Instructions for KAON-LT Shift Takers

December 20, 2018

Magnet setting and cycling procedures:

A quality L/T separation requires reproducible spectrometer acceptances, and so we must control hysteresis effects via the following procedures.

The ramping is about 0.5 A/s (pretty slow), so it is preferable to start ramping the magnets with the highest needed currents first when changing/cycling the magnets.

HMS dipole: The HMS dipole is set by NMR field. However, rather than use the automated ramping procedure, we will manually set the HMS dipole current, and iterate by hand until the desired field is reached.

Run **go_magnets_HMS_current P**, where **P** is in GeV/c, on any hcdesk computer to find the set current.

1. After polarity changes, the remnant residual fields from the previous polarity setting are eliminated by cycling as follows:
   - (a) Ramp to 0 Amps and change the polarity.
   - (b) Go to the Minimum On Loop (MOL) current in the HMS dipole (this is at least 1500 A, with a 300 A buffer above the set current).
   - (c) Decrease to target current. Watch the NMR readback. Make sure you have an NMR Lock. Wait 5 minutes before making changes to the current to get the correct field readback.
   - (d) Make small, iterative changes in either direction about the target current to obtain the desired field readback in the NMR. Again, make sure you have an NMR Lock!! This process will take approximately 10-15 minutes for the dipole to settle. Be sure to agree with the field setting program to within 5×10^{-5} T.
   - (e) Wait 5–10 minutes before proceeding to take data.
2. If the next set-point is higher than the previous one, first go to the MOL current as for the polarity changes above, then ramp down to the new set-point.
3. If the next set-point is lower than the previous one, the new set-point is set directly.

HMS quadrupoles: The HMS quadrupoles are set by current. Follow the below procedure to obtain a reproducible field:

1. After polarity changes, cycle the HMS quadrupoles as follows:
   - (a) Ramp to 0 Amps and change the polarity.
   - (b) Ramp from 0 Amps $\rightarrow$ MOL current (this will be 200 A above the desired current, unless this exceeds the maximum current that the magnet has been tested at.)
   - (c) Ramp from the MOL current down to the new set-current.

   Note that the Hall probe values are only a guide, as their zero settings may drift with time. **Do not adjust the set-point to reproduce a previous Hall probe value!**

FOR HMS: BE SURE TO WAIT 10 MIN. AFTER THE CURRENT IS STABLE TO LET THE DIPOLE STABILIZE ITS FIELDS! While you are waiting, record all information in the hclog.

SHMS: The SHMS magnets are set by current from the desired momentum. From any hcdesk computer, run **go_magnets_SHMS_current P**, where **P** is in GeV/c, to load the appropriate set and MOL currents into the magnet GUI. For precision physics, like this experiment, the magnets should be put "on loop". Follow the procedure:

1. Turn off the beam prior to ramping the magnets to put them "on loop".
2. After polarity changes, the remnant residual fields from the previous polarity setting are eliminated by cycling as follows:
   (a) Ramp to 0 Amps and change the polarity.
   (b) Ramp from 0 Amps → MOL current (except for Q1, this will be 300 A above the desired current, unless this exceeds the maximum current that the magnet has been tested at).
   (c) Ramp from the MOL current down to the new set-current.
3. If the next set-point is higher than the previous one, first go to the MOL current as for the polarity changes above, then ramp down to the new set-point.
4. If the next set-point is lower than the previous one, the new set-point is set directly.

For more information, see the "Magnets How-to" at `https://hallcweb.jlab.org/wiki/index.php/How_to_operate_and_monitor_the_Spectrometer_Magnets`.

Spectrometer Angles:

- Be aware of where the big red buttons are to stop SHMS, HMS rotations if the rotation computer dies while you are rotating, and the spectrometer keeps going past your desired stopping point. Also, make sure to watch the spectrometer moving on the TV in case there is some obstacle on the floor.
- Record all angles to two decimal places (from TV). One decimal place is not enough accuracy. Make an hclog entry of both the TV picture readings and the GUI values for both spectrometers.
- It should be possible to set the spectrometers to within 0.01 degree of the desired value without too much difficulty. If this is a problem, then set the angle to within 0.03 degree of what is requested, but make a clear record of the actual setting in the hclog.

Beam Position:

We would like to control both the position **and angle** of the beam on target. Unless specified otherwise, please ensure that MCC puts the beam at the nominal position (written on the white board) for both the 3H07A and 3H07C BPMs.

Rates:

- Single particle and coincidence rates have been estimated for all runs. Watch the scintillator rates (S1 and 3/4 planes) for each spectrometer for an indication of the particle rate through the wire chambers, and if actual rate is substantially ($> 50\%$) higher than what is listed in the run plan, the RC should be warned.
- We want to keep the particle rate in each spectrometer below 650 kHz, and for some low energy runs this will require the beam current to be reduced from the nominal 70 μA value.
- For some low rate runs, it may be possible to use up to 100 μA beam with particle rates still below 350 kHz. Consult with the RC before requesting a higher beam current.
- The prescaler values in the run plan are a guide. Adjust them to keep the singles data rate in each spectrometer between ∼100-150 Hz.
- All run times assume 100% running efficiency. Adjust the time for actual delivered beam time, and let the RC know if the efficiency drops below 60% for an extended period.

Logbook:

It is extremely important to get a good run table (with a careful check of angle settings (gui vs. TV), field settings, problems during a run). It is also of great help if during the data taking the shift leader checks if all entries in the logbook and the run sheet are filled, and gives a 'title' of the run which describes the run well, plus comments in case of unusual things.

Run table is at `/home/cdaq/hallc-online/hallc_replay/UTIL_KAONLT/kaonlt_runlist.csv`.

Run sheets are at `https://redmine.jlab.org/issues/383`.

Make sure all settings are entered correctly on the datafile header, the hclog, and the runsheets!

Replay:

- We would like the detector check replay to be done on first 50,000 events of every run, and compare plots with the standard ones in the binder. In addition, we want physics replay to be done on every run in its entirety. K^+ plots such as missing mass, t, W, Q^2 and ϕ should be checked for anomalies. Replay instructions are on the next page.
- Keep the file *standard.kinematics* up to date with the spectrometer settings for every configuration, so that the physics replay generates meaningful quantities. Use the beam energy determined from the arc measurement in the file, and the spectrometer angles from the TV.
- Shift leaders are asked to keep a running total of the number of $e - K$ coincidence events falling within the missing mass and fiducial volume cuts set in the physics replay script, so that we can better estimate when to move to the next setting.

Instructions for KAON-LT Online Replay

December 20, 2018

1. **At a new kinematic setting**, edit the file *standard.kinematics* in the DBASE/COIN subdirectory to add the current kinematic information. First, add a comment to indicate the kinematic setting. Then enter the range of runs the kinematics are valid to (enter 9999 as upper range if ongoing). Next, enter the beam energy determined from the arc measurement, the target mass in amu (available at the top of the file), and the spectrometer angles from the TV. Next are the central momenta of the HMS and SHMS, followed by the mass of the particle each arm should detect (the leading letter indicates which arm: p = SHMS, h = HMS).

2. **After 50,000 events have been taken**, check the detectors:

   (a) On cdaql1, type `go_analysis` to enter working directory.

   (b) Type `./run_coin_shms.sh` to automatically replay the most recent run, and launch the monitoring GUI to study the SHMS detectors. Compare with histograms in the "golden run binder")

   (c) Type `./run_coin_hms.sh` to repeat for HMS detectors.

   (d) For reference, all histograms in the GUI display are saved in the HISTOGRAMS directory as both .pdf and .root format.
   The scaler report is stored in REPORT_OUTPUT.

3. **After the run is over**, do coincidence replay:

   (a) On cdaql1, type `go_analysis` to enter working directory.

   (b) Type `cd UTIL_KAONLT/` to enter K+ analysis directory.

   (c) Type `KaonYield.sh` *run_number max_entries* for partial replay, leave *max_entries* blank for full replay. The script will do a coincidence physics replay.

   (d) A GUI will launch with physics distributions. Compare to the simulations in the binder. Record the number of Λ events on the run sheets.

   (e) An Emacs window will launch scaler and efficiency info, once ROOT is exited (by typing `.q`). Check to make sure this all looks reasonable.

   (f) **Continue by updating the run list at** `UTIL_KAONLT/kaonlt_runlist.csv`:

   - Once the Emacs window closes, a prompt will appear, asking if you would like to update the run list as well, enter `yes`.
   - When prompted, enter the production type (prod, heep, lumi, etc.) then enter target type.
   - A list of the information that will be entered into the run list will appear. Enter the accepted PreTrig 1,3,5 info on the run sheet. If the information looks correct, enter `yes`.
   - A prompt asking for comments will appear, please enter the number of Λ events and any other comments about the run here.
   - The Emacs window containing the run list should automiatically update, if it does not, simply hit `C-x C-v` then `Enter`.

(g) **If you need to look up the statistics from a previously replayed run:**

- All scaler information is saved in `OUTPUT/scalers_`*run_number*`.txt` and the canvas of kinematic data is saved as `Kinematics_`*run_number*`.pdf` Look at the pdf to get the $K^+\Lambda$ statistics.
- All histograms displayed on the GUI, along with several others showing spectrometer acceptance cuts, coincident timing cuts, random subtraction cuts, and missing mass profiles for π, K, and p are stored in the `UTIL_KAONLT/Histograms/` directory.

4. **Heepcheck runs:**

There is a special analysis script for $p(e, e'p)$ coincidence runs. To execute it:

(a) Enter the correct working directory via `go_analysis`

(b) Enter script directory `cd UTIL_KAONLT`

(c) Execute $p(e, e'p)$ script `peepYield.sh`

Anomalously large missing momentum components or missing mass either indicate an issue with the entries in *standard.kinematics* or some other problem with the spectrometer or beam settings.