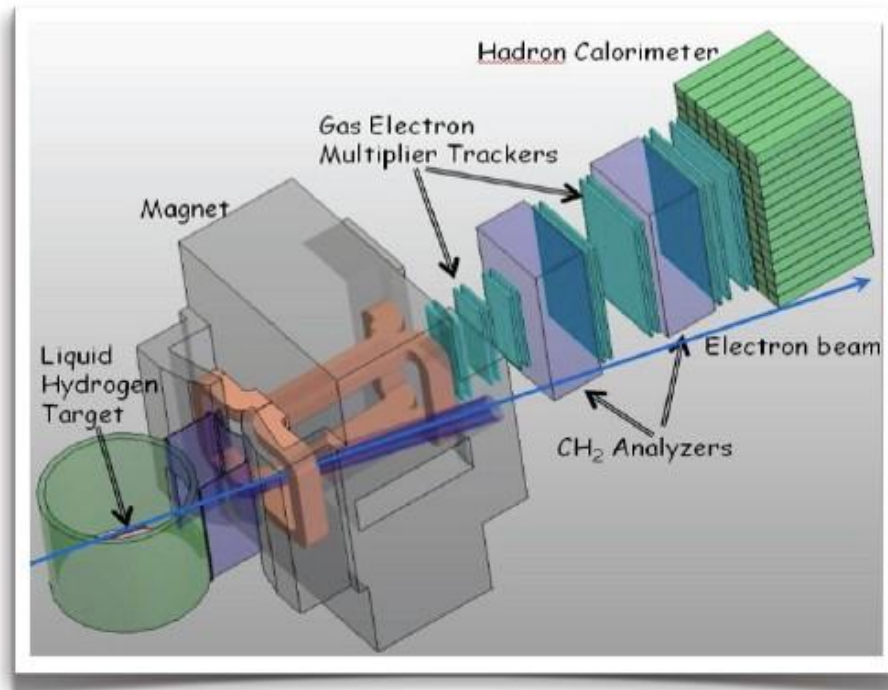


# ***Super-BigBite-Spectrometer (SBS)***

## **Monthly Progress Report**

**June 15, 2013**



## Introduction:

The SBS Program consists of three separate, but interrelated Projects.

- The first Project, **SBS Basic (WBS 1)**, involves the acquisition of an existing magnet and the associated work of preparing it for use during the SBS research program. The effort includes modifications to the magnet, including machining a slot in the yoke for beam passage, field clamps, and a solenoid to reduce the transverse magnetic field on the beam line, the design and development of the infrastructure needed to run the magnet, and the construction of the platform on which it will stand.
- The second Project, **Neutron Form Factor (WBS 2)**, involves the construction of twenty-nine GEM detector modules with associated front-end and DAQ modules to meet the requirements of the approved neutron form factor measurements.
- The third and final Project, **Proton Form Factor (WBS 3)**, involves the construction of thirty-five GEM detector modules with associated front-end and DAQ modules and the addition of pole shims for increased magnetic field integral to meet the requirements of the approved proton form factor measurements.

## Project Management Highlights:

This is the ninth Monthly Progress Report for the SBS Program. The collaboration is in place, and the Program Management Plan has been approved by Jefferson Lab management and by the DOE-NP Instrumentation Program Manager.

The first and second Projects within the SBS Program, SBS Basic (WBS 1) and Neutron Form Factor (WBS 2), started at the beginning of FY13.

Re DOE's request of May 21, 2013 that we add additional milestones to allow better tracking on at least a quarterly basis, we are working to assemble those and will add them to the PMP and subsequent monthly reports in the next month. When we formally update the PMP it will also include a clearer distribution of contingency funds (spread over each year rather than as a total at the end). The later was requested some time ago and was completed, but the updated PMP wasn't submitted for formal acceptance.

The third Project, Proton Form Factor (WBS 3), isn't scheduled to start until FY14.

## WBS 1: SBS Basic

<b>WBS 1</b>	<b>SBS Basic: (Hall A Infrastructure)</b>	<b>WBS 1.01</b>	Milestones
		<b>WBS 1.02</b>	Project Oversight
		<b>WBS 1.1</b>	Magnet, power and construction
		<b>WBS 1.2</b>	Magnet/detector platforms
		<b>WBS 1.3</b>	Beam line

### WBS 1.01 Milestones:

<b>Id #</b>	<b>Level</b>	<b>Milestone</b>	<b>Scheduled Date</b>	<b>Expected Date 5/1/2013</b>	<b>Expected Date 6/1/2013</b>	<b>Actual Date</b>
1.1-01M	1	Project start	10/1/2012	10/1/2012	<b>10/1/2012</b>	<b>10/1/2012</b>
1.2-01M	2	Magnet delivered to JLab	4/30/2013	5/30/2013	6/30/2013	
1.2-10M	2	Platform parts received	6/27/2014	6/27/2014	6/27/2014	
1.2-20M	2	Magnet assembled on platform	3/19/2015	3/19/2015	3/19/2015	
1.2-30M	2	Beam-line parts received	9/24/2015	9/24/2015	9/24/2015	
1.1-10M	1	Project completion	1/29/2016	1/29/2016	1/29/2016	

### WBS 1.02 Project Oversight:

- SBS weekly meetings are being held via tele and video conference almost every Wednesday. During this Report period, meetings were held on May 1<sup>st</sup>, May 8<sup>th</sup>, May 15<sup>th</sup> and May 22<sup>th</sup>.

Participants included Jefferson Lab, University of Virginia, St. Mary's University, William and Mary, University of Massachusetts, Carnegie-Mellon University, University of Glasgow, Norfolk State University, Idaho State University, and INFN – Rome.

- Project is staffed appropriately for this beginning stage, and includes a Jefferson Lab manager, scientist, and magnet engineer.
- Milestone 1.2-01M's expected date has moved out by one month. There remains sufficient float to accommodate this, with the receipt of the platform parts required to assemble the magnet milestone not until 06/27/2014, and the magnet assembly completion milestone of 03/19/2015. The only related magnet task between milestone 1.2-01M and assembly is the magnet steel machining. Should the delays continue into late June we will reconsider the backup option. Radioactivity measurements of the 48D48 steel are now ongoing at BNL. Those measurements are projected to be completed around the third week of June. On June 7, Al Pendzick of BNL, wrote to us that "...It should all be ready in 2 weeks".

### **WBS 1.1 Magnet, Power and Construction:**

- Continue yoke modification drawings. (50% completed)
- Continue detail drawings of new coils. (30% completed)
- Power supply specification completed, in procurement for sole source processing. (75% completed)
- Detail design of field clamps and clamp supports. (20% completed)
- Measurements of the 48D48 steel are now ongoing at BNL. Those measurements are projected to be completed around the third week of June. JLab internal requests have been submitted for shipping, rigging and storage. (i.e. JLab Departments, shipping/receiving, storage, and property transfer are ready to act upon BNL approval.)

### **WBS 1.2 Magnet/Detector Platforms:**

- Continuing design details on magnet counter weight support. (65% completed)
- Completed floor plate design, roller brackets and magnet mounting brackets.
- Designing detector supports. ( 30% completed)

### **WBS 1.3 Beam Line:**

- Layout and design of shielded beam pipe and vacuum snout. 20%

### **WBS 1 Costs:**

- Budget for this WBS for FY13 is \$838K.

- Costed and obligated to date (as of 6/1/2013): \$42,605 (5.08%)

## WBS 2: Neutron Form Factor

<b>WBS 2</b>	<b>Neutron Form Factor</b>	<b>WBS 2.01</b>	Milestones
		<b>WBS 2.02</b>	Project oversight
		<b>WBS 2.1</b>	GEMs (UVa)
		<b>WBS 2.2</b>	GEM Electronics (UVa)
		<b>WBS 2.3</b>	Electronics Hut, Lead Shielding, Lead platform, and Detector Frames
		<b>WBS 2.4</b>	Coordinate Detector

### WBS 2.01 Milestones:

ID #	Level	Milestone	Scheduled Date	Expected date 5/1/2013	Expected date 6/1/2013	Actual Date
2.1-01M	1	Project start	10/1/2012	10/1/2012	10/1/2012	10/1/2012
2.2-01M	2	UVa receives GEM parts	2/3/2014	2/3/2014	2/3/2014	
2.2-20M	2	UVa receives electronics parts	8/20/2014	8/20/2014	8/20/2014	
2.2-10M	2	UVa GEM modules assembled and tested	10/17/2014	10/17/2014	10/17/2014	
2.2-40M	2	Coordinate Detector Assembled	11/17/2014	11/17/2014	11/17/2014	
2.2-30M	2	UVa front-end electronics assembled and tested	2/2/2015	2/22/2015	2/22/2015	
2.2-40M10	2	WBS 2.3 completed (Electronics Hut Assembled etc.)	10/5/2015	10/5/2015	10/5/2015	
2.1-10M	1	Project completion	1/29/2016	1/29/2016	1/29/2016	

## WBS 2.02 Project Oversight:

- SBS weekly meetings are being held via tele and video conference almost every Wednesday. During this Report period, meetings were held on May 1st, May 8th, May 15th and May 22th. Participants included Jefferson Lab, University of Virginia, St. Mary's University, William and Mary, University of Massachusetts, Carnegie-Mellon University, University of Glasgow, Norfolk State University, Idaho State University, and INFN – Rome.
- Project is staffed appropriately for this beginning stage, and includes Jefferson Lab (manager, scientist), UVa (two scientists), and Idaho State University (one scientist).

## WBS 2.1 GEMs (UVA):

Pre R&D work on the production of GEM modules for WBS 2.1, aimed at starting production work, has continued. Below is a report on how that pre R&D work is progressing.

In May the characterization of the first 50 cm x 50 cm SBS GEM prototype using cosmic and radioactive source data was continued. The high statistics data indicate that:

- All sectors are operational with dark current < 5 nA. (**n.b.** Foils having < 5 nA dark current is a key performance parameter as stated in the PMP)
- The chamber gain is uniform within  $\pm 20\%$ , except at the location of the GEM foil spacers, where the gain drops and at the locations of GEM sector boundaries, where the gain drops to about 30%. These effects are expected.
- The ADC values for x and y readout signals of a hit are correlated to better than 20%.

A detailed report on the test results is being prepared. These results show that the module design and construction techniques are successful, the chamber meets design goals and we have reached readiness for final SBS module production.

Data was also collected with the SBS prototype combined with a tracker of three 10 cm x 10 cm GEM chambers. This data is currently being analyzed to evaluate the coordinate resolution and the efficiency of the SBS prototype chamber.

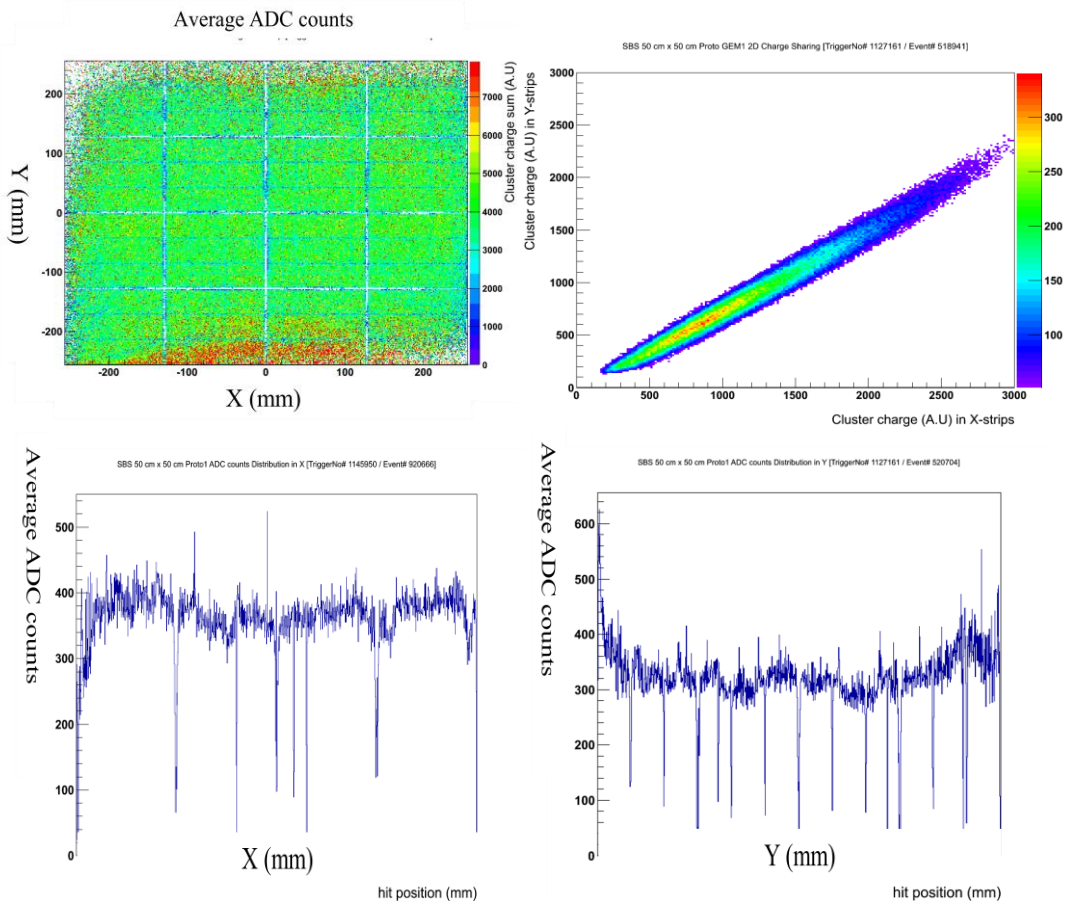
The pre-R&D phase will be completed with the completion of the final report. Nevertheless, some minor modifications will be tested in the coming months. These modifications include:

- Adding extra leads to the common side of the GEM foils. This would allow grounding the bottom side of the bottom GEM foil through capacitors.

- Reducing the number of spacers inside the GEM module to minimize the loss of efficiency due to these spacers.
- Exploring the possibility of reducing the thickness of the chamber support board.
- Exploring the possibility of a small increase of the width of the active area of the GEM module within constraints of the already proven technology and construction methods.

These improvements could add to the performance in long term operation and may still be considered for incorporation into the SBS module design. However, they are not requirements.





**Figure 1:** The results first  $50 \times 50 \text{ cm}^2$  SBS GEM prototype built at UVA: 1) (top left) A 2-D plot showing the gain uniformity over the chamber; the effects seen at the edges of the chamber are due to poor statistic resulting from the trigger scintillator arrangement. 2) top-right: x and y signal ADC correlation. 3) bottom- right and left: 1D gain variations along x and y directions. The places where the gain drop correspond to the spacer and sector boundary locations.

## **WBS 2.2 GEM Electronics (UVa):**

As with WBS 2.1, pre R&D continues on the GEM electronics. Below is a report on that work.

The new ADC module for the upgraded INFN electronics has been received. Delivery of the other components of this upgraded system is expected soon. This will provide a new version of the APV25-MPD electronics, which will begin undergoing tests as soon as those components are received.

A medium sized SRS electronics setup (APV25 based) has been acquired expanding the laboratory capability to 10k channels.

With the full assembly of both DAQ setups full comparative testing can be done.

## **WBS 2.3 Electronics Hut, Lead Shielding, Lead platform, and Detector**

### **Frames:**

- No activity this period.

## **WBS 2.4 Coordinate Detector:**

- No activity this period.

## **WBS 2 Costs:**

- Budget for this WBS for FY13 is \$81K.
- Costed and obligated to date (as of 6/1/2013): \$18,686 (23.1%)

## WBS 3: Proton Form Factor

This Project is not scheduled to start until FY14: October 1, 2013. The WBS structure and milestone table are included below for completeness.

<b>WBS 3</b>	<b>Proton Form Factor</b>	<b>WBS 3.01</b>	Milestones
		<b>WBS 3.02</b>	Project Oversight
		<b>WBS 3.1</b>	Magnet Pole shims and exit field clamp
		<b>WBS 3.2</b>	GEM's (UVa)
		<b>WBS 3.3</b>	GEM electronics (UVa)
		<b>WBS 3.4</b>	Trigger (RU)

### WBS 3.01 Milestones:

ID #	Level	Milestone	Scheduled Date	Expected date 5/1/2013	Expected date 6/1/2013	Actual Date
3.1-01M	1	Project start	10/1/2013	10/1/2013	10/1/2013	
3.2-01M	2	UVa receives parts for GEM modules	8/20/2014	8/20/2014	8/20/2014	
3.2-10M	2	UVa begins assembly of electronics	1/5/2015	1/5/2015	1/5/2015	
3.2-50M	2	RU begins trigger design	1/6/2016	1/6/2016	1/6/2016	
3.2-20M	2	UVa electronics assembly and tests completed	7/20/2016	7/20/2016	7/20/2016	
3.2-30M	2	JLab receives pole shims	8/22/2016	8/22/2016	8/22/2016	
3.2-40M	2	JLab receives exit field clamp	8/22/2016	8/22/2016	8/22/2016	
3.2-70M	2	RU completes trigger	12/1/2016	12/1/2016	12/1/2016	
3.2-60M	2	UVa GEM modules assembled (and tested)	2/2/2017	2/2/2017	2/2/2017	
3.1-10M	1	Project completion	7/31/2017	7/31/2017	7/31/2017	