Online Target Polarization Monitoring

CLAS Collaboration Meeting

November 1, 2022

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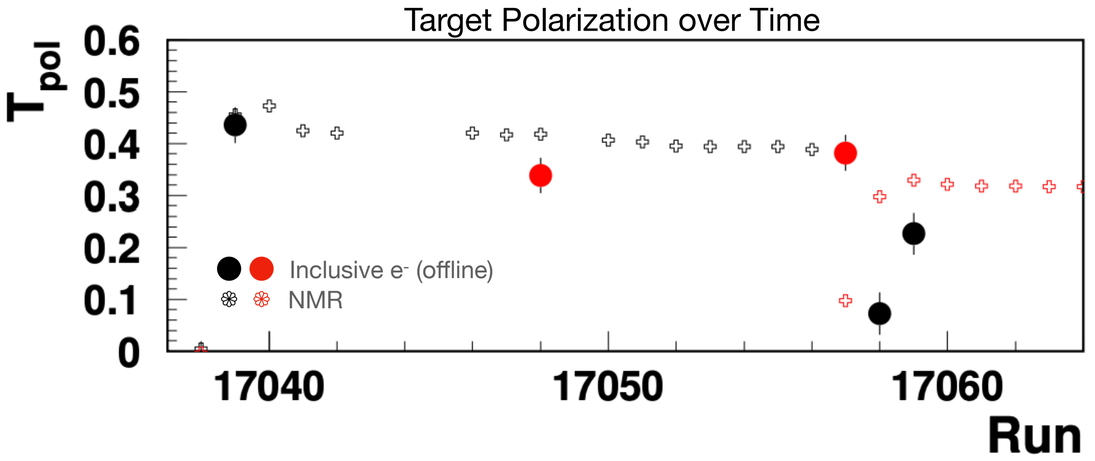
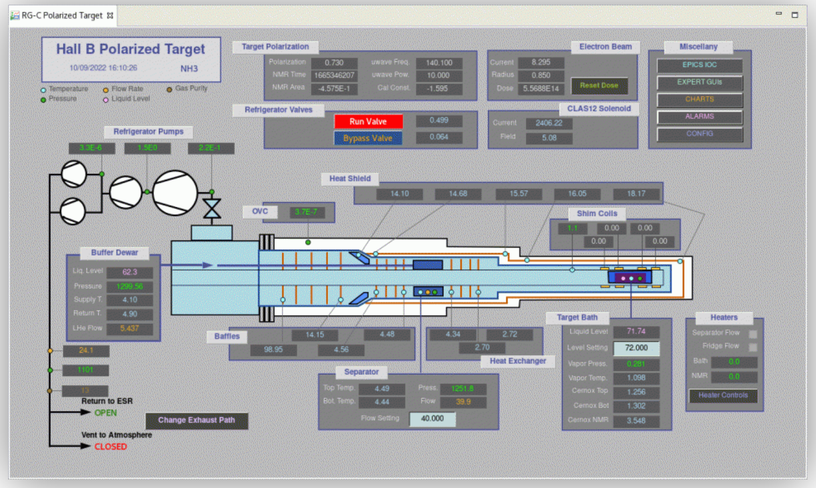
Motivation

- **RG-C is the first CLAS12 experiment requiring both polarized beam and target**
- Beam polarization is measured with our traditional means, intrusive, dedicated Moller runs every few days
    - generally known to be stable unless there's significant changes to accelerator parameters
- Target polarization is measured constantly, in situ with NMR
    - monitoring it is critical for guiding run decisions, e.g., target changes, annealing, dose effects
    - *however, NMR and the electron beam can probe significantly different regions of the target*
        - ***so a supplemental, independent, online measurement was desired***
- Various, well-known scattering reactions, even inclusive, can be used to extract target polarization ...
    - But feedback turnaround for online operations isn't ideal, as those measures currently require:
        - compute time (offline currently, but online would usually be slower with available resources, even w/o moving data, given the statistics required for these particular measurements)
        - offline analysis, and maybe good calibration in some cases
    - ***Any other useful, faster options?***





An Idea - Trigger Rates as a Proxy

- **Derek Glazier had an idea:** The RG-C trigger is inclusive electrons, and *maybe its purity/contamination is sufficient for trigger-bit-helicity-asymmetries to serve as a proxy to inclusive electron scattering and be sensitive to target polarization*, at least as a relative measure?

- Delayed-helicity correction was already being performed in L3 DAQ, so we added tallying helicity-latched trigger-bit scalers in L3 and sending them to EPICS periodically

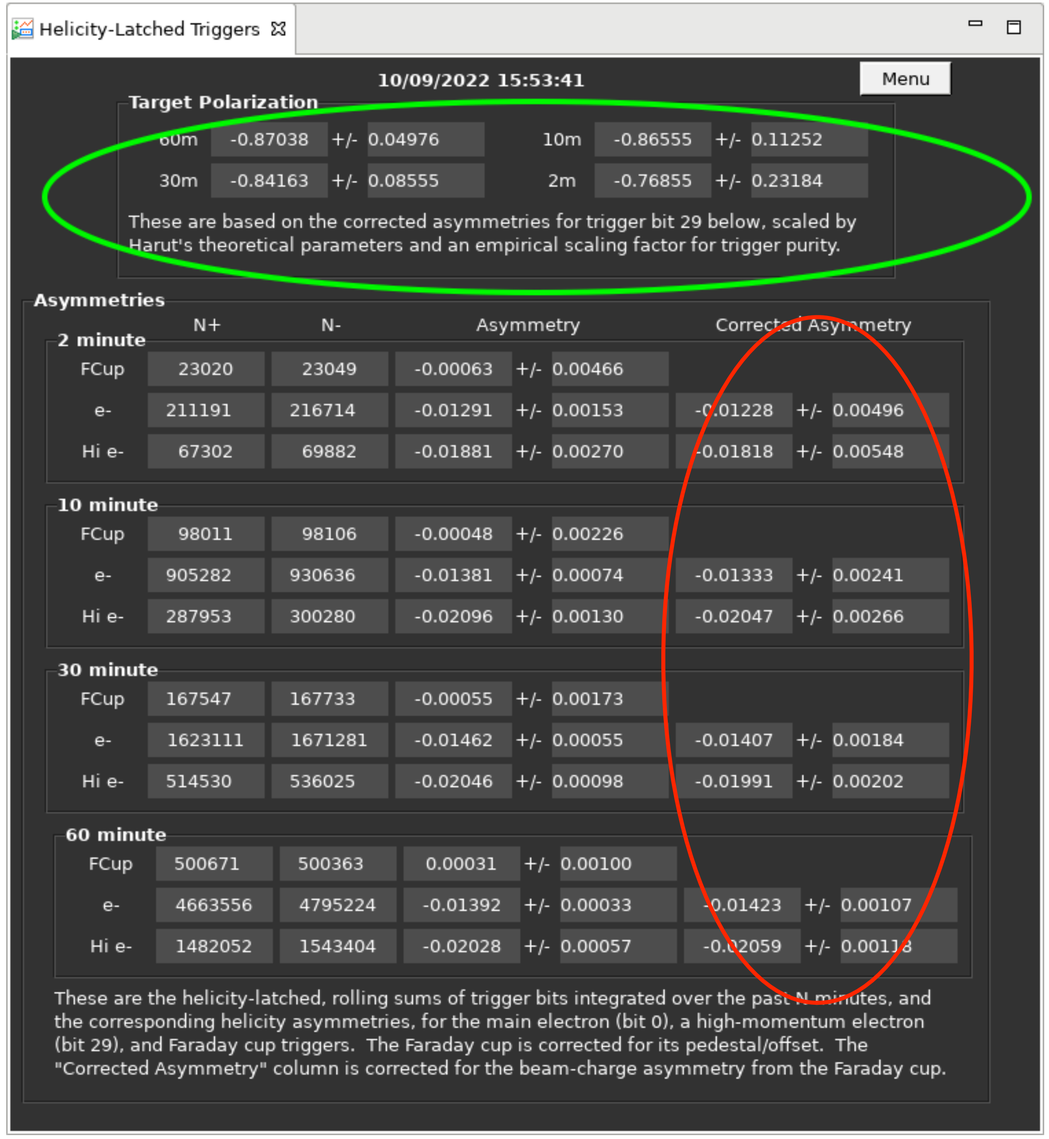
    - Could instead do a more hardware-based approach very similar to our Moller runs, sending trigger pulses instead of Moller L/R coincidence/accidentals, but RG-C was already running and the software approach was attractive and non-invasive, at least to see if it works ...

    - Set up some running averages over the previous N-minutes to accommodate different running conditions. We also setup a higher-threshold electron trigger to increase purity.

- ***Turns out, it seems to work pretty well.***

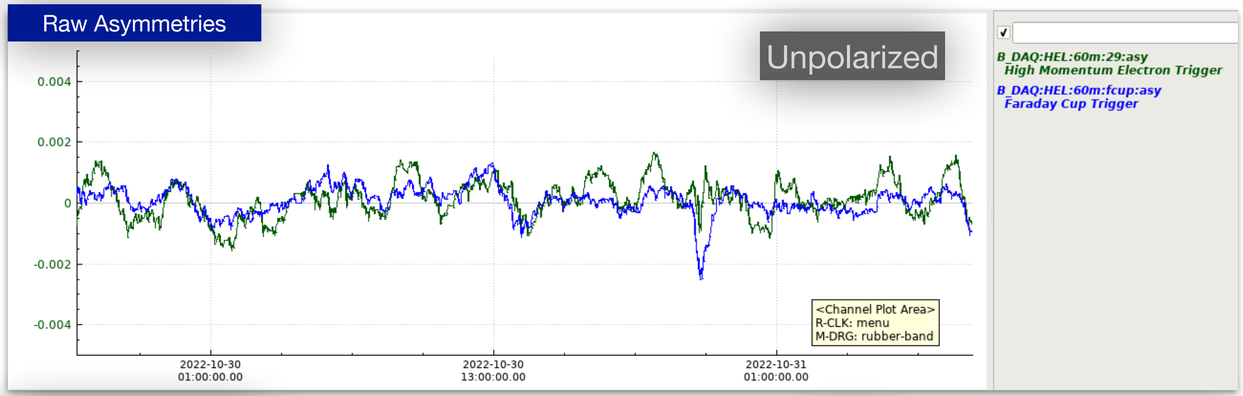
    - We also correct it for beam-charge asymmetry (which was much larger a few weeks ago) based on Faraday cup trigger rates.

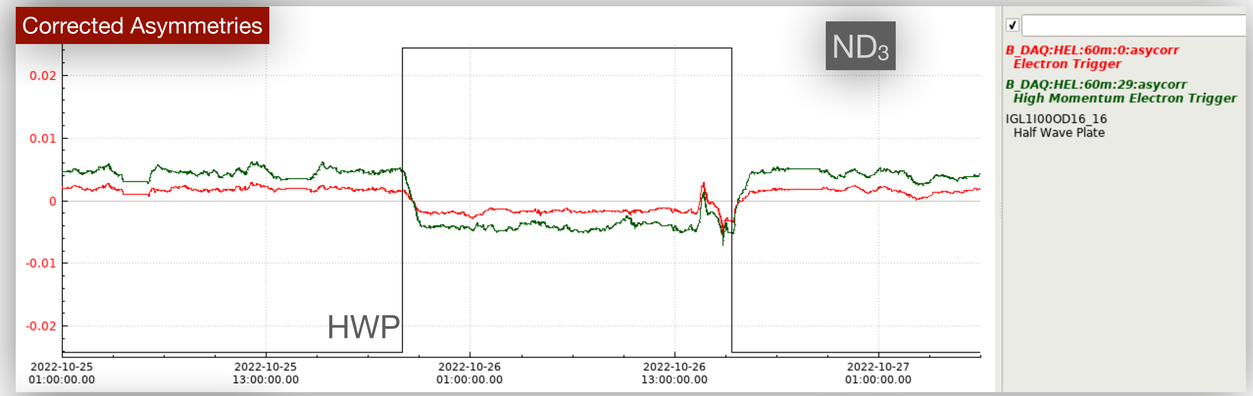
    - We also eventually calibrated it to Harut's inclusive e⁻ asymmetries to convert it to an absolute target polarization.

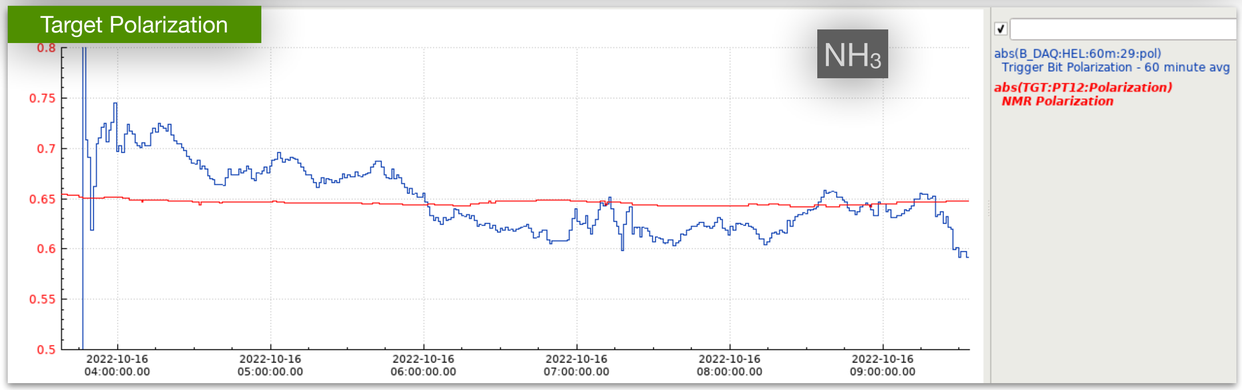


Results

- Sanity checks
  - ☑ sign inverts when Half-Wave Plate is inserted or target polarization inverted
  - ☑ on carbon/unpolarized targets, physics asymmetry negligible and largely tracks with beam charge asymmetry
  - ☑ beam charge asymmetry from Faraday cup triggers agrees with offline helicity scalers (after offline software fixes!) and other online measures
- *Relative changes are consistent with inclusive electron scattering.*
- ***On some targets/configurations, shows a polarization decay faster than the NMR, which was the prime motivation for this measurement.***
- Note ...
  - Even though we convert to target polarization, it's still best interpreted as a relative measurement, e.g., even the more rigorous physics analysis that conversion is based on are still being understood.
  - These are rolling sums over N-minutes, to give faster feedback, updating once per minute, so points within N minutes of each other are correlated. And, hence the smooth transition after discrete changes, e.g. HWP.
- Currently we only have access to prescaled (17x) Faraday cup triggers. One improvement would be to get the non-prescaled version, as the beam charge asymmetry is currently the dominant source of statistical uncertainty.







Questions?