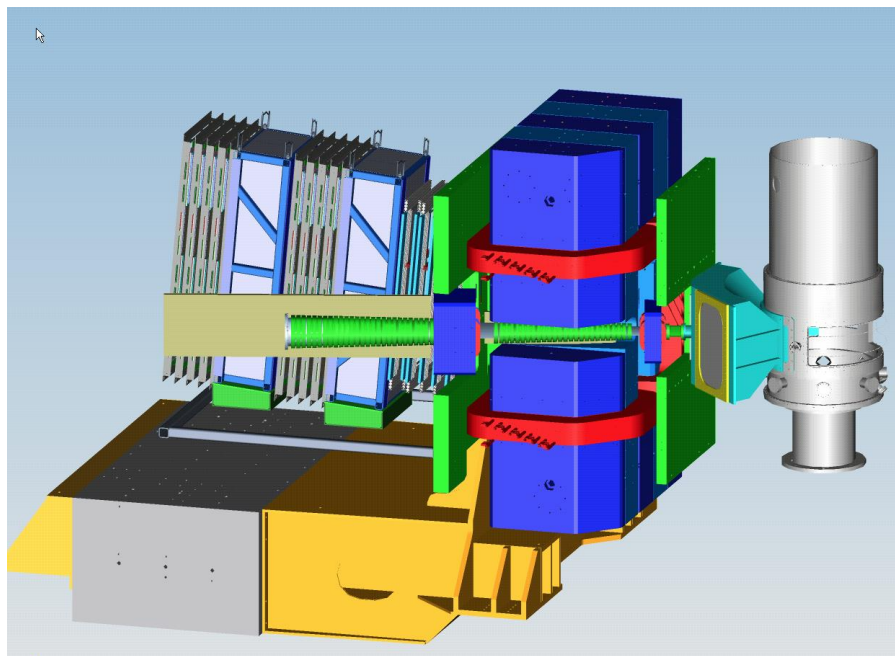


Super-Bigbite-Spectrometer (SBS)

Monthly Progress Report

January 15, 2017



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 49th Monthly Progress Report for the SBS Program.

The SBS Basic (WBS 1) project started in FY13 and was completed in January 2016. 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 final purchase for WBS2 was delivered on Jan 5th.

WBS 1: SBS Basic

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

WBS1 Project was completed on January 22nd, 2016.

WBS 1 Costs:

- The budget for this WBS for FY15 is \$212K.
- The incremental budget (FY13+FY14+FY15) is \$1,694K.
- At project completion, costed and obligated: \$1738K (103%).

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

Level (ID#)	Milestone	Scheduled Date	Expected Date N/A	Expected Date N/A	Comment
1 (1.1-01M)	Project start	10/1/2012			Completed 10/1/2012
2 (2-01M)	Magnet delivered to JLab	4/30/2013			Completed 8/21/2013
3	Power supply received	1/4/2014			Completed 10/17/2014
3	Magnet yoke modifications Completed	4/1/2014			Completed 5/22/2014
2 (1.2-10M)	Platform parts received	6/27/2014			Completed 3/24/2015
3	Assemble magnet in Testlab	7/1/2014			Completed 9/4/2014
3	Commissioning test of magnet in Testlab completed	10/1/2014			Completed 10/29/2014
3	Beampipe solenoid correctors received	1/5/2015			Completed 12/11/2015
3	Detector supports completed	4/1/2015			Completed 3/24/2015
2 (1.2-30M)	Beam-line parts received	9/24/2015			Completed 11/30/2015
1 (1.1-10M)	Project completion	1/29/2016			Completed 1/22/2016

WBS 2: Neutron Form Factor

WBS 2	Neutron Form Factor	WBS 2.01	Milestones
		WBS 2.02	Project oversight
		WBS 2.1	Coordinate Detector (ISU)
		WBS 2.2	Electronics Hut, Lead Shielding, Lead platform, and Detector Frames (JLab)
		WBS 2.3	Pole Shims and field clamp (JLab)
		WBS 2.4	Trigger (RU)

WBS 2.02 Project Oversight:

- SBS weekly meetings, via tele and video conference, were held on . 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, Christopher Newport 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):

- Completed

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

- Spacer strips for the beamline magnetic shielding will be delivered on Jan 5th. This is the last of the items for SBSNFF. Once officially accepted by the JLab engineers, the project will be complete.
- The ten UVa GEM frames were completed by the JLab machine shop on December 9th.

WBS 2.3 Pole Shims and field clamp

- Completed.

WBS 2.4 Trigger:

- Completed.

WBS 2 Costs:

- The total budget for WBS2 is \$1,372K.
- Costed and obligated as of 1/1/2017: \$1,340K (98%).

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

Level	Milestone	Scheduled Date	Expected date 11/1/2016	Expected date 12/1/2016	Comment
1	Project start	10/1/2013			Completed 10/1/2013
3	Finish testing of module prototype	8/30/2014			Completed 8/30/2014
3	Scintillator ordered	9/30/2014			Completed 9/15/2014
2	CDET module design completed	11/30/2014			Completed 11/30/2014
3	Wavelength Shifting Fibers ordered	1/15/2015			Completed 1/20/2015
3	Scintillator shipped for machining	4/30/2015			Completed 4/10/2015
2	JLab receives exit field clamp	6/2/2015			Completed 11/18/2015
3	Begin preparation of WLS fibers	6/15/2015			Completed 7/6/2015
3	Begin construction of CDET modules	9/1/2015			Completed 9/24/2015
3	Assembled one CDET module	10/1/2015			Completed 11/15/2015
2	Electronics hut parts received	10/2/2015			Completed 3/30/2016
2	Trigger completed	10/4/2015			Completed 3/15/2016
3	Assembled one CDET plane	12/1/2015			Completed 7/15/2016
2	Coordinate Detector assembled	6/30/2016			Completed 8/31/2016
1	Project completion	1/29/2017	1/29/2017	1/29/2017	

WBS 3: Proton Form Factor

WBS 3	Proton Form Factor	WBS 3.01	Milestones
		WBS 3.02	Project Oversight
		WBS 3.1	GEM's (UVa)
		WBS 3.2	GEM electronics (UVa)

WBS 3.02 Project Oversight:

- SBS weekly meetings, via tele and video conference, were held on . 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, Christopher Newport University and INFN Rome.
- Project is staffed appropriately and includes Jefferson Lab (manager, scientist) and UVa (two scientists).

WBS 3.1 GEMs

- Present status for completion of 40 GEM modules:

GEM module #	Status
35	Constructed and passed final QA
36	Constructed and passed final QA
37	Constructed and prepared for final QA
38	Constructed and prepared for final QA
39	Constructed and prepared for final QA
40	Under Construction

- Module #37 is prepared for final QA with X-ray source.
- Module #38 was completed by Dec 13th and is prepared for final QA with X-ray source.
- Module #39 was completed by the end of December and is prepared for final QA with X-ray source.
- Three GEM foils arrived from CERN at the end of December and will be used to construct module 40. If these new foils do not pass QA test, then a prototype module that passed QA tests will be used as module #40.
- A set of five GEM modules were placed in Hall A and setup with the DAQ electronics that will be used for the SBS experiments. The GEM modules were placed at 75 degrees from the target and parasitically detected scattered particles while the main Hall A experiments were running.

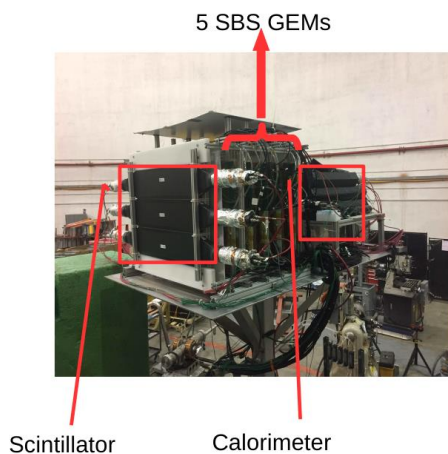


Figure 1 GEM module setup

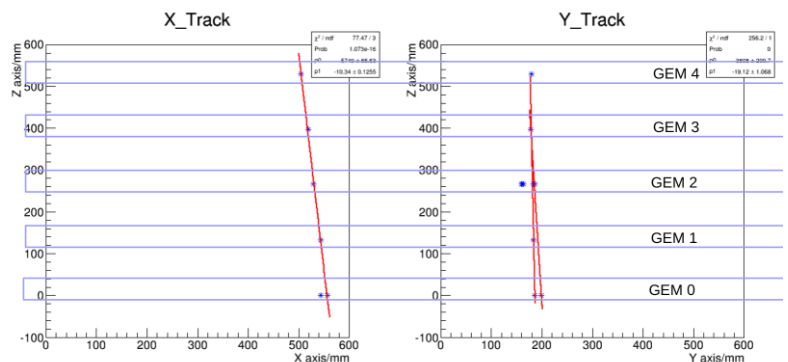


Figure 2 Example of track in the 5 GEM modules. X is the vertical direction and Y is the horizontal direction.

WBS 3.2 GEM electronics

- All electronics have been delivered to UVA.

WBS 3 Costs:

- The total budget for WBS3 is \$1781K.
- Costed and obligated as of 1/1/2017: \$1752K (98%).

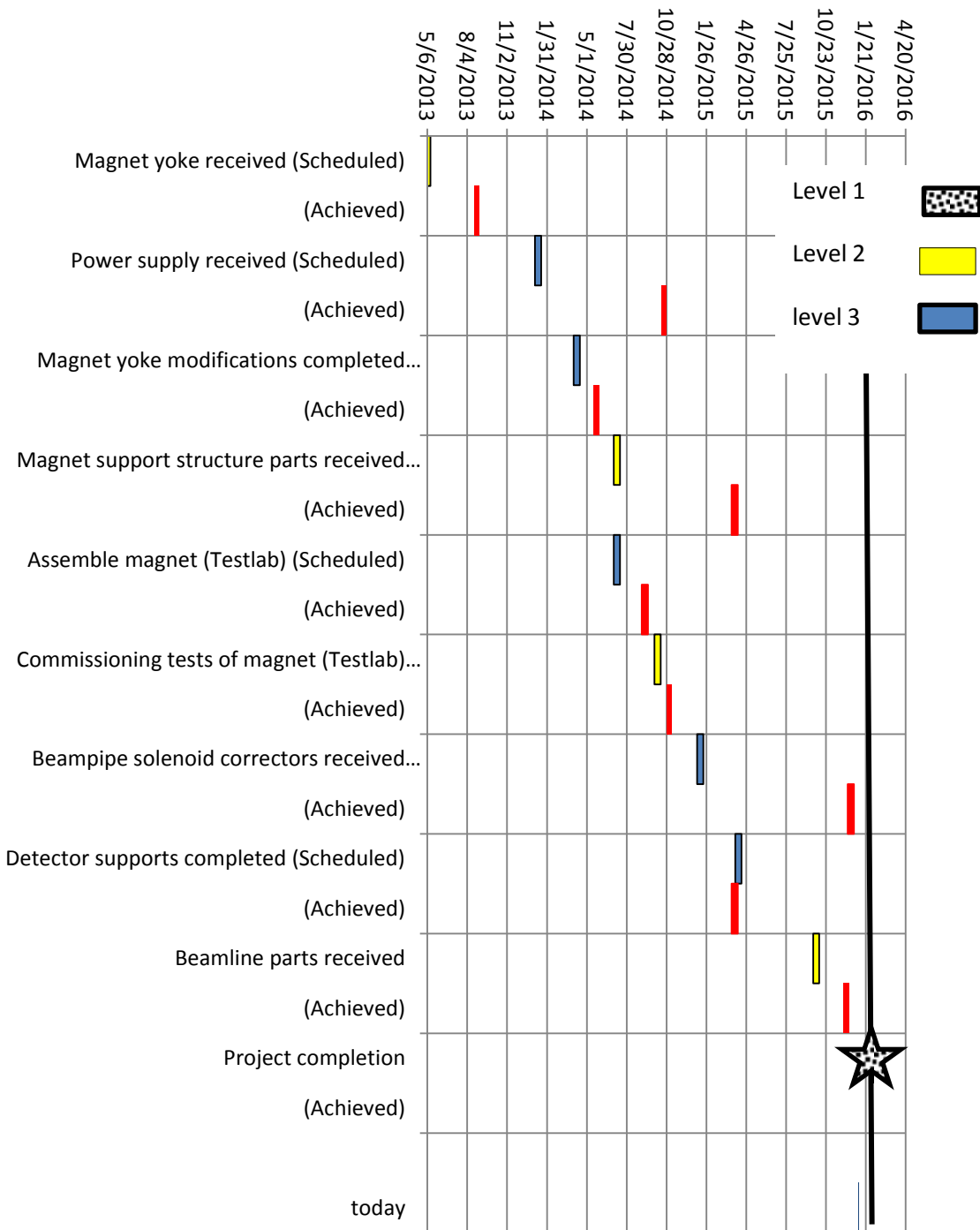
WBS 3.01 Milestones: (see [Appendix 1](#) for a graphic view of the milestones)

Level (ID#)	Milestone	Scheduled Date	Expected date 11/1/2016	Expected date 12/1/2016	Comment
1 (3.1-01M)	Project start	10/1/2012			Completed 10/1/2012
3	Order GEM Parts	10/1/2013			Completed 10/18/2013
3	UVa receives GEM parts	2/3/2014			Completed 4/23/2014
2 (3.2-01M)	First module assembled and tested	3/3/2014			Completed 5/15/2014
2 (3.2-10M)	UVa 5 GEM modules assembled and tested	6/2/2014			Completed 12/23/2014
2 (3.2-20M)	UVa 6-16 GEM modules assembled and tested	9/30/2014			Completed 7/28/2015
2 (3.2-30M)	UVa 17-29 GEM modules assembled and tested	3/2/2015			Completed 3/30/2016
2 (3.2-40M)	UVa 30-40 GEM modules assembled and tested	7/15/2015	1/15/2017	1/15/2017	
2 (3.2-50M)	1st order of Front End Electronics	10/1/2014			Completed 3/5/2015
2 (3.2-60M)	2nd order of Front End Electronics	10/1/2015			Completed 3/5/2015
1 (3.1-10M)	Project completion	2/1/2017	2/1/2017	2/1/2017	

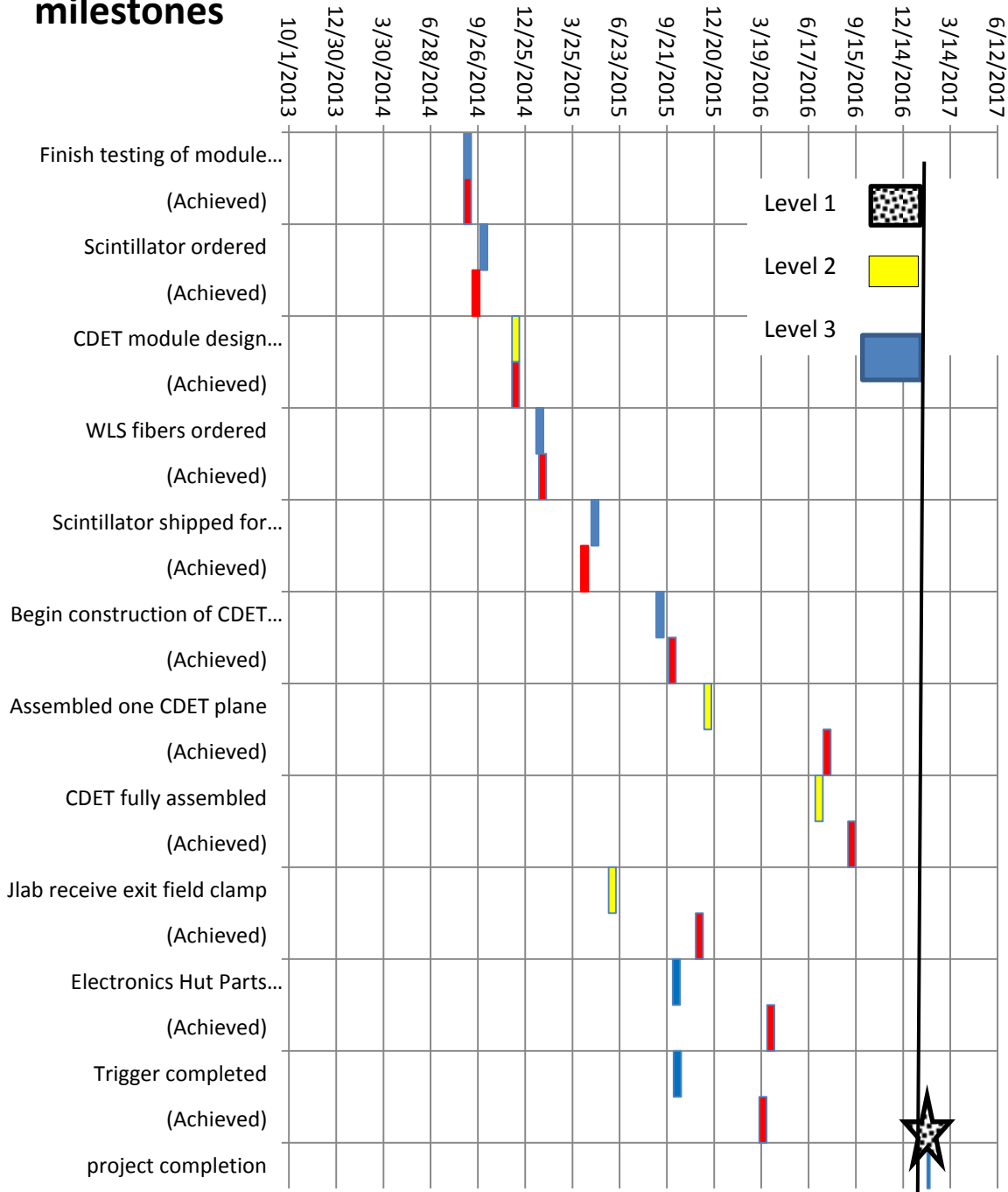
Appendix I

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).

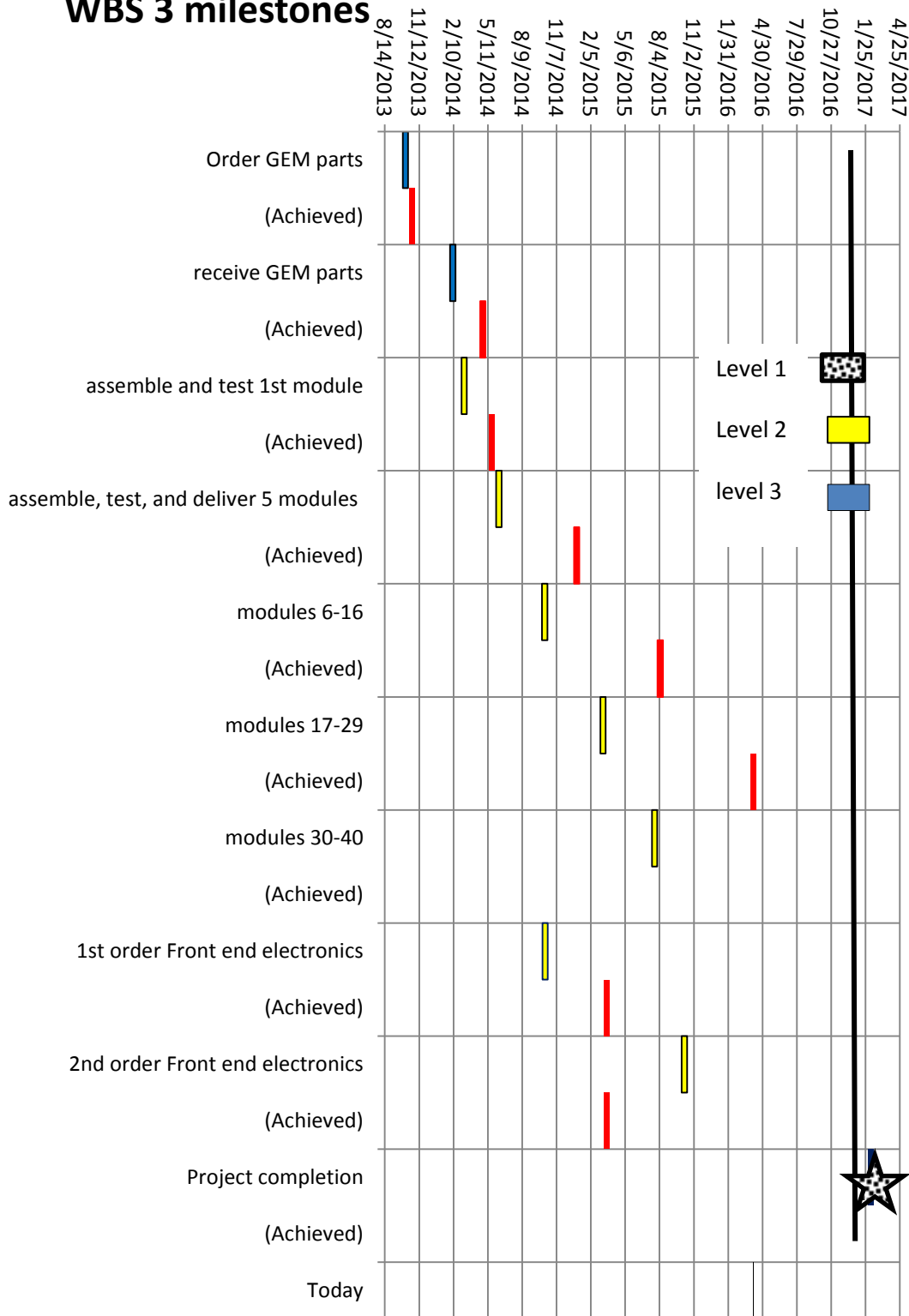
WBS 1 Milestones



WBS 2 milestones



WBS 3 milestones



Appendix II

GRINCH from W&M/NCCU/JMU (for GMN and GEN)

Milestone	Scheduled date	Comment
Design and drawings for vessel are complete	Feb 1, 2015	Completed Feb 2015
Photon Detector Array assembled and tested	Aug 1, 2015	Received by JLab in Aug 2015. Testing complete by May 2017
NINO chip front end cards system shipped to JLab	Jul 1, 2015	Completed Oct 2015
Purchase order issued for vessel	Oct 15, 2015	Completed Aug 2015
Full DAQ system ready	Dec 1, 2015	Expected June 2017
Vessel completely assembled	Mar 15, 2016	Completed Sept 2016
GRINCH ready for installation	Jun 15, 2016	Expected June 2017
Final analysis software complete	Jun 15, 2016	Expected Sept 2017

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

Milestone	Completion date	Comment
Electronics in production	Sept 2014	Completed Sept 2014
GEM chambers 1 and 2 completed	Sept 2015	Completed Dec 2015
Initial Electronics QA completed	Dec 2015	Completed Dec 2015
GEM chambers 3 and 4 completed	May 2016	Expect delivery in Jan 2017
GEM chambers 5 and 6 completed	Dec 2016	Expect in May 2017

Status update:

- Seven modules are undergoing cosmic tests in Rome and the data is being processed. The plan is to send six modules to JLab at the end of January.
- Two modules have been completed at Catania and are ready to shipped to Rome. A third module will be finished by the end of January.
- In December, Italian physicists and technicians visited JLab. They worked on DAQ and testing chambers. The six modules at JLab were taken to UVa to test with the X-ray source setup. Data from the test is being analyzed.

HCal-J from CMU/INFN-Catania (for GMN, GEN and GEP)

Milestone	Completion date	Comment
Detailed design completed	June 2014	Completed July 2014
Design review	Sept 2014	Completed Dec 2014
Module construction initiated	Mar 2015	Completed Mar 2015
Module assembly 25% complete	Sept 2015	Completed Sept 2015
Module assembly 50% complete	Mar 2016	Completed April 2016
Module assembly completed	Sept 2016	Expected in Feb 2017

Status update:

- Module production is ongoing. Have produced 238 modules (235 modules at JLab) of the total of 288 modules in HCal.
- Delivery of 66 modules to JLab was done in middle of December.
- No modules were produced in December. Work was done on producing the light guides for the modules. The remaining wavelength shifters were inspected. Those that failed QA were sent back to St. Gobain in the beginning of December and their replacements have been shipped to CMU. Production of modules were resume in January.

Ecal from JLab/SBU/JMU (for GEP)

Milestone	Completion date	Comment
Light guide procurement	Jan 2017	
Mechanical design for main frame	Feb 2017	
Start gluing of light guides to leadglass blocks	Mar 2017	
Super module procurement	Apr 2017	
Main frame procurement	June 2017	
Detector assembly in main frame starts	Sept 2017	
Detector testing in the main frame starts	Oct 2017	Critical decision
Connection of Signal and HV cables	Dec 2017	
Finished first pass cosmic tests	Apr 2018	

Status update:

- The milestones have been updated to those presented at the DOE November 2016 Review.
- Since the time of the DOE review, the projected time for the main frame procurement has slipped from March 2017 to June 2017. This is because it is taking longer to produce the design drawings for the main frame than previously estimated. The mechanical design of the main frame will be completed by February 2017 while the detailed drawings and consultation with JLab engineers will be completed for procurement of the main frame in June 2017. To absorb this slip in the schedule, the detector assembly in the main frame and the test will be done at JLab rather than NCCU. This will save the three months of disassembly, shipping and reassembly that were in the original schedule and keep the completion date for finishing the cosmic tests as April 2018.

Polarized ^3He target from UVa (for GEN)

Milestone	Completion date	Comment
Selection of target-cell design for high luminosity	Nov 2014	Completed Oct 2014
Conceptual design document complete	Jan 2016	Completed Mar 2016
Conceptual design review	Mar 2016	Completed Mar 2016
Start bench test of 3 liter glass convection target	April 2016	Completed Aug 2016
Conceptual design frozen	June 2016	Completed Oct 2016
Test of glass/metal technology complete	June 2016	Completed July 2016
Begin engineering and design	July 2016	Completed May 2016
Bench test of 3 liter glass/metal target	Jan 2017	
Simulated beam test on the bench for full scale 6 liter cell	Sept 2017	
Begin production of full-scale cells	Nov 2017	
Engineering complete	Jan 2018	
Design of target hardware and instrumentation complete	June 2018	After CDR review updated to July 2018
Target is ready for installation	Jan 2019	