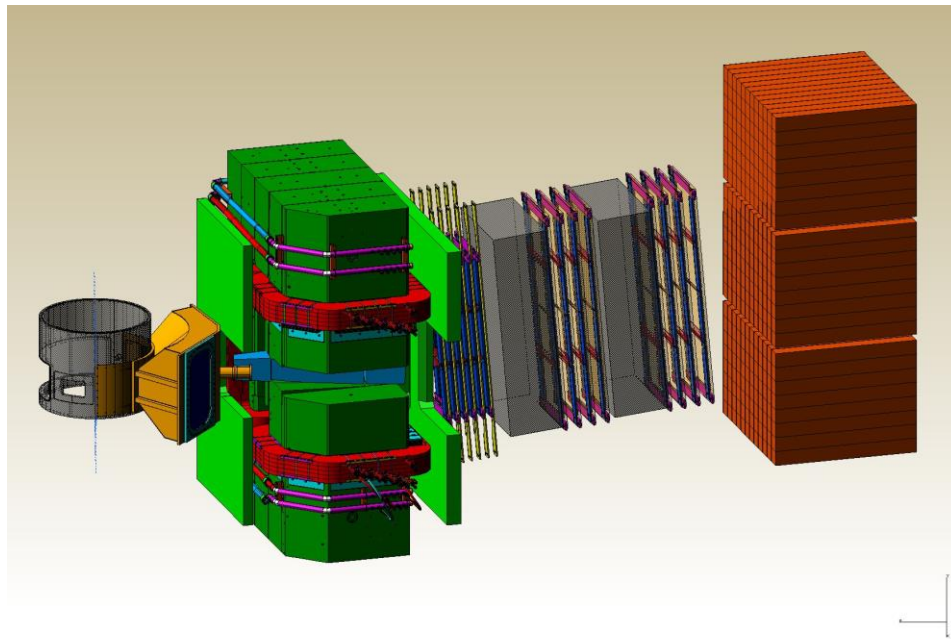


# *Super-Bigbite-Spectrometer* *(SBS)*

## Monthly Progress Report

April 15, 2015



## 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 The PMT-based Coordinate Detector (CDet), trigger electronics for the Hadron Calorimeter (HCal) 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 forty GEM detector modules with associated front-end and DAQ modules to meet the requirements of the approved proton form factor measurement.

## Project Management Highlights:

This is the 31<sup>st</sup> Monthly Progress Report for the SBS Program.

The SBS Basic (WBS 1) project started in FY13. The SBS Neutron Form Factor (WBS 2) started at the beginning of FY14. The SBS Proton Form Factor (WBS 3) started on October 1, 2012.

- The SBS platform and counterweight were delivered to JLab on March 24<sup>th</sup>. This completes two Level 2 milestones for WBS1.
- The HCAL module construction was initiated at the end of March. This completes a milestone for this dependency.
- The updated Program Management Plan is being signed. The updated WBS2 project completion date and the updated milestones for the Coordinate Detector are presented in the WBS2 tables and charts.
- The GEM electronics contract was signed by UVa and this completes a Level 2 milestone for WBS3.

## 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 1.02 Project Oversight:

- SBS weekly meetings, via tele and video conference were held on March 4, 11, 18 and 25<sup>th</sup>. Participants included Jefferson Lab, University of Virginia, Carnegie-Mellon University, William and Mary, Norfolk State University, University of Connecticut, University of Glasgow, Saint Mary's University, Idaho State University, and INFN Rome.
- Project is staffed appropriately for this stage, and includes a Jefferson Lab manager, scientist, and magnet engineer.

### WBS 1.1 Magnet, Power and Construction:

- A local vendor has been selected for the modifications to the SBS magnet. Hall A technicians dismantled the SBS magnet and it is ready for pick up by the local vendor on April 1<sup>st</sup>.
- Coils:
  - Racetrack coils: All coils are at JLab.
  - Saddle coil: Completed fabrication of tooling and winding is ready to proceed. Scheduled for delivery by July 31, 2015.
- Detailed design work on the corrector magnets and exit beam pipe is ongoing. Have decided on two options for conducting wire for the beam line corrector magnets. Each option will be readily available from vendors. Investigating whether steel is available at the lab to use in the corrector magnets. Expect to have order placed by June 2015.
- Power supply has passed acceptance tests and has been accepted from the vendor.

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

- The platform and counter weight were delivered to JLab on March 24<sup>th</sup>. This completes two Level 2 milestones, since the platform is for the SBS magnet and the counter weight will be used as the detector support.

## **WBS 1.3 Beam Line:**

- The vacuum snout delivery was delayed because the O-ring groove needed to be remachined. New delivery date is April 7<sup>th</sup>.

## **WBS 1 Costs:**

- The budget for this WBS for FY15 is \$212K.
- The incremental budget (FY13+FY14+FY15) is \$1,694K.
- Costed and obligated as of 4/1/2015: \$1,224K (72%).

**WBS 1.01 Milestones:** (see [Appendix 1](#) for graphic view of milestones)

Level (ID#)	Milestone	Scheduled Date	Expected Date 3/1/2015	Expected Date 4/1/2015	Comment
1 (1.1-01M)	Project start	10/1/2012			<b>Completed 10/1/2012</b>
2 (2-01M)	Magnet delivered to JLab	4/30/2013			<b>Completed 8/21/2013</b>
3	Power supply received	1/4/2014			<b>Completed 10/17/2014</b>
3	Magnet yoke modifications Completed	4/1/2014			<b>Completed 5/22/2014</b>
2 (1.2-10M)	Platform parts received	6/27/2014	3/31/2015		<b>Completed 3/24/2015</b>
3	Assemble magnet in Testlab	7/1/2014			<b>Completed 9/4/2014</b>
3	Commissioning test of magnet in Testlab completed	10/1/2014			<b>Completed 10/29/2014</b>
3	Beampipe solenoid correctors received	1/5/2015	6/1/2015	9/28/2015	4 months of float until project completion.
3	Detector supports completed	4/1/2015	3/31/2015		<b>Completed 3/24/2015</b>
2 (1.2-30M)	Beam-line parts received	9/24/2015	9/24/2015	10/16/2015	3 1/2 months of float until project completion.
1 (1.1-10M)	Project completion	1/29/2016	1/29/2016	1/29/2016	

## 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>	Coordinate Detector (ISU)
		<b>WBS 2.2</b>	Electronics Hut, Lead Shielding, Lead platform, and Detector Frames (JLab)
		<b>WBS 2.3</b>	Pole Shims and field clamp (JLab)
		<b>WBS 2.4</b>	Trigger (RU)

### WBS 2.02 Project Oversight:

- SBS weekly meetings, via tele and video conference were held on March 4, 11, 18 and 25<sup>th</sup>. Participants included Jefferson Lab, University of Virginia, Carnegie-Mellon University, William and Mary, Norfolk State University, University of Connecticut, University of Glasgow, Saint Mary's University, Idaho State University, and INFN Rome.
- Project is staffed appropriately for this stage, and includes Jefferson Lab (manager, scientist) and Idaho State University (one scientist).

### WBS 2.1 Coordinate Detector (ISU):

- Fermilab has produced about 1/3 of the scintillator. Production is planned to be finished in April with shipment for machining at the end of April.
- The purchase order for machining of scintillator has been sent to Eljen .
- Delivery of WLS fiber is scheduled for April 10<sup>th</sup>.
- Completed tests with sample scintillator provided by Fermilab and the tests meet the acceptance criteria for the detector.

## **WBS 2.2 Electronics Hut, Lead Shielding & platform, and Detector Frames:**

- Decided on a location for the electronics hut which is minimally invasive to other experiments and reduces changeover and installation times. Preliminary radiation assessment of the proposed location of electronics was completed and gave suggestions for electronics hut layout. Designer incorporated suggestions into the layout and will send new drawings for radiation calculation in beginning of April.
- INFN tested a prototype amplifier board as a possible solution to the noise problem with long HDMI cables for the GEM modules. The amplifier board did not provide a solution to the problem. JLab and INFN are investigating other possible solutions.

## **WBS 2.3 Pole Shims and field clamp:**

- The pole shim drawings have been completed. Design of device to insert pole shim was completed.
- Engineering analysis of field clamp support was started and will be finished by mid April. Design work on combining steel pieces that are available at Jlab into a clamp has been completed. The design work on the clamps and clamp support will continue in April with expectation to send to procurement by beginning of May.

## **WBS 2.4 Trigger:**

- 2 VXS crates and two CPUS for the trigger electronics were ordered. The expected delivery date is July 1<sup>st</sup>.

## **WBS 2 Costs:**

- Budget for this WBS for FY15 is \$710K.
- The incremental budget for FY14+FY15 is \$1,309K.
- Costed and obligated as of 4/1/2015: \$798K (61%).

**WBS 2.01 Milestones:** See [Appendix 1](#) for a graphic view of the milestones .

Level	Milestone	Scheduled Date	Expected date 3/1/2015	Expected date 4/1/2015	Comment
1	Project start	10/1/2013			<b>Completed 10/1/2013</b>
3	Finish testing of module prototype	8/30/2014			<b>Completed 8/30/2014</b>
3	Scintillator ordered	9/30/2014			<b>Completed 9/15/2014</b>
2	CDET module design completed	11/30/2014			<b>Completed 11/30/2014</b>
3	Wavelength Shifting Fibers ordered	1/15/2015			<b>Completed 1/20/2015</b>
3	Scintillator shipped for machining	4/30/2015	4/30/2015	4/30/2015	
2	JLab receives exit field clamp	6/2/2015	6/2/2015	7/31/2015	
3	Begin preparation of WLS fibers	6/15/2015	6/15/2015	6/15/2015	
3	Begin construction of CDET modules	9/1/2015	9/1/2015	9/1/2015	
3	Assembled one CDET module	10/1/2015	10/1/2015	10/1/2015	
2	Electronics hut assembled	10/2/2015	10/2/2015	12/18/2015	
2	Trigger completed	10/4/2015	10/4/2015	10/4/2015	
3	Assembled one CDET plane	12/1/2015	12/1/2015	12/1/2015	
2	Coordinate Detector assembled	6/30/2016	6/30/2016	6/30/2016	
1	Project completion	1/29/2017	1/29/2017	1/29/2017	



## WBS 3: Proton Form Factor

<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>	GEM's (UVa)
		<b>WBS 3.2</b>	GEM electronics (UVa)

### WBS 3.02 Project Oversight:

- SBS weekly meetings, via tele and video conference were held on March 4, 11, 18 and 25<sup>th</sup>. Participants included Jefferson Lab, University of Virginia, Carnegie-Mellon University, William and Mary, Norfolk State University, University of Connecticut, University of Glasgow, Saint Mary's University, Idaho State University, and INFN Rome.
- Project is staffed appropriately and includes Jefferson Lab (manager, scientist) and UVa (two scientists).

### WBS 3.1 GEMs

- Module #8 was tested with cosmics: all sectors fully operational. This module is now being installed in the x-ray box for high intensity testing.
- Module #9 construction was completed. All QA including HV tests passed. The chamber is currently being tested with cosmics.
- Module #10 construction was completed. Module currently being prepared for HV testing.
- Module #11 construction currently underway.
- Data collection and analysis with the x-ray tube setup continues.
- The draft design of the back tracker GEM chamber holding frame completed with the drawing shown in the following figure.

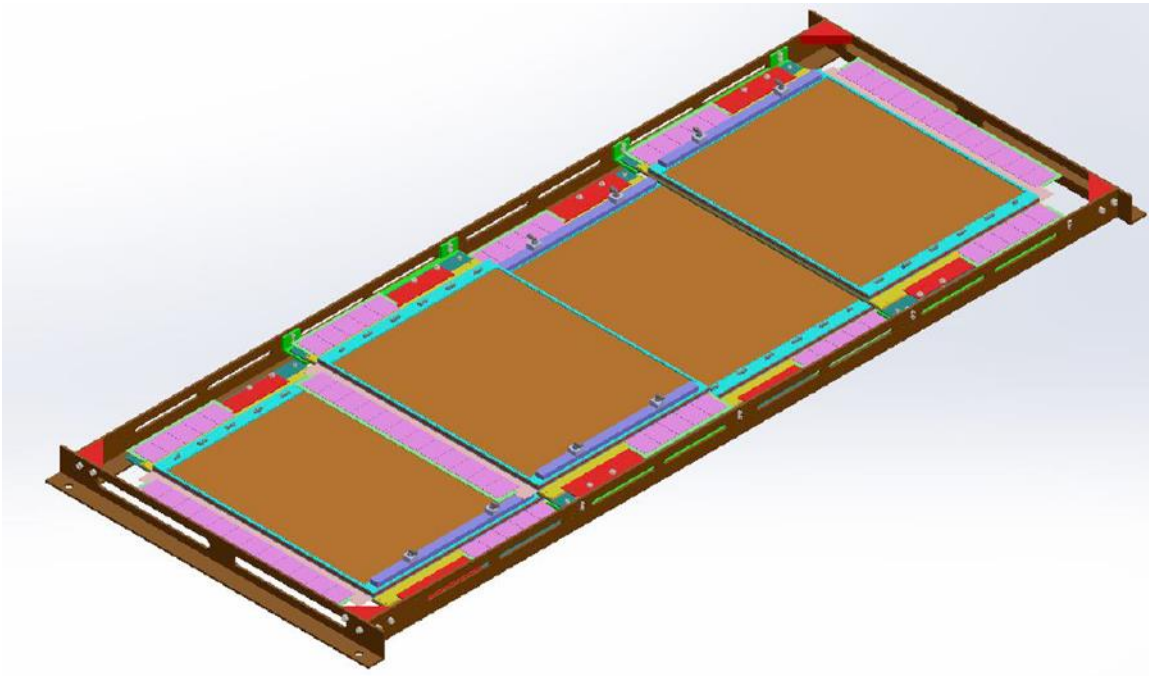


Figure 1 Drawing of the draft design of the chamber frame which holds four GEM modules.

### **WBS 3.2 GEM electronics**

- The contract for GEM electronics with UVA was signed in the beginning of March. This completes the Level 2 milestones for ordering the electronics.
- The design of the electronics backplane was completed; the first batch of prototype back planes will be ordered in April.

### **WBS 3 Costs:**

- Budget for this WBS for FY15 is \$371K.
- The incremental budget of FY13+FY14+FY15 is \$1,440K.
- With the addition of the moving the \$209K plus contingency forward from FY16 makes an incremental budget of \$1,687K.
- Costed and obligated as of 4/1/2015: \$1426K (85%).

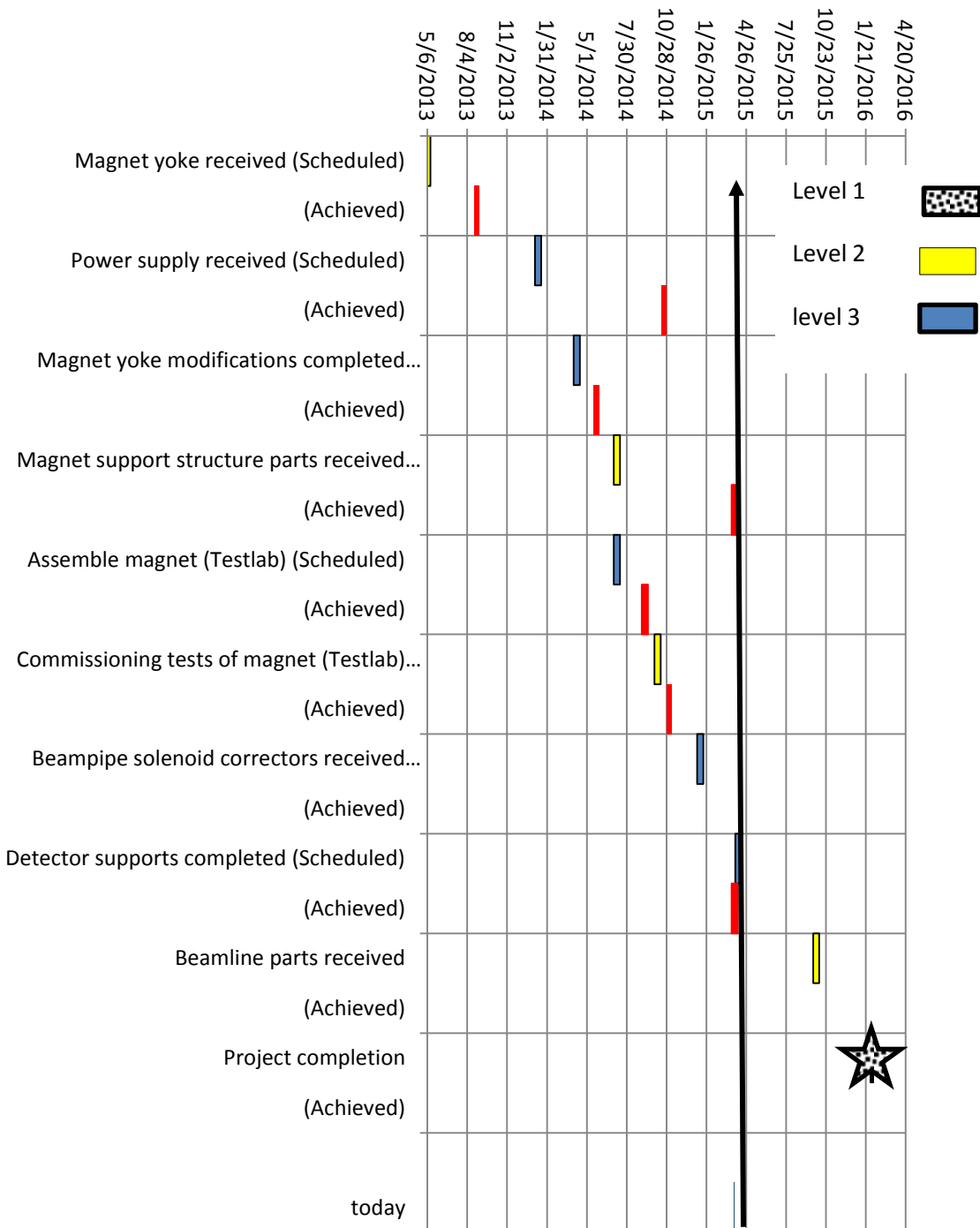
**WBS 3.01 Milestones:** (see [Appendix 1](#) for a graphic view of the milestones)

Level (ID#)	Milestone	Scheduled Date	Expected date 3/1/2015	Expected date 4/1/2015	Comment
1 (3.1-01M)	Project start	10/1/2012			<b>Completed 10/1/2012</b>
3	Order GEM Parts	10/1/2013			<b>Completed 10/18/2013</b>
3	UVa receives GEM parts	2/3/2014			<b>Completed 4/23/2014</b>
2 (3.2-01M)	First module assembled and tested	3/3/2014			<b>Completed 5/15/2014</b>
2 (3.2-10M)	UVa 5 GEM modules assembled and tested	6/2/2014			<b>Completed 12/23/2014</b>
2 (3.2-20M)	UVa 6-16 GEM modules assembled and tested	9/30/2014	6/15/2015	6/15/2015	
2 (3.2-30M)	UVa 17-29 GEM modules assembled and tested	3/2/2015	1/1/2016	1/1/2016	
2 (3.2-40M)	UVa 30-40 GEM modules assembled and tested	7/15/2015	6/15/2016	6/15/2016	
2 (3.2-50M)	1st order of Front End Electronics	10/1/2014	3/15/2015		<b>Completed 3/5/2015</b>
2 (3.2-60M)	2nd order of Front End Electronics	10/1/2015	3/15/2015		<b>Completed 3/5/2015</b>
1 (3.1-10M)	Project completion	7/31/2017	7/31/2017	7/31/2017	

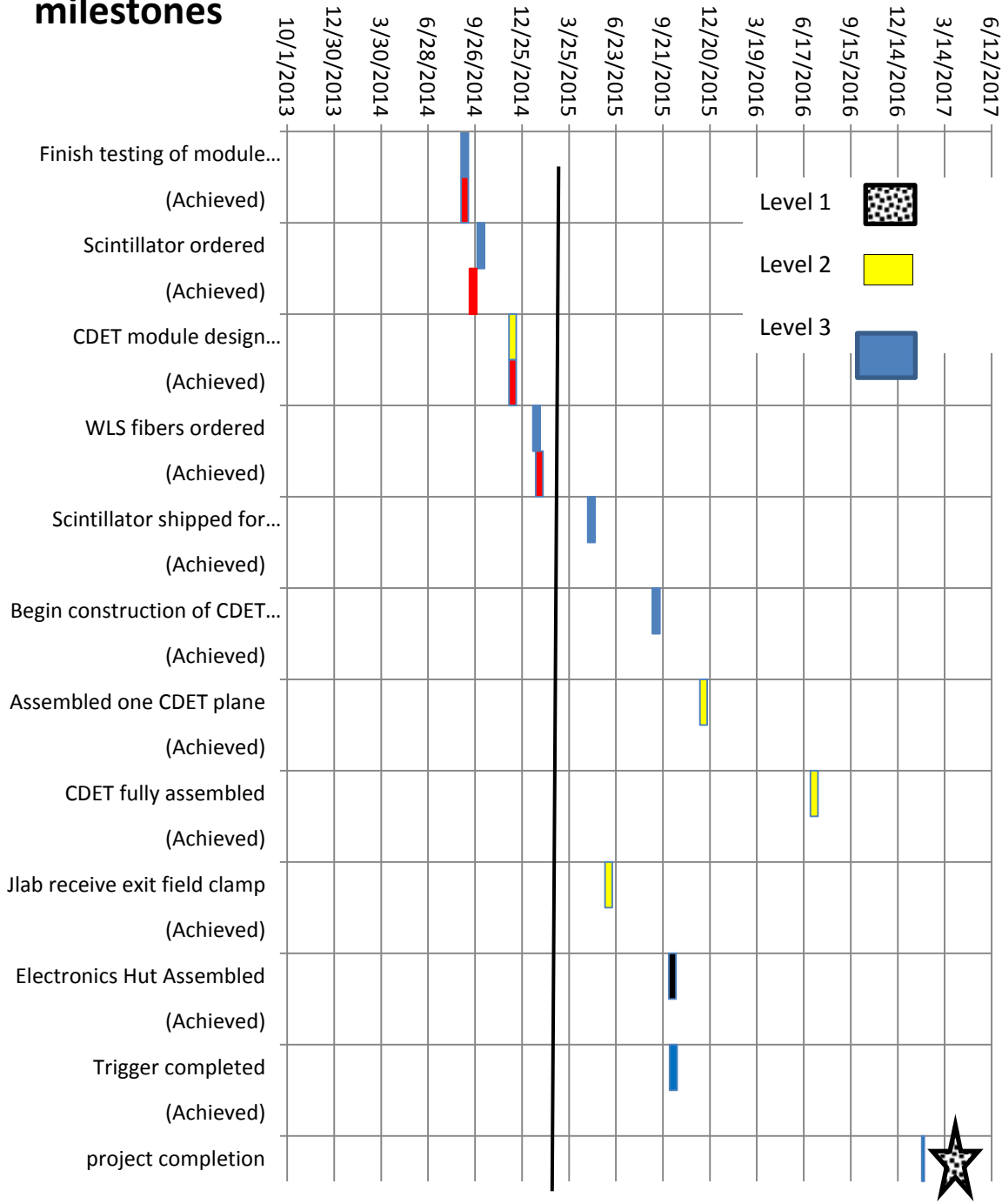
## Appendix I

The following are graphical representations of the milestones for SBS Basic (WBS 1), Neutron Form Factor (WBS 2,) and Proton Form Factor (WBS 3), updated on December 1, 2013. Black represents level 1 milestones as specified in the PMP. Yellow represents level 2 milestones from the PMP. Blue represents the new level 3 milestones to allow better quarterly tracking. The black vertical line indicates the day the chart was made. The red bar indicates when the milestone was achieved (e.g. Magnet yoke received).

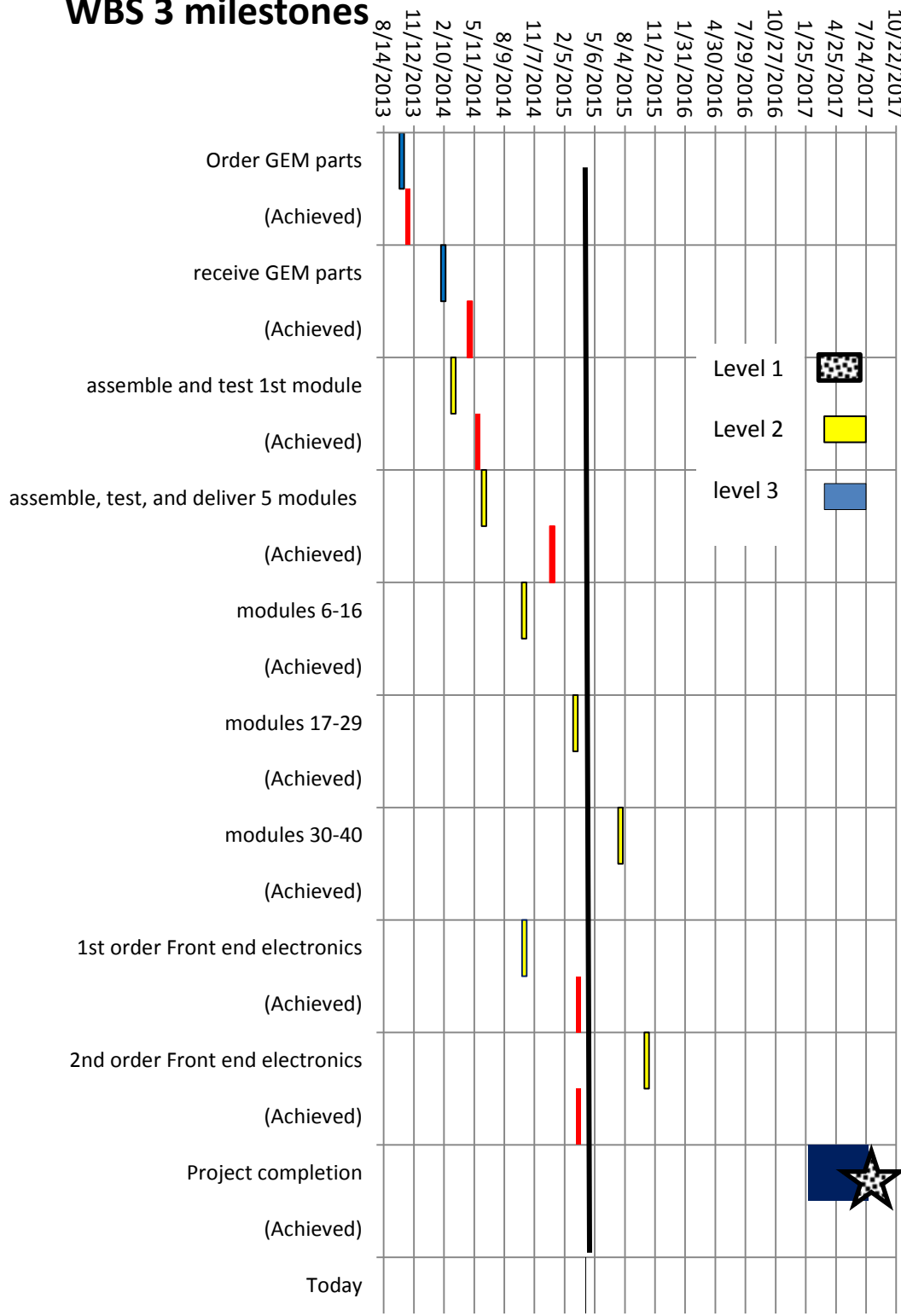
## WBS 1 Milestones



## WBS 2 milestones



## WBS 3 milestones



## Appendix II

**List of integration milestones for all equipment off-project, as well as key JLab readiness and safety reviews. For each milestone the additional float is indicated.**

### The Gas Cherenkov detector(GRINCH) from W&M ( for GMN and GEN)

Milestone	Completion date	Comment
Design and drawings for vessel are complete	Feb 1, 2015	<b>Completed Feb 2015</b>
Photon Detector Array assembled and tested	Aug 1, 2015	
NINO chip front end cards system shipped to JLab	Jul 1, 2015	
Purchase order issued for vessel	Oct 15, 2015	
Full DAQ system ready	Dec 1, 2015	
Vessel completely assembled	Mar 15, 2016	
GRINCH ready for installation	Jun 15, 2016	
Final analysis software complete	Jun 15, 2016	

### HCal-J from CMU (for GMN, GEN and GEP)

Milestone	Completion date	Comment
Detailed design completed	June 2014	<b>Completed July 2014</b>
Design review	Sept 2014	<b>Completed Dec 2014</b>
Module construction initiated	Mar 2015	<b>Completed Mar 2015</b>
Module assembly 25% complete	Sept 2015	
Module assembly 50% complete	Mar 2016	
Module assembly completed	Sept 2016	

#### Status update:

- Assembly of the first module began on March 30<sup>th</sup>.
- 65 light guide assemblies completed.
- End plates for 20 modules completed.

### Front Tracker from INFN (for GMN, GEN and GEP)



Milestone	Completion date	Comment
Electronics in production	Sept 2014	<b>Completed Sept 2014</b>
GEM chambers 1 and 2 completed	Sept 2015	
Initial Electronics QA completed	Dec 2015	
GEM chambers 3 and 4 completed	May 2016	
GEM chambers 5 and 6 completed	Dec 2016	

### Ecal from JLab ( for GEP)

Milestone	Completion date	Comment
Develop concept of annealing	July 2014	<b>Completed July 2014</b>
Design review	Nov 2015	
Electronics are ready	Nov 2016	
ECAL is ready	July 2017	

#### Status update:

- Prototype 4x4 block ECAL with heating oven has been prepared for tests.

### Polarized <sup>3</sup>He target from UVa ( for GEN)

Milestone	Completion date	Comment
Selection of target-cell design for high luminosity	Nov 2014	<b>Completed Oct 2014</b>
Simulated-beam test (bench test) of selected design	Dec 2016	
Design for target hardware and instrumentation complete	July 2017	
GEn Polarized <sup>3</sup> He target is ready	Jan 2018	