RSIDIS Analysis Meeting 2026-09-21 12:16(GMT-4:00)

Key Outcomes

The meeting focused on finalizing Pass 1 replay readiness across multiple detector calibration and analysis workstreams. The team agreed to use **average aerogel gain parameters** (rather than online values) for both Phase 1 and Phase 2, with a future run-dependent correction to be applied offline for Phase 1's time-varying gain behavior. Zichen pushed new aerogel calibration profiles and submitted a pull request by the end of the meeting. Ryan and Bhishm presented early-stage optics correction work on **XPTAR/YPTAR data-simulation comparisons**, with the group converging on a fitting-based correction strategy parameterized by delta bins. Provakar indicated that Pass 1 replay could begin the following day, pending yield stability checks from the team.

Aerogel Calibration Status (Zichen)

- **Method:** All SIDIS runs were selected and chained in **6-round batches by time order**, run through the same simulation script used previously, to extract **gain vector values for all 14 aerogel Cherenkov (AC) channels**.
- **Outputs plotted:** Mass ratio to the online value, mass ratio to the Phase 2 average, and offset (each batch value minus the online value).
- **Phase 2 behavior:** Generally stable; periodic drops observed but deemed less concerning — likely artifacts of kinematic changes affecting pion-to-proton ratio and contamination sensitivity, not a fundamental calibration issue.
- **Phase 1 behavior:** Clear time-dependent trend — gain factors are **larger at the beginning** and drop progressively across the entire phase. This is the primary concern.
    - Dave noted the drop is a **smooth, continuous variation**, not a discrete jump, making it difficult to implement as a simple step-change in parameter files.
    - Runs 0–40 (approximately) show the most significant deviation; beyond run ~40–60, a single average calibration is considered acceptable.

- **Fixed vs. variable fit range:** A second version of the calibration was run using a **suggested fit range** (as opposed to the default), with that being the primary script difference between the two variants.
- **Batch robustness:** ~200 batches covering ~1,200 runs total; a small number of batches may have issues (e.g., calibration running during data-taking), but the majority are expected to be valid.
- **Decision — Phase 2:** Use the **average calibration** across all Phase 2 runs.
- **Decision — Phase 1:** Also use the average for now, but apply a **run-dependent correction to the number of photoelectrons post hoc**, stored in the lookup table, to account for the smooth gain drift.
    - Dave: "You could put it in the bigtable. Yeah, yeah, sure. That would be the best thing to do."
- **Pull request:** Zichen pushed two new aerogel profiles and submitted a pull request during the meeting (his first PR); Provakar to follow up offline to confirm it is correctly structured.

Timing / Hodoscope QA (Radwan)

- **Phase 1 QA runs:** Only 8 runs; coincidence time plots reviewed and deemed acceptable — no problems identified.
- **Phase 2 QA runs:** A known anomaly ("bump") was present and acknowledged by the group as a pre-existing issue.
- **New plots reviewed:** Coincidence time vs. HMS XFP and coincidence time vs. SHMS XFP.
- **Beta HMS issue:** An abnormal beta distribution (4:00–5:00 region) traced to **paddle 1x positive side, paddle 11**, which intermittently drops out. Taking the two-sided average distorts the mean slightly.
    - This issue does **not** appear to corrupt the coincidence time in a way correlated with acceptance — confirmed from plots, though the plots are not detailed enough to be definitive.
    - Identified as a **hardware problem**; may require a software fix if it turns out to be acceptance-correlated. Flagged as a potential **Pass 2 correction**.
- **Recommendation:** Continue making detailed coincidence time plots (narrowed to the main peak region) to monitor and confirm the hardware nature of the issue before concluding no software intervention is needed.

BCM / Beam Current Monitor Checks

- **BCM 1 and BCM 2:** Match within **0.5% consistently** — considered good.
- **BCM 4A and 4C:** Consistently high relative to 1 and 2, but this is irrelevant above 60 µA since BCM 4C saturates in that regime; the experiment will use **BCM 2** as the primary reference.
- **Pending check:** Behavior around **30 µA** has not yet been verified — flagged as a personal to-do for Radwan; not a blocker for Pass 1.
- **Average BCM branches validation:** Dave suggested plotting current vs. event number from the T-tree and comparing to the scalar tree as a qualitative sanity check; one or two runs is sufficient if the implementation was done correctly.

Pass 1 Replay Readiness & Infrastructure

- **Replay speed:** Pass 1 covers ~3,000 runs and is expected to complete within **10 hours** after recent fine-tuning.
- **Start condition:** Provakar plans to start Pass 1 replay the following day, contingent on yield stability sign-off from the team by end of day.
- **Calibration inputs confirmed as complete:** BPM parameters, BCM, calorimeter timing, drift chamber, Cherenkov, hodoscope timing, aerogel.
- **Validation step:** Once Zichen's aerogel pull request is merged, Provakar will replay a list of **~50 runs** spanning the full run range as a quick check before submitting the full replay.
- **Yield stability check:** Team asked to review DIS and SIDIS yield stability for the full run collection using existing scripts; results expected by end of day.

Schema Files Update (Radwan)

- **Status:** Nearly complete; full presentation planned for Thursday.
- **Key enhancement:** Schema files will now include **reconstructed branches**, enabling kinematic offsets and ad hoc optics corrections (e.g., delta corrections) to be applied **post hoc** without re-running the full replay.
    - Example use cases: correcting spectrometer angles, momenta, or applying a delta correction after the fact.
- **Beam energy handling:** Beam energy is an **input**, not a reconstructed quantity; it will be read from **report files** (generated during main replay) for use in the schema reconstruction scripts.

- **New branch to add — dipole exit:** Projects tracks back to the SHMS dipole exit to flag whether an event originates from within the dipole aperture.
    - Particularly important for **small-angle running** where garbage candidate tracks are common.
    - Will be added as a **variable** (not a hard cut) so analysts can choose their own threshold (likely > 0).
- **Other confirmed branches:** Age/hot/good start variables, coincidence time variables, HMS/SHMS XFP branches.
- **RF time branch (Zichen's request):** Zichen noted difficulty seeing peaks from the RF time branch in the schema; Provakar suspects the issue is that the RF time must be taken **mod 4 or mod 2** depending on the bunch structure, not that a new branch is needed.
    - Action: Zichen to attempt plotting using the existing RF time branch (mod operation) within two days; will only escalate to adding a new branch if genuinely impossible.

Optics Corrections — XPTAR / YPTAR Data-Simulation Comparison

Ryan's Analysis

- **Task context:** Investigating whether data/simulation ratios in **XPTAR and YPTAR** vary across delta bins — a precursor to deriving an explicit acceptance correction parameterized by delta.
- **Current implementation:** Delta binning is controlled via min/max values in a configuration file; switching the delta correction on/off requires only a flag change.
- **Key decision:** Dave directed Ryan to start with **no delta correction applied**, then perform XPTAR/YPTAR fits in each delta bin, and subsequently parameterize the polynomial coefficients as a function of delta.
- **Fitting approach:** Fit **fixed-order polynomials** to the data/MC ratio in each delta bin for both XPTAR and YPTAR, then parameterize those coefficients vs. delta.
- **XPTAR vs. YPTAR behavior:**
    - **XPTAR (theta):** Shape changes significantly across delta bins — correction clearly needed.
    - **YPTAR (phi):** Looks somewhat better constrained in the center, but certain delta bins still show poor agreement; Dave noted phi looks "much worse" in some cases.
- **Target/pass scope so far:** Analysis done primarily for **carbon target, five-pass, last year's data**; behavior will differ across targets and settings.

- **Cherenkov acceptance for HMS:** Bhishm confirmed **no Cherenkov acceptance correction** is needed for the HMS based on prior efficiency vs. delta studies (Cameron had flagged something, but it was resolved).
- **Coulomb corrections:** Ryan is applying Coulomb corrections by weighting cross-sections; grabbing the nearest available kinematic point for the correction factor. Different targets on the same setting yield different correction factors as expected.
    - After applying corrections, points on the current year's data come into better agreement and shift below zero.
    - Dave acknowledged uncertainty on the exact correct implementation for the interpolation tool (CalcDIS XSEC).
    - Systematic uncertainties: **1.5% estimated** on cross-section extraction for RD; **1%** on cross-section ratio extraction.

Bhishm's Analysis

- **Scope:** Full delta range (−8 to +8), Phase 1 data, carbon target, all runs in the setting included; **no delta correction applied**.
- **XPTAR:** Ratio looks good in the range approximately **−0.6 to +0.6** (or up to ±0.7).
- **YPTAR:** Ratio acceptable up to a certain range but exceeds 1 beyond that, indicating shape mismatch.
- **Proposed approach (cuts):** Bhishm suggested defining acceptance cuts based on the good-ratio region; Dave initially pushed back but reconsidered, noting it could be a **complementary approach** to explicit fitting corrections.
    - However, Dave cautioned that strict acceptance cuts are risky due to small resolution mismatches and will not fix shape mismatches in the middle of the distribution.
- **Central delta bin observation (Ryan):** Even in the central delta bin, YPTAR looks problematic — just in a different way than at the edges — suggesting the correction is genuinely delta-dependent and non-trivial.

Single Spin Asymmetry — Exclusive Contamination Systematics

- **Goal:** Estimate the systematic impact of exclusive π^+ production events (deep exclusive meson production, DEMP) contaminating the SIDIS sample on the measured single spin asymmetry.
- **Key identity:** FLU/FUU = σ_LT'/σ_0, so the relevant quantity to extract from literature is σ_LT'/σ_0 for the exclusive process at the kinematics of interest.

- **Reference data:** Alicia's paper provides $\sigma_{LT'}/\sigma_0$ as a function of t for given x and Q^2; another paper plots FLU/FUU directly.
- **Analysis approach:**
    - Identify the **vertex-level t** (not reconstructed t) of exclusive events that fall into the SIDIS acceptance.
    - For a particular theta_pq setting (hydrogen, theta_pq = 2), the **acceptance-averaged reconstructed t ≈ 1.6**, but the **vertex t ≈ 0.24** — the latter is the relevant quantity for the asymmetry lookup.
    - At t ≈ 0.24, $\sigma_{LT'}/\sigma_0$ appears to be approximately **10%** based on the referenced plots.
- **Impact estimation framework:**
    - If exclusive fraction in SIDIS sample is ~5% and exclusive asymmetry is ~10%, the contamination contribution to the measured asymmetry is ~0.5% (i.e., 5% × 10%).
    - Dave noted: if the SIDIS asymmetry itself is also ~10%, the contamination has **no net effect** — it only matters if the exclusive asymmetry differs from the SIDIS asymmetry.
    - The exclusive and SIDIS asymmetries are likely the **same sign**, which limits the worst-case impact (opposite signs would be additive).
- **Process distributions plotted:** SIDIS (black), exclusive (red), delta (blue) shown for x, xi (x_initial), Q^2, Q^2_i, and t/t_i for a given setting.
    - SIDIS: x and xi distributions are similar; small difference.
    - Exclusive events: distribution shapes change substantially — consistent with the fact that exclusive events entering the SIDIS acceptance come from a different x/Q^2 acceptance region.
- **Z distribution plots:** Exclusive/SIDIS and delta/SIDIS ratios plotted vs. Z for hydrogen, deuterium, carbon, and copper.
    - Carbon and copper show a drop in the ratio at certain Z values; hydrogen and deuterium behave similarly.
- **Delta (Δ^{++}) contamination:** Only available reference is Ali Usman's thesis from CLAS with very low precision for π^+ from the delta.
- **Multi-theta_pq settings:** Dave advised using only the **central theta_pq setting** for the qualitative systematic estimate, as differences between settings are not expected to be large enough to matter at this level of precision.
- **"Deep" exclusive definition clarified:** $Q^2 > 1$ and $W > 2$ (analogous to DIS); ensures sampling of quark structure rather than resonance production. Resonances exist above W = 2 but are assumed to average out at high W.

- **T vs. PT relationship:** Mandelstam t is analogous to PT but more complex because T_min varies with x and Q^2; plotting T − T_min is approximately equivalent to plotting PT^2.

Open Questions

- **Phase 1 gain drift (aerogel):** Root cause of the smooth gain decrease across Phase 1 is unknown; Dave flagged it as "weird" and worth understanding but not a blocker for Pass 1.
- **Coulomb correction implementation:** Exact method for applying Coulomb corrections within the CalcDIS XSEC interpolation tool is not fully resolved; Dave to think further.
- **RF time branch:** Whether the existing RF time branch (with mod operation) is sufficient for Zichen's plot, or whether a new branch is needed, remains to be confirmed.
- **YPTAR correction necessity:** Whether an explicit YPTAR correction is needed (vs. cuts) and how to implement it across all targets and settings is still being investigated.

Action Items

- **Zichen:** Generate new aerogel gain parameters using the average calibration for both phases; pull request already submitted — Provakar to review and confirm offline.
- **Zichen:** Attempt to produce the RF time peak plot using the existing RF time branch (with mod 4 or mod 2) within two days; report back by Thursday.
- **Team (all):** Review yield stability for DIS and SIDIS runs using existing scripts by **end of day** to give Provakar the go-ahead to start Pass 1 replay.
- **Provakar:** Once Zichen's pull request is confirmed, select ~50 runs spanning the full run range for a quick validation replay before submitting the full Pass 1 batch.
- **Provakar:** Start Pass 1 replay (3,000 runs, ~10 hours) the **following day**, assuming yield stability sign-off is received.
- **Radwan:** Present schema files machinery update on **Thursday**; ensure dipole exit branch is added as a variable (not a cut).
- **Ryan:** Rerun XPTAR/YPTAR analysis with **delta correction turned off**; fit fixed-order polynomials per delta bin; parameterize coefficients vs. delta for both x-prime and y-prime.
- **Team:** Apply run-dependent photoelectron correction for Phase 1 aerogel offline, stored in the lookup table, after Pass 1 replay is complete.

- **Provakar (physics):** Continue exclusive contamination systematic study — compute acceptance-averaged x, Q^2, and t for exclusive events per setting; look up $\sigma_{LT'}/\sigma_0$ at those kinematics and scale by the exclusive fraction to estimate asymmetry impact.