REPLIES TO RGB-Spring19 PASS2 REVIEW (in RED)

Charge #1: Are the quality of detector calibration and alignment adequate to achieve the performance specifications foreseen for CLAS12 or achievable at the current time, given the "state-of-the-art" calibration, alignment, and reconstruction algorithms?

FINDINGS:

The RG presented the status of data set calibration showing that the calibrations constants that will be used to reconstruct data from the CLAS12 FD components result in performance similar to Pass1, in terms of resolutions. A significant improvement was demonstrated in the calibration of CLAS12 CD components and their alignment (internal and with respect to the FD).

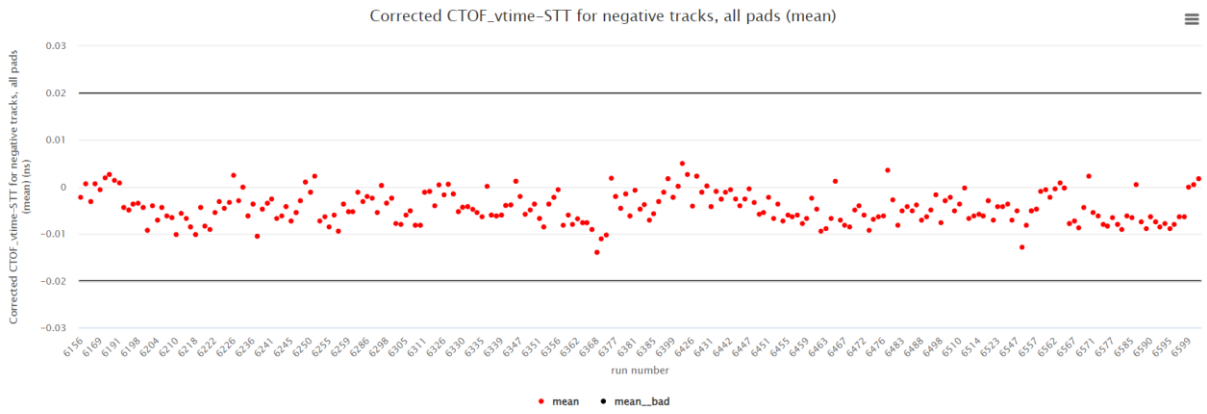
COMMENTS:

The committee found it odd that this review was called before all calibrations were completed.

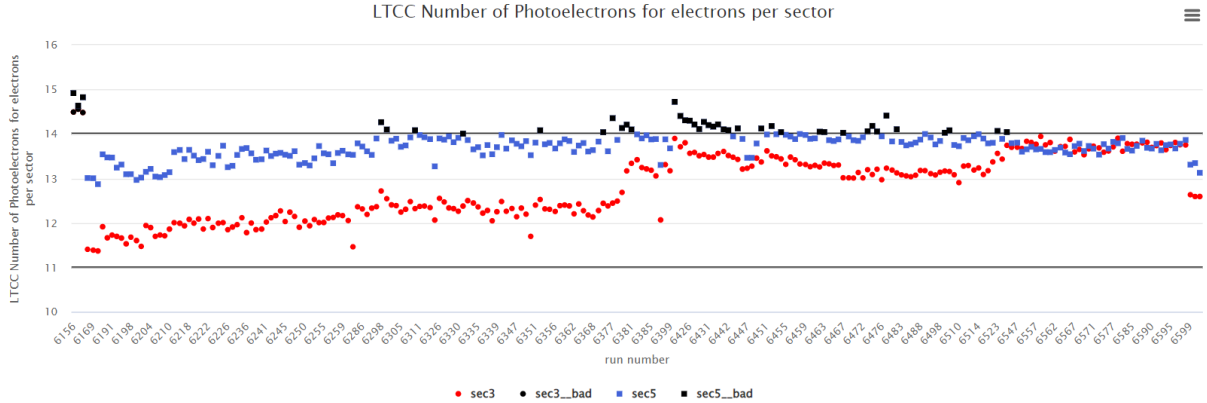
RECOMMENDATIONS:

Overall, the status is sound but, before Pass2 starts, all subsystems must be calibrated.

First of all, we are sorry about the fact that the CTOF and LTCC calibrations were not yet optimal at the time of the review. For CTOF, an unforseen slight (<15 ps) but systematic timing shift was found at the last minute, just before the review. This required further studies and in the end itw as established that more runs had to be calibrated to compensate for losses of gain of the PMTs. This problem has now been solved, as it can be seen in the CTOF timeline:



The calibrations of LTCC were improved as well, and the timelines now show that the greatest majority of the runs are within specs :



All other calibrations were within specs and without pathological behaviors already at the time of the pass2 review.

Charge #2: Is data quality as a function of run number or time for the data set proposed for pass2 cooking stable and understood? Have runs been classified in terms of type (empty target, calibration, special, production, …) and quality (golden run, known issues found during Pass1, …), and is a detailed list available? Based on Pass1 cooking, have all CLAS12 subsystem!s performances been understood and issues identified?

FINDINGS:

The RG-B timelines presented at the review demonstrate good stability (within the specs) of all CLAS12 subsystems as a function of time (or, equivalently, run numbers). A detailed list reporting run quality (golden run) as well as special running conditions (empty target, calibration, luminosity scan, …) has been provided. Problematic runs were identified and tagged.

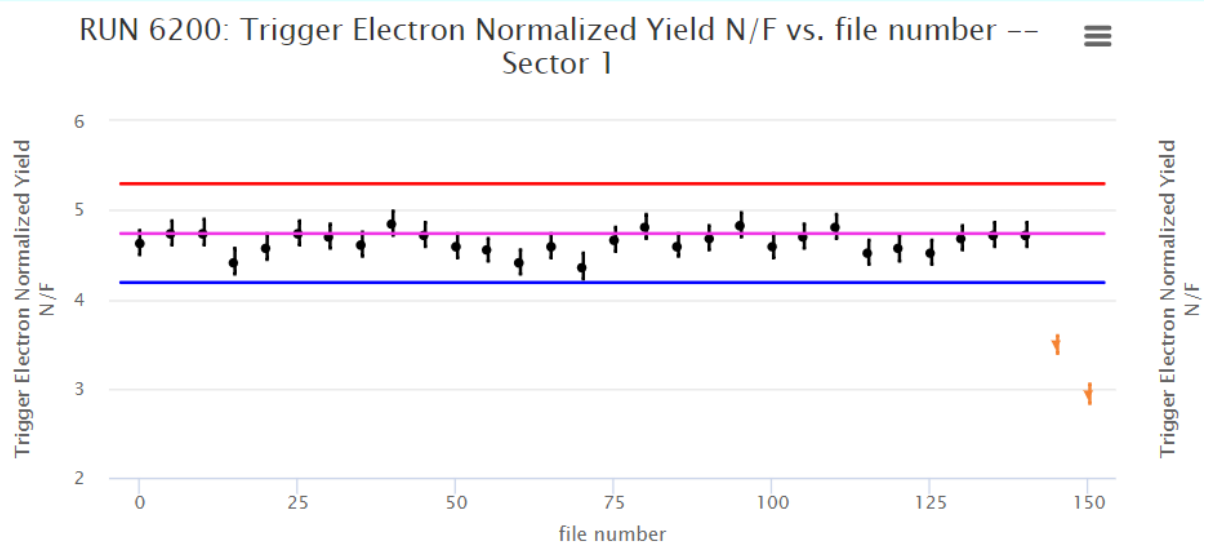
COMMENTS:

For the golden run list, the limits on event number have no explanation. Perhaps these are tallied automatically from QA violations but it would be useful to know what QA issue triggered these cuts.

RECOMMENDATIONS:

None

The limits on event numbers were determined « by hand », from the run-by-run check of the QA timelines. For each run the normalized yields were checked. Ranges of file numbers, within a run, which exhibited an anomalous normalized yield were excluded – by excluding the corresponding ranges of event numbers. See for instance, here below, the example for run 6200, where the last two groups of files (5 files per point) was excluded.



Charge #3: Has a #Hardware (HW) status table (i.e., bad channel table) for use in the MC simulation been compiled? Has the efficiency versus beam current been studied? How does it compare to MC simulations with merged backgrounds?

FINDINGS:

An HW status table has been defined for most CLAS12 subdetectors. This will help to have a better matching between data and MC simulations.

COMMENTS:

None

RECOMMENDATIONS:

The missing systems (BMT, DC, FTHODO) need to be completed before the Pass2 start.

BMT : Status tables updated on 30/11/2022 and on 15/12/2022 for RGB Spring19

DC : Status tables updated on 30/11/2022 for RGB Spring19

FTHODO : Status tables updated on 12/2/2022 for RGB Spring19

The overall summary of the readiness of tatus tables for all RG's is summarized at this link:

https://docs.google.com/spreadsheets/d/1ohrgE_MNlwoq8eew5M1p6nzdc1ZjJh5-C0tog2dVHU0/edit#gid=0

Charge #4: Are analysis plans for the data set developed at adequate levels? Is the list of planned skims defined and tested running the analysis trains on preliminary data? Is all ancillary information (helicity, Faraday Cup, …) available and understood?

FINDINGS:

Overall, the RG-B group presented a clear analysis plan that includes nDVCS, tagged DIS, SIDIS, and exclusive channels. The preliminary analysis of Pass1 data was extremely useful to define the analysis procedure for Pass2 data. Similarly, the proposed skims (with wagons for jpsi, gmn, edeut, sidis pdvcs, and two) are the same as those used to cook RGB SPRING 2020 data. The run-by-run comparison between Pass1 and Pass2 shows a significant improvement in data yield driven by the new CVT tracking code, especially for pDVCS and nDVCS. No significant improvement in resolution was found.

Two main issues remain 1) the difference in the beam charge extracted from two sets of files processed with two different versions of the reconstruction software; 2) the detailed comparison between the « old » and « new » CVT tracking code that indicates a large yield gain when the « new » less tested version was used.

COMMENTS:

The cause of the beam-charge issue needs to be understood and fixed. It is likely connected to a problem in DB manipulation and timeline filling rather than a dependence on the SW version used. The suggestion is to analyze in detail a single run that shows a discrepancy and find where it comes from.

RECOMMENDATIONS:

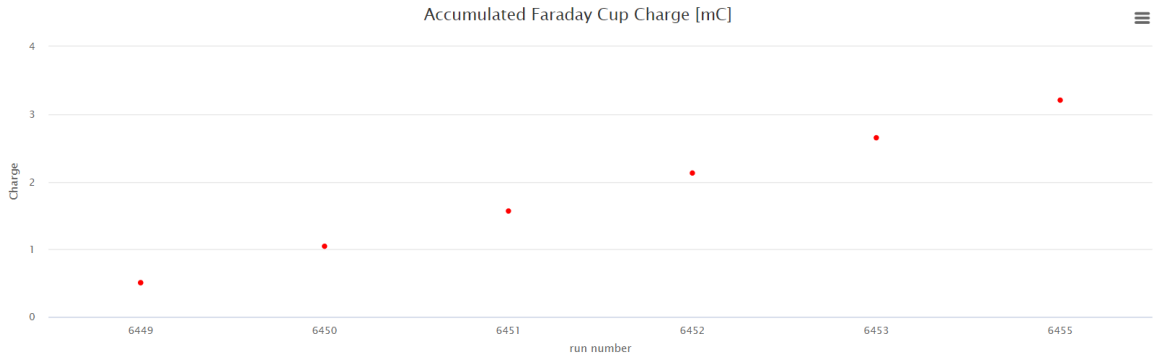
Given the significant improvement in event yield associated with the « new » CVT tracking code, we recommend the RG-B complete thorough tests and check to assure no side-effects are present. In particular, we recommend checking the effect of the minimum momentum cut (pt >

250 MeV/c) and production vertex (z<TargetLength+10mm) on physics channels where low momentum pions/hadrons and detached vertices are expected. All RG-B spokespersons need to be informed and aware of the possible consequences of the cuts reported above. Moreover, since the software version will be the same for all RGs Pass2 cooking, we recommend that the same checks and tests be performed on all other RGs (especially RG-A since several analyses require combining RGA and RGB results). We strongly encourage RGB and all other RG analysis coordinators and spokespersons to extensively compare the results of old and new code promptly. We recommend postponing the RGB Pass2 data cooking until all RGs agree on the choice of CVT tracking code version and until the results are presented and discussed in another session of this readiness review.

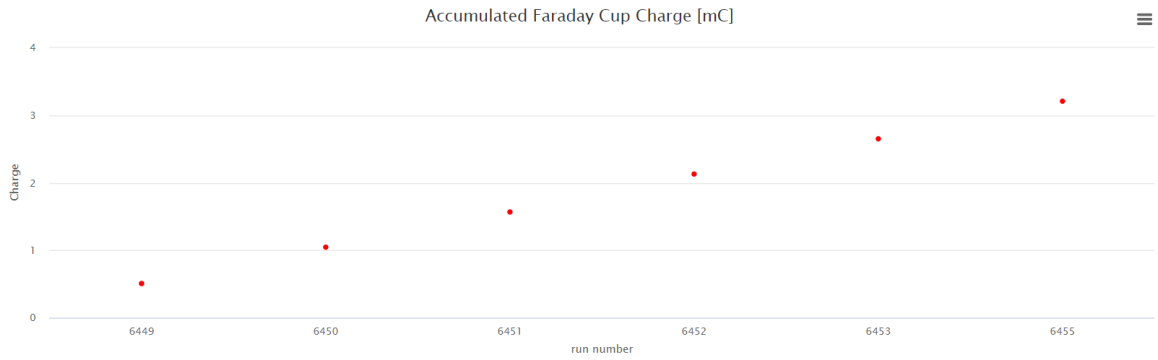
First of all, indeed the beam-charge issue was due to a problem with wrong constants put by mistake in CCDB during the cooking of the test sample. This was fixed, and other improvements were applied to the QA timelines code.

The QA timelines were rerun on a set of six runs cooked with the two versions of Coatjava (old and new CVT tracking). The results can be found at the following links:

- **Old CVT tracking: https://clas12mon.jlab.org/dilks/rgb_pass2_test_8.4.0/timeline/**
- **New CVT tracking: https://clas12mon.jlab.org/dilks/rgb_pass2_test_8c.4.0/timeline/**



Accumulated FC charge, runs cooked with 8.4.0



Accumulated FC charge, runs cooked with 8c.4.0

For the choice of CVT reconstruction, at the end of a phase of extensive cross-check, RGB has established that the version 8c.4.0 (new CVT tracking, with improvements and bug fixes with respect to 8c.3.2, which was discussed at our pass2 review) with the cuts adopted

for our test (radius cut equivalent to pt=180 MeV and vz cut =1cm) is the one we plan to use for pass2.

Cross-checks were done on both data and MC by various RG's. For all the relevant analyses of RGB there is a sizeable improvement in the detection efficiency for charged particles in the CD, as well as in the coverage in phi, thanks to the improved efficiency in the « dead » regions of the CVT. An improvement in the neutron purity is also observed for the nDVCS channel, as the improved CVT efficiency reduces the proton contaminaton in the CD neutron-candidates sample. A sizeable improvement in both efficiency and resolution was observed for deuterium detection. No significant losses of low-momentum particles were observed in the RGB analyses.

The comparative studies carried out after the pass2 review, comparing 5 runs cooked with version 8c.4.0 and 8.4.0, are shown at the following links:

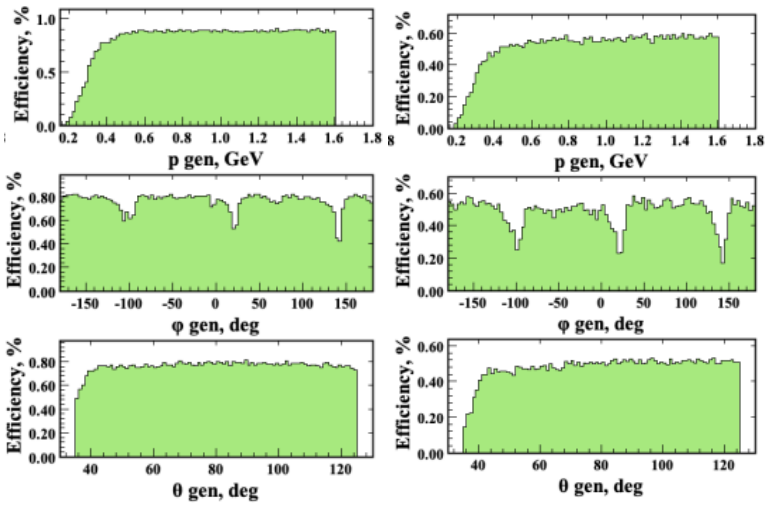
- **pDVCS and nDVCS in deuterium: https://clasweb.jlab.org/wiki/images/e/ef/Pass2preparations_newCJ_6runs.pdf. ~30% higher yield for pDVCS with the new CVT tracking with respect to the old one. Improved phi coverage for the protons. No losses at the lowest proton momenta. Improved purity of the neutrons in the nDVCS channel.**

- **Gmn analysis: https://clasweb.jlab.org/wiki/images/b/b1/Pass1vspass2.pdf. Here no impact of the CVT tracking version adopted is observed, as expected, as the analysis only uses FD information.**

More discussions took place on this subject between RGA and RGB, and within the software group. No strong evidence was shown that the cuts on the radius (equivalent to pt=180 MeV) and the z-vertex cut at 1cm bring any harm to good low-momentum tracks, as below pt=180 MeV particles cannot reach the CTOF and they end up therefore to have a bad chi2pid.

The validation study done by Yuri (MC with background) can be found at this link:

https://clasweb.jlab.org/wiki/images/4/42/20221215-soft.pdf



Comparison of efficiency for pi+ (momentum 0.1-1.6 GeV/c) for MC with background

Charge #6: Have the tools for monitoring the quality of the cooking output and identifying/correcting failures been defined and ready to be used?

FINDINGS:

RG-B presented a set of tools for monitoring data quality. These include the same set used for Pass and some new tools specifically designed to check CVT tracking quality and stability.

COMMENTS:

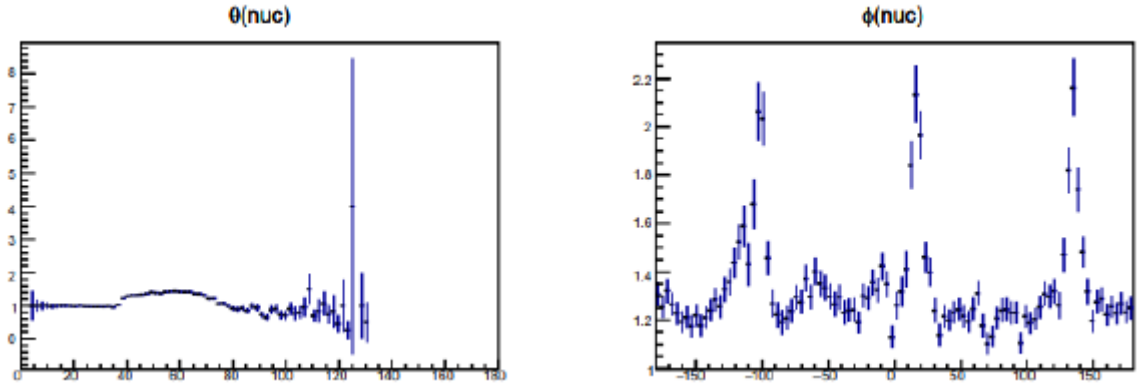
(New) Tools are in place but some results (e.g. the aforementioned Faraday cup information) are not consistent with expectations and full debugging of the new tools should be done before the start of the Pass2 cooking.

RECOMMENDATIONS:

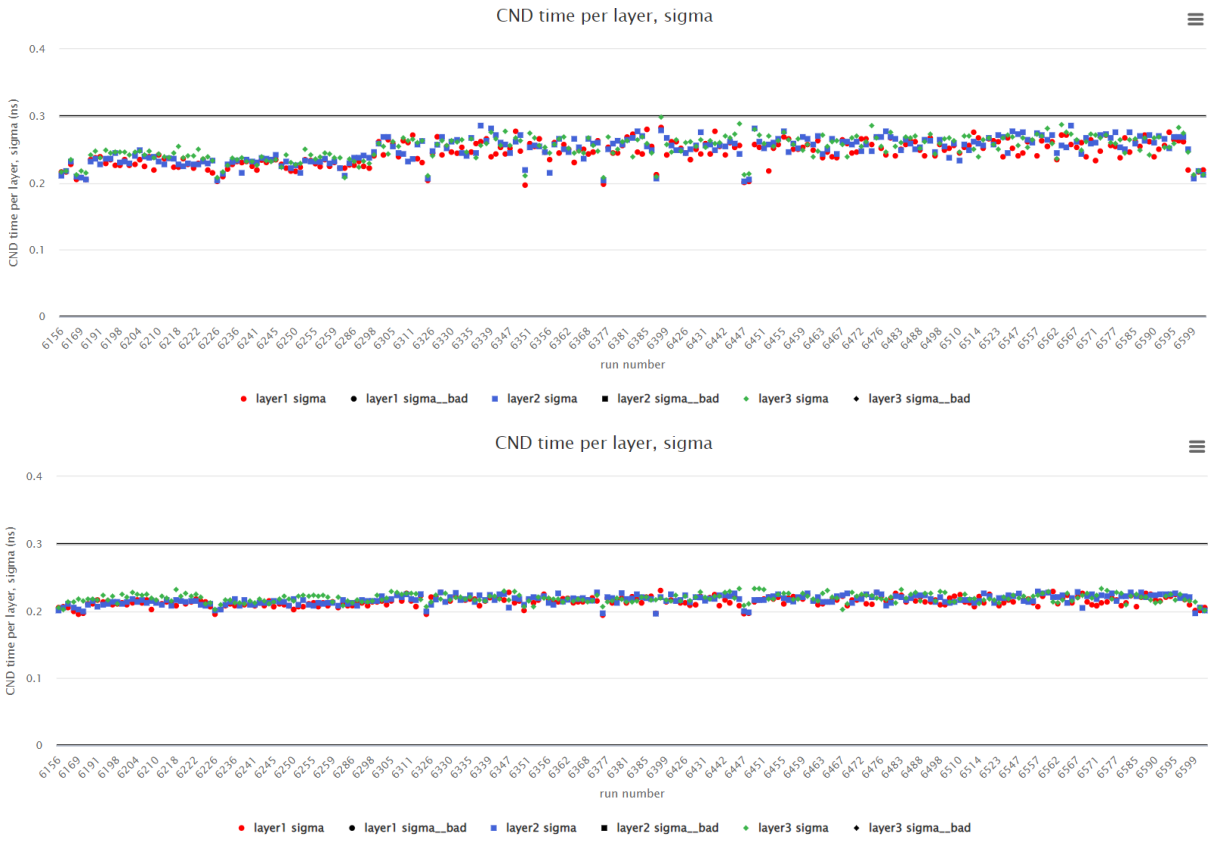
In connection with the recommendation on Charge #4, a list of additional analysis and monitoring plots should be identified to demonstrate that the chosen CVT tracking version outperforms the other.

As shown in the reply for point 5, we have run full analyses comparing the two CVT tracking versions. A sizeable gain of efficiency was observed for charged particles in the CVT. Improved resolution was also observed for the detection of deuterons. No losses of acceptance were observed for the channels of interest in the RG. We showed an improvement in timing resolution for CND at high beam current when using the new CVT reconstruction. All this has allowed us to establish which version to use.

Here below are some relevant plots, to be added to the efficiencies from MC with background computed by Yuri (shown in the reply to the previous point):



Ratio of yields of pDVCS events for 6 runs (new CVT tracking divided by the old one). Theta (left) and momentum (right). The theta distribution shows that the improvement is coming fully from the CD (theta>40°). The phi distribution shows, in particular, the sizeable improvement of efficiency in the « dead » regions if the CVT.



Sigma of the vertex time distributions computed for negative pions in the CND. Top: old CVT reconstruction (8.3.2); bottom: new CVT reconstruction (8c.4.0). At run 6299 the current went up from 35 to 50 nA. The vt resolution for the old CVT reconstruction worsens as the beam current goes up, while it stays constant for the new CVT reconstruction.