

Response to DOE 2014 November SBS Review

Two Recommendations:

1. The schedule for WBS2 should be updated to reflect the realities as presented, namely the change in CDet to a scintillator based detector, and the effects of financial constraints on the DAQ (need to use Fastbus instead of FADC). The revised schedule should be submitted to DOE by February 15, 2015.

Response: *Revised the PMP with new schedule for the CDET shifted by one year to 1/29/2017. Revised PMP was submitted with Jan 15, 2015 report. Accepted by DOE in April 2015. Updated PMP is included in prebrief materials. To answer the question about financial constraints on DAQ included a short response outlining the FASTBUS and other DAQ hardware available for CDET and other systems in March 15th SBS report (in prebrief materials and DAQ talk).*

2. The collaboration should test the continuous thermal annealing in a realistic radiation environment with constant monitoring of the detector response, before finalizing the design of the detector.

Response: *Test successfully completed in Spring of 2015. Report in the prebrief materials. Will be discussed in the "Dependency" talk and ECal breakout talk.*

Comments

1. Theoretical efforts could be stimulated by organizing workshops on this topic (like at the Institute for Nuclear Theory [INT]) focusing on the high Q² range.

Response: *Bogdan, Ian Cloet, Dave Hamilton and Seamus Riordan submitted proposal to the Seattle INT. Proposal was rejected, but the letter encouraged the proposers to resubmit with an additional focus on WACS. Proposal for workshop at Trento with Evaristo Cisbani as additional co-proposer was accepted. Workshop will be in April 18-22, 2016.*

2. Systematics

- A good understanding of many systematic effects will be essential.

Response: *The magnet polarity flip was added to the plan of GMn experiment.*

- The issue of higher-order radiative corrections was not discussed.

Response: *The two-photon induced asymmetries were found to be sufficiently small.*

- The effect of dead time losses on the physics results is unclear. It would be desirable to investigate the effects if it has not yet been done.

Response: *The deadtime losses have no systematic effect on results in the proton electric form factor experiment.*

- The precision of the magnetic field needs to be known for different experimental aspects:

- i. Tracking of particles through the spectrometer in order to discriminate signal from background processes.
Response: *The Geant4 simulation of experiments with the full magnetic field map has been developed. Details in the Simulation talk.*
 - ii. Tracking the spin rotation angle of particles through the spectrometer in order to be able to extract the transverse polarization of the nucleon.
Response: *Spin rotation for GEP experiment Geant4 simulation is under development.*
 - iii. Residual magnetic field (and more importantly field gradients) from the SBS magnet at the target location and its effect on the degree of target polarization
Response: *The He-3 target design included the total magnetic system.*
 - iv. The effect of the magnetic field on the exit beam line.
Response: *The beam line design addressed the primary/secondary beam deflection and activation of the beam line elements.*
3. While simulation tests of the exit beam pipe magnetic field compensation scheme meet the integral field requirement there is a concern about components which may affect the beam "size/shape"; beam transport calculations may be useful to ensure that any such effects are under control.
Response: *Variation of the field integral is small so no effect on beam size. Details in WBS 1 talk.*
4. It is strongly suggested that at full field, the region near the pole tip adjacent to the slot be well measured.
Response: *Making plans to map the magnet by reusing previous mapping equipment at JLab.*
5. It is important to extend the Monte Carlo simulations to understand the impact of the trigger cuts on the physics results. The experimental simulations to date do not include analysis of minimum bias events.
Response: *Including the Pythia event generator into the GEANT MC is in progress. The preliminary results are similar to what was presented at last year's review.*
6. In the context of designing the DAQ, simulations need to have a more realistic approach to event generation, including effects of "room backgrounds" and multiple particle events, in the time window of the trigger.
Response: *Initiated more detailed responses of detectors, detailed shielding for "room backgrounds" into GEANT simulation.*
7. The panel strongly suggests the generation of a data event flow analysis for each of the 3 experiments that identifies bytes per detector (average and extremes) going onto storage for offline analysis, specifically to look for any bottlenecks.
Response: *The data flow will be shown in the DAQ talk.*
8. CDET
 - The collaboration should consider having a reflecting surface on the non-MAPMT end of the CDET fibers.

Response: *Implemented. Detailed studies of light yield from scintillators with WLS fibers mirrored at one end completed – effect of mirror is ~ 40% increase in light yield.*

- The plan for shimming the scintillator slats could be quite labor intensive as it involves getting the mylar wrap flat and applying the tape for shimming. Workforce availability should be considered carefully

Response: *New design of scintillator plane has been developed and implemented in module construction. Additional resources allocated for construction manpower.*

- The proponents should consider using the mechanical prototype to develop a simpler technique for achieving the projective geometry, such as rotating entire groups of slats by mechanical means in the mounting structure.

Response: *Major improvements made in mounting structure of scintillator bars such that groups of 14-strip bundles glued together and mounted at definite angles for accurate alignment and pointing of scintillators to target.*

9. GEMs

- Concerning the gain variation across the chamber that is reduced with increased gas flow, the team may wish to add water and oxygen monitors to the exit gas stream.

Response: *The outlet gas system has been modified from a number small diameter pipe outlets to a large diameter pipe outlet. This allows larger gas flow rates with smaller internal chamber pressure. The SBS front tracker group at INFN is currently conducting a study on the water and oxygen contamination in the output gas line. Based on the results of this we will evaluate the need to use water and oxygen monitoring on back tracker chambers.*

- As modules are completed and delivered to JLab suitable personnel will need to be identified to carry out the testing at JLab. The team may find it beneficial to keep the present 5 production modules at UVa for a more detailed evaluation that may indicate improvements in fabrication for future modules.

Response: *UVa has kept all production chambers at their lab. As pointed out, it has allowed detail evaluation in the X-ray test set-up. It has allowed modifications to chambers from knowledge gained in the X-ray test set-up. A dry N₂ system was setup and is currently used at UVa to keep flushing all stored chambers to prevent contamination. The plan is to start moving GEM modules, in batches of 4, from Uva to Jlab starting in early 2016. Two graduate students, well trained in the operation of SBS GEM chamber, recently moved from UVa to Jlab. These students will be responsible for the installation and testing the SBS GEM modules in the test lab as well as in Hall A. Senior personnel from UVa will travel to Jlab and will participate in these activities as needed.*

- Consideration needs to be given to the acquisition of adequate spare components. Spare modules and readout will not only provide backup in case of failure but will also allow reconfiguration or expansion for future physics programs. 10% is considered a

minimum; the panel encourages the collaboration to consider increasing the number of spare modules. The provision of a complete spare plane (four modules, and including electronics) is strongly encouraged.

Response: *Rolf has allowed contingency in WBS3 to be used for 5 more modules which enable the construction of a spare plane (Four modules = one plane). The modification of the contract is complete. Three spares were already in the WBS3 so this gives a total of 8 spares. The electronics contract included electronics for a spare plane.*

- The production workflow indicates that most of the module fabrication is carried out by two people, leaving the production flow vulnerable to illness or personnel turnover. Mitigation is encouraged by having other personnel capable of performing fabrication and QA processes.

Response: *Hired a new technician for GEM construction in January. This left trained graduate students and senior staff available for short term replacement. The technician left in June and has been replaced with a visiting Chinese graduate student who is gaining experience for his institute in conjunction with GEM construction for the SoLID spectrometer. This student is now fully trained and has already taken part in the construction of 10 module. He will continue to stay and work with the UVa group till June 2016. A technician will be hired around March 2016 to replace him. Furthermore, a new graduate student who recently joined Liyanage's group is currently gaining experience in GEM related activities.*

- The desired production rate of 2 modules per month has been achieved only in the past month. Production rate for the next set of modules should be carefully monitored.

Response: *Progress is monitored in monthly report and with spreadsheet which tracks QA on the GEM foils and readout boards along with QA on the chambers. 2 modules/month has been maintained for past eight months. The X-ray test set-up has allowed for rapid evaluation of the chambers.*

- The X-ray test set up should be completed expeditiously so that the early production modules can be tested under extreme rates, as similar to those expected in the experiments.

Response: *The X-ray test set-up was completed in Jan 2015. The photon flux can be increased to rates which mimic the expected MIP rate during SBS experiments. The UVa group discovered a problem with charging of the entrance window at high rates which has been resolved. The x-ray data showed that the charge sharing issue that was reported last year has been resolved with the improved quality readout boards; the x-ray tests indicated that the charge sharing ratio remains constant up to the highest charging levels expected during SBS running.*

10. HCAL

- With module HCAL assembly scheduled to start in March 2015 it is important that the “design review” expected to be held in December serve also as a module mass production review.

Response: *December reviewed focused on the subassembly structures where CMU needed additional resources. Did not see need for production review. JLab took over the design and production of the subassembly structures. The order for the subassemblies went out in August 2015 with delivery in March 2016.*

11. 3He target

- The He-3 target is critical to the neutron form factor measurements. Monitoring progress in this dependency is essential. Some technical milestones in this project would be helpful to keep the SBS program on track.

Response: *Funding for the 3He target is part of the JLab capitol spending plan. It has been determined that the Helmholtz coils used for previous JLab 3He experiments can be used in the SBS experiments. An updated set of milestones has been created and the table is in the Oct 15th 2015 monthly report. One of the key early milestones to be completed by Jan 2016 is a conceptual design report for the target which will set the parameters for the designers and engineers. In March 2016, a review of the design report will be held and the goal is to have design “frozen” by June 2016.*