Straightforward calculation of PbPt @ RG-C w/ DIS A_{LL}

- Per run we express the event-by-event probability

$$\mathcal{P}_i(x_i, Q_i^2) \propto (1 + \lambda_i A_{LL}(x_i, Q_i^2) f(x_i, Q_i^2) [P_b P_t])$$

- with event *i* and $\mathbf{P_b P_t}$ as a parameter we are fitting to

For each run we have a **FCUP⁺** and **FCUP⁻** for helicity +/- , so we define weights

$$w^{\pm} = \frac{\mathrm{FC}^{+} + \mathrm{FC}^{-}}{2\mathrm{FC}^{\pm}}$$

So that the log-likelihood is written by $\mathcal{L} = -\sum_i w_i \ln(\mathcal{P}_i)$

I use `iminuit` with python to fit for $P_b P_t$

Obtaining A_LL and Dilution

- The A_LL were obtained a while ago binned in (x,Q^2) from Sebastian
  - An interpolator was used to create a function for $A_{LL}(x,Q^2)$ so that an A_LL is obtained event-by-event
- The dilution factors were recently obtained from Derek, also binned in (x,Q^2)
  - Another interpolator was used to create a function that return the dilution factor AND its error given (x,Q^2).
- To fold the dilution factor into the log-likelihood error, we define a systematic error which is half-the-range of using **d+d_err** and **d-d_err** for extracting PbPt
  - For larger runs, this error contributes on the order of 10% w.r.t statistical errors

DIS Cuts

We loop over all events in a file's `sidisdvcs` train, searching for a scattered e^-

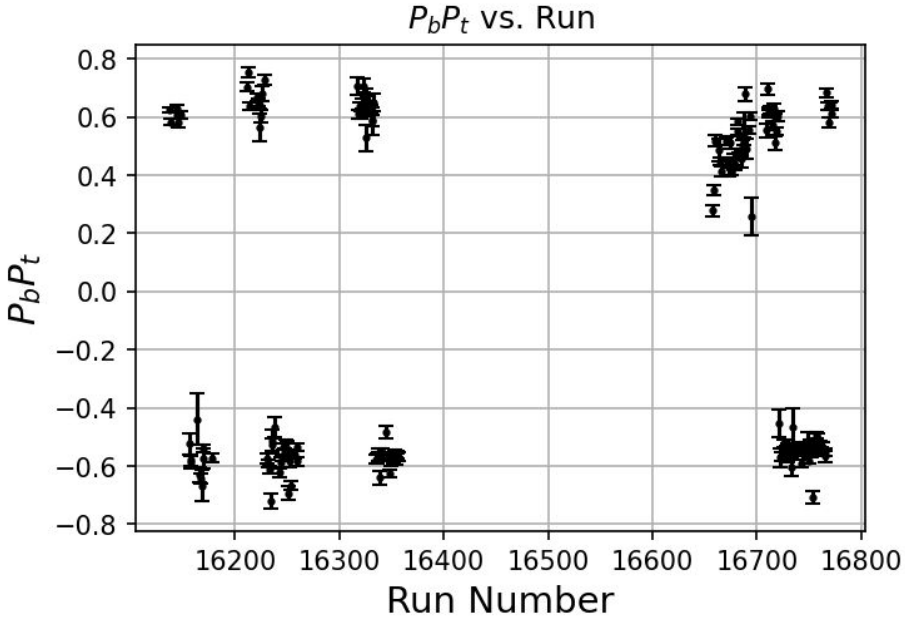
- $E_e > 2.6$ GeV
- $5 < \text{Theta}(e) < 35$ [deg]
- $\text{abs}(Vz_e + 4.5\text{cm}) < 4\text{cm}$
- $W > 2$ GeV

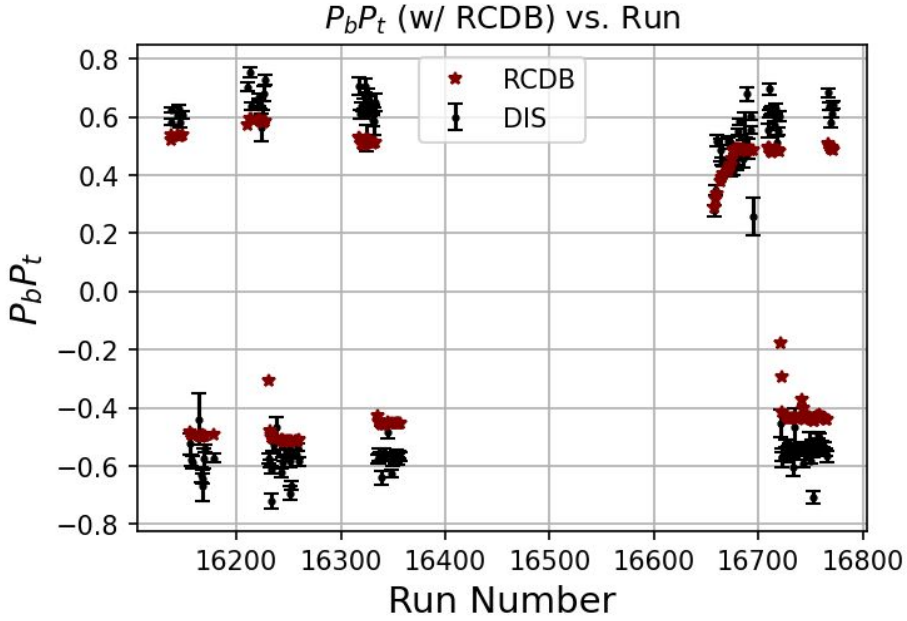
For each file's `sidisdvcs` train, we extract $FCUP^+$ and $FCUP^-$ by reading HEL::scaler and summing the **fcupgated** for hel==1 and hel==-1, respectively

$P_b P_t$ vs. Run Number

In the following plots, we assume the beam polarization is 85% → RCDB gives P_t so we multiply by 0.85 to give an "RCDB $P_b P_t$"

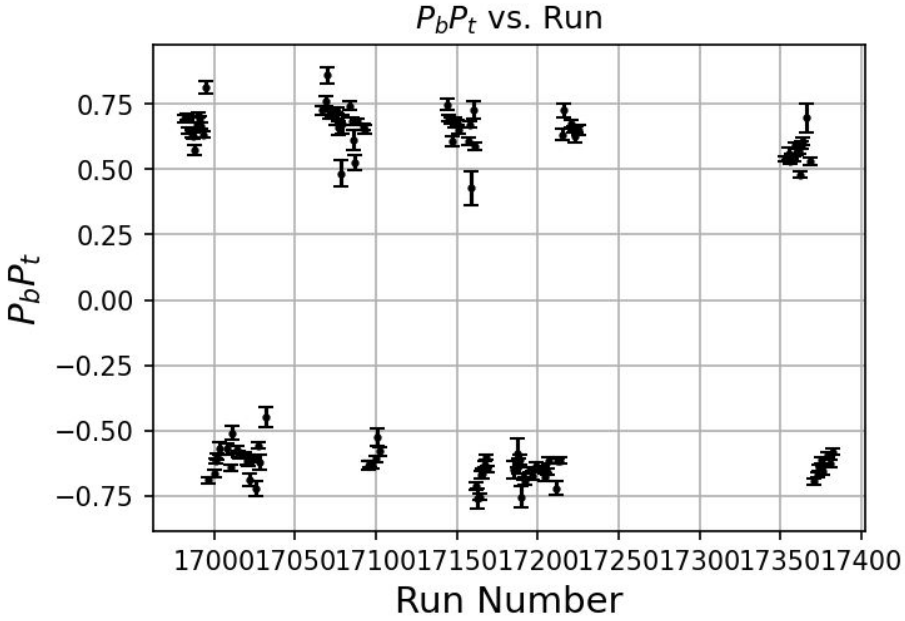
RG-C Summer 2022

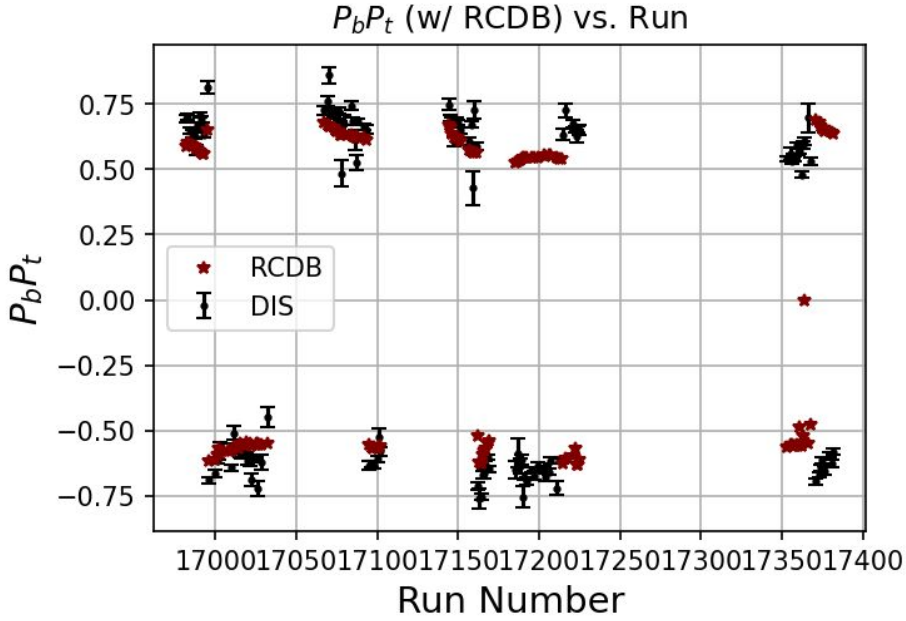




/work/clas12/users/gmat/RGC_Tpol_maxLikelihood_summer22_4_16_2025.csv

RG-C Fall 2022

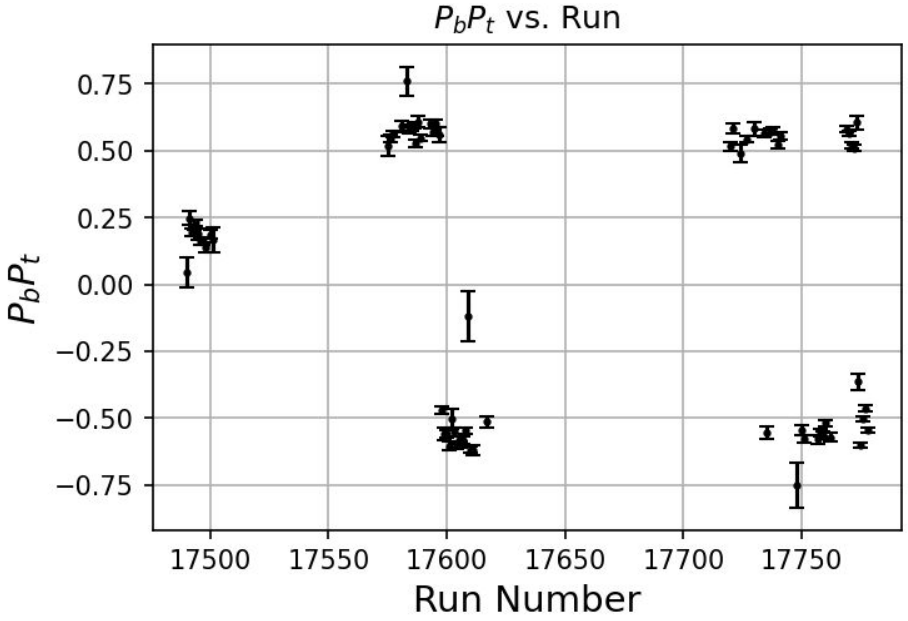


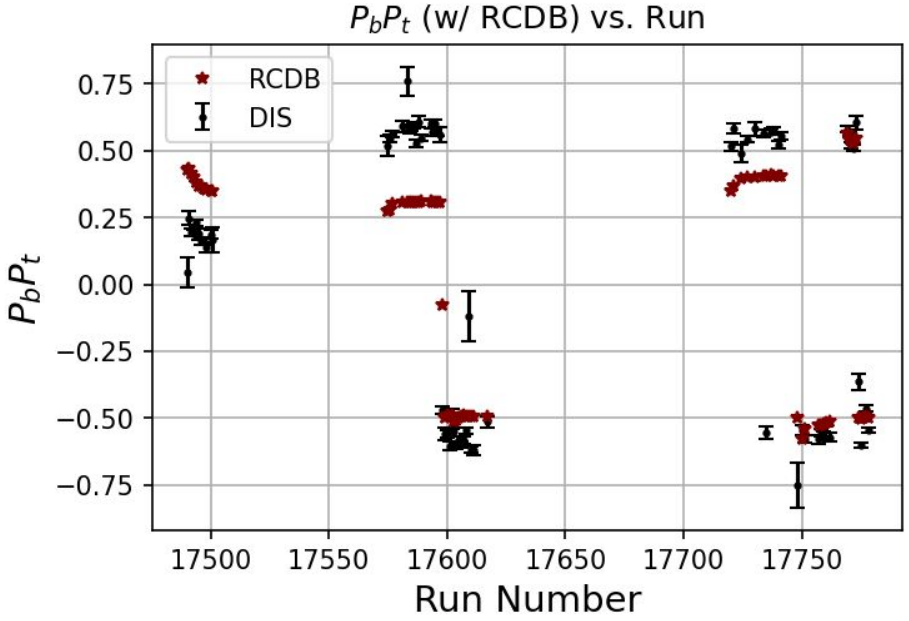


/work/clas12/users/gmat/RGC_Tpol_maxLikelihood_fall22_4_16_2025.csv

** Note the solenoid flip around the half-way point (RCDB and DIS PbPt are opposite) **

RG-C Spring 2023



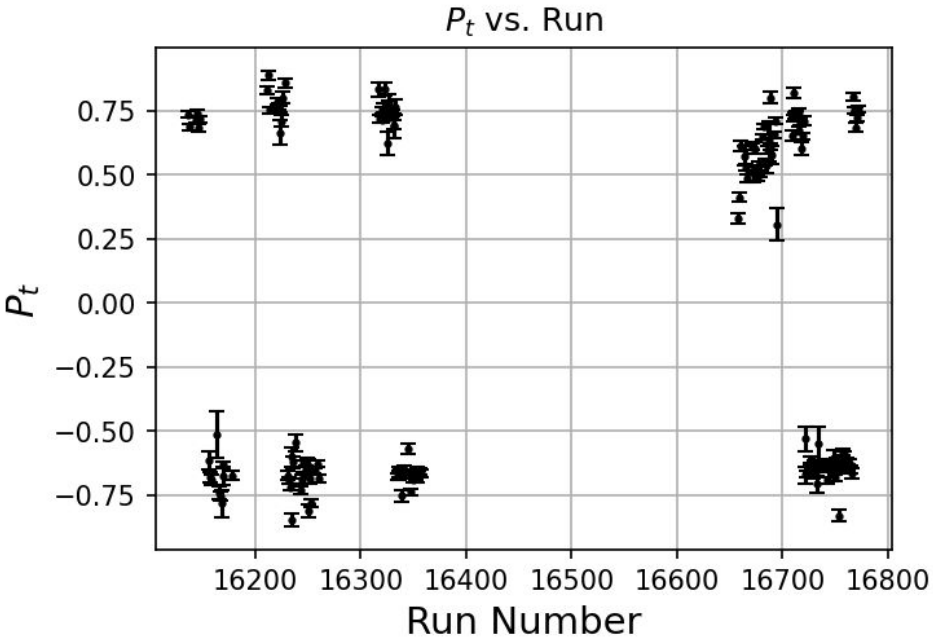


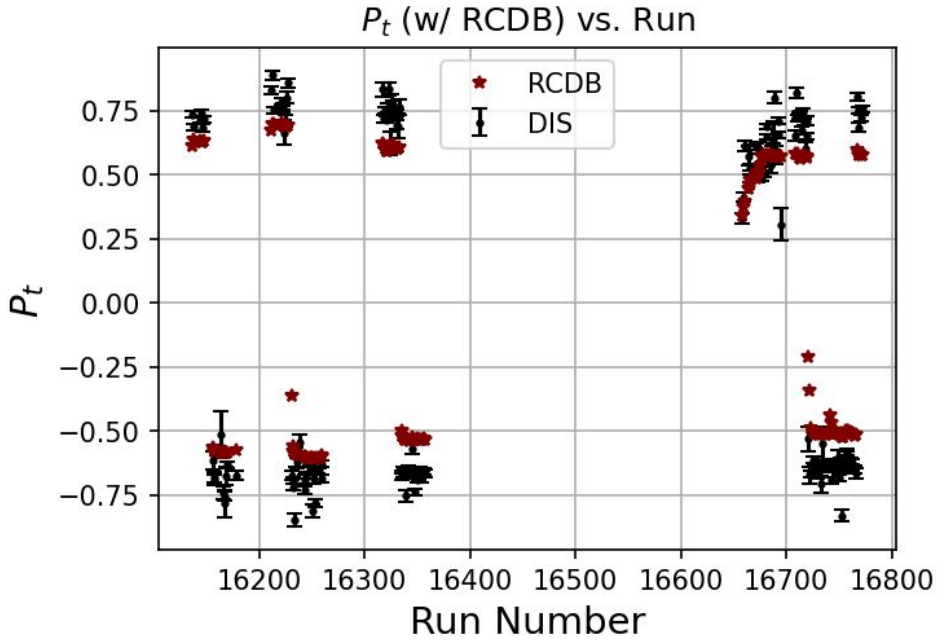
/work/clas12/users/gmat/RGC_Tpol_maxLikelihood_spring23_4_16_2025.csv

P_t vs. Run Number

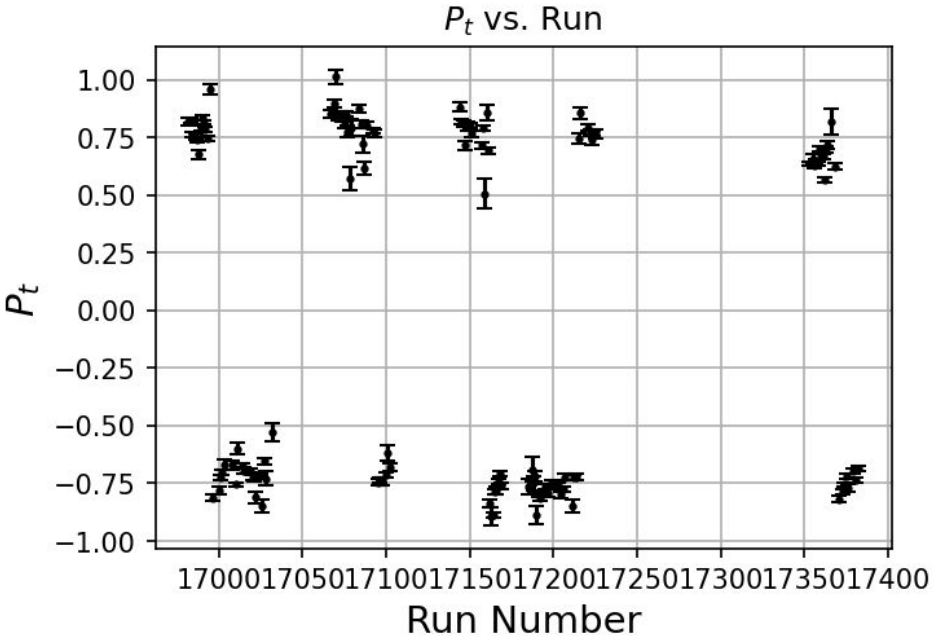
In the following plots, we assume the beam polarization is 85% → DIS A_LL gives $P_b P_t$ so we divide by 0.85 to yield the P_t

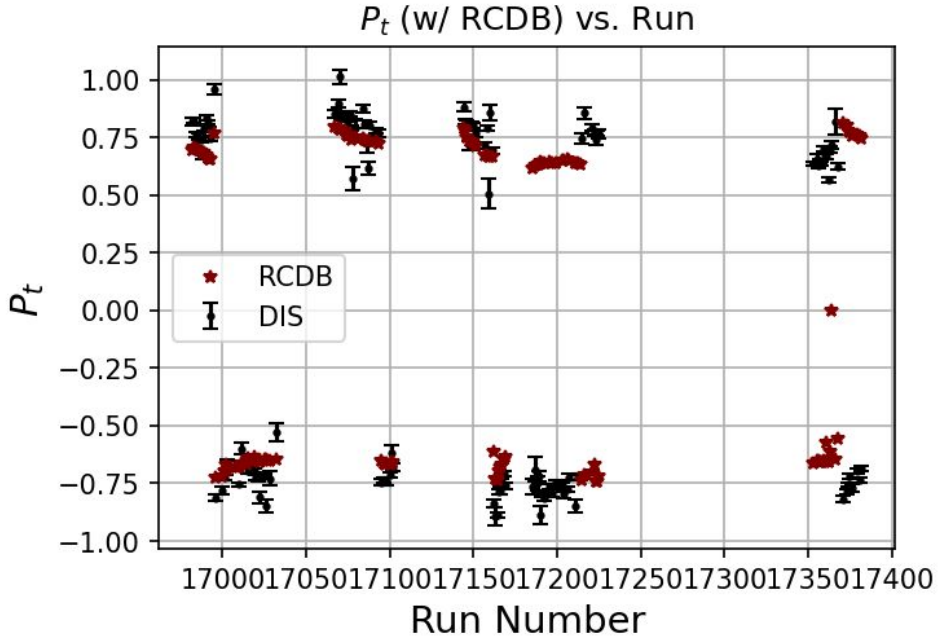
RG-C Summer 2022





RG-C Fall 2022





RG-C Spring 2023