Procedure for measuring the beam polarization with the Möller polarimeter

Version 1.5

S. Stepanyan

February 13, 2018

0.1 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**

0.2 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. Turning ON the polarimeter is done from EPICS GUIs (for now multiple control GUIs in expert mode are used).
   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 polarization[1]. 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 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 will need 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.

---

[1]The polarization and charge asymmetry have GUIs their own, but for now this main GUI will be used.
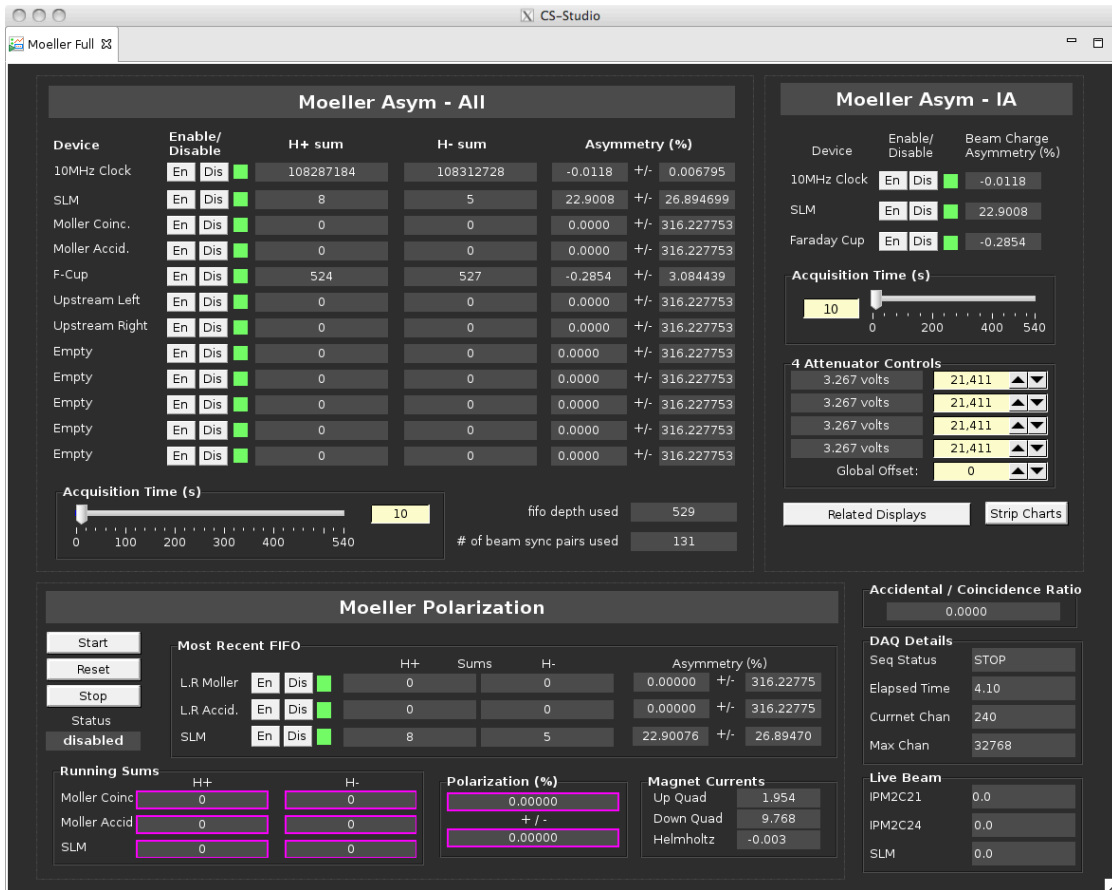
Figure 1: The main Möller Epics expert GUI.

The "Attenuator Controls" are to control beam charge asymmetry. By changing voltage on intensity attenuators (IA) one can equalizes intensity across 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.

(b) The control for Möller quadrupole power supplies are provided in "Moeller Quadrupoles" GUI, see Fig.2. Power supplies will be turned ON and in remote 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.

(c) The target is polarized to its saturation by a longitudinal (along the beam) magnetic field generated using 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 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. Typicaly it will be in "STANDBY" state when is not used. To energize coils first from the menu in "STATE" chose PS ON, then in "Current Setpoint", a white window, write the value, either 3 or -3. Beam polarization measurements with both orientations the Helmholtz field is recommended to check systematics.

(d) a target control GUI, Fig.4, allows to position desired target on the beam. Left target is the recommended target for the measurements.
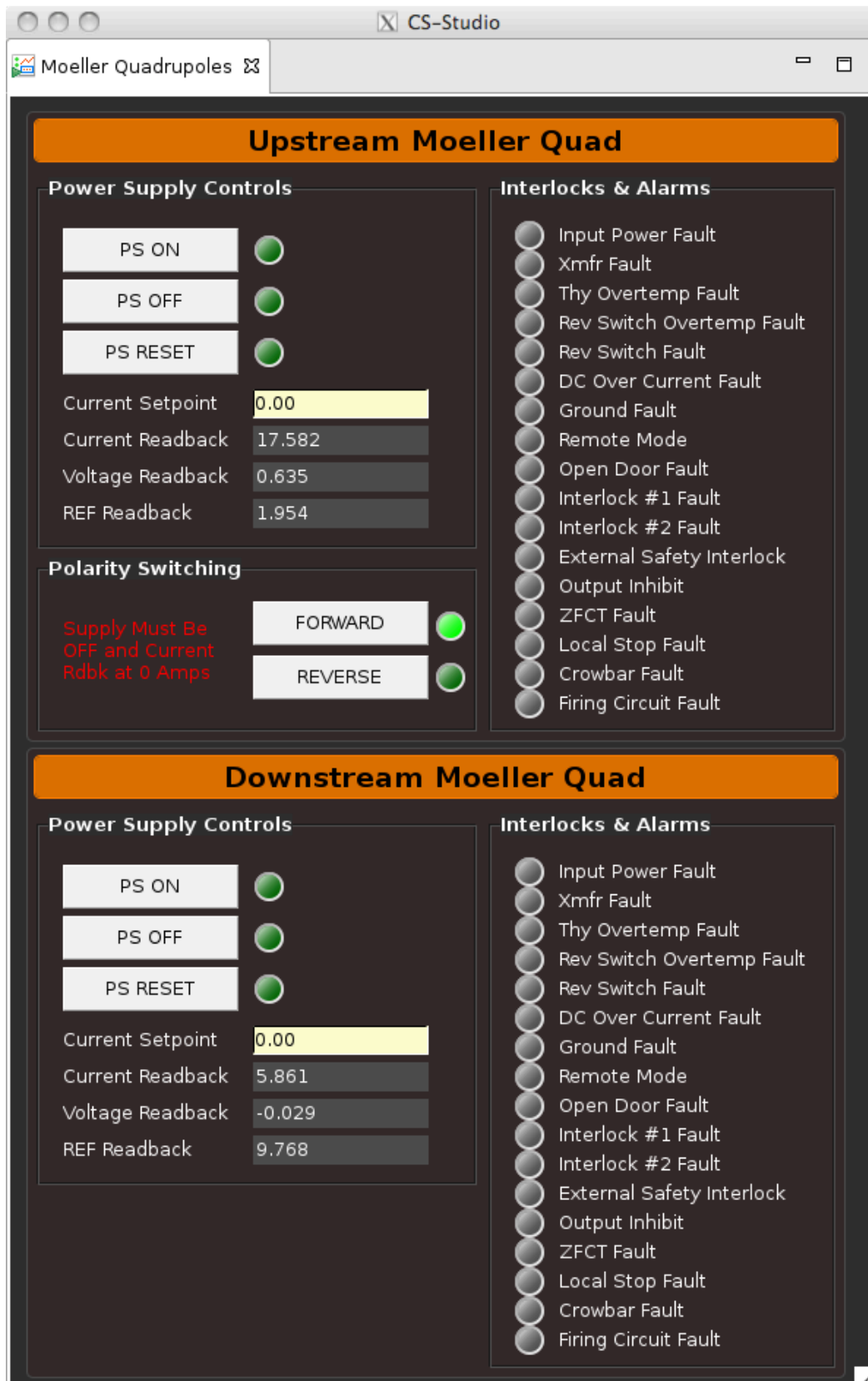
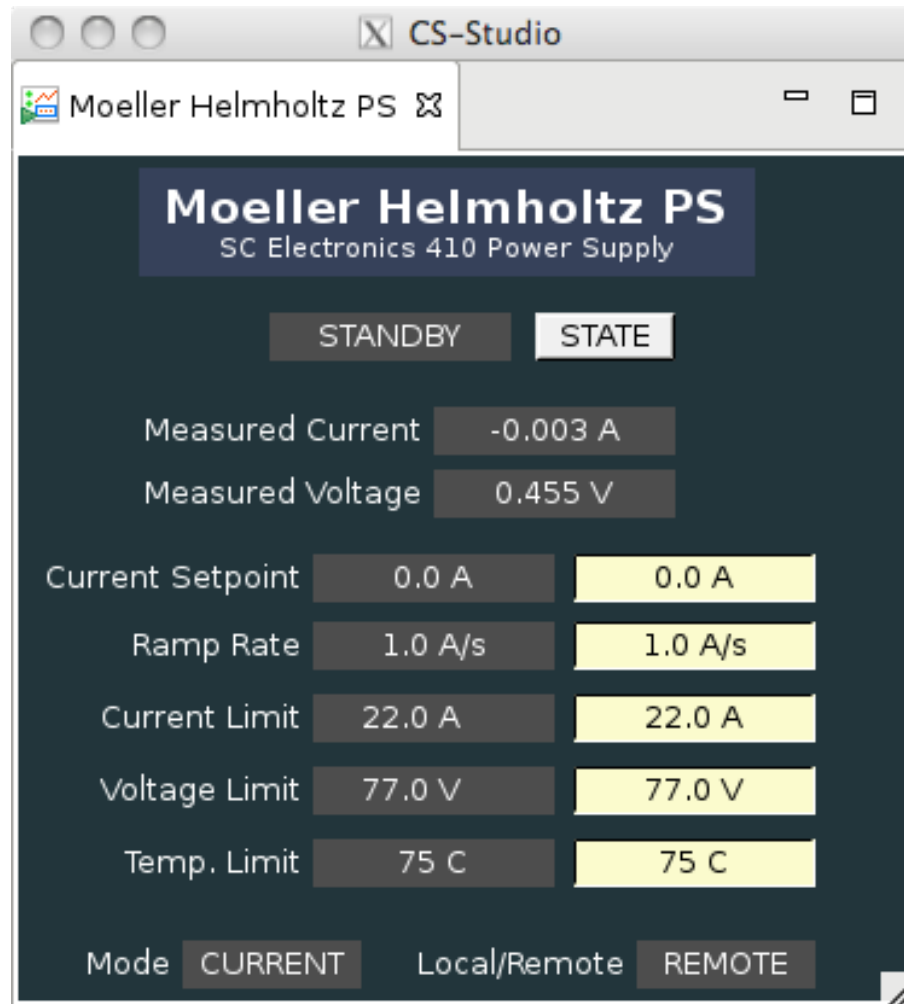Figure 2: Control GUI for the Möller quadrupole power supplies.

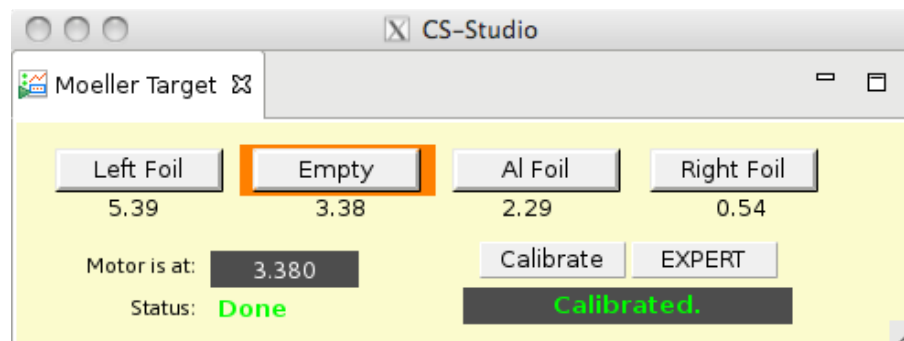Figure 3: Control GUI for the Möller target Helmholtz coils power supply.

Figure 4: Control GUI for the Möller target.

4. Once the tagger magnet is energized, Møller setup is UP and ready, request the beam current as specify for the given energy Møller measurements to be delivered[2], as measured by 2C21 nA BPM and/or SLM. 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.

0.3 Data Taking

- To start a new run when DAQ is still running hit the "Reset" button on "Moeller Asym - All" GUI. If run was stoped 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).

- Make 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 perform measurements with both polarity of the Helmholtz coils.

- Log every measurement by sending "Moeller Asym - All" GUI to logbook together with main scaler GUI to document beam currents, beam position, and halo counter rates.

0.4 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" button

- Turn off Helmholtz coils by setting 0 in the current "Current Setpoint" and change "STSTE" to "STANDBY" when "Measured Current" is ∼ 0

- Retract the target by pushing "Empty" button on the target GUI

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

- Turn ON CLAS12

---

[2]The 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. 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.