Report of the Director's Cost and Schedule Review of the sPHENIX Project

1. Introduction

The Brookhaven National Laboratory Director's cost and schedule review of the sPHENIX project was held on August 2-4, 2017. The appendices of this report contain the agenda and charge for the meeting and the members of the committee attending this meeting.

The goals of this review were to provide sPHENIX and the Laboratory management with an assessment of the status of the project, their readiness to undergo a DOE OPA CD-1 review in the spring of 2018, and advice about actions that would significantly improve the likelihood of a successful CD-1 review.

2. Overall assessment

The project team is experienced, well-structured and, with adequate resources, should be capable of successfully carrying out sPHENIX. The technical expertise and experience is high.

The scientific collaboration is strong and engaged and the science case is strong. The Laboratory clearly wants sPHENIX to succeed. Adequate support from CAD, Physics, SMD will be essential. These are necessary (but not sufficient) ingredients for success.

The committee believes that sPHENIX should be positioned for a successful CD-1 review in the spring of 2018 if continued progress is made in development of the technical, management and cost/schedule aspects of the project. Following the advice and recommendations of this committee will significantly enhance the likelihood of a successful CD-1.

3. Overall comments and Recommendations

Comment- The MIE scope is in flux due to excess cost. The current cost estimate exceeds the MIE cap. Descope options are being evaluated and value engineering is planned

Recommendation- By the end of CY2017 the project should resolve descope options to bring the MIE cost within cap.

Comment- The schedule is aggressive, technically limited and based on a highly unlikely MIE funding profile.

Recommendation- By the end of CY 2017 the project should develop a realistic profile expectation with BNL and DOE, and plans for approaches like phased funding. The schedule should then be adjusted accordingly.

Comment- Time between now and CD-1 allows for in-depth reviews of key design/technical/management issues/concerns/risks that would strengthen the project.

Recommendation- BNL management should plan for and execute in-depth reviews, with action items cleared, well before Director's pre-CD-1 review. Suggested reviews include:

- Cost & schedule including contingency, realistic resource profile ($ and people) for both MIE," upgrade support" and "infrastructure and facility upgrades"
- Needs outside of the project for software, storage and processing of the data
- Technical review of calorimeters and electronics.
- Technical review of TPC and electronics

Recommendation- BNL should hold a Director's pre-CD-1 Review at least 2 months before the OPA CD-1 review.

Comment- The "upgrade support" and "infrastructure and facility upgrades" are under BNL control. Needed staff has been defined but not yet locked in with mutual agreements with CAD, Physics and SMD.

Recommendation- By November 2017, the project should execute mutual agreements with the relevant BNL departments defining support for sPHENIX including staff.

Comment- At this point the project presented no plans for assuring EH&S at remote sites (other Labs and universities) or EH&S documentation related to activities to occur within the BNL Physics Department. These may represent serious oversights.

Recommendation- The project leadership must remedy this as soon as possible

Comment- The project does not have a single individual responsible for all systems engineering functions. The current distribution of systems engineering tasks among the project leadership leads to significant risk of something important falling through the crack.

Recommendation–In the next month the project should assign one person as project system engineer with appropriate authority and responsibility.

Comment- The current schedule doesn't allow time to map the magnet volume. The project states that they will investigate whether this mapping is required and, if so, the schedule would be extended to accommodate it. It is also not clear that the project has as yet a clear idea about how to do the mapping if needed.

Recommendation– Well before the CD1 review the project should decide whether mapping of the field volume is needed, and if so, the schedule should be modified to accommodate this and solid plans made to do the mapping. Alternatively, if the issue can't be settled before CD-1, time for mapping should be added to the schedule and if later it were determined not to be needed, then there would be additional schedule contingency.

Comment- The sPHENIX project seems not yet to have fully explored their schedule and cost risks. A number of risks surfaced during this review that should have been identified at this point.

Recommendation– By the end of September 2017 the project should reassess and update their risk register with special attention to schedule and cost risk. It might be useful to have a few knowledgeable BNL people from outside sPHENIX look over the resulting set of risks.

4. Calorimeter and Calorimeter Electronics

4.1 Answers to MIE Charge Questions:

Question 1-Is the conceptual design technically sound and likely to meet the objectives of its scientific case?

We find that the conceptual design has been backed up by significant R&D efforts in recent years, and the design should meet the scientific objectives of sPHENIX.

Question 3- Are the resources, including (wo)men-power adequate and likely to be provided?

The groups for building calorimeters and electronics are experienced and strong, and detailed estimates of the needed resources are documented. The costs for the calorimeters have risen significantly, leading to the total project cost exceeding the envelop. Significant efforts need to be made for reducing the cost, including investigation of descoping. The resources for labor cost, both on MIE through university contracts, or off-project with BNL funding have been estimated but should be formalized through agreements with the relevant departments.

Question 5- Are the EH&S aspects being properly addressed?

EH&S needs to address safety issues outside BNL, and document procedures concerning safety in all relevant departments at BNL.

4.2 Findings, comments and recommendations

Finding: SiPM's are susceptible to radiation damage from low energy neutrons. sPHENIX has calculated that the amount of exposure should lead to an acceptable excess leakage current after five years of heavy ion running at RHIC.

Comment: Since the SiPM's are so critical to the physics performance it is important to carryout further study of the radiation damage.

Recommendation: Continue studying neutron radiation damage to SiPM's.

Finding: The Collaboration has worked very successfully with a firm in Russia on HCal. The firm has given a proposal to supply scintillators with grooves machined and wavelength fibers inserted.

Comment: We worry that in the current climate conditions may occur where business relations with Russia may become impossible.

Recommendation: Identify and quantify the cost and schedule for an alternate source for the HCal scintillator.

Finding: The University of Illinois at Urbana Champaign has shown great leadership in the development of EMCal scintillating fiber blocks filled with tungsten powder/epoxy.

Comment: This is a sole source for the EMCal and the fabrication of these blocks is on the critical path.

Recommendation: Quantify the cost and schedule impact and mitigation of the risk should Illinois not be able to deliver.

Recommendation: Mitigate the risk of production delays by aggressively pursuing R&D in FY18 by producing ~100 EMCal blocks.

Finding: The schedule for the MIE was moved out by one year due to the funding uncertainties in FY18.

Comment: Perhaps some of this time could be used productively by moving other tasks earlier.

Recommendation: Move tasks funded by non-MIE sources such as tooling and installation fixtures earlier in the schedule.

Finding: Plans for water cooling the EMCal are being finalized. The calorimeter electronics are also close to final design.

Comment: It is always best to test complete systems.

Recommendation: Test the full electronics system including the water-cooling in the February 2018 beam test.

5. TPC, Tracking, Trigger, and DAQ

5.1 Answers to MIE Charge Questions

Question 1- Is the conceptual design technically sound and likely to meet the objectives of its scientific case?

We find the conceptual designs of the TPC, trigger, DAQ and tracking approach to be technically sound and likely to meet the requirements needed for the success of the sPHENIX physics program.

Question 3- Are the resources, including (wo)men-power adequate and likely to be provided?

An adequate workforce is identified with the groups involved having a solid reputation in supplying the promised personnel on schedule. It is not entirely clear how all the resources are funded**.**

Question 5- Are the EH&S aspects being properly addressed?

EH&S needs to ensure that safety issues outside of BNL are addressed.

5.2 Findings, comments and recommendations

5.2.1 General:

Comment: Mechanical requirements or corrections should be developed based on the tracking precision required for good Upsilon resolution. This includes the field cage precision, space charge corrections and the B field map. It is likely that a sagitta resolution of 70 μm will be required.

5.2.2 Tracking and mechanical related issues:

Finding- The CD-1 should include specifications based on the requirement of resolving the Upsilon states and how these specifications can be achieved. For example, the precision of the mechanical dimensions of the field cage can be set by the tracking accuracy required to achieve the necessary momentum resolution.

Finding- There were presentations showing that misplacement of the central membrane and the GEM locations could be tolerated, but it was not clear what the limits are.

Finding- According to the draft CD-1 document the sweet spot for Upsilon measurements are electrons with a momentum range of 2-10 GeV/c. The sagitta for a 10 GeV/c track over 80 cm with a 1.5 T field is 3.6 mm. To achieve the required 2% invariant mass determination dp/p = ds/s= ~2% 2% of 3.6 mm gives ~70 μm. So, in the end the drift path accuracy must be of this order. In addition to the field cage requirement this sets the requirements on the B field map, the space charge correction and drift gas uniformity. How the space charge correction is monitored and corrected needs to be addressed since it is ~50 times the required sagitta resolution. In STAR it was found that the space charge fluctuates significantly, driven presumably by fluctuations in luminosity. In sPHENIX variations in GEM gain will likely contribute both spatial and time dependent space charge density variations. If there are temperature variations in the gas this will also cause space charge changes due to variations in gain.

Comment**:** More on interfacing of the inner detectors would be desirable. For example, how will beampipe bake out be done in the presence of inner detectors.

5.2.3 Installation and Assembly of the inner tracking detectors

Finding- Some work was presented on how the MVTX would be supported, but it would be good if more design work was presented on how the MVTX and the intermediate tracker are interfaced into the system. Issues of maintenance could be addressed, and such things as how the beampipe will be baked out without compromising the inner tracking detectors.

Comment: An integrated detector cooling plan is desired.

5.2.4 Integrated Cooling plan

Comment- An integrated cooling plan for all the detectors in the magnet volume would be desirable so as to insure the required uniform temperature over the full surface of the TPC cylinder.

5.2.5 TPC

Finding- The TPC design is compact, covering $\eta<1.1$ with length of 2.11 m and outer radius 80 cm, it has 2 (z) x 3 (radial) x 12 (azimuthal) = 72 GEM chambers to achieve position resolution < 250 μm. The TPC mechanical design and analysis is very advanced and a TPC v1 module and outer field cage v1 prototype are being constructed. The TPC pad design is being optimized and a small prototype FEE card is under test with a FELIX v1.5 prototype card.

Comment: The GEM schedule drives the module production schedule and hence the TPC's overall schedule. Since CERN is the sole source of GEM production, a formal agreement with CERN should be obtained as soon as possible.

Comment: The bench tests required to confirm the stability issues of IBF should be addressed as soon as possible.

5.2.6 TPC Electronics

Findings- The TPC has a continuous readout and the electronics includes FEE, DAM (Data Aggregator Module) and EBDC (Event Buffering and Data Compressor). The TPC FEE is being developed around the SAMPA ASIC used by ALICE and STAR, while TPC DAM is being developed based on the FELIX card developed by ATLAS. The TPC FEE has 600 256-ch boards, with a total 154k channels. Each board has 8 SAMPA chips and 1 Xilinx Artix-7 FPGA with scrubbing to mitigate SEE in radiation environment. The TPC DAM will collect data from 600 bi-directional 4+ Gbps fiber links to FEEs at rate of 940Gbps. It is planned that the data rate will be reduced to 80 Gbps via triggering, clustering and compression.

Comment: SAMPA chip is a significant fraction of the cost estimate of the TPC electronics. Better sources for the cost estimates should be obtained.

Comment- A summary of the radiation tolerance requirements of TPC FEE should be documented and used to justify the design choice.

5.2.7 TPC Support

Findings- The TPC support system includes a laser system, gas system and a cooling system. The gas system design is based on the PHENIX HBD gas system,

and the cooling system design is based on the PHENIX VTF/FVTX cooling system with a negative pressure loop. The laser system design is based on the STAR and ALICE laser calibration system. Studies are on-going as to whether the include laser tracks from the endcaps as well. The integration and installation of TPC is covered in the WBS 1.10, which is supported by infrastructure/facility upgrade, not by MIE fund.

Comment: The cooling plate of the FEE scope is not covered by either TPC FEE WBS or TPC support WBS.

Recommendation- A BOE should be developed and included in an appropriate WBS.

5.2.8- Trigger/DAQ

Finding- A DAQ/Trigger system is being designed to provide minimum bias and calorimetry based triggers at a rate necessary to carry out the sPHENIX physics program in A+A, p+A and *pp* at RHIC.

Finding- The calorimeter readout uses a modest number of DCM II's developed for PHENIX, as does the INTT. The calorimeter electronics is designed to drive trigger primitives on fiber. The data logging rate (25Gb/s in average) is feasible today, and allows a data volume if ~ 2PB/week.

Comment**:** The sPHENIX raw data will be sent to RACF at an estimated rate of 20-30 PBytes/year. It is estimated that it will take ~350 weeks to reconstruct with computing power available for RHIC at BNL today. While this is not technical issue we suggest that sPHENIX continues discussions with RACF and BNL management to ensure adequate computing requirements for reconstruction and simulations/embedding are available for quick publication of first data.

5.2.9- Tracking

Findings**:** sPHENIX tracking system includes a Ne-based TPC, a 4-layer intermediate silicon tracker (INTT) and a 3-layer MAPS-based vertex detector (MVTX). The INTT is the in-kind contribution supported by Japanese funds, while the MVTX will be proposed as a separate DOE upgrade project.

Finding- The INTT and MVTX were outside of the scope of this review. Never-the-less presentations were given to the committee and the tracking review

presented results with and without these subsystems included. A comprehensive tracking simulation and reconstruction is being developed and significant progress has been made. Simulation studies show excellent Upsilon mass resolution (~90 MeV) with or without the MVTX, with a tracking efficiency in central Hijing events of >90% for tracks above $p_T = 1$ GeV/c.

Comment- The sPHENIX tracking group is encouraged to vigorously pursue their stated plans to significantly enhance the GEANT simulation of the TPC and include estimates of the expected beam pile-up.

6. Management

6.1 Answers to MIE charge questions -

Question 2- Are the cost and schedule estimates credible and reasonable for this stage of the project?

Yes, the cost estimates are fairly complete and reasonable for a CD-1 maturity. The schedule is credible and reasonable for CD-1. However, some durations seem optimistic (for example procurement steps) and it was difficult to associate resources with the funding source (MIE or other).

Question 4- Is the project appropriately managed? Is there a capable team in place to effectively manage risks, interfaces and ensure quality?

Yes, mostly… This is a strong team with a long history of working together. However, we worry about the lack of specific experience with current formal DOE OPA & NP expectations. The team can learn, but may not yet be fully prepared for all the rigor involved in preparing for and executing a successful OPA CD review, completing monthly EVMS reporting, and so on.

Question 6- Has the project met all CD-1 prerequisites and is ready for CD-1?

There is a lot left to do. For example, an sPHENIX specific PHAD hazards assessment needs to be completed, a re-work on the risk management plan, a good deal of scrubbing of schedule and cost, smoothing of the funding, cost & obligations profiles and decisions on final CD-1 scope, are needed.

Question 7- Is the project ready for long lead procurements and meets the appropriate DOE requirements?

No, not yet. Final design reviews of these elements need to take place and recommendations addressed. Also, scope decisions need to be made to determine the final list of 3a items and quantities.

6.2 Cost and Schedule findings-

The resource loaded schedule (RLS) was presented in MS Project. It was developed by the L2 managers with the active participation by the L3 managers and institutional representatives. Then all the schedules were integrated and logically linked in one master schedule. It includes all 7 MIE subsystems and the Infrastructure and Facility Upgrade WBS elements. It contains ~1800 activities and milestones. The critical path is identified and goes through the production of EMCal absorber blocks. A schedule contingency of 25 months is added at the end of the completion.

The team is working on transitioning the schedule to Primavera. The plan is to complete all the coding and resource loading by September 2017.

DOE guidance for the MIE portion of the project is for a range of 29-35M AY$.

The labor is mostly covered by operation funds and is ~20M AY$.

The infrastructure, integration and installation are estimated ~20M AY$ and is not part of the project KPPs.

The project is seeking CD-1/CD-3A in spring of 2018. The funding for early procurement of 8.8M is expected in January 2019.

The cost in the schedule is in FY16 dollars and it is manually escalated to produce the cost summary for the PM presentation. Three scenarios have been presented.

The first scenario includes the full project scope with cost as shown below:

WBS	SYSTEM	Baseline	Contingency	Total
1.1	Project Management	1,850	555	2,405
1.2	TPC	2,604	781	3,385
1.3	EMCal	6,698	2009	8,707
1.4	HCal	11,986	3596	15,582
1.5	Calorimeter Electronics	5,221	1566	6,787
1.6	DAQ & Trigger	1,200	360	1,560
1.7	Min Bias Trigger Det	136	41	177
	MIE Totals	29,695	8909	38,604

This TPC is more than the DOE guidance range of 29M-35M.

The second scenario that was presented includes de-scoping of 50% of the EMCal, the cost table is below.

WBS	SYSTEM	Baseline	Contingency	Total
1.1	Project Management	1,850	555	2,405
1.2	TPC	2,604	781	3,385
1.3	EMCal	3,478	1043	4,521
1.4	HCal	11,986	3596	15,582
1.5	Calorimeter Electronics	3,294	988	4,282
1.6	DAQ & Trigger	1,200	360	1,560
1.7	Min Bias Trigger Det	136	41	177
	MIE Totals	24,547	7364	31,911

The third scenario includes removing the Inner HCal and 85% of EMCal, the cost table is below

WBS	SYSTEM	Baseline	Contingency	Total
1.1	Project Management	1,850	555	2,405
1.2	TPC	2,604	781	3,385
1.3	EMCal	5,732	1720	7,451
1.4	HCal	8,636	2591	11,227
1.5	Calorimeter Electronics	4,161	1248	5,409
1.6	DAQ & Trigger	1,200	360	1,560
1.7	Min Bias Trigger Det	136	41	177
	MIE Totals	24,319	7296	31,615

The cost profile is front-loaded. Bottom-up contingency is estimated at an activity level and is based on Material and Labor cost uncertainty rules.

For CD-1 the team has to produce cost books with separate base cost, contingency (cost and percentage) and TPC by WBS at lower level. The risk-based contingency is not estimated.

BOEs are developed for most but not all WBS elements.

6.3- Management Comments and Recommendations:

Comments**:**

1) The L3 managers, approximately 20, are currently listed as *Control* Account Managers (CAMs). This is too many. We would suggest that the project develop an understanding of the full set of CAM responsibilities with regard to monthly reporting and variance analysis. Consider the number, skill set…and interest level…of the people you want to train to hold these CAM responsibilities.

2) The contingency of 30% is lower than what is typical for projects preparing for CD-1. The project should look carefully at their BOE documentation to shore up the cost estimate and resulting contingency estimate. Current contingency analysis does not include all the impact of the risks in the registry.

3) The logic and data in the BOEs should be independently reviewed prior to the CD-1 reviews. Holding these independent reviews can help during the agency reviews because you have an independent assessment and report to point the committee to

4) The current plan for holding Final Design Reviews (FDRs) and Operational Readiness Reviews (ORRs) is not sufficient. Earlier design feedback is valuable and will help to focus effort. Production Readiness Reviews (PRRs) focused on the final drawing set, technical specification, likely vendors are also productive.

5) The Safety Officer/Engineer talk and the PHAD too often referenced prior work of PHENIX or C-AD leaving the wrong impression with the committee.

6) A potential conflict of interest arises when the EH&S engineer position is occupied by the same person who is designing portions of the infrastructure and safety systems.

7) All the "system" lead engineers (5+) report directly to the Project Director. This would seem to create too flat of an organization with too many people reporting to the top.

8) It is very challenging for the reviewers to understand the difference between contributed and costed labor.

9) OPC and TEC costs need to be separated clearly and consistently. It will be useful to present the cost profile at a lower level in the L2 talks. In addition a slide for the major cost drivers in each sub-system would be useful.

10) The documentation outlined as required in the OPA Project Decision Matrix for pre CD-1 was made available for the committee to review. Some of it is in a very preliminary "extended outline' state of development. Some specific suggestions include:
   - Revise the preliminary PEP to be specific to roles and not named individuals (minimizes revisions for changes in personnel), and that the ESH section of the document should be brought up to date.
   - Clarify the strategy (and membership) for a risk management board in the risk management plan
   - Provide specific risk assessment tables or similar in the preliminary hazard analysis report
   - Revise and expand the ISM plan beyond its current state of development

Recommendations**:**

1) The L2 managers (not the L3's) should be made CAMs and receive all the associated CAM training for EVMS reporting.

2) Include the impact *of appropriate risks* in the contingency. Consider a MC analysis of the cost/schedule impacts associated with the risk registry. This is then added to the cost contingency to form the total contingency.

3) Organize and hold independent Basis of Estimate (BOE) reviews prior to the CD-1/3a review.

4) Add a Preliminary Design Review (PDR) and a Production Readiness Review (PRR) for all major elements.

5) At the CD-1 review a more rigorous, all encompassing talk will be needed to make sure EHS reviewers are comfortable that safety is a primary focus of sPHENIX

6) All the various system level engineering entities should report through the Project Engineer. The lone exception would be the Safety Engineer function that should continue to report to the Project Director.

7). At the CD-1 review present the contributed and costed labor in a consistent and clear way

Appendix 1—Charge to the Committee

The committee is charged to evaluate the sPHENIX plan focusing on cost and schedule for the MIE component, in view of CD-1 and the readiness for long lead procurements. In the event that deficiencies are identified the committee is asked to recommend corrective actions.

1. Is the conceptual design technically sound and likely to meet the objectives of its scientific case?
2. Are the cost and schedule estimates credible and reasonable for this stage of the project?
3. Are the resources, including (wo)men-power adequate and likely to be provided?
4. Is the project appropriately managed? Is there a capable team in place to effectively manage risks, interfaces and ensure quality?
5. Are the EH&S aspects being properly addressed?
6. Has the project met all CD-1 prerequisites and is ready for CD-1?
7. Is the project ready for long lead procurements and meets the appropriate DOE requirements?

Appendix 2--- Committee Membership

Michael Begel (BNL)
Howard Gordon (BNL)
Hong Ma (BNL)
Helen Caines (Yale)
Hucheng Chen (BNL
Howard Wieman (LBNL)
Bill Edwards (LBNL- retired)
Erik Johnson (BNL NSLS)
Penka Novakova (BNL)
Jay Marx -Chair (Caltech- retired)
George Ganetis (BNL)
Yousef Makdisi (BNL- retired)

Appendix 3—Review Agenda

Wednesday, August 2, 2017

08:00 - 08:30 Executive Session 30'
08:30 - 08:40 Welcome 10'
Speaker: James Dunlop (Brookhaven National Laboratory)
08:40 - 09:30 Project Overview (35+15) 50'
Speaker: Edward O'Brien (BNL)
09:30 - 10:00 Science and the Collaboration (20+10) 30'
Speaker: Dr. David Morrison (BNL)
10:00 - 10:30 Technical Overview (20+10) 30'
Speaker: John Haggerty (Brookhaven National Laboratory)
10:30 - 11:00 Break
11:00 - 11:30 Project CD-1 Documentation (20+10) 30'
Speaker: James Mills (Brookhaven National Laboratory)
11:30 - 11:45 ES&H (10+5) 15'
Speaker: Paul Giannotti (Brookhaven National Laboratory)
11:45 - 12:15 Time Projection Chamber (20+10) 30'
Speaker: Prof. Thomas Hemmick (Stony Brook University)
12:15 - 13:30 Lunch
13:30 - 14:00 EM Calorimeter (20+10) 30'
Speaker: Craig Woody (BNL)
14:00 - 14:30 Hadron Calorimeter (20+10) 30'
Speaker: Prof. John Lajoie (Iowa State University)
14:30 - 15:00 Calorimeter Electronics (20+10) 30'
Speaker: Dr. Eric Mannel (Brookhaven National Laboratory)
15:00 - 15:15 DAQ/Trigger (10+5) 15'
Speaker: Dr. Martin Purschke (BNL)
15:15 - 15:25 Min Bias Detector (5+5) 10'
Speaker: Dr. Mickey Chiu (Brookhaven National Lab)
15:25 - 15:50 Break
15:50 - 16:20 Overview of Infrastructure and Facilities Upgrade (20+10) 30'
Speaker: Edward O'Brien (BNL)
16:20 - 16:50 Engineering Management and Coordination (20+10) 30'
Speaker: James Mills (Brookhaven National Laboratory)
16:50 - 18:00 Executive Session 1h10'
19:00 - 20:30 Dinner

Thursday, August 3, 2017

08:30 - 09:00 SC-Magnet including the High Field Test (20+10) 30'
Speaker: Dr. Kin Yip (BNL)
09:00 - 09:30 Infrastructure (20+10) 30'
Speaker: Paul Giannotti (BNL)
09:30 - 10:00 Installation (20+10) 30'
Speaker: Don Lynch (BNL)
10:00 - 10:20 Break
10:20 - 15:20 Project Management:
Convener: Edward O'Brien (BNL)
10:20 PEP and Organization (20+10) 30'
Speaker: Edward O'Brien (BNL)
10:50 Resources, Costs and Procurements (20+10) 30'
Speaker: Mr. Robert Ernst (Brookhaven National Laboratory)
11:20 Project Controls and Risk Management 30'
Speaker: Mrs. Irina Sourikova (Brookhaven National Laboratory)
11:50 Quality Assurance (10+5) 15'
Speaker: D Passarello (BNL)
12:05 Management Drill down 15'
12:20 Lunch 1h0'
13:20 Calorimeter and Calorimeter Electronics Drill downs 2h0'
10:20 - 15:40 Calorimeter and Calorimeter Electronics:
Convener: John Haggerty (Brookhaven National Laboratory)
10:20 Calorimeter Simulations (15+5) 20'
Speaker: Dr. Jin Huang (Brookhaven National Lab)
10:40 EMCal Block Production (15+5) 20'
Speakers: Anne Sickles (University of Illinois), Anne Sickles (BNL)
11:00 EMCal Module and Sector Production (15+5) 20'
Speaker: Mr. Sean Stoll (BNL)
11:20 Inner HCal (15+5) 20'
Speaker: Prof. John Lajoie (Iowa State University)
11:40 Outer HCal (15+5) 20'
Speaker: Anatoli Gordeev (BNL)
12:00 Calorimeter Electronics Digitzer (15+5) 20'
Speaker: Cheng-Yi Chi (Columbia University)
12:20 Lunch 1h0'
13:20 Drill down Calorimeter and Calorimeter Electronics 1h20'
14:40 Si Photomultipliers 20'
Speaker: Prof. Christine Aidala (Michigan)
15:00 Calorimeter Front End Electronics 20'
Speaker: Mr. Steve Boose (BNL)
15:20 Cooling Slides 20'
Speaker: Robert Pisani (BNL, sPhenix)
10:20 - 15:41 Tracking and DAQ/Trigger:
Convener: Dr. David Morrison (BNL)
10:20 Tracking Simulations 20'
Speaker: Dr. Anthony Frawley (Florida State University)

10:40 TPC Mechanics 20'
Speaker: Dr. Klaus Dehmelt (BNL)
11:00 TPC Support Systems 20'
Speaker: Robert Pisani (Phenix)
11:20 TPC Front End 20'
Speaker: Dr. Takao Sakaguchi (BNL)
11:40 TPC Data Aggregator Module 20'
Speaker: Dr. Jin Huang (Brookhaven National Lab)
12:00 Intermediate Tracker 20'
Speakers: Dr. Rachid Nouicer (Brookhaven National Laboratory), Dr. Yasuyuki Akiba (RIKEN)
12:20 Lunch 40'
13:00 DAQ Details 20'
Speaker: Dr. Martin Purschke (BNL)
13:20 Trigger 20'
Speaker: Prof. James Nagle (University of Colorado)
13:40 MVTX 20'
Speaker: Dr. Ming Liu (Los Alamos)
14:00 Tracking, DAQ/Trigger Drill downs 1h20'
10:20 - 16:00 Magnet/Infrastructure/Installation:
Convener: James Mills (Brookhaven National Laboratory)
10:20 Integration Details 20'
Speaker: Mr. Richard Ruggiero (BNL)
10:40 Magnet Assembly and Valve Box 20'
Speaker: Anerella Michael
11:00 Magnet Cryogenics 20'
Speaker: Roberto Than (BNL)
11:20 Magnet Power Supplies and Controls 20'
Speaker: Mr. Carl Schultheiss (Brookhaven National Lab)
11:40 Drill downs Magnet/Infrastructure/Installation 40'
12:20 Lunch 1h0'
14:00 Drill downs Tracking and DAQ/Trigger 2h0'
15:20 - 16:00 Break 40'
16:00 - 17:00 Executive Session 1h0'
17:00 - 17:15 Homework Assignment to Project 15'

Friday, August 4, 2017

08:30 - 09:30 Homework Answers 1h0'
Speaker: Edward O'Brien (BNL)
09:30 - 12:00 Report Writing 2h30'
12:00 - 13:00 Close Out 1h0'
Speaker: Jay Marx (Caltech)
13:00 - 13:30 Lunch