KAON-LT Run Plan - Part 2

November 7, 2018

3.835 GeV Beam Plan

Initial beam activities

- Hall entry for SHMS aerogel change.
  During the linac gradient change, and in co-ordination with the RC, the SHMS aerogel experts (Bernikov, Trotta, Horn) need to enter the hall to remove the n=1.015 aerogel and replace it with n=1.03 aerogel. Estimated time required – 8 hours.

- SHMS fringe field beam steering study.
  MCC will want to do this "first thing" after beam is delivered to the hall, to establish operating parameters. Set the SHMS to the smallest angle, highest momentum setting needed at this beam energy [6.79^o, –3.007 GeV/c (polarity apparently does not matter)], and follow MCC instructions to either rotate the spectrometer or change the momentum setting. It could take 1–4 hours to complete the studies, depending on how much deflection they find.

- After the studies are done, configure the spectrometers for the carbon sieve run:

  1. SHMS angle = 9.50 deg (from TV). **Beam off during the SHMS movement. Pay close attention to the hall cameras while departing the beamline, and be prepared to hit the rotation kill switch, if necessary.**
  2. SHMS momentum = –3.007 GeV/c (negative polarity).
  3. HMS angle = 13.00 deg (from TV).
  4. HMS momentum = –3.007 GeV/c (negative polarity and all magnets cycled).

- 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.

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

- Superharp scan (BPM calibration check).
  The Run Co-ordinator should let the MCC know in advance that we are planning a Superharp scan. The beam should be stable and less than 25 μA. We want this done with the raster off, so that the beam spot size can be measured. If the spot size at 00A is < 0.1mm (sigma), instruct MCC to increase the spot size and remeasure to verify. **This must be completed before any production cross section data are to be taken!**

- 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.

Calibration runs.

1. HMS and SHMS sieve runs with $z = 0$ 1.5% r.l. carbon target.

   - Spectrometer angles and momenta as on previous page.
   - Sieve slits on both spectrometers.
   - **Raster off.** Current limit=20 μA. Carefully center the beam to the previously determined central position.
   - Verify that MCC has position at target lock on, and energy lock on.
   - Prescale factors:
     HMS singles daq disabled (all PS=-1).
     SHMS singles daq disabled (all PS=-1).
     COIN daq PS1(SHMS-3/4)=–1, PS2=(SHMS-ELREAL)=0, PS3(HMS-ELREAL)=0, PS4(HMS-3/4)=–1, PS5(HMS-ELREAL×SHMS-3/4)=–1, PS6(HMS-3/4×SHMS-3/4)=–1.

   Singles runs. Take 100,000 HMS and 100,000 SHMS electron triggers. Adjust PS2(SHMS-ELREAL) and PS3(HMS-ELREAL) as necessary to keep the deadtime at reasonable levels (below 20%).

	E_e	θ'_e	P'_e
HMS:	3835.0	13.0	-3007.0
SHMS:	3835.0	9.5	-3007.0

   Look at HMS and SHMS $x - fp$ vs $y - fp$ scatterplots, and compare to the "reference plots" taken at the beginning of the 10.6 GeV beam time. They should look extremely similar. If not, contact Mark Jones or Holly Szumila-Vance for instructions on what to do next.

→ Due to HMS sieve being stuck at beginning of run, we started with SHMS sieve Run 6620 to check beam position + optics, then did HMS sieve Run 6731 when fixed.

2. $\boxed{p(e,e')p}$ Hydrogen elastic singles, and associated Thick Dummy target runs.

Set up the following configuration:

(a) HMS and SHMS angles and momenta as specified in the tables below. Negative polarity.

(b) Record all TV angle values on the runsheets.

(c) HMS large and SHMS collimators.

LH2 target runs:

Take two runs for each of the following HMS, SHMS angle and momentum settings. Stable 70 μA beam with **raster on**. Set the PS2(SHMS-ELREAL) and PS3(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 100,000 total electron events (times below are only a guide). The total event estimate includes inelastics.

Thick Dummy target runs:

One run for each angle and momentum setting, taken immediately after the corresponding LH2 run. Remember to reduce the current to 40 μA.

3.835 GeV Heep-check singles runs									
θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$\frac{PS3}{HMS}$	$Rate_{SHMS}$	$\frac{PS2}{SHMS}$	$\frac{Time}{LH2run}$	$\frac{Time}{ALrun}$
21.14	-3.007	21.14	-3.007	26 kHz	5	33 kHz	6	15 min	10 min
24.00	-2.834	24.00	-2.834	9.7 kHz	4	13 kHz	4	15 min	10 min
26.00	-2.713	26.00	-2.713	5.2 kHz	3	7.9 kHz	4	15 min	10 min
28.20	-2.583	28.20	-2.583	2.8 kHz	2	4.6 kHz	3	15 min	10 min
30.00	-2.478	30.00	-2.478	1.8 kHz	0	3.1 kHz	2	15 min	10 min
Total Time (including overhead): 3.3 hrs									

→ first set of runs had missing reference times on SHMS drift chambers

→ Data Retaken on Nov 29-30.

3. $\boxed{p(e,e'p)}$ Heep-check coincidence run.

Set up the following configuration:

(a) Set the HMS to –2.026 GeV/c (negative polarity).

(b) HMS angle = 38.60 deg (from TV).

(c) Switch the SHMS to positive polarity (follow the cycling procedure) and set to +2.583 GeV/c.

(d) SHMS angle = 29.31 deg (from TV).

(e) Prescale factors PS1(SHMS-3/4)=2, PS3(HMS-ELREAL)=0, PS5(HMS-ELREAL×SHMS-3/4)=0. All others disabled (i.e. -1).

(f) HMS large and SHMS collimators.

(g) Stable 70 μA beam with raster on.

Take two runs with a combined total of 50,000 $e+p$ elastic scattering coincidences. The first run should be ~ 15 minutes, and should be immediately analyzed, checking E_m and p_m, while taking the second run.

3.835 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{SHMS}$	$Rate_{DAQ}$	Time
38.60	-2.026	29.31	2.583	3.8 kHz	1500 Hz	0.75 hr

4. $\boxed{Al(e,e'p)X}$ Thick Dummy target run for Heep-check.

Insert the "thick" dummy target (±5 cm) and **run for 12 minutes** at 40 μA (assuming 100% efficiency).

Q^2=0.5, W=2.40, x=0.09, low ϵ data taking

Nominal Q^2=0.5 GeV^2/c^2, W=2.40 GeV, x=0.09 Kinematics

E_e GeV	$E_{e'}$ GeV	$\theta_{e'}$ deg	ϵ	$\lvert t \rvert$ (GeV/c)^2	p_K GeV/c	θ_q deg
3.835	0.968	21.14	0.4515	0.081	2.583	-6.79

1. $p(e,e'K^+)\Lambda$ LH2 SHMS center ($\theta = 6.79^o$) run PART 1.

   Set up the following configuration:

   (a) SHMS angle = 6.79 deg (from TV). **Beam off during the SHMS movement. Pay close attention to the hall cameras while approaching the beamline, and be prepared to hit the rotation kill switch, if necessary.**

   (b) SHMS momentum = 2.583 GeV/c. Positive polarity (should already be there).

   (c) HMS momentum = –0.968 GeV/c. Negative polarity.

   (d) HMS angle = 21.14 deg (from TV).

   (e) 10 cm LH2 target.

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

   (g) Set the PS1(SHMS-3-4) and PS3(HMS-ELREAL) target rates to 100 Hz, PS5(HMS-ELREAL×SHMS-3/4)=0, all others disabled (i.e. -1). For the projected rates listed below, these should correspond to factors of about PS1(SHMS-3/4)=13, PS3(HMS-ELREAL)=10, giving 100 Hz HMS and SHMS singles event rates to disk, and a 2800 Hz DAQ rate overall, for 16 μA beam.
   Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

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. $e^- \cdot K$
5.0 kHz	178 kHz	466 kHz	59 kHz	103 kHz	2590 Hz	0.018-0.034 Hz

Expected rates for 16 μA beam current. The real rate above is only for the $p(e,e'K^+)\Lambda$ reaction, exclusive π^+ and p coincidence reactions are likely to at least triple this rate.

In total, we want 4,700-8,880 $p(e,e'K^+)\Lambda$ events, which will take approximately 71.3 hours (at 100% efficiency). Given its length, we will break it into two pieces.
For part 1, take about 40 hours of data (at 100% efficiency) to give 2,600-4,600 $\mathbf{p(e,e'K^+)\Lambda}$ coincidences. Use the physics replay to keep track of the event total.

→ Rates on both spectrometers were lower than calculated above. Data taken at currents from 12-35µA to better understand rate-dependent corrections to the data.

2. $\boxed{\text{Al}(e,e'K^+)X}$ Thick Dummy target SHMS center ($\theta = 6.79^o$) 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, then the PS1,3 factors can be decreased accordingly.

Take data for 5.0 hours (100% efficiency) at 20 μA. Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

3. $\boxed{p(e,e'K^+)\Lambda}$ LH2 SHMS left ($\theta = 9.79^o$) run.

Set up the following configuration:

(a) SHMS angle = 9.79 deg (from TV). **Beam off during the SHMS movement. Pay close attention to the hall cameras while departing the beamline, and be prepared to hit the rotation kill switch, if necessary.**

(b) Leave the magnet settings unchanged.

(c) Put the 10 cm LH2 target back in.

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

(e) Set the PS1(SHMS-3-4) and PS3(HMS-ELREAL) target rates to 100 Hz, PS5(HMS-ELREAL×SHMS-3/4)=0, all others disabled (i.e. -1). For the projected rates listed below, these should correspond to factors of about PS1(SHMS-3/4)=13, PS3(HMS-ELREAL)=10, giving 100 Hz HMS and SHMS singles event rates to disk, and a 3150 Hz DAQ rate overall, for 24 μA beam.
Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

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. $e^- \cdot K$
7.5 kHz	270 kHz	315 kHz	49 kHz	106 kHz	2920 Hz	0.027-0.048 Hz

Expected rates for 24 μA beam current. The real rate above is only for the $p(e,e'K^+)\Lambda$ reaction, exclusive π^+ and p coincidence reactions are likely to at least triple this rate.

Take data for approximately 42.8 hours (at 100% efficiency) to give 4,225-7,500 $\mathbf{p(e,e'K^+)\Lambda}$ coincidences. Use the physics replay to keep track of the event total.

→ take data at 24, 40, 50 μA.

4. $\boxed{\text{Al}(e, e'K^+)X}$ Thick Dummy target SHMS left ($\theta = 9.79^o$) 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, then the PS1,3 factors can be decreased accordingly.

Take data for 3.0 hours (100% efficiency) at 30 μA. Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

5. $\boxed{p(e, e'K^+)\Lambda}$ LH2 SHMS center ($\theta = 6.79^o$) run PART 2.

Return to the $\theta_{SHMS} = 6.79^o$ setting for the remainder of the 3.835 GeV beam time and complete the data taking for this setting. If things have progressed reasonably on schedule, there should be about 72 hours until the linac gradient change.

Set up the following configuration:

(a) Set SHMS angle = 6.79 deg (from TV). **Beam off during the SHMS movement. Pay close attention to the hall cameras while approaching the beamline, and be prepared to hit the rotation kill switch, if necessary.**

(b) Look up from the run sheets the PS1,3,5 values and beam currents used for the first part of the 6.79 deg run, and return to those settings. In consulation with the RC, verify that all running conditions are comparable to those of part 1.

(c) Update *standard.kinematics* with the new settings, and fill out a "new configuration" run sheet. Carry over the $p(e, e'K^+)\Lambda$ event tally from the part 1 run sheets.

Desired total $\mathbf{p(e, e'K^+)\Lambda}$ statistics: 4,700-8,880. Use the physics replay to keep track of the event total.

→ take $\frac{1}{3}$ of time at each of 16, 24, 32 μA.

KAON-LT Run Plan - Part 3

December 8, 2018

4.933 GeV Beam Plan

Initial beam activities

- While waiting for beam, configure the spectrometers for the carbon sieve run:

  1. SHMS angle = 9.50 deg (from TV).
  2. SHMS momentum = –3.500 GeV/c (negative polarity and all magnets cycled).
  3. HMS angle = 13.00 deg (from TV).
  4. HMS momentum = –3.000 GeV/c (negative polarity and all magnets cycled).

- 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.

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

- Superharp scan (BPM calibration check).
  The Run Co-ordinator should let the MCC know in advance that we are planning a Superharp scan. The beam should be stable and less than 25 μA. We want this done with the raster off, so that the beam spot size can be measured. If the spot size at 00A is $<$ 0.1mm (sigma), instruct MCC to increase the spot size and remeasure to verify. **This must be completed before any production cross section data are to be taken!**

- 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.

Calibration runs.

1. HMS and SHMS sieve runs with $z = 0$ 1.5% r.l. carbon target.

    - Spectrometer angles and momenta as on previous page.
    - Sieve slits on both spectrometers.
    - **Raster off.** Current limit=20 μA. Carefully center the beam to the previously determined central position.
    - Verify that MCC has position at target lock on, and energy lock on.
    - Prescale factors:
      HMS singles daq disabled (all PS=-1).
      SHMS singles daq disabled (all PS=-1).
      COIN daq PS1(SHMS-3/4)=–1, PS2=(SHMS-ELREAL)=0, PS3(HMS-ELREAL)=0, PS4(HMS-3/4)=–1, PS5(HMS-ELREAL×SHMS-3/4)=–1, PS6(HMS-3/4×SHMS-3/4)=–1.

    Singles runs. Take 100,000 HMS and 100,000 SHMS electron triggers. Adjust PS2(SHMS-ELREAL) and PS3(HMS-ELREAL) as necessary to keep the deadtime at reasonable levels (below 20%).

	E_e	θ'_e	P'_e
HMS:	4933.0	13.0	-3000.0
SHMS:	4933.0	9.5	-3500.0

    Look at HMS and SHMS $x - fp$ vs $y - fp$ scatterplots, and compare to the "reference plots" taken at the beginning of the 10.6 GeV beam time, located at:
    `https://redmine.jlab.org/projects/kltexp/wiki/Golden_SIEVE_runs`.
    They should look extremely similar. Ask Holly Szumila-Vance or Mark Jones to inspect the plots, and if required, for instructions on what to do next.

2. $\boxed{p(e,e')p}$ Hydrogen elastic singles, and associated Thick Dummy target runs.

Set up the following configuration:

(a) HMS and SHMS angles and momenta as specified in the tables below. Negative polarity. Cycle all magnets before the first setting. Record all TV angle values.

(b) HMS large and SHMS collimators.

LH2 target runs:
Stable beam with **raster on**. Set the PS2(SHMS-ELREAL) and PS3(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 100,000 total electron events (times below are only a guide). The total event estimate includes inelastics. For the last setting, divide the data taking into two runs, analyzing the first run while acquiring the second.

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

4.933 GeV Heep-check singles runs

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{HMS}$	$\frac{PS3}{HMS}$	$Rate_{SHMS}$	$\frac{PS2}{SHMS}$	$\frac{Time}{LH2run}$	$\frac{Time}{ALrun}$
12.71	-4.371	8.86	-4.642	51 kHz	7	580 kHz	10	15 min@10 μA	10 min
15.00	-4.184	11.86	-4.436	51 kHz	7	303 kHz	9	15 min@35 μA	10 min
18.00	-3.923	15.00	-4.184	12 kHz	4	64 kHz	7	15 min@35 μA	10 min
34.20	-2.583	34.20	-2.583	0.14 kHz	0	0.69 kHz	0	40 min@70 μA	10 min

Total Time (including overhead): 3.1 hrs

3. $\boxed{p(e,e'p)}$ Heep-check coincidence run.

Set up the following configuration:

(a) Cycle HMS magnets and set to –3.124 GeV/c (negative polarity).

(b) HMS angle = 27.15 deg (from TV).

(c) Switch the SHMS to positive polarity (follow the cycling procedure) and set to +2.583 GeV/c.

(d) SHMS angle = 33.50 deg (from TV).

(e) Prescale factors PS1(SHMS-3/4)=0, PS3(HMS-ELREAL)=0, PS5(HMS-ELREAL×SHMS-3/4)=0. All others disabled (i.e. -1).

(f) HMS large and SHMS collimators.

(g) Stable 70 μA beam with raster on.

Take two runs with a combined total of 55,000 $e+p$ elastic scattering coincidences. The first run should be ~ 15 minutes, and should be immediately analyzed, checking E_m and p_m, while taking the second run.

4.933 GeV Heep-check coincidence run

θ_{HMS}	P_{HMS}	θ_{SHMS}	P_{SHMS}	$Rate_{SHMS}$	$Rate_{DAQ}$	Time
27.15	-3.124	33.50	2.583	2.0 kHz	2840 Hz	0.5 hr

4. $\boxed{\text{Al}(e,e'p)X}$ Thick Dummy target run for Heep-check.

Insert the "thick" dummy target (±5 cm) and **run for 15 minutes** at 40 μA (assuming 100% efficiency).

Q^2=0.5, W=2.40, x=0.09, high ϵ data taking

Nominal Q^2=0.5 GeV^2/c^2, W=2.40 GeV, x=0.09 Kinematics

E_e	$E_{e'}$	$\theta_{e'}$	ϵ	$\|t\|$	p_K	θ_q
GeV	GeV	deg		(GeV/c)^2	GeV/c	deg
4.933	2.066	12.71	0.6979	0.081	2.583	-8.86

1. $p(e, e'K^+)\Lambda$ LH2 SHMS center ($\theta = 8.86^o$) run.

   Set up the following configuration:

   (a) Move the SHMS to 8.86 deg (from TV).

   (b) SHMS momentum = 2.583 GeV/c. Positive polarity (should already be there).

   (c) HMS momentum = –2.066 GeV/c. Negative polarity.

   (d) HMS angle = 12.71 deg (from TV).

   (e) 10 cm LH2 target.

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

   (g) Set the PS1(SHMS-3-4) and PS3(HMS-ELREAL) target rates to 100 Hz, PS5(HMS-ELREAL×SHMS-3/4)=0, all others disabled (i.e. -1). For the projected rates listed below, these should correspond to factors of about PS1(SHMS-3/4)=13, PS3(HMS-ELREAL)=10, giving 100 Hz HMS and SHMS singles event rates to disk, and a 3200 Hz DAQ rate overall, for 13 μA beam.
   Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

HMS	HMS	SHMS	SHMS	SHMS	Random coinc.	Real coinc.
e^- rate	π^- rate	π^+ rate	K rate	p rate	$(e^- + \frac{\pi^-}{5}) \cdot (\pi + K$+p)	$e^- \cdot K$
28 kHz	118 kHz	395 kHz	58 kHz	102 kHz	2935 Hz	0.25-0.73 Hz

Expected rates for 13 μA beam current. The real rate above is only for the $p(e, e'K^+)\Lambda$ reaction, exclusive π^+ and p coincidence reactions are likely to at least triple this rate.

Take data for approximately 25.1 hours (at 100% efficiency) to give 22,800-65,900 p(e, e'K$^+$)Λ coincidences. Use the physics replay to keep track of the event total.

If the singles and random coincidence rates are lower than expected (likely, given our experience from the 3.8 GeV run), the RC should instruct how to divide the run time between several different currents (e.g. ~~13, 20, 28~~ μA) to better understand the rate-dependent corrections to the data.

2. $\boxed{\mathrm{Al}(e, e'K^+)X}$ Thick Dummy target SHMS center ($\theta = 8.86^o$) 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, then the PS1,3 factors can be decreased accordingly.

Take data for 1.8 hours (100% efficiency) at up to 40 μA. Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

3. $\boxed{p(e, e'K^+)\Lambda}$ LH2 SHMS left ($\theta = 11.86^o$) run.

Set up the following configuration:

(a) SHMS angle = 11.86 deg (from TV).

(b) Leave the magnet settings unchanged.

(c) Put the 10 cm LH2 target back in.

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

(e) Set the PS1(SHMS-3-4) and PS3(HMS-ELREAL) target rates to 100 Hz, PS5(HMS-ELREAL×SHMS-3/4)=0, all others disabled (i.e. -1). For the projected rates listed below, these should correspond to factors of about PS1(SHMS-3/4)=13, PS3(HMS-ELREAL)=10, giving 100 Hz HMS and SHMS singles event rates to disk, and a 3000 Hz DAQ rate overall, for 24 μA beam. **Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.**

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. $e^- \cdot K$
10 kHz	218 kHz	318 kHz	56 kHz	122 kHz	2750 Hz	0.51-1.27 Hz

Expected rates for 24 μA beam current. The real rate above is only for the $p(e, e'K^+)\Lambda$ reaction, exclusive π^+ and p coincidence reactions are likely to at least triple this rate.

Take data for approximately 11.3 hours (at 100% efficiency) to give 21,000-68,250 $\mathbf{p(e, e'K^+)\Lambda}$ coincidences. Use the physics replay to keep track of the event total.

If the singles and random coincidence rates are lower than expected, the RC should instruct how to divide the run time between several different currents (e.g. ~~24, 37, 50~~ μA) to better understand the rate-dependent corrections to the data. 20, 25, 30 μA

4. $\boxed{\text{Al}(e,e'K^+)X}$ Thick Dummy target SHMS left ($\theta = 11.86^o$) 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, then the PS1,3 factors can be decreased accordingly.

Take data for 0.8 hours (100% efficiency) at up to 40 μA. Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

5. $\boxed{p(e,e'K^+)\Lambda}$ LH2 SHMS right ($\theta = 6.00^o$) run.

   (a) SHMS angle = 6.00 deg (from TV). **This requires a hall access. The Run Coordinator will need to arrange in advance which expert personnel (e.g. Fowler, Lassiter) need to be present.** Our goal is for this to happen at the beginning of Monday Dec 17 day shift.

   (b) Leave the magnet settings unchanged.

   (c) **SHMS fringe field beam steering study.**
   The RC needs to arrange this in advance with Jay Benesch, to occur immediately after the hall is restored to Beam Permit. Follow instructions from MCC. **SHMS remote angle changes are not possible this close to the beamline.** SHMS momentum should not be changed without permission of the RC.

   (d) Put the 10 cm LH2 target back in.

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

   (f) Set the PS1(SHMS-3-4) and PS3(HMS-ELREAL) target rates to 100 Hz, PS5(HMS-ELREAL×SHMS-3/4)=0, all others disabled (i.e. -1). For the projected rates listed below, these should correspond to factors of about PS1(SHMS-3/4)=13, PS3(HMS-ELREAL)=9, giving 100 Hz HMS and SHMS singles event rates to disk, and a 2400 Hz DAQ rate overall, for 8.5 μA beam.
   Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

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. $e^- \cdot K$
18 kHz	73 kHz	505 kHz	60 kHz	86 kHz	2120 Hz	0.15-0.43 Hz

Expected rates for 8.5 μA beam current. The real rate above is only for the $p(e,e'K^+)\Lambda$ reaction, exclusive π^+ and p coincidence reactions are likely to at least triple this rate.

Take data for approximately 38.9 hours (at 100% efficiency) to give 20,900-60,800 p(e, e'K$^+$)Λ coincidences. Use the physics replay to keep track of the event total.

If the singles and random coincidence rates are lower than expected, the RC should instruct how to divide the run time between several different currents (e.g. ~~10, 15, 20~~ μA) to better understand the rate-dependent corrections to the data. 11, 16

6. $\boxed{\text{Al}(e, e'\pi^+)X}$ Thick Dummy target SHMS right ($\theta = 6.00^o$) 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, then the PS1,3 factors can be decreased accordingly.

Take data for 2.7 hours (100% efficiency) at up to 40 μA. Adjust the beam current accordingly, keeping SHMS singles rates <650 kHz and live time >85%.

7. **To be determined in consultation with the RC:** If there is extra time left over before the end of beam, go back to the $p(e, e'K^+)\Lambda$ setting with the lowest statistics and take more data.