SBS Newsletter #2

April 26th, 2010

Letter from the Editor

The newsletter will be a forum for progress reports updating the collaboration on our response to the Technical Review's report. At the March 2010 SBS meeting, response to the TR was the main topic of the discussion. A summary of these discussions has been written and people have agreed to lead groups to address and respond to specific questions in the TR's report. By the middle of July 2010, each group will contribute a report that will be a part of the response to the TR. A wiki has been setup for the SBS experiments. Right now it is barebones, but please use it.

Upcoming Conferences:

- Exclusive Reactions at High Momentum Transfers IV, May 18-21, 2010, Newport News, VA, US . Early registration deadline April 15th.
- 12th International Conference on Meson-Nucleon Physics and the Structure of the Nucleon (MENU2010), May 31-June 4, 2010, Williamsburg, VA, US. Deadline Mar 5th
- International Nuclear Physics Conference 2010 (INPC2010), Vancouver, Canada 7/4/10- 7/9/10. Abstract deadline March 15.
- Gordon Conference on Photonuclear Reactions, August 1-6, 2010, Tilton, NH, US .

Table of Contents

Update on GEM (E. Cisbani)

1. GEM foils: CERN expects to deliver the foils for the first 40x50 cm2 module at the end of April .
2. electronics: the VME controller/ ADC prototype has arrived (see Fig. 1) and our collaborators in Genova are testing it. Initial visual inspection found a few monir hardware bugs that have been fixed. Presently testing the power consumption on isolated sectors of the VME module.

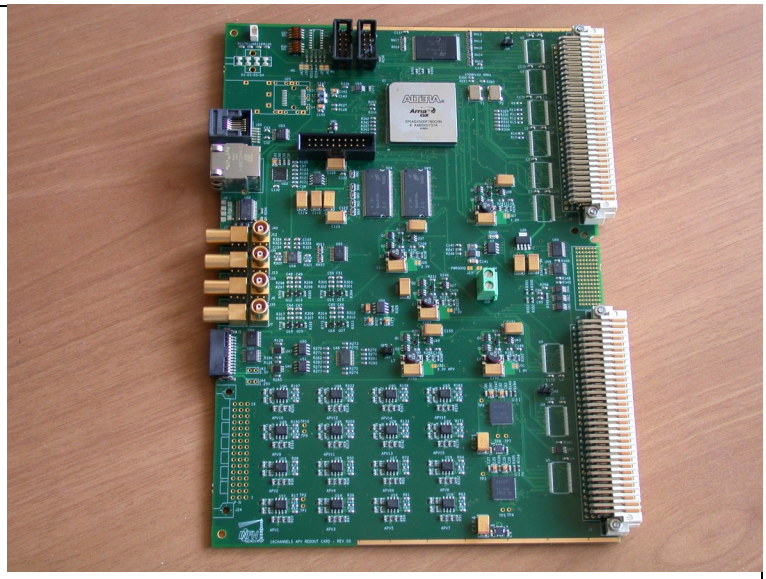

Fig. 1: The GEM VME controller/ADC prototype.

Update on SBS magnet (J. LeRose)

We have made contact with the engineer at BNL who will be our main contact in the property exchange. He says that we should probably plan on visiting BNL in the late summer, given that we won't be able to move anything till the fall anyway. The magnets are easy. Re power supplies, they have several, but they are old, refurbished in the 80's. We will need to interface them with our controls. He recommends we bring a magnet power supply engineer when we visit. The magnets will be disassembled into 18 ton pieces, 5-6 trucks per magnet. He estimates 100m-h per magnet to ship = $10k. He also says the equipment is not going anywhere so we don't need to hurry. He also promised to tell us if there's any other interest. Here at JLab, Robin Wines has been assigned the task of doing the TOSCA modeling for the SBS magnet. It should be the middle of May before we see the first results.

Update on BigCal (M. Jones)

In response to TR recommendation section 4.2, we are planning to do a test of UV curing of the blocks. Two options are being considered. One would be to use the UV lamp that were used to cure the lead glass after the Hall A RCS experiment. Another would be to use a similar setup to the one used to cure the glass during Hall C Gep3 experiment. Frank Wesselmann has agreed to help setup a test space this summer. Work is also being done to setup the GEANT MC for studying the position and energy resolution with a 20cm Aluminum absorber in front of BigCal.

Updates on SBS activities for DAQ and Simulations (O. Hansen)

30 April 2010

TR Recommendation 3.2 (3-sample method & DAQ rate):

As was suggested by the Technical Review Committee, the 3-sample readout method will be used for all APV25. In this scheme, 3 adjacent samples of 25~ns integration time are read from the APV25 analog pipeline and digitized for each hit. This allows us to do a rough fit of the signal peak to obtain improved time and amplitude resolution, and to reject background from data in the 200~ns tail of earlier hits. This improvement comes at the cost of increased data rates. Assuming 4 bytes/channel (7 bits address, 3x8 bits data) instead of 2 bytes/channel, 100k tracker channels, and an average occupancy of 15%, the event size becomes 60 kB. At the design trigger rate of 1 kHz, the data rate becomes 60 MB/s from the trackers. This is still within the 100 MB/s specification. Even with a twice higher trigger rate of 2 kHz, the resulting tracker data rate of 120 MB/s will be comfortably within the CODA3 and JLab 12 GeV capabilities. To allow a safety margin, we increase our data rate design limit to 200 MB/s.

TR Recommendation 5 (Simulations):

Efforts are actively underway at INFN and JLab to implement a full track simulation and reconstruction chain. INFN has designed a GEANT4 simulation of the particle propagation in the GEM front trackers. Physics track data from L. Pentchev's earlier simulations are used as input to this simulation. At present under development is the digitization of the GEANT4 output and conversion of the digitized data to ROOT file format. In parallel to the efforts at INFN, the JLab group has been working on modifying the existing BigBite track reconstruction software for the SBS GEM systems. The BigBite software is based on the TreeSearch recursive template matching algorithm. At this point, the code modifications are about 50% complete. Still missing are the interface and decoder for the simulation file format, the analysis algorithm for the 3 samples per hit from the APV25, and the matching of track projections via amplitude correlations in each GEM readout plane.

The simulations group has set the following milestones:

June 1: - Fully digitized test data from the simulation available, including Monte Carlo truth information.
- Successful tracking of clean test data

July 1: - Tracking algorithms debugged and tuned;
- Production Monte Carlo data for various detector configurations and background conditions available

July 15: - Analysis of production data complete

Aug 1: - Write-up of simulation and tracking work complete

Update on tests of GEMS (A. Camsonne)

Two GEM chambers prototype were built by INFN and four by the UVA group. Their dimension is 10 cm by 10 cm in a XY configuration. Those chambers are intended for cross check of the VDC at high rates during the PREX experiment. The electronics used for the read out is the same that was used for the Hall A RICH detector which is based on the Gassiplex chip. Software and hardware is still under heavy development and being checked. Several features were added and more will be added along the testing during the PREX experiment.

From the lower current beam data we managed to take so far we can say that some signals is seen : we clearly see the correlation with the VDC. Some work on grounding helped significantly since swings up to several hundreds of millivolts could be observed before the chambers were grounded to both low voltage and high voltage supply. Signal over background ratio is still not clearly defined since we have not yet observed a clear minimum ionizing peak. Some calibration and analysis work and hardware tweaks are still needed. Eye balling at the individual strip amplitude we have roughly a signal amplitude around 100 channels for a raw pedestal width of about 10 channels which yields a signal to background ratio of about 10.

The plan for now is to continue testing parasitically with PREX with some tests on the bench using sources and cosmics to find the optimum operating point for the chambers. Once this is found and we are confident all the software and tools are ready to generate quality data, we will request for a few hours of dedicated beam to check out the GEMs at several beam currents. The final test with beam is to run close to the full rate allowed by the integration time of the Gassiplex using a random trigger. Using the VDC information, we aim to determine the intrinsic resolution and rate capabilities of the chambers. Depending on the prospects for beam time extension we might be able to test with the APV25. We are quite limited in dynamic range right now with the Gassiplex though a careful choice of the high voltage should allow us to get good data for tracking.

Update on GEMs at UVa (N. Liyanage)

1. Dr Vladimir Nelyubin has agreed to continue with the UVa group. Once SBS construction is ready to start this Fall, he will assume responsibility as the full time technical expert for the large GEM tracker project. We have also hired four graduate students and two undergraduate students for the GEM project. These students will work this summer on GEM chamber prototyping, testing and simulations. More undergraduate students will be hired in the fall as needed.

2. UVa group has a set of 5 10 cm x 10 cm prototype GEM chambers. We plan to setup a DAQ system at UVa this summer, so that we can test these chambers with radioactive sources to study GEM response for low energy photons. We plan to move this setup to Jlab in the fall to test with low energy photon background from the beam.

Update on future GEM tests (M. Khandaker)

Preliminary plans for GEM tests during DVCS experiments (E07-007, E08-025) in Hall A}
In the summary section of the Technical Review committee's report (section 7), it was recommended that:
Remaining uncertainties in background rates and electronics performance can be reduced by performing experimental tests under similar conditions. This should be done as soon as possible since the results could lead to modifications of the segmentation scheme and the readout rates which need to be known before the start of mass production.
In order to implement this recommendation, the SBS collaboration has formed a sub-group, consisting of E. Brash, M. Jones, M. Khandaker, C. Perdrisat, and V. Punjabi, to coordinate this task. The plan is to do high rate studies of the existing 10 x 10 cm^2 GEM chambers during the upcoming DVCS run in Hall A.

DVCS configuration

- DVCS running period: 09/06/2010 to 12/07/2010
- Target: 15 cm-long LH2 and LD2.
- Beam energy: 3.6 GeV, 4.8 GeV, and 6.0 GeV.
- Beam current: 1-10 μA.
- Scattering chamber: 63 cm radius, 1 cm thick Al sphere.
- L-HRS angle: between 15 to 40deg.
- BigBite stand angle for PbF2 calorimeter: between 14 and 21deg.
- R-HRS angle: around 60-70 deg (100-110 deg is also under consideration by the DVCS collaboration).
- R-HRS will be mainly used as a luminosity and trigger monitor.
- Collimator box in front of R-HRS is also being considered, no final decision yet.
- With collimator box in the setup, the space available in front of the R-HRS is about 30 cm.

GEp(5) considerations and preliminary test plans

- GEp(5) luminosity: proposal is for a 40 cm-long LH2 target with 75 μA beam, L is 8.5×10^{38} s^{-1} cm^{-2}.
- DVCS luminosities: 10 μA beam on a 15 cm-long LH2 target, L is 0.4×10^{38} s^{-1} cm^{-2}
  (L is 0.5×10^{38} s^{-1} cm^{-2} on LD2).
- Scaling the GEp(5) rates in Table 1 at $\theta_{SBS} = 12$ deg with no magnet at DVCS luminosities with 10 uA beam at correcting for differences in distance gives an expected rates on the front chambers of 800 MHz/cm^2.

Table 1: Counting rate in the First GEM Tracker for different configurations of the MC simulation.

Configuration w/ $\theta_{SBS} = 12^\circ$ E_{beam}=11 GeV, 75 μA	γ rates (MHz/cm^2)	γ induced hits (MHz/cm^2)	Charged rates (MHz/cm^2)
LH2 Target	115	0.351	1007
Target + Scatt. Chamber	118	0.361	1010
Target + Scatt. Chamber + Magnet	143	0.437	0.119

- With the R-HRS at around 60-70 deg, the rates on the GEM chambers will be dominated by low energy. Calculations by P. Degtyarenko for e + p to e + X at 11 GeV show that the rates drop by a factor of 6 in going from 12 to 70 deg for particle energies > 320 keV. Similar drop can be expected for the difference between the SBS and the R-HRS angle settings making the rates on the front GEM chambers more realistic for the GEp(5) setup.
- With the space available upstream of the R-HRS, we can probably place a 4-GEM chamber telescope with APV25 readout boards (this will be confirmed with the UVa group).
- With the R-HRS at around 60-70 deg, the rates on the GEM chambers will be too low for doing the TR recommended realistic tests (elastic *ep* cross sections drop by about 10^5 between 12 and 60 deg). We plan to do MC simulation studies for the GEp(5) rates with DVCS configuration.
- An alternative plan for the tests is also under consideration, setup a 6-GEM chamber telescope on the floor at around 30 deg. The possibility of setting up a magnet from the Hall C group in front of the telescope is being pursued.
- DVCS collaboration would like to have a proposal from us detailing our test request.