHMS ~~right~~ left ($\theta = 8.93^o$) run.

   Set up the following configuration:

   (a) Set the SHMS momentum = +6.265 GeV/c (follow the cycling procedure).

   (b) Move the SHMS angle = 8.93 deg (from TV).

   (c) Set HMS momentum = -2.193 GeV/c. Negative polarity.

   (d) Keep HMS angle = 20.90 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

   (e) 10 cm LH2 target.

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

   (g) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

   (h) 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)	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. $e^- \cdot \pi$
7 kHz	144 kHz	71 kHz	31 kHz	29 kHz	290 Hz	5.5 Hz

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

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

(k) **Take data for 0.9 hours (at 100% efficiency) at 80 μA to get about ~~17,800~~ 12k-15k $p(e,e'\pi^+)n$ coincidences.** 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 $\sim$ 25 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 ($\theta = 8.93^o$) 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 target).

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

3. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 6.93^o$) run.

(a) Move the SHMS to 6.93 deg (from TV). **This rotation can be done remotely with expert oversight, provided the angle rotation GUI was set to be in agreement with the floor angle during the 8.16 deg setting. 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 vernier value to 0.005 degree precision.

(b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.

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

(d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

(e) 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 1259 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. $e^- \cdot \pi$
7 kHz	144 kHz	267 kHz	104 kHz	77 kHz	1002 Hz	5.5 Hz

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

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

(h) **Take data for 1.0 hours (100% efficiency) at ~~80~~ 60 μA to get 19,800 p(e, e'π^+)n coincidences.** Use the physics replay to keep track of the event total. The first run should be $\sim$ 30 minutes (at 100% data taking efficiency), and should be immediately analyzed to get an indication of the pion rate. Use this to calculate how long to run to get the desired statistics.

4. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta =$ ~~21.22~~ 6.93°) 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 target).

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

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS ~~left~~ right ($\theta = 5.50^o$) run.

Set up the following configuration:

(a) Keep the SHMS momentum = +6.265 GeV/c (follow the cycling procedure).

(b) Move the SHMS angle = 5.50 deg (from TV). **This requires a hall access. The Run Co-ordinator will need to arrange in advance which expert personnel (e.g. Amy Comer, Steve Lassiter) need to be present.**

(c) Keep HMS momentum = -2.193 GeV/c. Negative polarity.

(d) keep HMS angle = 20.90 (from TV).

(e) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.

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

(g) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 50 μA. Do not change PS5=0!

(h) Set the PS1(SHMS-3/4) and PS4(HMS-ELREAL
For **50 μA beam** and the projected rates listed b
100 Hz HMS and SHMS singles event rates to d

Was ~1hr extra to get to original target

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	...coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
4 kHz	90 kHz	414 kHz	144 kHz	88 kHz	903 Hz	3.44 Hz

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

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

(k) **Take data for 1.4 hours (100% efficiency) at 50 μA to get ~~17,400~~ 12000 p(e,e'π^+)n coincidences.** 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**

→ watch SIX <2MHz SHMS 3/4 <600kHz

Dependent on time / reduce to 12k.

~~16~~ 8 SJDK 11/8/22 — This was a little vague — ran till ~ 15.5k

into the physics replay. The first run should be ~ 25 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.

6. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 5.50^o$) 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 target).

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

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

Nominal Q^2=3.85 GeV$^2/c^2$, W=3.07 GeV, x=0.31 Kinematics						
E_e	$E_{e'}$	$\theta_{e'}$	ϵ	$\lvert t\rvert$	p_π	θ_q
GeV	GeV	deg		(GeV/c)^2	GeV/c	deg
8.487	1.882	28.42	0.387	0.120	6.538	-7.47

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

   Set up the following configuration:

   (a) Set the SHMS momentum = +6.538 GeV/c (follow the cycling procedure).

   (b) Do not move SHMS. Just keep the SHMS to 5.50 deg.

   (c) Set HMS momentum = -1.882 GeV/c. Negative polarity.

   (d) Move HMS angle = 28.42 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

   (e) 10 cm LH2 target.

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

   (g) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 60 μA. Do not change PS5=0!

   (h) 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 a 550 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 π^+ rate	SHMS K rate	SHMS p rate	Random coinc. $(e^- + \frac{\pi^-}{5}) \cdot (\pi + K + p)$	Real coinc. $e^- \cdot \pi$
1.2 kHz	33 kHz	368 kHz	137 kHz	82 kHz	283 Hz	0.86 Hz

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

PAGES 11-36

REPLACED BY GH- AUG 10,

Done @38nA 12/18/22 OWL STOK

✓1 Done 12/8/22 OWL 58.0k PS1 14 PS3 9 PS6 0 → 700Hz @ 38μA

Second run: 16125

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

(k) **Take data for 5.2 hours (at 100% efficiency) at 60 μA to get about ~~16,050~~ 12k $p(e, e'\pi^+)n$ coincidences.** 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 $\sim$ 15 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.

Very quick initial look

→ 10 π per 100k events

→ 250 Hz rate to disk

→ ~16m events to reach stats goal

$$\left(\frac{16000000}{250}\right)/(60)^2 \approx 18 \text{ hrs}$$

OR → ~2046mC to get 16k π

$$\left(\frac{2046\times10^3}{35}\right)/60^2 \rightarrow \sim 16 \text{ hrs}$$

2. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 5.50^o$) 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 target).

Take data for 1 hour (100% efficiency) at 40 μA.

Done
11/8/22
Owl Shift
STDK

3. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 7.47^o$) run.

(a) Move the SHMS angle = 7.47 deg (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.

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

(d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

(e) 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 344 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	12
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL×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. $e^- \cdot \pi$
1.6 kHz	43 kHz	130 kHz	56 kHz	44 kHz	148 Hz	1.14 Hz

(f) **fadcmode10 Run:** Start by taking a 2 minute fadcmode10 run. Be sure to mark this clearly on the Run Sheet. After the run, it is extremely important to **unclick the fadcmode10 setting button.** ✓ Run 16133 13/8/22 OWL SOK

PS1-13 PS3-10 ✓ PS6-0

(g) **HMS-3/4 trigger run:** Since the HMS momentum is fairly low, take a 20 minute run with HMS-3/4 triggers enabled instead of hELREAL (i.e. PS6 instead of PS5, and PS3 instead of PS4). This is to monitor the ELREAL threshold and will count as part of the physics run total. If the PS3 trigger rate is excessive, adjust PS3 to a higher level to compensate. ✓ Run 16134 13/8/22 OWL SOK

(h) **Take data for 4.0 hours (100% efficiency) at 80 μA to get 16,500 p(e,e'π^+)n coincidences.** 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 $\sim$ 30 minutes (at 100% data taking efficiency), and should be immediately analyzed to get an indication of the pion rate. Use this to calculate how long to run to get the desired statistics.

4. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 7.47^o$) 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 target).

Take data for 0.8 hours (100% efficiency) at 40 μA.

5. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 9.47^o$) run.

(a) Move the SHMS angle = 9.47 deg (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.

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

(d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

(e) 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 243 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	10
PS2(SHMS-ELREAL)	–1
PS3(HMS-3/4)	–1
PS4(HMS-ELREAL)	8
PS5(HMS-ELREAL×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. $e^- \cdot \pi$
1.6 kHz	43 kHz	32 kHz	15 kHz	15 kHz	39 Hz	1.14 Hz

Run 16150 ✓

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

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

Run 16151

12K.

(h) **Take data for 4.0 hours (100% efficiency) at 80 μA to get ~~16,500~~ p(e, e'π^+)n coincidences.** 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 $\sim$ 30 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.

6. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 9.47^o$) 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 target).

Take data for 0.8 hours (100% efficiency) at 40 μA.

Run 16158

Heep-check coincidence run

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

8.487 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$Rate_{DAQ}$	Time
14.55	6.579	37.947	2.688	16.3 Hz	146 Hz	12 min

Set up the following configuration:

(a) Keep the SHMS momentum = +2.688 GeV/c.

(b) Move the SHMS angle = 37.947 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision.

(c) Keep HMS momentum = -6.579 GeV/c (follow the magnet cycling procedure).

(d) Keep HMS angle = 14.55 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(e) 10 cm LH2 target.

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

(g) 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 146 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)	0
PS5(HMS-ELREAL×SHMS-3/4)	0
PS6(HMS-3/4×SHMS-3/4)	–1
EDTM Target Prescale Rate	10 Hz
cermode10	ON

(h) HMS large and SHMS collimators.

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

Take two runs with a combined total of 11,700 $e + p$ elastic scattering coincidences. Run should be immediately analyzed, checking E_{miss} and p_{miss}.
Estimated Running Time: 0.2 hours at 100% efficiency.

2. $\boxed{\mathrm{Al}(e, e'p)X}$ 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).

3. $p(e,e'p)$ setting for both spectrometer angles and momenta

8.487 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$Rate_{DAQ}$	Time
17.45	5.992	32.970	3.302	5.58 Hz	225 Hz	30 min

Set up the following configuration:

(a) Set the SHMS momentum = +3.302 GeV/c (follow the magnet cycling procedure).

(b) Move the SHMS angle = 32.97 deg (from TV). Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision.

(c) Set HMS momentum = -5.992 GeV/c (follow the magnet cycling procedure).

(d) Move the HMS angle = 17.45 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(e) 10 cm LH2 target.

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

(g) 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 225 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	5
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

(h) HMS large and SHMS collimators.

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

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

Estimated Running Time: 0.5 hour at 100% efficiency.

4. $\boxed{\mathrm{Al}(e,e'p)X}$ 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).

DONE

5. $p(e,e'p)$ setting for both spectrometer angles and momenta

8.487 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$Rate_{DAQ}$	Time
19.55	~~5.578~~ 5.587	30.021	3.731	2.86 Hz	264 Hz	1 hr

19.56 30.02

Set up the following configuration:

(a) Set the SHMS momentum = +3.731 GeV/c.

(b) Move the SHMS angle = 30.021 deg (from TV). Beam off while approaching the beam line. Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision.

(c) Set HMS momentum = ~~-5.578~~ 5.587 GeV/c (follow the magnet cycling procedure).

(d) Move HMS angle = 19.55 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(e) 10 cm LH2 target.

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

(g) 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 264 Hz DAQ rate overall.

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

(h) HMS large and SHMS collimators.

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

Take two runs with a combined total of 10,200 $e + p$ elastic scattering coincidences. The first run should be 30 minutes (at 100% data taking effciency), and should be immediately analyzed, checking E_{miss} and p_{miss}, while taking the second run.
Estimated Running Time: 1 hour at 100% efficiency.

DONE

6. $\boxed{\mathrm{Al}(e, e'p)X}$ 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).

7. $p(e,e'p)$ setting for both spectrometer angles and momenta

8.487 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$Rate_{DAQ}$	Time
20.90	-5.321	28.358	3.996	1.96 Hz	273 Hz	1.5 hr

20.905 28.34 .68 22.74 28.355 .16

Set up the following configuration:

(a) Set the SHMS momentum = +3.996 GeV/c.

(b) Move the SHMS angle = 28.358 deg (from TV). Beam off while approaching the beam line. Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision.

(c) Set HMS momentum = -5.321 GeV/c (follow the magnet cycling procedure).

(d) Move HMS angle = 20.90 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(e) 10 cm LH2 target.

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

(g) 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 273 Hz DAQ rate overall.

Projected prescale GUI settings:	
PS1(SHMS-3/4)	3
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

(h) HMS large and SHMS collimators.

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

Take two runs with a combined total of 10,500 $e + p$ elastic scattering coincidences. The first run should be 30 minutes (at 100% data taking effciency), and should be immediately analyzed, checking E_{miss} and p_{miss}, while taking the second run.
Estimated Running Time: 1.5 hour at 100% efficiency.

8. $\boxed{\mathrm{Al}(e, e'p)X}$ 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).

Calibration runs with SHMS at negative polarity

1. $\boxed{p(e,e')p}$ Hydrogen elastic singles, and associated Dummy target runs.
   Set up the following configuration:

   (a) HMS and SHMS angles and momenta as specified in the table below. Both spectrometers should be at negative polarity and will have to be cycled initially.

   (b) Record all TV angle values on run sheets and hclog. Update *standard.kinematics* with the new settings.

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

LH2 target runs:

- Set the PS1(SHMS-3/4) 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.
- Projected beam currents are listed below, we desire to keep the SHMS-3/4 rate below 600 kHz so adjust accordingly. Stable beam with 2×2 **raster on.**
- We want at least 10,000 elastics (in both spectrometers). The total event estimate in right-most column includes inelastics (times below are only a guide).

Thick Dummy target runs:

One run for each angle and momentum setting, current limit: 40 μA.
To be efficient, please minimize target changes and do LH2, Dummy for first setting, followed by Dummy, LH2 for second setting, etc.

8.487 GeV Heep-check singles runs

	θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	Current	$Rate_{HMS}$	$\frac{PS4}{HMS}$	$Rate_{SHMS}$	$\frac{PS2}{SHMS}$	$\frac{Time}{LH2run}$	$\frac{Time}{ALrun}$	Evt_{SHMS}
1	15.050	-6.477	9.45	-7.559	10 μA	0.98 kHz	0	57.6 kHz	8	10 min	6 min	266k
2	15.630	-5.878	11.90	-7.106	25 μA	4.55 kHz	30	28.6 kHz	74	10 min	6 min	261k
3	17.970	-5.878	13.85	-6.720	80 μA	1.80 kHz	0	30.5 kHz	75	12 min	6 min	334k
4	20.385	-5.878	14.75	-6.538	80 μA	0.13 kHz	0	18.6 kHz	65	12 min	6 min	400k

Total Time (including overhead): 4.3 hrs

2. Carbon-Sieve Optics at -5.878 GeV/c for HMS

Set up the following configuration:

(a) Ensure HMS magnets are set to –5.878 GeV/c.

(b) Set HMS angle = 13.00 deg (from TV).

(c) Insert HMS sieve collimator. Leave SHMS collimator unchanged.

(d) Insert the Carbon 0.5% target.

(e) Stable 40 μA beam with 2×2 raster on. Adjust beam current as needed to both maximize pTRIG4 (H-EL_REAL) rate to 2000 Hz and **ensure that pTRIG1 (SHMS 3/4) is under 600 kHz and SHMS S1X rate is under 2 MHz.**
Carbon Target Current Limit = 80 μA.

(f) Set the PS4(HMS-ELREAL) target rate to 2000 Hz, all others disabled (i.e. -1). Note that no SHMS trigger should be enabled. Estiamted prescale values are below.
Prescale GUI settings:

PS1(SHMS-3/4)	–1
PS2(SHMS-ELREAL)	–1
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) Update *standard.kinematics* with the new settings.

(h) Run the 50k analysis script as normal. Note that there should only be HMS events. The statistics goal is 200 electron events per sieve hole. The 50k replay should be used to determine the event rate. **Jacob Murphy should be called to remotely determine the event rate. His phone number is on the whiteboard, available regardless of the hour.** If need be, there are instructions on how to estimate these cuts in root in the file "Carbon_Optics_README.txt" (located in the hallc_replay_lt directory), however Jacob should be tried to be contacted first to complete the estimate. Continue data taking until rate goal is reached based on the 50k analysis. 358k events

(i) Once data taking is complete based on the rate estimate, insert Optical ±8 Carbon target. **Limit beam current to 50 uA on this new target. Lower as needed.** Adjust the prescale as needed to keep the target rate to 2000 Hz. Repeat the previous step with the new target. 600k events

Estimated Running Time (combined both targets): 2.0 hours at 50% efficiency.

HMS Carbon Optics Replay Instructions

Loading replay into root

When running carbon optics, use the 50k replays to determine event rate.

For the HMS, these are saved into ROOTfiles/Analysis/50k/hms_coin_replay_production_####_50000.root, where #### is the run number.

From the hallc_replay_lt directory, enter:

root -l ROOTfiles/Analysis/50k/hms_coin_replay_production_####_50000.root

to load the 50k replay file.

Selecting Carbon Foil

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

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

T->Draw("H.gtr.dp:H.gtr.y>>(300,-15,15,200,-10,10)","","colz")

To select one foil, apply cuts along H.gtr.y depending on your target.

For the 0.5% Carbon target, this requires no cut.

For the Optics #2 +/- 8 cm, select the first foil using:

T->Draw("H.gtr.dp:H.gtr.y>>(300,-15,15,200,-10,10)","H.gtr.y<0","colz")

and select the second foil using:

T->Draw("H.gtr.dp:H.gtr.y>>(300,-15,15,200,-10,10)","H.gtr.y>0","colz")

Ensure only one foil is visible after these cuts before proceeding. The cuts on H.gtr.y will be used for selecting the sieve hole.

Selecting Sieve Hole

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>>(200,-10,10,400,-20,20)","","colz")

And apply your H.gtr.y cut you used to select ONE carbon foil (if any cut was needed).
For the Optics #2 target, this step will need to be completed twice for the two cuts.

Now you should apply cuts along H.gtr.x+H.gtr.th*166.032 and H.gtr.y+H.gtr.ph*166.032 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 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.

OLD SHMS instructions

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:

```
T->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")

Now 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
```

To be completed if time allows:

3. $\boxed{p(e,e')p}$ Hydrogen elastic singles, and associated Dummy target runs PART 2
   Set up the following configuration ~~for the HMS (leave SHMS alone).~~

   (a) HMS and SHMS angles and momenta as specified in the table below. Both spectrometers should be at negative polarity ~~and will have to be cycled initially.~~

   (b) Record all TV angle values on run sheets and hclog. Update *standard.kinematics* with the new settings.

   (c) 10 cm LH2 and "thick" dummy target data should be taken with the HMS large and SHMS collimators. **Ensure HMS collimator is moved off of "sieve" and set to "large".**

LH2 target runs:

- Set the PS1(SHMS-3/4) 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.
- Projected beam currents are listed below, we desire to keep the SHMS-3/4 rate below 600 kHz so adjust accordingly. Stable beam with 2×2 **raster on.**
- We want at least 10,000 elastics (in both spectrometers). The total event estimate in right-most column includes inelastics (times below are only a guide).

Thick Dummy target runs:

One run for each angle and momentum setting, current limit: 40 μA.
To be efficient, please minimize target changes and do LH2, Dummy for first setting, followed by Dummy, LH2 for second setting, etc.

8.487 GeV Heep-check singles runs

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	Current	$Rate_{HMS}$	$\frac{PS4}{HMS}$	$Rate_{SHMS}$	$\frac{PS2}{SHMS}$	$\frac{Time}{LH2run}$	$\frac{Time}{ALrun}$	Evt_{SHMS}
* Beam current may need to be lowered if deadtime >15%											
17.24	-5.587	16.10	-6.265	~~80~~ 22 μA	6.80 kHz	~~3~~ 0	9.90 kHz	~~5~~ 3 ✓	12 min	6 min	412k
19.505	-5.587	19.20	-5.646	80 μA	0.90 kHz	0	2.63 kHz	3	18 min	6 min	554k
21.875	-5.587	23.20	-4.902	80 μA	0.07 kHz	0	0.65 kHz	0	30 min	6 min	738k
Total Time (including overhead): 3.8 hrs											

Aerogel change $n=1.011 \Rightarrow n=1.015$.

15,96

Q^2=2.12, W=2.05, x=0.39, high ϵ data taking

Nominal Q^2=2.12 GeV$^2/c^2$, W=2.06 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
8.487	5.587	12.14	0.899	0.195	2.792	-21.22

Camera 19,22
Rotation 18,90
(13 2)?

1. $p(e,e'\pi^+)n$ LH2 SHMS right ($\theta = 19.22^o$) run.

   Before moving to this setting, we have to change the aerogel tray in SHMS detector (from n=1.011 to n=1.015). Please contact RC to make the arrangements in advance.
   Set up the following configuration:

   (a) Set the SHMS momentum = +2.792 GeV/c (follow the cycling procedure).

   (b) Move the SHMS angle = 19.22 deg (from TV). Beam off while approaching the beam line. Be sure to record and photograph the actual achieved vernier value to 0.005 degree precision.

   (c) HMS momentum = -5.587 GeV/c. Negative polarity (follow the cycling procedure).

   (d) HMS angle = 12.14 (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

   (e) 10 cm LH2 target.

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

   (g) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

   (h) 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 3140 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)	11
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. $e^- \cdot \pi$
143 kHz	6.6 kHz	163 kHz	39 kHz	133 kHz	2901 Hz	74.7 Hz

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

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

(k) **Take data for 1.0 hours (at 100% efficiency) at 80 μA to get about 134,500 p(e, e'π^+)n coincidences.** 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 $\sim$ 30 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.

Need ~~16.5~~ 19.1 million
coda
events.

I think.

2. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 19.22^o$) 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 target).

Take data for 0.1 hour (100% efficiency) at 40 μA.

21.22
.32

3. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS center ($\theta = 21.22^o$) run. Set to 20.90 to get 21.22

(a) Move the SHMS to 21.22 deg (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.

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

(d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

(e) 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 1846 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)	11
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. $e^- \cdot \pi$
143 kHz	6.6 kHz	82 kHz	21 kHz	82 kHz	1598 Hz	74.7 Hz

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

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

(h) **Take data for 1.0 hours (100% efficiency) at 80 μA to get 134,500 p(e, e'π^+)n coincidences.** 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 $\sim$ 30 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.

5. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS center ($\theta = 21.22^o$) 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 target).

Take data for 0.1 hours (100% efficiency) at 40 μA.

6. $\boxed{p(e,e'\pi^+)n}$ LH2 SHMS left ($\theta = 23.22°$) run. Set to 22.90 to get 23.22

(a) Move the SHMS to 23.22 deg (from TV). Be sure to record and photograph the actual vernier value to 0.005 degree precision.

(b) Put in the LH2 target. Leave the spectrometer magnet settings unchanged.

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

(d) **Adjust the beam current to keep the SHMS-3/4 rate below 600 kHz.** We project the current for this run to be about 80 μA. Do not change PS5=0!

(e) 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 1128 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)	11
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. $e^- \cdot \pi$
143 kHz	6.6 kHz	41 kHz	11 kHz	49 kHz	872 Hz	74.7 Hz

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

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

(h) **Take data for 1.0 hours (100% efficiency) at 80 μA to get 134,500 p(e, e'π^+)n coincidences.** 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 $\sim$ 30 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. 5M

7. $\boxed{\text{Al}(e,e'\pi^+)X}$ Thick Dummy target SHMS left ($\theta = 23.22°$) 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 target).

Take data for 0.1 hours (100% efficiency) at 40 μA.

Do AFTER all 3 physics settings complete

4. $p(e,e'\pi^+)n$ coincidences fADC deadtime study ✓

(a) Do not change any HMS and SHMS settings. except rotate to $\theta_{SHMS}=21.22°$ (center angle) + update standard kinematics

(b) 10 cm LH2 target.

(c) Projected prescale GUI settings:

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

(d) Make sure the raster is on (2 × 2), and take coincidences at 65, 50, 30, 20, 12μA. Start at the highest current and take LH2 target data. Then go down in current and repeat. **The goal is 10k prompt p(e, e'π^+)n coincidences per setting.**

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

Q^2=2.12 GeV^2, W =2.05 GeV, ϵ =0.899 central angle

θ_{HMS} = 12.14, P_{HMS}=-5.587 GeV/c, θ_{SHMS} = 21.22, P_{SHMS}=+2.792 GeV/c

	μA	Targets	$\frac{Rate_{SHMS}}{LHrun}$	$\frac{PS1}{SHMS}$	$\frac{Rate_{HMS}}{LHrun}$	$\frac{PS4}{HMS}$	$Rate_{DAQ}$	Time	
(4)	65	LH2	150 kHz	11	122 kHz	11	5.2 kHz*	0.2 hr	✓
	* If the CODA deadtime is excessive (>20%), consider PS5=1								
(1)	50	LH2	115 kHz	11	94 kHz	11	3.4 kHz	0.2 hr	✓
(3)	30	LH2, Dummy	69 kHz	10	56 kHz	10	2.1 kHz	0.3 hr	✓
(2)	20	LH2	46 kHz	10	38 kHz	9	1.1 kHz	0.4 hr	✓
(5)	12	LH2	28 kHz	9	23 kHz	9	0.5 kHz	0.7 hr	✓
	Total Time (including overhead): 3.33 hrs								

↑ Do in this order.

Ensures a good dynamic range if you have to end early.

(Note: the physics at p. 29 is already at 80 uA).

SKIP

Lumi Scans

we are here

2. First Luminosity scans on LH2, LD2 and $z = 0$ Carbon targets.

   This scan relies on MCC's ability to deliver stable high beam currents.

   (a) Set the HMS momentum to -4.570 GeV/c, and the SHMS momentum to -5.370 GeV/c, both negative polarity.

   (b) Rotate the HMS to 12.50 degrees, and the SHMS to 9.50 degrees. Record the TV camera angles on the runsheet to 0.005 degree accuracy.

   (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, 18, 12, 8, 5, 2.5, 1 μA on LH2 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 about 0.3 hour. During this run, the Target Operator should park the LH2 target and prepare for LD2 data taking.

   (g) Repeat the scans with LD2 target at 40, 25, 18, 12, 8 μA. (80, 60 μA rates on LD2 are too high and can be excluded.)

   (h) 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.

Don't Worry about analysing the data online, run e replay only

The most important thing here is Stable high quality beam for each run

There are not any analysis plots to examine here as such. Just replay the data

$SHMS$	DAQ_{HMS}	$\frac{Time}{run}$
=-5.370 GeV/c		
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min
Hz	1 kHz	10 min

SKIP

3. Second Luminosity scans on LH2, LD2 and $z = 0$ Carbon targets.

   This scan relies on MCC's ability to deliver stable high beam currents. If they can not, then RC will instruct whether to defer the luminosity scan later in the experiment.

   (a) Keep the HMS momentum to -4.570 GeV/c, and the SHMS momentum to -5.370 GeV/c, both negative polarity.

   (b) Rotate the HMS to 13.00 degrees, and the SHMS to 10.50 degrees. Record the TV camera angles on the runsheet to 0.005 degree accuracy.

   (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) **Change the EDTM target rate from 10 Hz to 25 Hz.**

   (e) Make sure the raster is on (2×2), and take HMS and SHMS runs at 80, 60, 40, 25, 18, 12, 8 μA on LH2 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) Take one Thick Dummy target run at 40 μA about 0.3 hour. During this run, the Target Operator should park the LH2 target and prepare for LD2 data taking.

   (h) Repeat the scans with LD2 target at 40, 25, 18, 12, 8 μA. (80, 60 μA rates on LD2 are too high and can be excluded.)

   (i) 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.

8.487 GeV Luminosity Scans								
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}=-4.570 GeV/c, θ_{SHMS} = 10.50, P_{SHMS}=-5.370 GeV/c								
80	LH2, C	430 kHz	13	120 kHz	7	1 kHz	1 kHz	10 min
60	LH2, C	322 kHz	12	90.2 kHz	7	1 kHz	1 kHz	10 min
40	LH2, Dummy, LD2, C	215 kHz	12	60.2 kHz	6	1 kHz	1 kHz	10 min
25	LH2, LD2, C	134 kHz	11	37.6 kHz	6	1 kHz	1 kHz	10 min
18	LH2, LD2, C	96.7 kHz	11	27.1 kHz	5	1 kHz	1 kHz	10 min
12	LH2, LD2, C	64.5 kHz	10	18 kHz	5	1 kHz	1 kHz	10 min
8	LH2, LD2, C	43.0 kHz	9	12 kHz	4	1 kHz	1 kHz	10 min
5	LH2, C	26.9 kHz	9	7.5 kHz	3	1 kHz	1 kHz	10 min
2.5	LH2, C	13.4 kHz	8	3.76 kHz	2	1 kHz	1 kHz	10 min
1	LH2, C	5.37 kHz	6	1.5 kHz	0	1 kHz	1 kHz	10 min
Total Time (including overhead): 13.7 hrs								