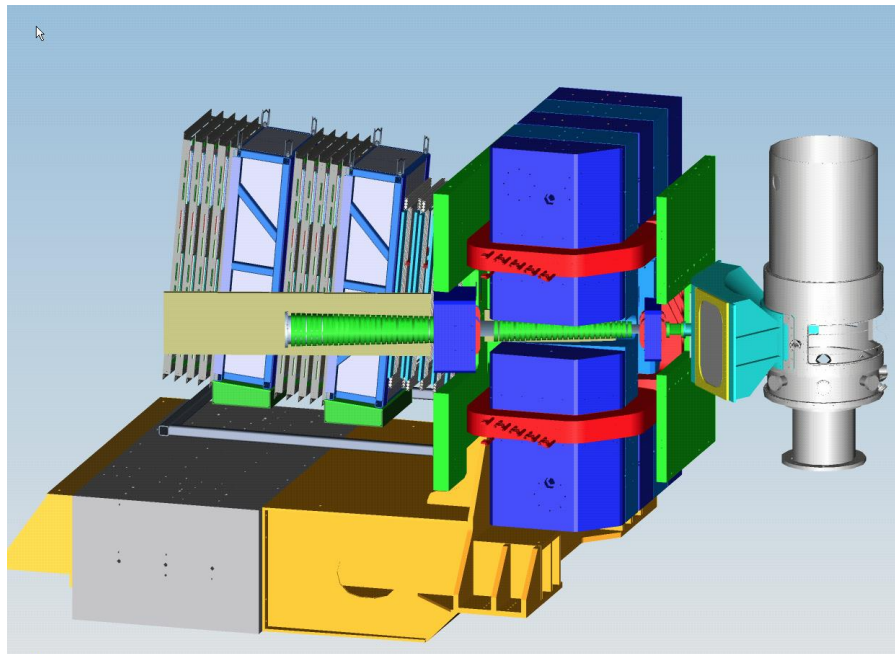


Super-Bigbite-Spectrometer (SBS)

Monthly Progress Report

June 15, 2016



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 42nd 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.

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 May 4, 11, 18 and 25th. 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):

- 14-scintillator "group" status:
 - All 168 groups completed.
- 16-fiber "bundle" status (total of 168 bundles needed for CDet):
 - 148 fiber bundles have fibers inset with epoxy, remaining 20 to be inset.
 - 44 fibers bundles have been machined from both sides; 104 remain to be machined.
 - The ball bearings in the polishing machine needed to be replaced in mid-May. It took about two weeks to order the ball bearings and make the replacement. Polishing of fiber bundles began again at the beginning of June.

- The assembly of all three modules (one plane) is delayed by 1 ½ months until 7/15/2016. The delay is caused by the problems with polishing machine and training new students to do the assembly. With the additional summer manpower, the assembly of all six modules is now expected by end of August (1/2 month delay).
- Ordered cables connecting MaPMTs to NINO front end cards. Expect delivery by September 2016.
- One module has been fully assembled with half the module setup for cosmic tests using the full DAQ readout chain that will be used in the SBS experiment. Figure 1 is a photo of the assembled module.



Figure 1 CDet module 1 assembled and ready for cosmic tests

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

- The conceptual design for the beam line stands for corrector magnets has been finalized. Three weeks of engineering design will be done in June, followed by 5 weeks of detailed design work. In the first week of August, the beam line stands for the corrector magnets will be sent to procurement.

WBS 2.3 Pole Shims and field clamp

- Completed.

WBS 2.4 Trigger:

- Completed.

WBS 2 Costs:

- Budget for this WBS for FY16 is \$77K.
- The incremental budget for FY14+FY15+FY16 is \$1,361K.
- Costed and obligated as of 6/1/2016: \$1195K (88%).

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

Level	Milestone	Scheduled Date	Expected date 6/1/2016	Expected date 7/1/2016	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	5/30/2016	7/15/2016	
2	Coordinate Detector assembled	6/30/2016	8/15/2016	8/30/2016	
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 May 4, 11, 18 and 25th. 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

- The construction of modules #32 was completed.
- Construction of module #33 is underway.
- The MPD electronics based readout setup at UVa was successfully completed and tested. Module diagnostic software was written and implemented. X-ray testing of module 28 was completed using the new readout system. All sectors are operational. This readout system is currently being used for testing modules 27 and 29-32. The readout noise and performance of the system were improved to get the expected performance parameters.
- The last readout board on hand has been used for module #33. The expected shipment of two readout boards from CERN in May was delayed due to issues at CERN; one of the two readout boards was found to be faulty during tests at CERN. Now a shipment containing one readout board is expected to arrive by June 10th. The next readout foil will arrive at the end of June. Ten GEM foils (enough for 3 modules) are at UVa. UVa is talking with CERN to get the schedule of readout foils back to 2 per month and resume shipment of GEM foils.

WBS 3.2 GEM electronics

- Paolo Musico and Evaristo Cisbani of INFN visited EES on May 26 and 27th to install and setup the test bench for the APV front ends.
- MPDs: SMD assembly done, optical checking in progress, through hole component soldering will follow. Functional testing after that.
- Backplanes: 5-slots ready, 12-slots almost ready. EES found few pieces (6-7) with delamination problems on the PCB and agreed to produce new parts.
- APVs: PCB were ready and tested for bonding (by the bonding company). Some delays caused by late shipping of the Panasonic connectors. SMD assembly started by May 30th. Expected 1st batch to be tested by June 10th.

WBS 3 Costs:

- Budget for this WBS for FY16 is \$309K.
- The incremental budget of FY13+FY14+FY15+FY16 is \$1739K.
- Costed and obligated as of 6/1/2016: \$1670K (96%).

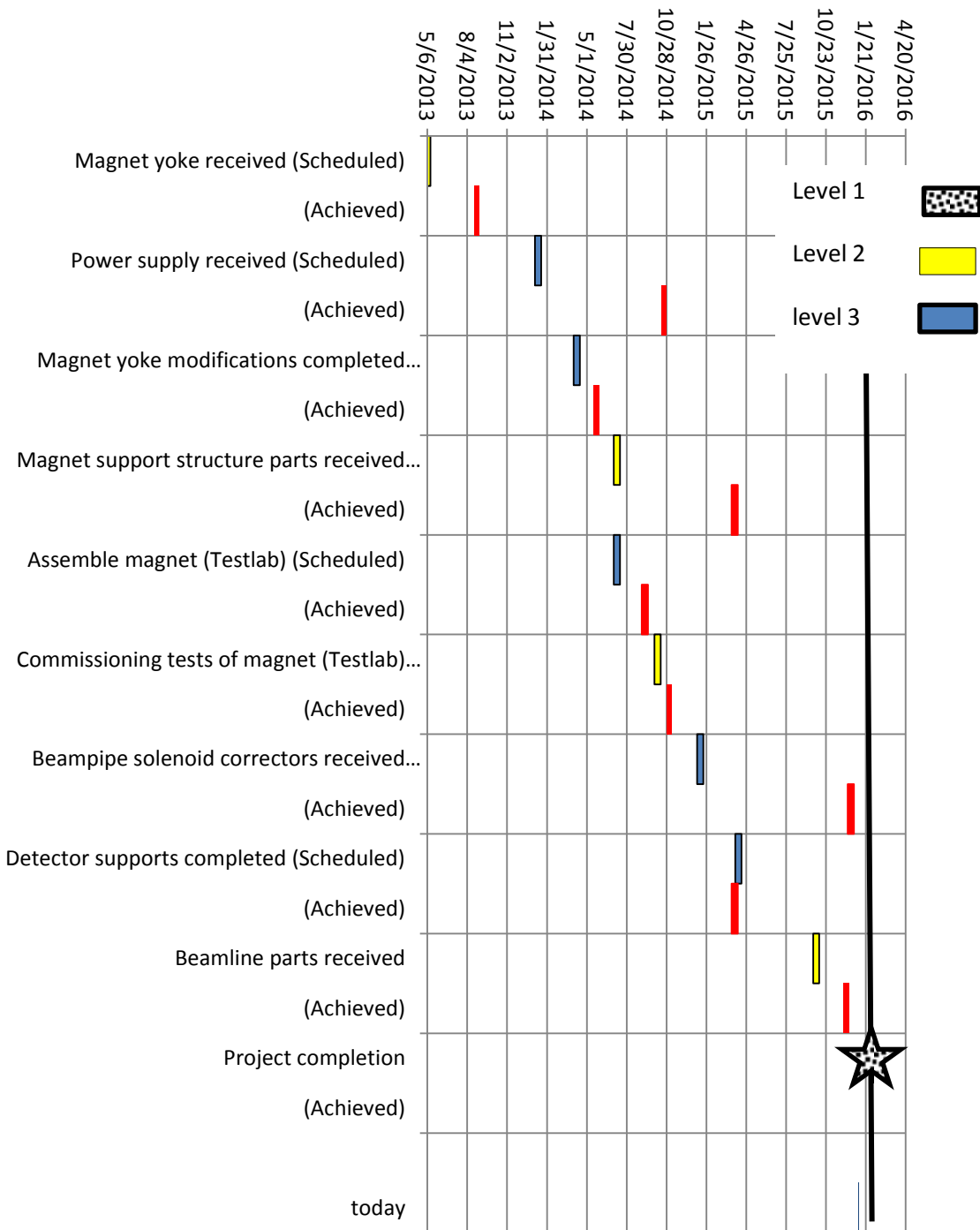
WBS 3.01 Milestones: (see [Appendix 1](#) for a graphic view of the milestones)

Level (ID#)	Milestone	Scheduled Date	Expected date 6/1/2016	Expected date 7/1/2016	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	9/15/2016	9/15/2016	
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	

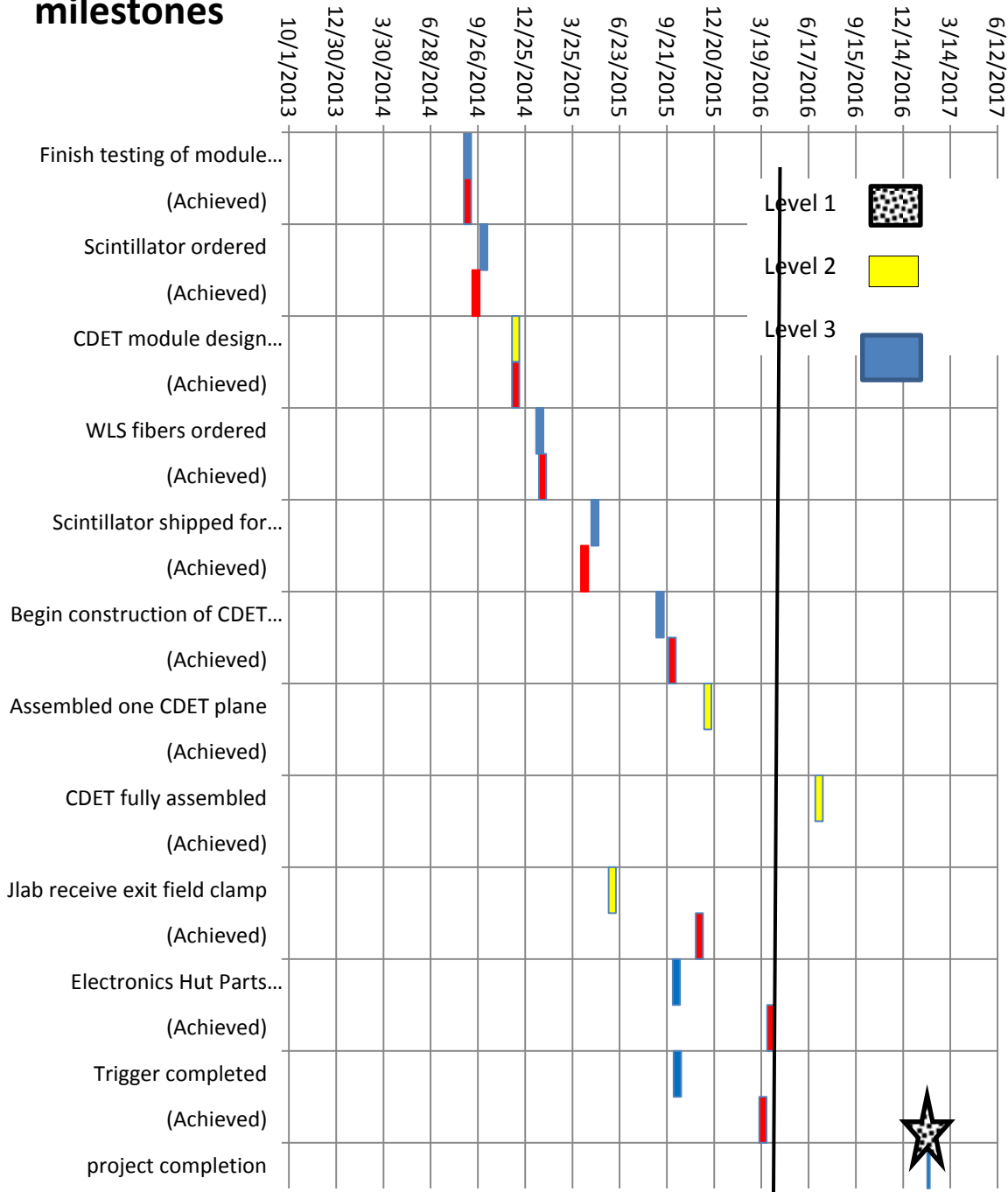
Appendix I

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).

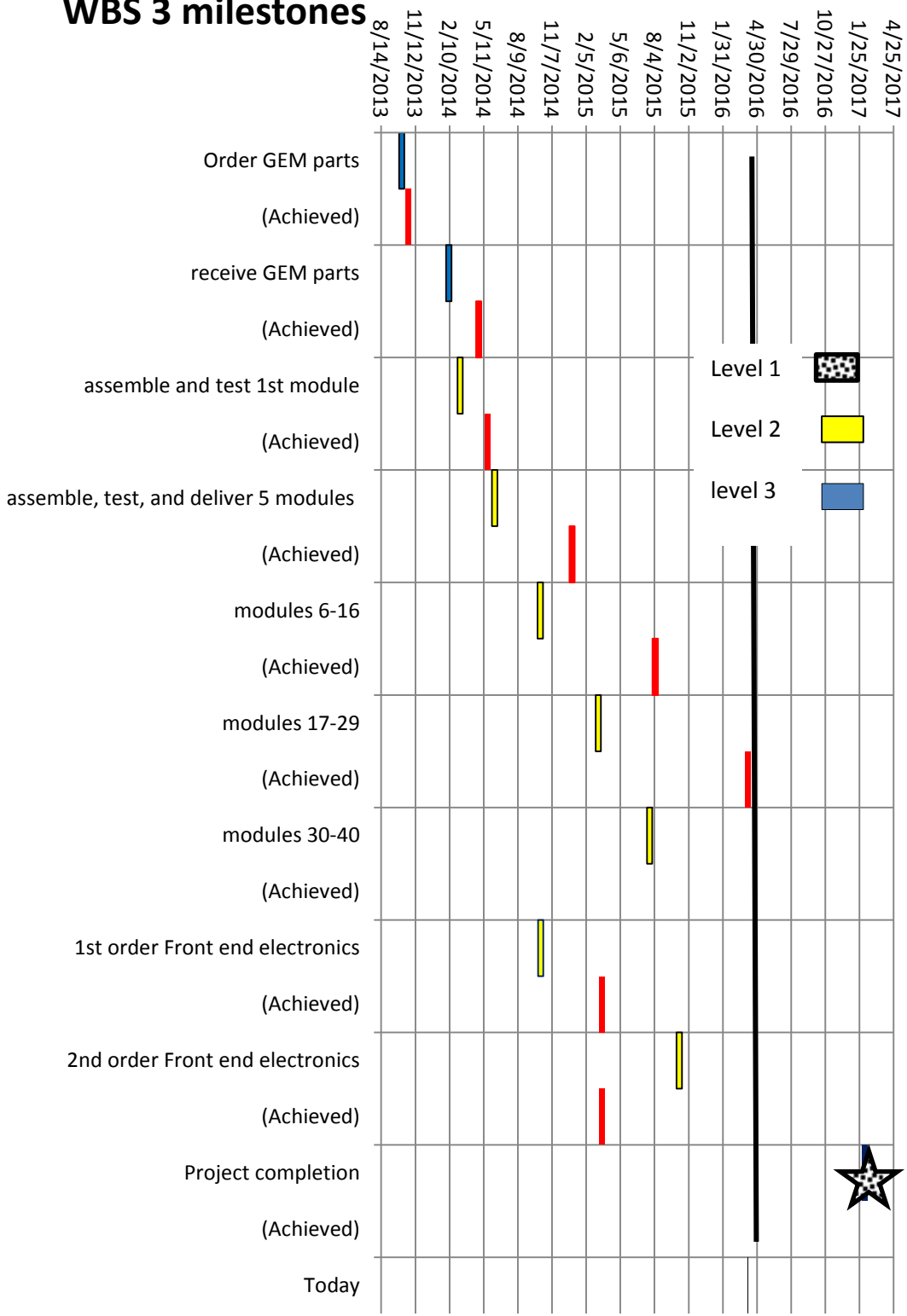
WBS 1 Milestones



WBS 2 milestones



WBS 3 milestones



Appendix II

The Gas Cherenkov detector(GRINCH) from W&M (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 Aug 2016
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 August 2016
Vessel completely assembled	Mar 15, 2016	Expected July 2016
GRINCH ready for installation	Jun 15, 2016	Expected Sept 2016
Final analysis software complete	Jun 15, 2016	Expected Sept 2016

HCal-J from CMU (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	

Status update:

- Module production is ongoing. Have produced 168 modules (all 168 modules at JLab) of the total of 288 modules in HCal.
- CMU produced 26 more modules in May and CMU shipped 66 modules to JLab on May 26th.

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 Oct 2016, delay due to manufacturing of carbon frame
GEM chambers 5 and 6 completed	Dec 2016	Expect in March 2017

ECal from JLab (for GEP)

Milestone	Completion date	Comment
Develop concept of annealing	July 2014	Completed July 2014
Test of annealing with prototype	Nov 2015	Completed May 2015
Fabrication of C200 frame started	Sept 15 2015	Completed Sept 2015
Design of ECAL platform modification started	Dec 1 2015	Delay until Aug 2016
C200 assembly completed and testing begins	Jan 15 2016	Completed Jan 2016
C200 report results, recommendations completed	June 1 2016	July 1 2016
Design of ECAL frame/oven started	July 1 2016	Delay until Aug 2016
ECAL platform in testlab .	Nov 1 2016	Delay until Dec 2016
Installation of lead glass started	Jan 15 2017	
Lead glass installation complete and cabling started	July 15 2017	
Cabling completed and cosmic tests started	Nov 1 2017	
Finished cosmic tests and ECAL is ready to install	Jan 15 2018	

Status update:

- At Stonybrook, the design of the nine block submodule is nearly complete. It is a simple design that should be fabricated quickly and ready for testing in the oven in June.
- The report comparing the three options for ECal is being revised. The report is being updated and will be sent to outside reviewers by July 8th. The final report that describes the technical design, the schedule, and the financial path forward will be completed by August 15th.

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	Expect start in July 2016
Conceptual design frozen	June 2016	
Test of glass/metal technology complete	June 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	

Status update:

- Following the concept design agreed to at the March 2016 review, the Hall A designers have been working with UVa on the design of the polarized target. This is a completion of the milestone “Begin engineering and design”.
- The final version of the CDR for the polarized target is due in June 2016. When CDR arrives then the milestone “Conceptual design frozen” will be considered complete.