Hall B 12 GeV Upgrade - CLAS12 Commissioning with Beam Review January 15, 2015 FINAL Report, Feb 11, 2015.

Review committee: Yves Roblin, JLab CASA Lars Schmitt, GSI, PANDA Elton Smith, JLab Hall D (chair) Stepan Stepanyan, JLab Hall B Glenn Young, JLab 12 GeV Project

We would like to commend the CLAS12 Calibration and Commissioning (CALCOM) group for providing materials to the committee well in advance of the review and the excellent preparation for the day's presentations. This allowed the committee to provide feedback to the organization of the review and have the presenters address some early questions during their talks. The material was well organized, easily accessible, and directed toward the goals of the review. We would also like to commend everyone for open and frank assessment of issues that came up during discussions.

We first answer the questions posed in the charge point by point, and then provide general feedback in the form of findings, comments and recommendations as defined here:

FINDINGS: describing the major relevant points presented to the committee or observations made during the presentations.

COMMENTS: Suggestions or other remarks that do not amount to be included in formal recommendations.

RECOMMENDATIONS: Describing more definite statements that must be addressed in the future.

Charge to the Review Committee

The scope of this meeting is to review the part of the developed plan that addresses the commissioning of the CLAS12 spectrometer system using the electron beam from the CEBAF accelerator as presented in the Commissioning With Beam (CWB) document, which is available on the review web page. The review committee is asked to address the following questions and bring up related questions, where appropriate:

1. Is the CWB plan for CLAS12 comprehensive and developed in sufficient detail to ensure that upon completion the CLAS12 system will be ready for production data taking?

Yes. However, because the majority of CLAS12 experiments require polarized beam, time should be allocated for commissioning the Moller polarimeter and helicity related systems.

2. Is the CWB timeline reasonable and optimized, both in terms of duration of the studies and the order of activities?

No. The timeline is too compressed for proposed program. See recommendations.

3. Are there studies or tests missing that should be specifically included in the plan to ensure the readiness for production data taking?

Some studies that should be considered during the commissioning include

- Moller polarimeter commissioning
- Studies of beam time structure (250 MHz) at 5 pass
- Transport of 11 GeV beam to the electron dump
- Specific beam time allocated to DAQ studies
- Studies using accelerator RF timing signal for time-of-flight measurements

4. Is the list of simulation studies that is planned before the CWB period adequate to understand the expected baseline performance of the CLAS12 system?

Yes, but manpower resources need to be monitored.

5. Are the planned monitoring and software tools for both online and offline analysis adequate for the efficient beam commissioning of CLAS12?

Yes, except for the slow controls (see recommendations)

6. Are our online and offline shift staffing plans during the commissioning period appropriate and adequate to ensure appropriate levels of support for the planned and expected operations?

Yes, but because detector experts must be available almost all the time during the commissioning period to direct specific tests, we suggest more than one expert be trained per sub-system to accommodate continuous presence.

7. Have ES&H considerations been adequately incorporated into the procedures to minimize risk to personnel and to equipment?

Presentations were not sufficiently detailed to judge. Standard Experimental Readiness Review procedures must be followed to ensure that ES&H considerations are adequately addressed.

Findings

- 1. According to the current schedule, the CLAS12 commissioning with beam will take place during a period of two weeks during the fall of 2016. Thus, this review is providing feedback well in advance of that date and therefore the experiment should easily accommodate input to the proposed activities.
- 2. The coordination of the commissioning is organized by the Calibration and Commissioning (CALCOM) group, which was formed in 2011. The collaboration should be commended for creating this group early on, which can track progress and ensure success of overall commissioning.
- 3. The pre-commissioning activities are at an advanced stage, especially for detectors on the forward carriage that have virtually completed their calibrations already.
- 4. The two magnets drive the schedule for detector assembly. The completion of the toroid is expected in third quarter of FY16 and the solenoid should be ready for detector installation in the fourth quarter FY16.
- **5.** All detector systems, including software infrastructure for analysis, are scheduled to be ready well in advance of magnet completion. The central neutron detector (CND) will be shipped to JLab in spring of 2016 is off-project but needed for sequential assembly of the central detectors.
- 6. The commissioning with beam will use a solid target; the hydrogen target used for most experiments will be commissioned at a later time.
- **7.** The accelerator will provide 250 MHz beam at 5-pass, although at lower passes the accelerator may be able to deliver 500 MHz.

Comments

- 1. Complete slow control interface specifications to accelerator control group as soon as possible.
- The "CLAS12 Spectrometer Subsystems Details" document is a very nice summary of the characteristics of the detector. However, the schedules therein are not consistent with the current overall schedule. See, for example, the installation schedule under Infrastructure. Since this document is not used for project tracking, one might consider omitting projected dates.

- 3. Exercise all monitoring and calibration tools well in advance of taking data, for example during pre-commissioning activities.
- 4. Once the Key Performance Parameters are determined (see recommendations), clarify how off-project detectors may impact achieving them, and how they will be integrated into the commissioning run. For example, the CND is needed for the assembly sequence of the central detector.
- 5. In detailing the commissioning schedule and timeline, add man-hours needed to accomplish each task, in addition to clock time for each activity.
- 6. Begin data challenges to stress existing software.
- 7. One could investigate synergies between systems, which can be tested and calibrated in parallel to make more efficient use of the short commissioning beam time. In the meeting parallel work was mentioned but it is not written in the report.
- 8. For the drift chambers a pre-commissioning check-out without beam could be part of the preparation after transport and installation.
- 9. Monitoring and tracking of environmental conditions was not mentioned in the slow controls presentation. These need to be tracked together with the calibration of detectors. In particular temperature dependence of calibration and alignment constants needs to be tracked constantly.
- 10. The order of checks and calibrations should be done in a way that tracking detectors are tuned before PID detectors because tracking input is important for tuning PID performance. Trigger detectors are tuned first but should be retuned once good tracking is available.
- 11. Alignment and calibration should be done before the energy and magnet scans, and before luminosity scans.
- 12. Consider evaluating electron rates at proposed luminosities to make sure there are sufficient rate and enough time allocated for activities required specifically for low luminosity studies with electrons.
- 13. The choice of target for the commissioning run was not well motivated. Physics running requires a hydrogen target, which allows studies with exclusive reactions. One could consider using the windows of an empty hydrogen target cell as a point source instead of building a special holder for separate solid targets. This allows using hydrogen as a target if time permits.
- 14. We suggest that the commissioning period be broken up into two with a break in between to digest first data and fix any initial problems.

Recommendations

- 1. Work with the 12 GeV Project to determine the Key Performance Parameters (KPP) for Hall B. Optimize the commissioning plan to address the KPPs early in the plan.
- 2. The timeline for comprehensive commissioning is too ambitious. We recommend that the team develop a more realistic schedule. From our experience, we estimate the period should be extended by at least a factor of two.
- 3. In the extended time period begin commissioning with 3 pass beam. This will allow tuning the beam to the tagger dump before sending the beam through the detector, will make detector calibrations simpler, and allow direct comparisons with existing data.
- 4. Identify an on-site person to lead the slow control activities.