Hall C User Howto

HALL C Møller Step-By-Step Guide - How to take a Møller Run (includes special instructions for SANE)

Howard Fenker and Dave Gaskell

February 11, 2009

Abstract

A step-by-step guide for shift personnel to follow in order to take a Møller run. It is assumed that the polarimeter has already been set up and tuned for the present beam energy by an expert.

This HOW–TO assumes that the Møller quads are already ON, our normal condition for SANE. For a more detailed HOW–TO, see: `http://hallcweb.jlab.org/document/howtos/moller_sbys/`

1 HOW TO TAKE A Møller RUN

This document describes the steps to be taken by a Hall-C experimenter performing a Møller beam polarization measurement during SANE. Normally, SANE runs in "combined optics" meaning the Møller quads are already on and part of the nominal beam optics. There is a complimentary procedure[1] which the MCC operators will follow.

1. **Verify the Cryo status**: Before you start any part of the Møller measurement procedure, check the Møller cryo status. If both the liquid nitrogen and liquid helium levels in the Møller cryostat (shown

[1] `http://opsntsrv.acc.jlab.org/ops_docs/online_document_files/MCC_online_files/HallC_moller_pol_measurement_proc.pdf`

on the above screen) are about 40% or higher, the solenoid is cold and ready to go. If not, fill them if you are qualified, or consult a Møller cryo expert to fill them for you. The Møller cryo screen is available on cdaql1.

(a) `cd MEDM/moller/CRYO`

(b) `medm -x hcmcryo.adl`

2. **Møller GUI**: if not displayed already, bring up the main Møller screen:

   (a) Login: ssh cvxwrks@cdaql1. Standard **cvxwrks** password.

   (b) `cd MEDM/moller`

   (c) `medm -x moller.adl`

   (d) You should now see the main Møller control screen.

3. **Møller HV**: make the Møller high voltages are on. If the HV GUI is not already up:

   (a) Login: ssh cvxwrks@cdaql1. Change directory (cd $EPSHV/tk).

   (b) `./HV_moller.tcl`

   (c) You may need to wait a while (sometimes several minutes) before the GUI appears.

   (d) Do not turn on any detectors yet.

4. **Møller BPMs**: if not displayed already, bring up the relevant BPM screen:

   (a) Log in and change directory (cd MEDM/moller) as above.

   (b) `medm -x BPMs_for_moller.adl`

   (c) You should now see the Møller BPM screen.

5. **Call MCC**: tell them that you are getting ready for a Møller run and need beam OFF to retract the poplarized target and ramp up the Møller solenoid. MCC will turn off the beam and inform you that it is OK to procede.

6. **Change target Position**: While ramping the solenoid (see below), make sure the polarized target ladder is in the carbon, empty, or crosshair position.

7. **Turn off slow raster**: Also make sure to turn off the slow raster - inform MCC that you are going to do this and that you will turn it back on at the completion of the Møller data taking. The slow raster can be turned off in the electronics room, the NIM module labelled “SR SWITCH” in rack 3H03B14.

8. **Ramp Up the Solenoid**: if the solenoid is not already at field, you will need to ramp it up to 3 T. It will take about 12 minutes to ramp up. Under `Solenoid Control` on the Møller GUI screen:

   (a) Press `SDBY` and wait until `HEATER` is `ON` and `STATUS` changes to `STANDBY`.

   (b) Set Field to 3.000 (Tesla) and Ramping Speed to 8.000 A/min.

   (c) Press `GO SET` and observe field ramping up.

   (d) Later, to ramp field down, press `GO ZERO`, and, when field is down, press `OFF` to turn off heater.

9. **Beam Tune**: The beam requires tuning into and after the polarimeter.

   (a) The Møller expert should have made a log entry with a screen snapshot of the tuned settings for the system. Locate that log entry for reference.

   (b) Verify that the quad currents agree with those from the reference log entry.

   (c) Inform MCC when the solenoid field stabilizes. They will then continue with the Møller setup procedure.

   (d) MCC will establish beam and center it to within 0.5 mm of zero at 3C16, 3C17, and 3C17a, with the positions on these three BPMs within 0.5 mm of one-another. The beam at 3C18, 3C19, and 3H00 should be within 3-4 mm of center (a very loose requirement).

   (e) MCC should contact you when this is completed.

   (f) Verify the final BPM positions:
   3C16 = (3C17 $\pm$0.5 mm) = (3C17a $\pm$0.5)
   $|$3C16$|$ $\leq$ 0.5 mm $|$3C17$|$ $\leq$ 0.5 mm $|$3C17a$|$ $\leq$ 0.5 mm
   $|$3C18$|$, $|$3C19$|$, $|$3H00$|$ all $\leq$ 4.0mm.

10. **Turn Beam OFF**: request MCC to turn off beam to Hall-C so that you may insert the Møller target. (NB: this is NOT the same as moving the experiment target, and does NOT require masking any FSDs.)

11. **Ready Møller Detector**: Referring to the tune snapshot, verify that the Møller collimators are within 0.05cm of their tune positions.

12. **Insert Møller Target**: from the Møller GUI, select target 1 (10 μm thick). Targets 2 (4 μm thick) or 3 (20 μm thick) should not be used unless you have received specific instructions from the Møller expert.

13. **Turn on Møller Detectors**: While inserting the target, go ahead and turn on the Møller detector HV.

14. **Beam current**: By default NEVER take more than 2μA beam on a Møller target.

    SANE will take Møller data at close to the nominal current for the experiment running, in this case, 100 nA.

    Note that, in general, low currents in Hall C will require reducing the current using the "slit". Make sure the slit position has not changed during the Møller tuneup process.

15. **Turn Beam ON**: request MCC to turn beam ON to the Møller run current (80-100 nA).

16. **Check Møller Scalers**: observe the rates by running `./ratemon` on cdaql6 from the moller directory (`/home/cdaq/moller`). The left and right singles rates should be in the 100-1000 kHz range. The coincidence rate should be roughly 10% of the singles rate (at LEAST 5%), and the accidental rate should be no more than 5% of the coincidence rate.

    Also use `./scalerwatch` to make sure all scaler banks are counting (`/home/cdaq/moller/scalerwatch`). Pay special attention to channels 7 and 39 - these are the real coincidence scalers and should be roughly equal.

    If one scaler bank is not counting, you will need to reboot the IOC. This can be done using the usual rebootpanel: press the button labelled `Moller VME`.

17. **Setup the Data Acquisition**: you will need to change the mode of the DAQ for Møller running.

    (a) Carefully note the current status of CODA (i.e., coin, hmsonly, etc.).

    (b) Press "Reset" on theCodaMaster GUI.

    (c) Press "Config" and select "Moller" mode.

    (d) Take a test run - this will download setup info into the Møller VME crate.

18. **Take Data**: on the Møller DAQ screen, which is presently waiting for you to begin a new run, click `START`. 5 million coincidences yield about 0.7% statistical error (total number of coincidences can be found in channel 71 on `scalerwatch`).

    Once can also monitor the statistical precision achieved in a given run using the `./realmoller` tcl script found in the `/home/cdaq/moller` directory. Note that this script will provide an approximate value for the measured polarization in real time, but does not use all the corrections applied in the `FORTRAN` analyzer.

    Note that we are aiming for a measurement of the order of 1% relative precision. Hence, it may be wise to break your runs into samples of 2 million events or so if you wish to take multiple runs.

19. **Take More Data and Monitor Run Conditions**: while you have the system running, you may wish to take at least two or three runs to verify that beam conditions are stable. You may also wish to request a change of state for the half-wave plate (speak to MCC) for yet another run in order to verify your systematics. (The half-wave plate change requires agreement from any other halls taking polarized beam.)

    It is also important to be aware of any changes in the running conditions while taking Møller data. For example, changes in injector parameters (slit position, attentuator poisition, etc.) can impact the measured polarization. It is especially important to keep an eye on the beam energy; since we will be well away from the optimum Wien setting much of the time, small energy changes can have significant effects on the beam polarization. One can check the energy via epics by typing `caget HALLC:p`.

20. **Analyze Data**:

    (a) ssh cdaq@cdaql6. Standard **cdaq** password.

    (b) **cd moller**

    (c) **cd anal**

    (d) **cd sane**

    (e) **replay_moller RRRRR**, where RRRRR is the run number for Møller data.

    (f) Answer any questions asked. Non-experts shoule answer `''n''` for ntuples. The software will display the measured polarization and a number of other results. It also generates a .hbook file which may be of interest if something seems wrong with the result.

    (g) `cd hbook` and use `paw` or `paw++` to view the histograms. Running the macro `mscan RRRRR` (where `RRRRR` is the run number) will present a slide show of the more interesting histograms. The critical one for non-experts is the color surface plot showing left/right hodoscope correlation. It should show a ridge along the x=y diagonal. If this ridge is not present or is significantly off center, the polarimeter is not properly tuned. Note that since the scintillators are not very well gain–matched, the pattern may look a little chunky.

    (h) Make a log entry summarizing all of your Møller runs and the results. The value to record is the beam polarization with accidentals removed. If the polarized source setup was changed between runs be sure to make a clear note of the conditions in the hclog.

21. **Restore Conditions**: Undo whatever you did and go back to production running:

    (a) Request beam off.

    (b) Turn on slow raster.

    (c) Retract Møller target.

    (d) Turn off the Møller detector HV.

    (e) Turn off the Møller solenoid if it was off when you began.

    (f) Have MCC re-tune the beamline to data-taking condtions.

2 Troubleshooting

This section will help you deal with some common problems that pop–up from time to time.

- **One or both of the scaler banks is not counting.**

  This can usually be fixed by rebooting the VME crate. Click the “Moller VME” button on the Hall C “rebootpanel”.

  If this doesn’t seem to work, you can just walk into the electronics room to reset. Go to the lowest crate in the rack furthest to the left as you face the Møller electronics (rack 13). Push the “reset” button on the left-most module in that crate.

  You may need to do this more than once. You may also need to kill RunControl and start it again.

  On very rare occasions, rebooting does not work, and we need to power cycle the whole crate. Please consult with the Møller expert before you do this though.

- **I can’t get RunControl up and running - it keeps failing with some kind of “ET” error.**

  This happened once before and was resolved by logging out of the DAQ computer altogether and logging back in. I have no idea why this worked, but it’s something to remember in case we run into this problem again.

3 Møller Run quick reference

1. Verify Møller cryo status ok.
2. Bring up Møller GUI, BPM, and HV screen.
3. Call MCC to request setup for Møller run.
4. Ramp up the solenoid, turn off slow raster, and move polarized target ladder to "empty" position.
5. Watch MCC steer beam and verify positions near 3C17 are close to 0.0 mm.
6. Turn off beam, put in Møller target (position 2 by default), and turn on Møller detector HV.
7. Ask for $\approx$ 200 nA.
8. Check M oller scalers using `./ratemon` and `./scalerwatch`.
9. Set up RunControl for Møller running and take data ($\approx$ 5 million events).
10. Analyze the data (`./replay_moller RRRRR`).
11. Log your results.
12. Backout:
    - Møller detector HV off.
    - Turn on slow raster.
    - Ramp down Møller solenoid.
    - Retract Møller target.
    - Restore RunControl to production conditions.
    - Tell MCC to restore beam tune to pre-Møller conditions.