

Procedure for measuring the beam polarization with the Möller polarimeter

Version 1.8

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1 Before start

- Reasonable quality beam must be already present for Hall-B
- Beam has to be terminated on the tagger-yoke dump
- CLAS12 is OFF, especially sensitive detectors: HV on **Drift Chambers** and **SVT/MVT**

2 Setup

1. Notify MCC that you are about to do Möller run and **request to take the beam to the tagger yoke beam dump** (they will need to take the beam away and energize the tagger magnet), MCC will ask to change BTA setting to "photon"
2. Ask MCC to turn orbit locks off, and mask BOM and Halo Counters in FSD
3. Set SLM HV to 1400 V (use "High Voltage" control GUI from "Beamline" pull down menu in expert mode)
4. A multiple control GUIs in expert mode are used turning ON the polarimeter (for now).

NOTE: BEAM SHOULD BE OFF DURING the SETUP of MÖLLER POLARIMETER

Möller setup GUIs can be launched from the **Moeller** tab on the "*clascss*" GUI.

- (a) the "Moeller Asym - All" GUI, see Fig.1, contains all the helicity gated scalers, charge asymmetry, and the beam polarization¹. It has several controls for the measurement and monitoring:

Buttons "Start", "Reset" and "Stop" will start and stop acquisition of data or reset acquisition (clear scaler buffers).

The acquisition time controls update frequency of the scalers, measured polarization value, and the charge asymmetry value. It is recommended to have Möller polarimeter acquisition time > 60 seconds when taking the measurements. For practical reasons, at the start when charge asymmetry may need a tuning (see below) time for the scaler update can be set to ~ 10 seconds. The time can be set either by typing a value in the box or moving the slider.

¹The polarization and charge asymmetry have GUIs their own, but for now this main GUI will be used.

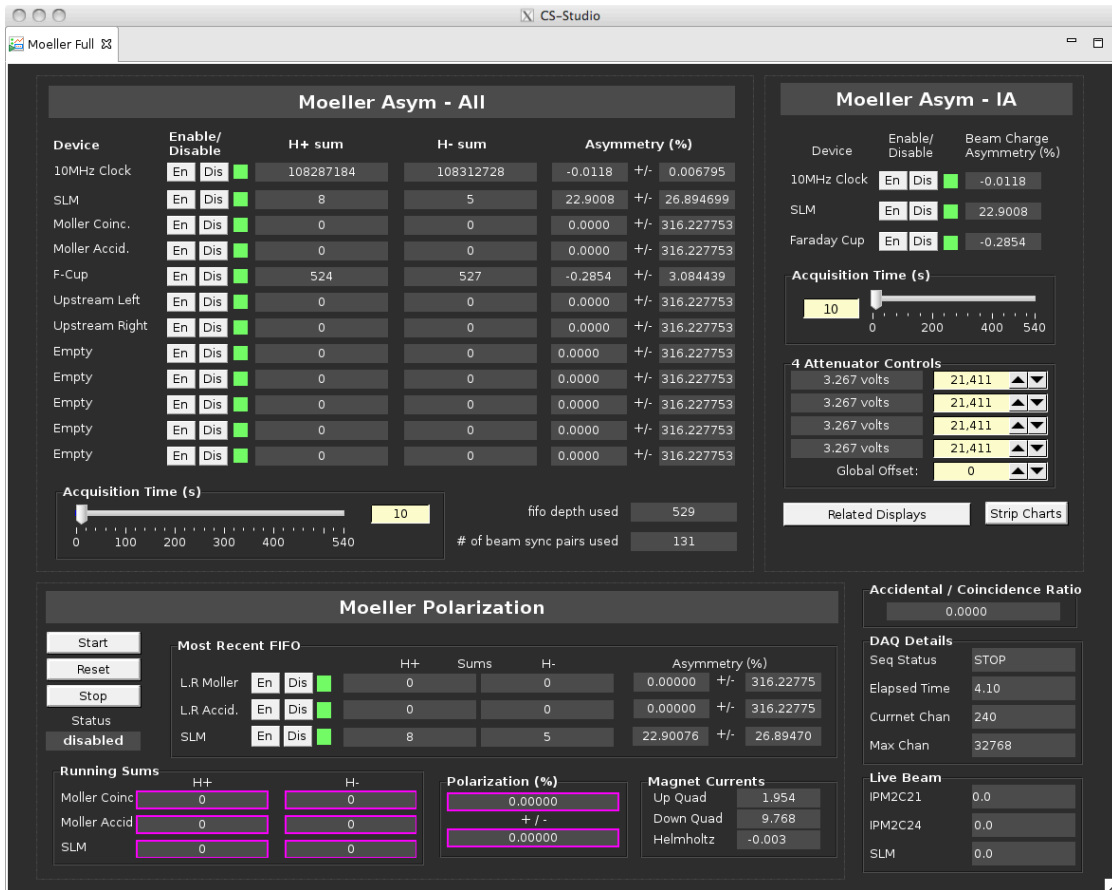


Figure 1: The main Möller Epics expert GUI.

The "Attenuator Controls" are to control beam charge asymmetry. By changing voltage on intensity attenuators (IA) one can equalizes intensity across the helicity states. It is recommended to use "Global Offset" that will change voltage on all four IAs at the same amount. Desire charge asymmetry is $< 0.1\%$ based on SLM rates.

- The control for Möller quadrupole power supplies are provided in "Moeller Quadrupoles" GUI, see Fig.2. Power supplies will be on and in remote mode before hall closing. From GUI one should first turn them ON by pushing the "PS ON" buttons, then set the desire value for currents in "Current Setpoint" window. For 10.7 GeV the suggested value for the quadrupoles is 3050 A, for 6.4 GeV suggested current is 1350 A.
- The target is polarized to its saturation by a longitudinal (along the beam) magnetic field generated using a pair of Helmholtz coils. It is expected that the target will be saturated at ~ 1.8 A current in the coils. The recommended current for Möller measurement is 3.5 A. A GUI for power supply of Helmholtz coils, "Moeller Helmholtz PS" see Fig.3, has two controls, button "STATE" defines state of the power supply. Typically it will be in "STANDBY" state when is not in use. To energize coils first from the pull down menu in "STATE" chose "PS ON", then in "Current Setpoint", a white window, write the value, either 3.5 A or -3.5 A. Beam polarization measurements with both orientations of the Helmholtz field is recommended to check systematics, check with RC.
- a target control GUI, Fig.4, allows to position desired target on the beam. Left target is the recommended target for the measurements.

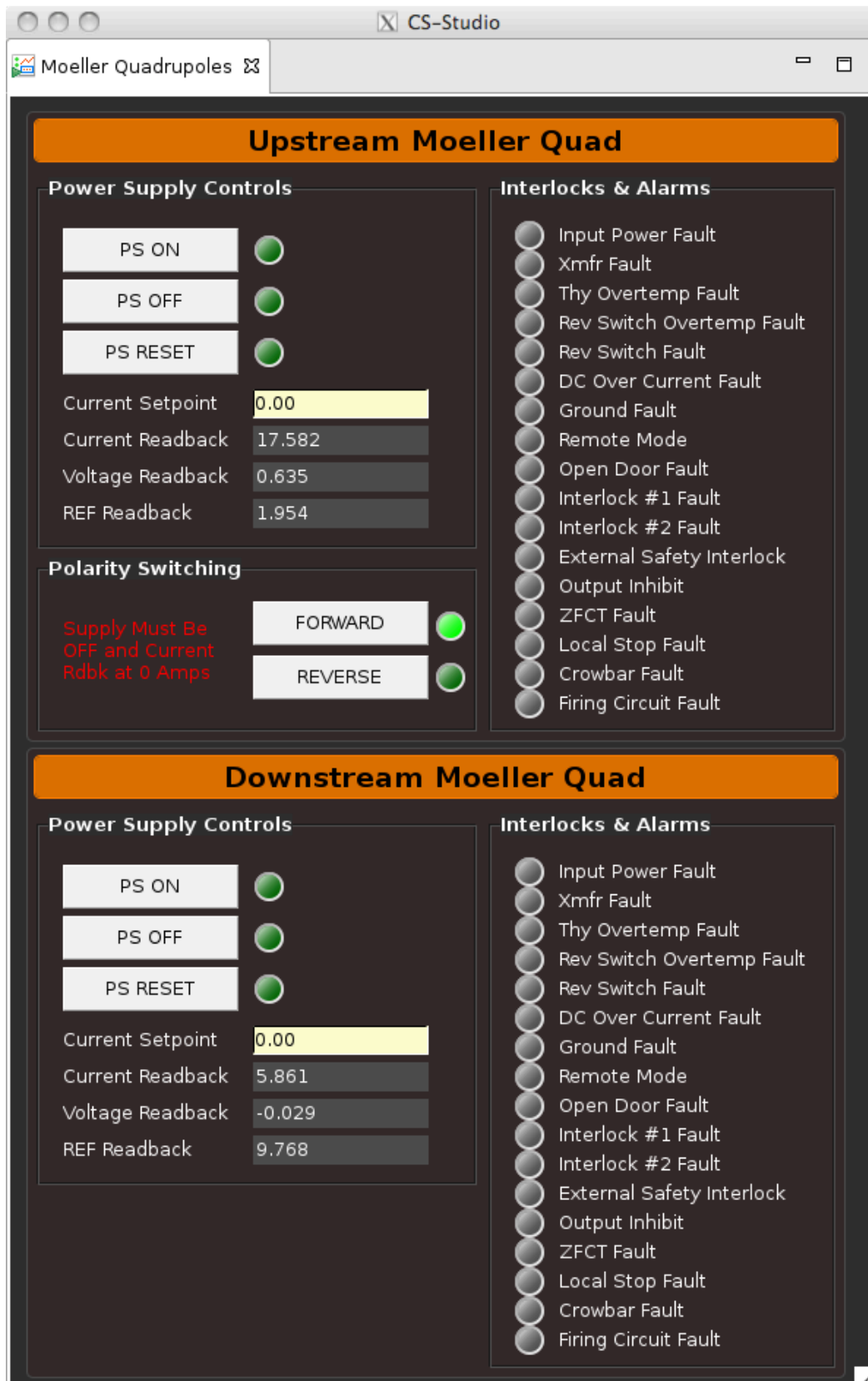


Figure 2: Control GUI for the Möller quadrupole power supplies.

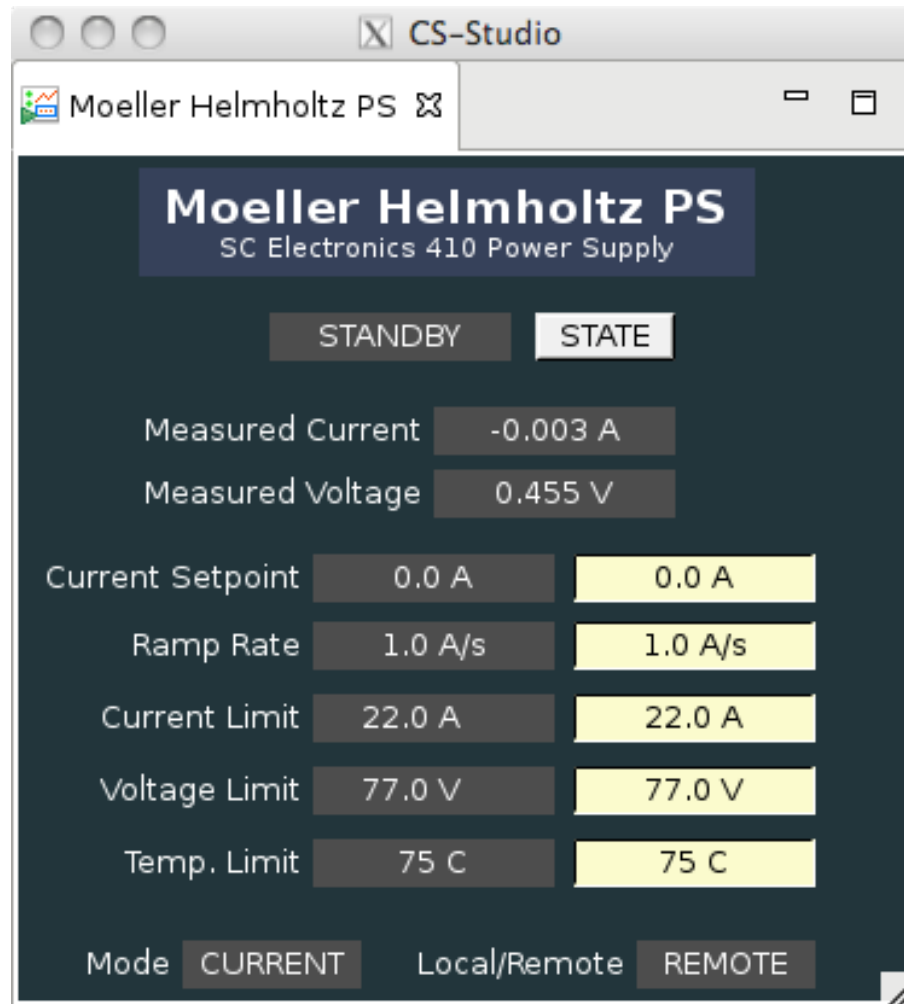


Figure 3: Control GUI for the Möller target Helmholtz coils power supply.

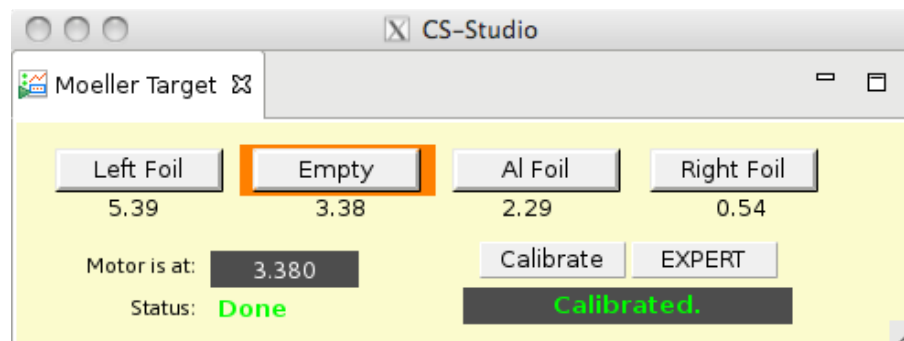


Figure 4: Control GUI for the Möller target.

5. Once the tagger magnet is energized, Möller setup is UP and ready, request a beam current as specified for the given energy Möller measurement to be delivered². The beam current value is set by 2C21 nA BPM. Do not use 2C24A since that BPM is located downstream of the Möller setup. For ~ 11 GeV beam, if beam conditions are normal, as expected, the beam current should be 4 nA. Regardless of what currents are specified on the white board or in this document, the ratio $Left \otimes Right$ accidentals to the true coincidence rate should be kept below 5%. It may be necessary to adjust the HV on the Left and Right PMT's to achieve a low accidental rate, while maintaining a reasonable true rate.

3 Data Taking

- To start a new run when DAQ is still running hit the "Reset" button on "Moeller Asym - All" GUI. If run was stopped hit the "Start" then "Reset".
- Run is complete when the error on the beam polarization on the GUI is below $\leq 1.5\%$ absolute. Typically it takes about 45 min to 60 min to get the required accuracy (beam condition dependent).
- Log measurement by sending the "Moeller Asym - All" GUI to the logbook together with main scaler GUI to document beam currents, beam position, and halo counter rates.
- The data for each buffer will be written in a file. File gets open at "Reset" and will close at "Reset". After logging, press "Reset" to close the file for that Moller run.
- If needed (RC decision) perform measurements with both positions of the half-wave plate, "IN" and "OUT" (start the first measurement with whichever position it is, then do the second measurement with the other setting).
- If needed (RC decision) perform measurements with both polarity of the Helmholtz coils.

4 Backing off Möller setup out

When done with the measurements:

- Do not forget to make a log entry including all details and the GUI!
- Request MCC to take the beam away and **de-gauss the tagger magnet if the next step is to send the beam to Faraday cup (usually it is)**.
- Turn off quadrupoles by setting 0 in "Current Setpoint"s and then when current readback is at ~ 0 A push "PS OFF" buttons
- Turn off Helmholtz coils by setting 0 in the current "Current Setpoint" and change the "STATE" to "STANDBY" when "Measured Current" is ~ 0
- Retract the target by pushing "Empty" button on the target GUI
- Set SLM HV back to 1100 V (use "High Voltage" control GUI from "Beamline" pull down menu in expert mode)

²The optimal beam current is a function of beam energy. More specific information may be available on the white board in the counting house or in the run period specific documentation on the run wiki.

- Once tagger magnet is degaussed, restore beam to the Faraday Cup.
- Turn ON CLAS12