

sPHENIX MIE Annual Review

Project Overview

Edward O'Brien

July 14-15, 2021

BNL

What is sPHENIX?



sPHENIX is a major upgrade to the PHENIX detector. It is a large-acceptance, high-rate detector for Heavy Ion physics that repurposes **>\$20M** in existing PHENIX equipment, infrastructure and support facilities.

The detector is optimized to measure jet and heavy quark physics by incorporating a Time Projection Chamber, Electromagnetic and Hadronic Calorimeter with a high rate DAQ/Trigger and a 1.4 T solenoidal magnetic field.

Review Charge

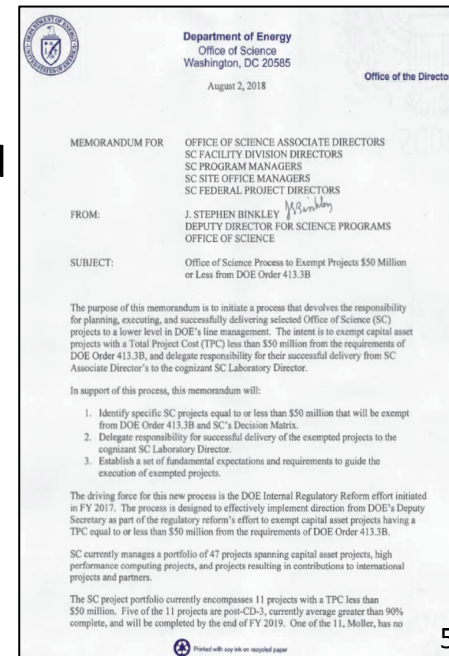
1. Project scope: Is the project executing its technical baseline in a manner to deliver the science? Is the fabrication progress appropriate for this stage of the project? Are all interfaces properly understood? **EO'B, D. Morrison, G. Young, J. Haggerty, R. Feder, L2 Managers**
2. Cost and Schedule: Will the project's remaining cost and schedule resources be sufficient to achieve PD-4? Is the contingency usage appropriate for this stage of the project? Is the project critical path clearly identified and understood? **I. Sourikova, L2 Managers**
3. Management: Is the project being properly managed at this stage? Are the risks properly identified and managed and are appropriate mitigation strategies in place? Are the procurements being properly managed? **EO'B, G. Young, I. Sourikova, L2 Managers**

Review Charge - continued

4. Environment, Safety & Health and Quality Assurance (ES&H/QA): Are the ES&H/QA requirements being properly addressed given the project's current state of development? **L. Stiegler, L2 Managers**
5. Preparation for installation: Is the hand off to installation properly planned? Are the tests of equipment and interfaces properly understood? **R. Feder, J. Haggerty**
6. COVID-19: Are the cost/schedule impacts from COVID-19 on the sPHENIX MIE cost and schedule understood and being properly assessed and managed? **G. Young**
7. Recommendations: Has the project responded appropriately to previous review recommendations? **EO'B, J. Haggerty**

DOE SC Memo on Project Management dated August 2, 2018

- Raised threshold for application of DOE Order 413.3B from \$10M to \$50M for SC projects.
- sPHENIX was on the DOE SC list of projects impacted by the change.
- Delegation for managing these projects now the responsibility of Laboratory Director
- DOE-OPA no longer responsible for managing these projects.
- DOE-ONP prepared guidance document for NP Oversight
- BNL Procedure for managing small projects (<\$50M) has been added to BNL's SBMS (Standards-Based Management System).
- DOE will assign a PEMP goal to BNL to hold the Lab accountable for the successful execution of the project.
- sPHENIX produced a PMP approved by BNL w/ concurrence by DOE.



sPHENIX MIE Project Overview

TPC	Project Director	Last CD Achieved	% Complete	CPI	SPI
\$27.0M	Edward O'Brien	PD-2/3	75.1% BCWP/BAC @ 5/31/2021	1.02	0.83

Scope

- Detector systems produced, tested and ready for installation: [Time Projection Chamber w/ electronics](#), [Electromagnetic Calorimeter w/ electronics](#), [Hadronic Calorimeter w/ electronics](#), [DAQ/Trigger](#), [Minimum Bias Detector](#), [Project Management](#)

Not in scope

- SC-Magnet, Bldg/Det Infrastructure, Installation and System Commissioning

Schedule

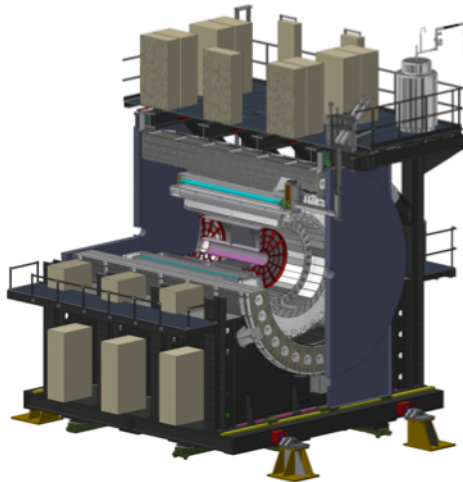
Costed and Committed= 90.8%

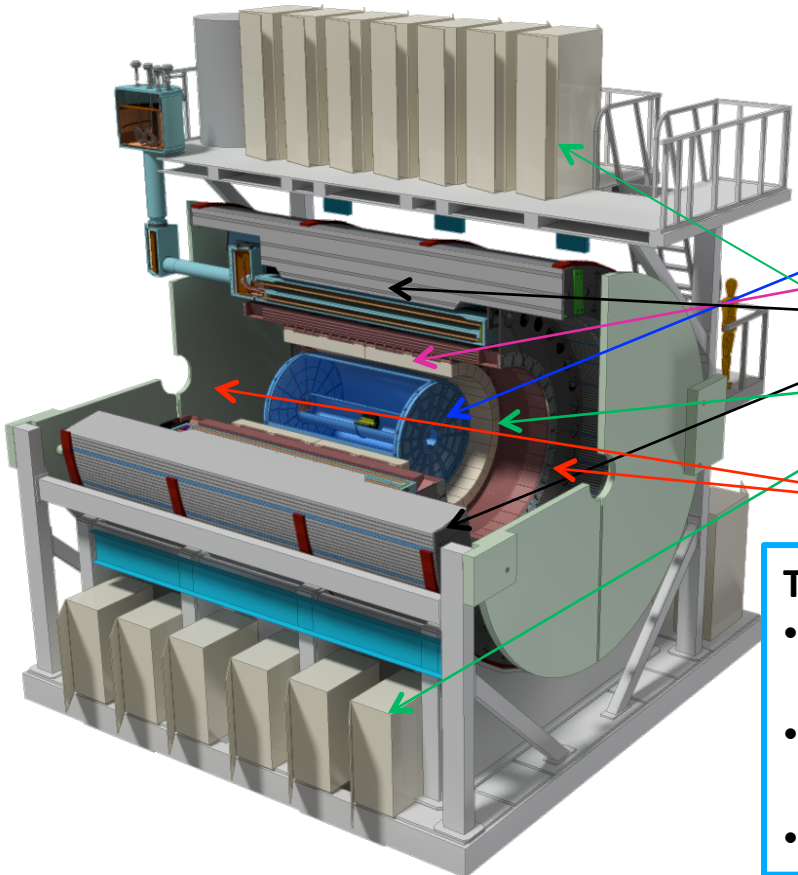
- CD-0 received Sept 2016
- CD-1/3A received Aug 2018
- PD-2/3 received Sept 2019
- **Early completion end Jan 2022 (11 months float to PD-4)**
- PD-4 Dec 2022

Charge Question # 2

Cost

- **\$27.0M AY TPC 34.6% contingency on an ETC of \$6.2M**





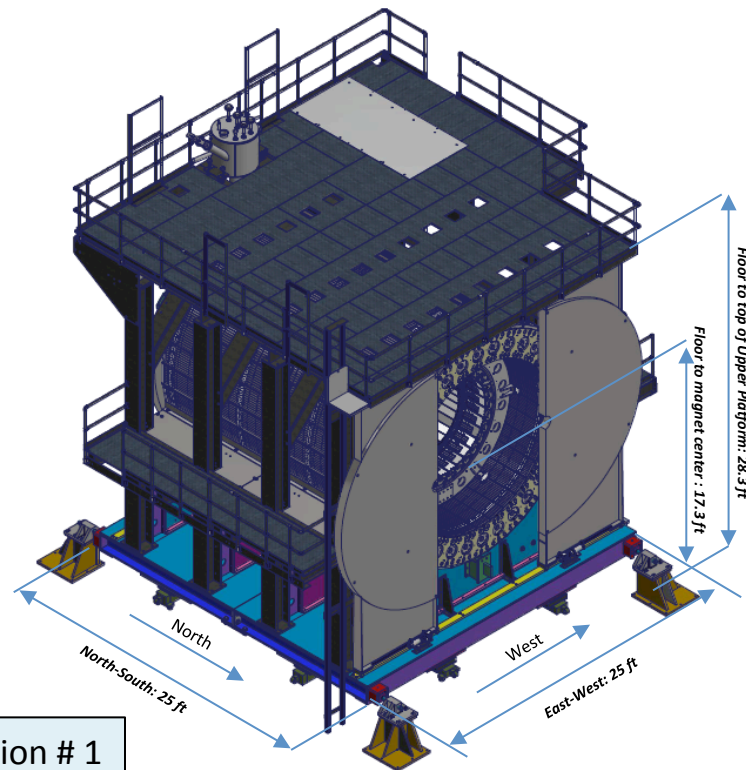
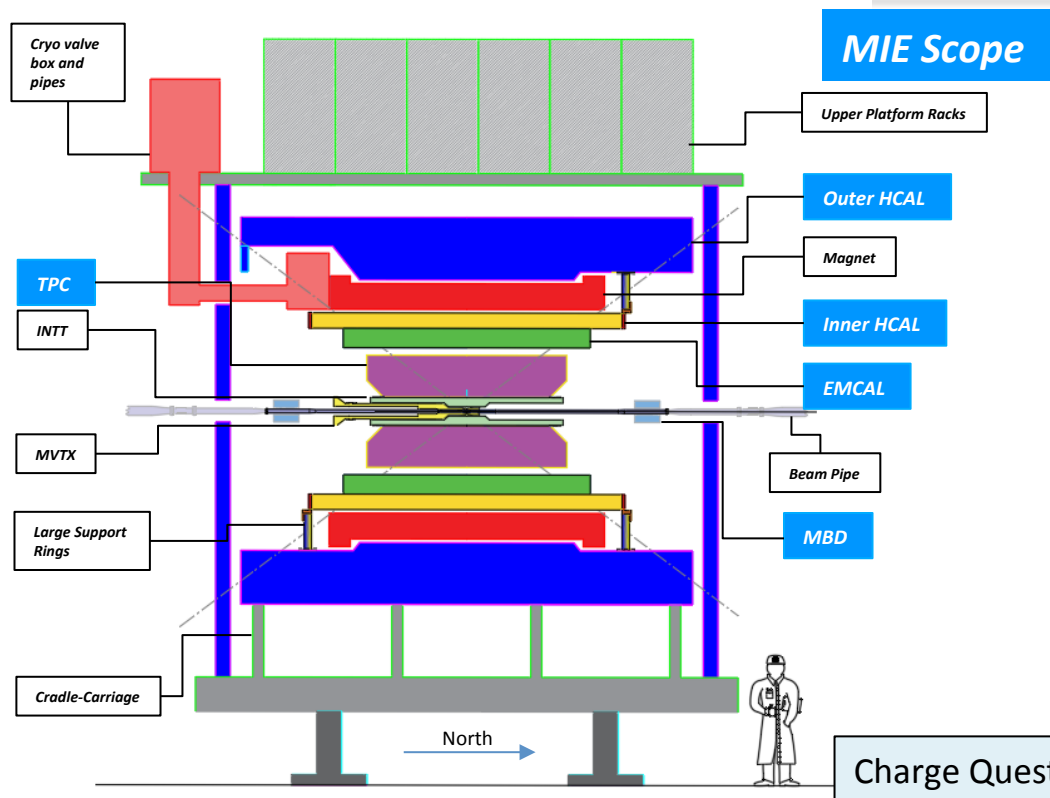
WBS sPHENIX MIE Project Elements

- 1.1 Project Management
- 1.2 Time Projection Chamber
- 1.3 Electromagnetic Calorimeter
- 1.4 Hadron Calorimeter
- 1.5 Calorimeter Electronics
- 1.6 DAQ-Trigger → To counting house
- 1.7 Minimum Bias Trigger Detector

The final design of sPHENIX is based on 3 principles:

- Design a detector to meet the Science Mission of measurements of Jets and Upsilon's in RHIC environment
- Maximize cost effectiveness and utilize modern technologies where appropriate (SiPMs, fast TPC readout)
- Build on existing \$20M+ PHENIX infrastructure

sPHENIX Elevation View and 3-D Model



This is a simplified 2D model of sPHENIX highlighting the nested detector structures and magnet return steel construction.

sPHENIX looking at the north side with pole tip doors open and EMCAL installed. This is the condition when sPHENIX is moved from the 1008 AH to the IR. sPHENIX will weigh ~880 tons when rolled into IR and 900 tons when complete.

- A **Time Projection Chamber** (TPC), **Electromagnetic Calorimeter** (EMCal), and a **Hadronic Calorimeter** (HCal) all covering 2π in azimuth. The TPC and HCal have pseudorapidity coverage of $-1.1 \leq \eta \leq 1.1$. The EMCal has pseudorapidity coverage of $-0.85 \leq \eta \leq 0.85$.
- A **Minimum Bias Trigger Detector** (MBD).
- **Readout electronics** to fully instrument the **TPC, EMCal, HCal and MBD**.
- A **Data Acquisition** (DAQ) system with the capability to readout the TPC, EMCal, HCal and MBD with an event rate and data-logging rate commensurate with the sPHENIX physics goals.
- A **DAQ/Trigger** system that can provide minimum bias and energy cluster triggers at a rate necessary to carry out the sPHENIX physics program in AA, pA and pp collisions at RHIC.
- **Project Management** to carry the project scope through to a successful on time and on budget completion.

Charge Question # 1

Available Resources & External Dependencies

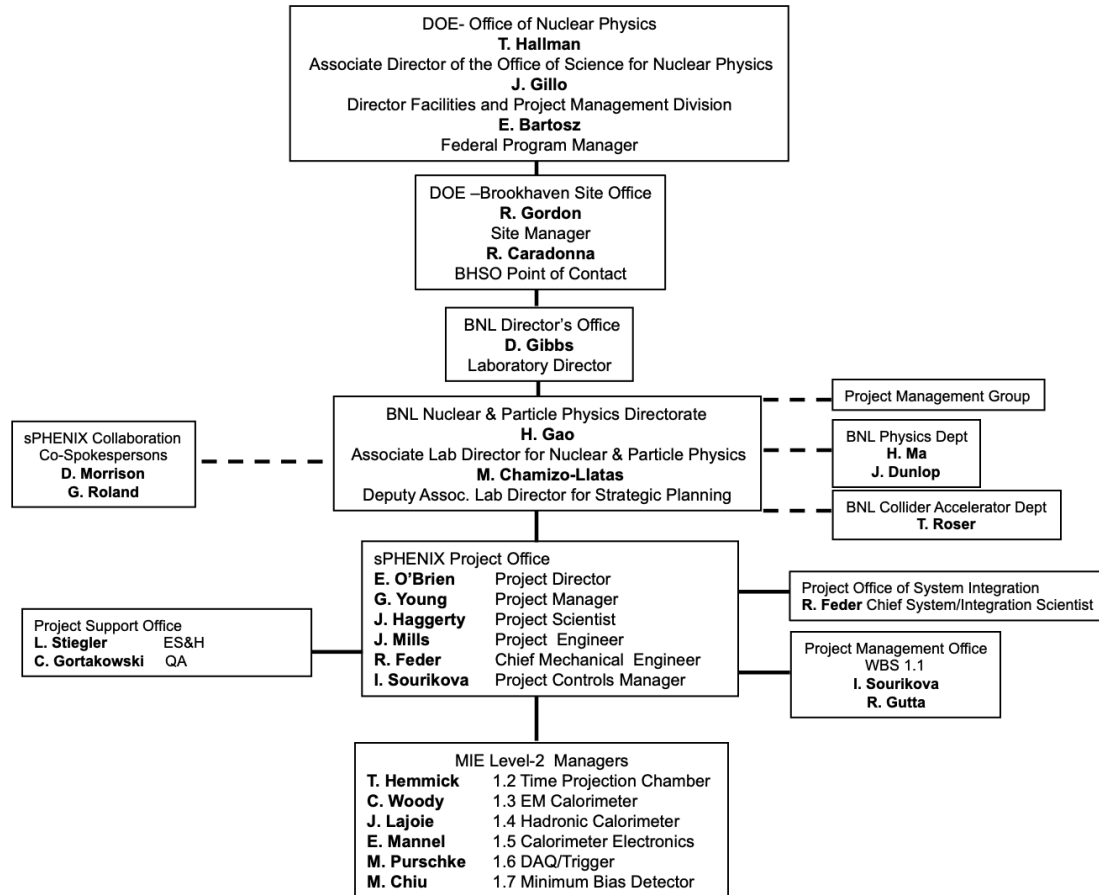


- BNL has granted the sPHENIX MIE an **Extraordinary Project Rate** (Reduced Overhead)
- Reuse of **>\$20M of existing infrastructure and equipment** from the PHENIX experiment including use of the **Building 1008 (PHENIX) complex**
- BNL-funded **Infrastructure and Facility Upgrade (\$33.4M AY) to 1008 complex** including bringing cryogenics for the SC-Magnet into the sPHENIX IR, upgrading safety, power, environmental controls, cooling systems, providing steel flux return for the magnet.
- **BNL contributed labor from RHIC Ops (\$25M AY)** (80% the PHENIX group in Phys Dept in addition to CAD, BNL Instrumentation, NSLSII and Magnet division)
- Former **BaBar SC-magnet received from SLAC spring 2015**. Tested to 105% of full current at BNL.
- Collaborator contributed labor (subsystem assembly and testing, QA, calibration, commissioning)
- **Si strip detector (INTT)** primary funding from RIKEN Lab –Japan with additional US and international contributions.
- **Extended** (in eta) **EMCal coverage to $(-1.1 < \eta < 1.1)$** from international sources.
- BNL-funded capital project for instrumentation of an **Inner HCal (\$1.68M)**
- BNL-funded capital project for an **Si pixel detector (MVTX) (\$4.8M)**

Other Aspects of the MIE

- The MIE budget is 90% M&S and 10% Labor
- BNL Labor (71 FTEs, FY19-FY21) is contributed to the Project from RHIC Experiment Ops.
- Approximately 80% of the **BNL** labor that is needed to complete the MIE deliverables is resident in the BNL Physics Department PHENIX group.
- The other 20% comes from the:
 - **Collider Accelerator Dept (sPHENIX Project Management, TPC Mech Engineering)**
 - **Instrumentation Division (TPC Electronics, EMCal, DAQ/Trigger).**
 - **Superconducting Magnet Division(TPC Mech engineering)**
 - **NSLS -II Dept (DAQ/Trigger, TPC electronics, cables)**
- MoU's/MoA's with the Physics Department, C-AD, Instrumentation, Magnet Div, NSLS-II cover sPHENIX MIE responsibilities or personnel assignments.

sPHENIX Management Organization MIE



We have an established and experienced project organization. The majority of the Project Office and L2 Managers have been working together on sPHENIX for over six years. Many in the organization have been collaborating for over twenty five years, since the days of PHENIX construction.

Charge Question # 3

sPHENIX Project Team Experience



Edward O'Brien

Project Director

Senior Scientist, Physics Department, BNL

Relevant Experience

Seven years as sPHENIX Project Director. Thirteen years as PHENIX Operations Director during which time he coordinated the addition of \$25M in upgrade detectors to PHENIX and managed a staff of 25-30 FTEs. Four years as project manager of the \$10M PHENIX Central Tracking system. Eight years as head of the PHENIX Central Tracking group and Project Manager of the \$4M Time Expansion Chamber. Designed and built major components of the E814/E877 Tracking System, a BNL AGS fixed-target HI experiment.

Glenn Young

Project Manager

Senior Scientist, Physics Department, BNL

Relevant Experience

Glenn Young was at Oak Ridge National Laboratory from 1978 until 2009, serving in many capacities, including Physics Division Director. He led ORNL's work on a series of heavy ion experiments at CERN (WA80, WA93, WA98). He was one of the founders of the PHENIX experiment in 1991 and led contributions by the Oak Ridge group to many PHENIX systems, and served as the experiment's Deputy Spokesperson. He went to Thomas Jefferson National Accelerator Facility in 2009, and led the experimental program for the 12 GeV upgrade. He joined sPHENIX as Project Manager in 2017.

John Haggerty

Project Scientist

Senior Scientist, Physics Department, BNL

Relevant Experience

BNL AGS/E-787 1986-1996, DAQ and 500 MHz waveform digitizers; PHENIX Deputy Project Manager, 1997-2001; PHENIX Data Acquisition Coordinator, 2001-2007; PHENIX Deputy Operations Director, 2008-2016; PHENIX Run Coordinator 2009-2010; sPHENIX management 2012-present. Design, construction, implementation, and software support for PHENIX timing system, slow controls of front end electronics, high speed PCI interface to DAQ. Managed BaBar solenoid move to BNL. Lead Scientist for Fermilab T1044, the prototype sPHENIX Calorimeter test, 2014-2018.

Charge Question # 3

sPHENIX Project Team Experience

James Mills, P.E.

Project Engineer

Senior Project Engineer, Collider-Accelerator Department, BNL

Relevant Experience

Over 38 years of Engineering and Project Management experience at Brookhaven National Laboratory. 8 years as Manager of the Modernization Project Office Engineering and Design Group (2006-2014) with overall responsibility for the successful completion of a portfolio of projects in excess of \$15 million annually; 6 years as Project Engineer for conventional construction in support of facility operations at Brookhaven (2000-2006); managing projects up to \$6 million in total scope. 4 years of experience as Head of the Facility and Experimental Support Group, RHIC Project (1996-2000). Responsible for approximately \$13 million dollars of conventional construction in support of experiments at RHIC. 6 years as Project Engineer for the STAR Magnet (1990-1996), providing engineering analysis and design of the 0.5 Tesla solenoidal magnet.

Russ Feder, P.E., PMP

Chief Mechanical Engineer

Senior Mechanical Engineer, Physics Department, BNL

Relevant Experience

Twenty seven years as a Mechanical Engineer including nineteen years at Princeton Plasma Physics Lab (PPPL). Most recently served as Project Manager for the NSTX-U Recovery Project and before that spent seven years as Chief Mechanical Engineer and WBS Manager for US ITER diagnostic systems contributions to ITER. M.S. in Nuclear and Mechanical Engineering and has experience in structural analysis, nuclear shielding, optical design and various aspects of engineering management.

Irina Sourikova, PMP

Project Controls

Project Management Analyst, Project Management Center, BNL

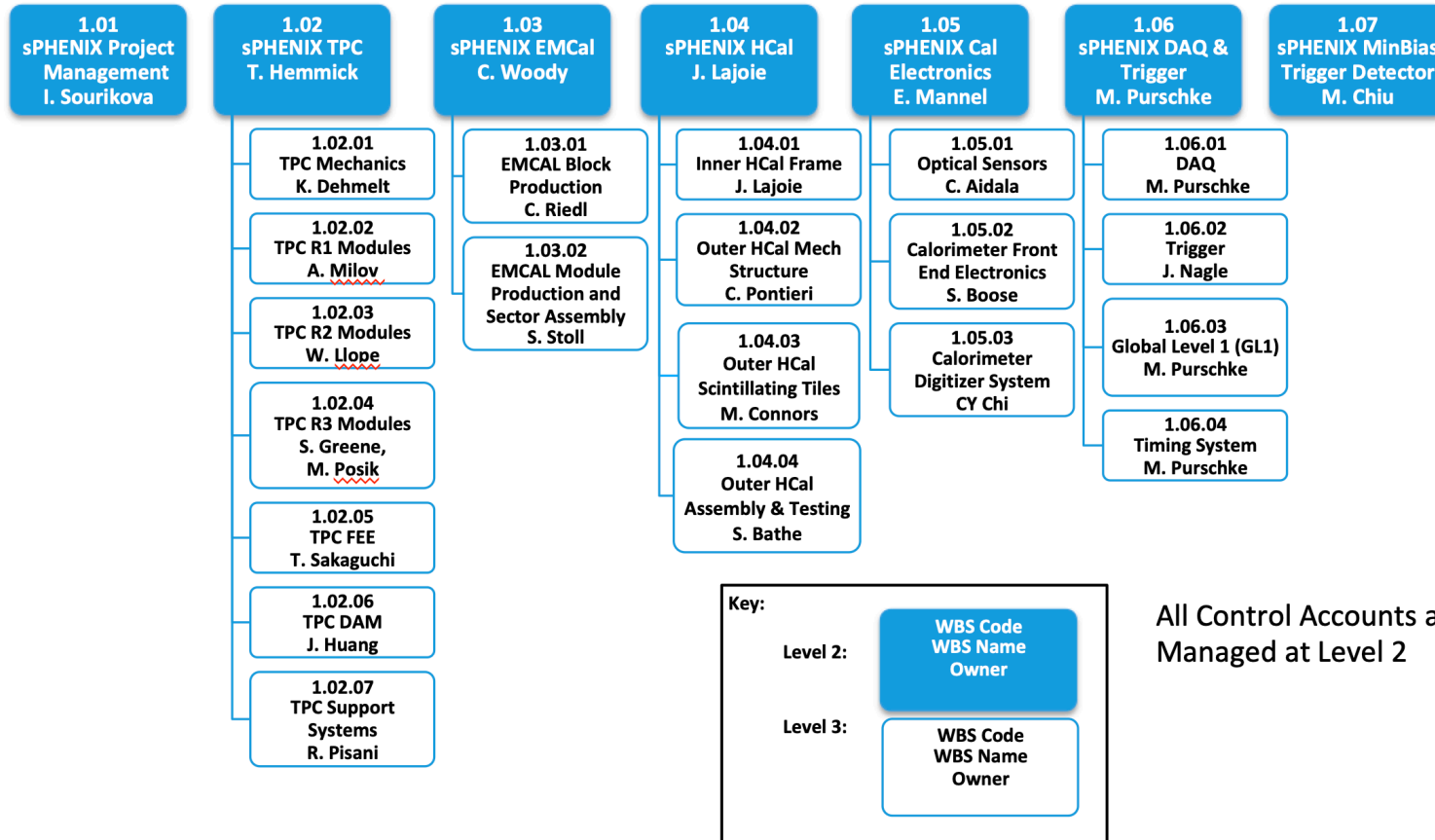
Relevant Experience

Sixteen years as PHENIX software Engineer, database developer and database administrator. Designed, implemented and supported PHENIX calibrations and collaboration databases providing legacy data migration, data archival and replication. Five years as sPHENIX Project Controls. Certified Project Management Professional.

The sPHENIX team has decades of experience managing DOE (NP, BES, HEP, FES and ASRC) projects, including sPHENIX, PHENIX, JLab 12-GeV, STAR, BNL F&O, ITER, NSTX-U...

Charge Question # 3

MIE Management Structure



Technical Progress/Status

- **sPHENIX Assembly has started in the 1008 Assembly Hall**
- **The Outer HCal Sectors are complete.** Electronic burn in tests continue prior to installation.
- **EMCal blocks for 70% complete at UIUC.** All but final 4% of blocks are started. **EMCal Sectors 45% complete at BNL.**
- **TPC Fee PCB fab started. Testing of all ASICs SAMPA v5 complete at Lund. 6300 good chips @BNL (5000 chips required)**
- **All EMCal and OHCAL on-detector electronics received at BNL.** Calorimeter digitizer components on order at Columbia Univ.
- **GEM Module framing for TPC > 85% complete at WSU, WIS, Vanderbilt, Temple.** All GEM foils delivered.
- Major computer orders, Buffer boxes, EBDCs, starting to arrive in sPHENIX Counting House
- **Inner HCal mechanical sectors 50% complete at vendor in July.**
- **All R1, R2, R3 TPC pad planes at SBU**
- **All long lead procurements complete**

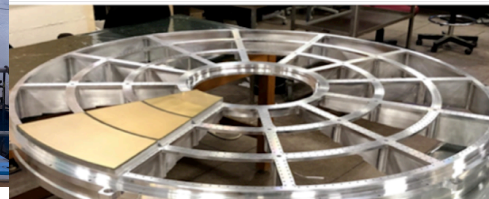
Charge Question # 1



OHCAL installations @ BNL



Inner HCal sectors at vendor



TPC Wagon Wheel w/ R1, R2, R3 @ SBU



EMCAL sector testing @ BNL



Outer HCal sectors going through final testing/burn-in

ES&H and QA



The sPHENIX MIE project has ES&H and QA experts embedded by BNL.

- The ES&H and QA reps have led the effort to develop sPHENIX specific Safety and Quality documents: Hazard Analysis Report, Quality Assurance Plan.
- We have QA procedures in place for all project component fabrication and testing at BNL and collaborating universities. All vendor fabrication contract have QA and ES&H requirements stipulated in SOWs, signed drawings and Technical Specification documents
- BNL ES&H experts review all sPHENIX fab facilities and work procedures at BNL. All sPHENIX equipment has design, pre-procurement and pre-installation reviews as specified in the BNL SBMS.
- All sPHENIX subsystems are reviewed by the CAD Experimental Safety Committee where the subsystems must demonstrate that they meet all CAD and BNL Safety standards prior to installation and operation in 1008.

Hazard – residual risk with controls	Typical Task / Initiator	Controls
Radiation	Use of sealed sources or radiation generating devices for testing, assembly in 1008 during RHIC run	Compliance with Radiological Control Program, dosimetry
Hazardous/Toxic materials	Cleaning/degreasing, epoxy	Safety Data Sheets, proper storage and handling
Electrical /arc flash	Testing electrical and electronic assemblies. Installing new electrical service	Compliance with BNL and institutional electrical safety and LOTO programs
Compressed Gas	Component testing Possible gases during operation	Compliance with pressure safety requirements, Training, proper PPE
Cryogenics/ODH	Component testing LHe during operation	Training, proper PPE, ODH evaluation, monitoring
Material Handling and Rigging	Moving large components, installation	Proper use of cranes, forklifts, hoists. Training, medical clearance, PPE
Working at Heights	Testing and installation of large components	Fall restraint/arrest systems, scaffolding, training
Fire	Use of open flames, improper storage of equipment	Proper storage of materials, HSSD, sprinklers, Fire Hazard analysis
Waste and Environment	Component testing	NEPA evaluation, proper storage of materials and waste Environmental Mgmt System/ISO 14001 certification

Hazard Table from sPHENIX HAR

See: ES&H talk by Lori Stiegler for answers to Charge Question #4

QA Plan for HCal Tiles

**Detector-Specific Quality Assurance Plan
For Hadronic Calorimeter Tile Production
For the sPHENIX Project**

Department of Physics and Astronomy
Georgia State University
Atlanta, GA

Revision 2
May 20, 2019

sPHENIX Project DETECTOR-SPECIFIC QUALITY ASSURANCE PLAN

Approved by:

Megan Connors _____ Date 5/21/2019

Megan Connors
sPHENIX L3 Manager for HCal Tiles, Georgia State University

JL _____ Date 5/21/2019

John Lajoie
sPHENIX HCal Level 2 Manager, Iowa State University

Accepted by:

Edwards _____ Date 5/23/19

Edwards
sPHENIX Project Director, Brookhaven National Laboratory

Chen _____ Date 5/23/2019

Chen Young
sPHENIX Project Manager, Brookhaven National Laboratory

James Mills _____ Date 5/21/2019

James Mills
sPHENIX Project Engineer, Brookhaven National Laboratory

sPHENIX Detector QAP: HCal Tile Production Rev 2.0

Threshold & Objective KPP's

Approved at CD-1/3A

- The individual L2 components of sPHENIX are the MIE deliverables.
- Installation is **not** part of the MIE and **not** a deliverable.
- Beam collisions are not needed to satisfy the KPP's.

System	Demonstration or Measurement	Threshold KPP's	Objective KPP's
Time Projection Chbr	Preinstall Bench Test	≥ 90% live chns based on laser, pulser, cosmics	≥ 95% live chns based on laser, pulser, cosmics
Time Projection Chbr	Preinstall Bench Test	Ion Back Flow ≤ 2% per QuadGEM Module	Same
Time Projection Chbr	Preinstall Test w/ cosmics	≥ 90% single hit efficiency / mip track	≥ 95% single hit efficiency / mip track
Time Projection Chbr FEE	Preinstall Bench Test	Cross talk ≤ 2% ea chn	Same
EM Calorimeter	Preinstall Bench Test	≥ 90% live channels based on LED, cosmics	≥ 95% live chns based on LED, cosmics
Hadronic Calorimeter	Preinstall Bench Test	≥ 90% live chns based on LED, cosmics	≥ 95% live chns based on LED, cosmics
EM Calorimeter	Preinstall Bench Test	Ea sector with an absolute energy pre-calibration to a precision of ≤ 35% RMS	Same
Hadronic Calorimeter	Preinstall Bench Test	Ea sector with an absolute energy pre-calibration to a precision of ≤ 20% RMS	Same
Min Bias Trigger Det	Preinstall Bench Test	≥ 90% live channels based on laser. 120 ps/ch timing resolution w/ Bench Test	≥ 95% live channels based on laser. 100 ps/ch timing resolution w/ Bench Test
DAQ/Trigger	Event rate	10 kHz with random pulser	15 kHz with random pulser
DAQ/Trigger	Data Logging rate	10 GBit/s with pulser	Same

Table 1: Table of Preliminary Key Performance Parameters

Ultimate Performance Parameters

Approved at CD-1/3A

Ultimate Performance Parameters
Upsilon (1S) mass resolution ≤ 125 MeV
$\geq 90\%$ Tracking Efficiency
$\leq 10\%$ momentum resolution at 40 GeV /c
$\leq 150\% / \sqrt{E_{\text{jet}}}$ jet-energy resolution for R=0.2 jets
$\leq 8\%$ single photon energy resolution at 15 GeV

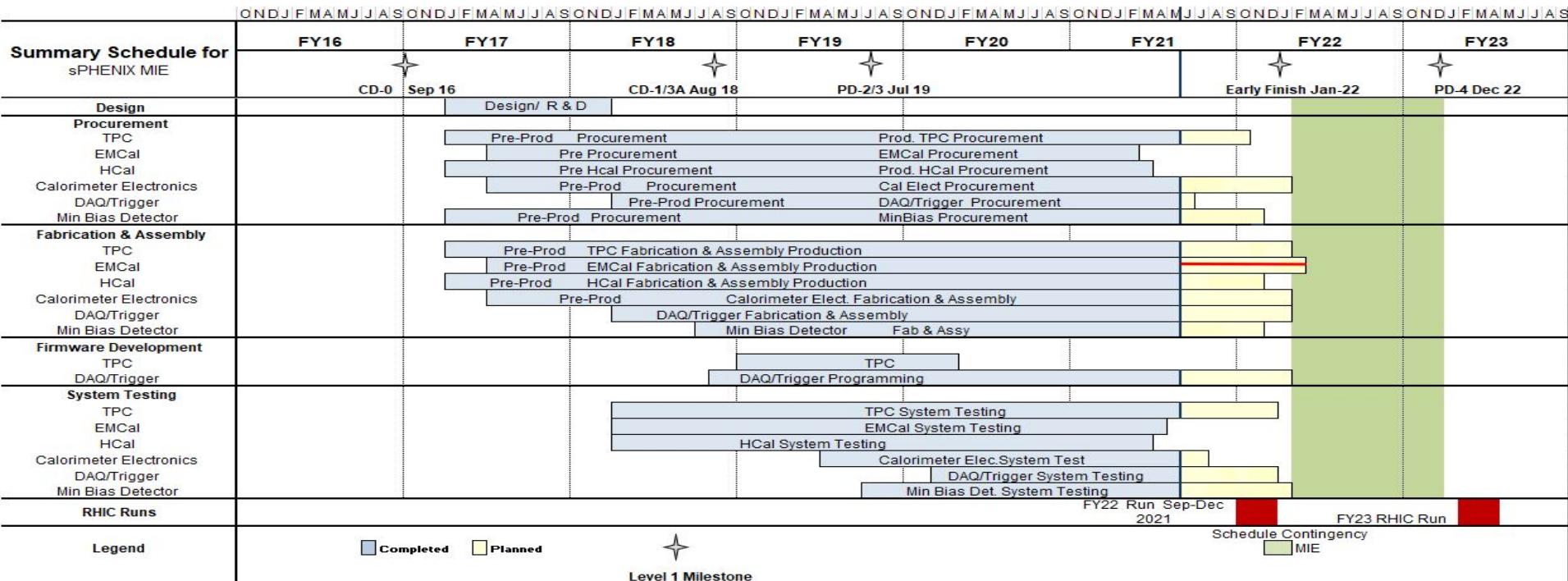
Table 1a: Preliminary Ultimate Performance Parameters. UPPs for measurements made at 10% central Au+Au RHIC events at the average RHIC store luminosity



Requested Funding Profile At Year K\$								
	Prior Yrs	FY17	FY18	FY19	FY20	FY21	FY22	Total
R&D		1,513	4,260	350				6,123
CDR		100	200					300
PED								
Pre-ops								
TEC				5,310	9,524	5,530	213	20,577
OPC		1,613	4,460	350				6,423
Total Project Cost		1,613	4,460	5,660	9,524	5,530	213	27,000

All FY21 Funds are at BNL

Summary Schedule – sPHENIX MIE



MIE Critical path is through the EMCal Sector assembly

Risk and Estimate Uncertainty



- 5 High risks out of 24 open risks. 44 risks retired
- **Overall contingency 34.6% on ETC of \$6.2M**
 - Available contingency \$2.146M
- Bottom Up **Est Uncertainty** on work to go **\$764k**
- Most likely Contingency needs based on Risks **\$575k**
- Total contingency needs **\$1,339k**
- Unassigned contingency **\$807k**
- Risks and EU developed by L2, L3 managers and cognizant engineers

Charge Question # 2,3

See talk by Irina Sourikova

Cost Contingency	
Requested Funds	
MIE Project	\$K
Funding	27,000
Current Baseline	24,854
Current Contingency PD-2	2,146
Estimate to go (less Actuals/Completed work)	6,203
% Contingency on ETC	34.60 %
MIE Project	\$K
Risk Events EMV	575
Bottom up Estimate Uncertainty	764
Total Contingency needs	1,339
Available Contingency	2,146
Balance Contingency Available	807

Risk Identification			Risk Handling Plan (Mitigations)	Residual Risk (Post- Mitigation Assessment)									
Risk ID Number	Risk Title	IF/THEN	Risk Handling Plan (Mitigations)	Residual Risk Likelihood of Impa	Low Cost Impact (\$K)	Likely Cost Impa (\$K)	High Cost Impact (\$K)	Low Schedule Impa (Mos)	Likely Schedule Impa (Mos)	High Schedule Impa (Mo.)	Overall Impact Score (Residual)	Expected Value (\$K)	Average Expected Valu (\$K)
Mgmt_003	Funding profile stretches	If funds are not available on time then procurements will be delayed, resulting in	Work closely with the funding agency so any funding profile	10%	0	213	213	0	0	0	High	21.30	14.20
Mgmt_008	COVID-19 delays	If the Project experiences COVID-19 delays, then additional labor will be needed and that will	Work with BNL management and implement all COVID safety	50%	200	300	400	2.0	4.0	6.0	High	150.00	150.00
sPH_EMCal_014	TECH Labor at UIUC for EMCal blocks	If rate of machining blocks is low, we will need another machinist at UIUC	Monitor block machining rate closely.	50%	0	200	200	0	0	0	High	100.00	66.67
sPH_CalEI_012	Digitizer component prices go up	If digitizer components cost more, then there will be additional costs	Accept	70%	117	117	117	0.0	0.0	0.0	High	81.90	81.90
sPH_CalEI_015	External cables delivery is delayed	If cables are late, then there will be schedule delays up to 6 mo	Work with BNL procurement, maintain Critical Procurement list	25%	0	0	0	1.0	3.0	6.0	High	0.00	0.00

sPHENIX Two PEMP Notables in 2021



1. *NP: Complete infrastructure and facility upgrades in Building 1008 to enable the planned start of installation of the sPHENIX calorimeters. (Objective 2.3)*
 - **Complete 1008 Assembly Hall track reinforcement by 31-May-2021 ✓ Completed ahead of schedule**
2. *BHSO/SC: Effectively plan, execute, and successfully deliver SC projects equal to or less than \$50 million that have been delegated to the Laboratory Director by SC under DOE O 413.3B [Super Pioneering High Energy Nuclear Interaction (sPHENIX)]. Clearly demonstrate successful accomplishment of key milestones in FY 2021 (adjusted for schedule impacts created by the COVID-19 pandemic) in accordance with SC guidance. (Objective 7.1)*
 - **EMCal Preproduction Blocks complete 1-Dec -2020 ✓ Completed ahead of schedule**
 - **1st OHCAL Sector ready to install 15-Apr-2021 ✓ Completed ahead of schedule**
 - **EMCal Scintillating Fiber Acquisition complete 31-May-2021 ✓ Completed ahead of schedule**
 - **EMCal Sector Assembly 50% Complete 15- Aug-2021**

- **PEMP Notable #1 complete.**
- **PEMP Notable #2 requires meeting one final milestone. EMCAL Sector Assembly currently 45% complete. On track to complete the last milestone on schedule.**

Monthly DOE-COVID Impact Spreadsheet

July 1, 2021

Office of Project Assessment
Office of Science

COVID-19 Project Impact Worksheet

Overview Information	
Date of Report	July 1, 2021
Project Name	sPHENIX
Laboratory/Project Location	Brookhaven National Laboratory
SC Program Office	Nuclear Physics
Federal Project Director	Robert Caradonna – BHSO Point of Contact
Project Director/Project Manager	Edward O'Brien

Project Status (as of date) May 31, 2021		
Project Type	Line Item / Major Item of Equipment (MIE)	
CD-0	Planned:	Actual:
CD-1/3A	Planned: August 2018	Actual: August 2018
PD-2/3	Planned: Sept. 2019	Actual: Sept. 2019
PD-4	Planned: Dec 2022	Actual:
TPC Percent Complete	Planned: 90.2%	Actual: 75.1%
TPC Cost to Date	\$18,292K	
TPC Committed to Date	\$3,922K	
TPC	\$27,000K	
TEC	\$20,577K	
OPC	\$6,423K	
Contingency - Cost	\$2,146K	% to go: 34.6 on ETC
Contingency - Schedule	10.75 months	% to go: 134.4%

COVID-19 Cost and Schedule Impacts			
Annual standing army cost (March 2020 to March 2021) ¹		\$ 230K/Year	
Estimated number of FTE (March 2020 to March 2021) ²		10 FTEs	
Escalation (weighted average of labor and material rates from March 2020 to March 2021) ³		1.1%	
Cost Impact (see Note 2)**			
		High Impact	Most Likely Impact
TPC	\$27,000K	\$0	\$0
TEC	\$20,573K	\$0	\$0
OPC - Complete	\$6,423K	\$0	\$0
Schedule Impact (in months)(See Note 1)*			
		High Impact	Most Likely Impact
		No impact on PD-4 date	No impact on PD-4 date

Office of Project Assessment
Office of Science

COVID-19 Project Impact Worksheet

*Note 1: As of May 31, 2021, sPHENIX has 10.75 months of schedule contingency. Even with a mitigation approach fully implemented it is likely that the baseline early completion date, Oct 2021, will be delayed as follows: **High Impact 8 mo./Most Likely Impact 6 mo./Low Impact 4 mo.** Any additional BNL or major sPHENIX University (UIUC, SBU) shutdown will delay the project schedule 1 month for each month of shutdown. The PD-4 date will not be impacted.

Note 2: The Cost Contingency impact is as follows: **High Impact \$2000k/Most Likely Impact \$1700k/Low Impact \$1500k. There is adequate contingency available to not impact the Total Project Cost. We have committed **\$1400k in contingency** to date to mitigate schedule delays due to COVID-19. We currently anticipate committing an additional \$100k in funds to mitigate further COVID-related schedule delays. However this amount could increase if COVID cases require future shutdowns of BNL, key collaborating universities or essential industries.

¹ The annual standing army cost or current staff charged to the project (including any support contractors) from March 2020 to March 2021. This includes cost that is fully burdened or loaded. Use actual numbers when available.

² The number of estimated FTEs from March 2020 to March 2021. The FTEs should correspond to the standing army cost provided. Use actual numbers when available.

³ The escalation rates (labor and material—weighted average) the project use and any expected changes from March 2020 to March 2021.

BNL began resumption of Operations for Phase 1 (Continuation of Essential Mission Critical Operations and beginning of Limited Operations) on June 4, 2020. BNL began Phase 2 of Limited Operations on July 6, 2020.

The sPHENIX Project has been submitting bi-weekly/monthly COVID impact reports to DOE beginning April 2020

Charge Question # 6

Recommendations from 2020 Annual Review :

- 1) Prior to the end of FY20, due to current COVID restrictions and rules in the workplace, the project should re-evaluate potential inefficiencies that might need to be included in the P6 forecast plan.
- 2) By the end of October 2020, conduct a comprehensive EAC update taking into account future COVID impacts due to social distancing inefficiencies.
- 3) By the end of FY20, revisit the Risk Register to review the assigned likelihoods and impacts and to check the consistency of assumptions across the project.
- 4) Prepare a plan by the end of October 2020, with anticipated decision dates, for potential scope opportunities that could be implemented should the project continue to perform well.

- The 2020 sPHENIX Annual review generated four recommendations.
- All 2020 Annual recommendations were addressed in a posted Review Response document: [sPHENIX 2020 Annual Review Response Document](#)
- Recommendations from previous external reviews CD-1/3A, PD-2/3 have also been fully addressed. (See posted documents)
- For recommendation responses to Internal technical reviews, see talk by John Haggerty and posted document: [Internal FDR, PRR and ESRC Reports](#).

Charge Question # 7

Issues and Concerns



- COVID-protocols: Need BNL permission to slowly increase number of sPHENIX persons on site from 35 FTEs now to 40 FTEs by mid-summer and 45 FTEs by the fall approved by BNL .
 - Anticipate new BNL COVID work rules to be released toward the end of July.
 - Challenge will be to work within the COVID rules while still maintaining a large sPHENIX staff of employees and visitors on site.
- Remaining Procurements: Placing procurements have been slow at BNL due to large backlog in BNL Procurement Division and recent staff change-over. We have \$2.4 M (including \$1.5 M in BNL system) in orders to place over the next few months.
- Labor force: Maintaining labor force to the end of the project. Especially important are:
 - Technicians for fabrication, assembly and installation
 - Visiting students, postdocs and scientists for QA, testing and commissioning.

Answers to Charge Questions



- 1) The sPHENIX scope is clearly defined. The design is mature and the fabrication of production components is proceeding well.
- 2) The project is 75% complete (91% costed and committed). It has 34.6% contingency on an ETC of \$6.2M. There is 11 months of schedule contingency between the early completion date in P6 and the PD-4 date.
- 3) We have a strong, experienced management team. We monitor and update the project risks with the L2 and L3 managers on a regular basis.
- 4) BNL ES&H and QA personnel are imbedded in the sPHENIX Project team. We have QA procedures developed for the various fabrication and testing stages of sPHENIX. All BNL activities follow BNL Work Planning and Exp Safety Review requirements. We hold reviews with BNL ES&H personnel as required by BNL SBMS. We inspect collaborator facilities where key sPHENIX fabrication is ongoing.
- 5) We are seamlessly integrated with the team responsible for sPHENIX integration. We communicate with them on a daily basis. We have a detailed plan for equipment testing and detailed interface documentation.
- 6) Both the sPHENIX project team and BNL continuously monitor the COVID situation on site and carry out mitigation plans with DOE oversight. A combination of vaccinations and COVID mitigation protocols are working effectively. sPHENIX had its last COVID case on site in March. BNL had its last case on site in early May.
- 7) We have responded to all recommendations from previous external reviews. Response documents are posted on the review site.

Summary

- **sPHENIX Assembly has started in 1008.**
- Excellent progress in sPHENIX factories: **OHCAL sectors complete, 70% of EMCAL Blocks and 45% EMCAL sectors complete. All TPC ASIC chips tested and delivered to BNL.** Electronic, DAQ/Trigger, MBD, INTT, IHCAL all making good progress.
- **All CD-3A long lead procurements complete.**
- **Good progress on the MIE PEMP notable.** Three of four key project milestones for FY21 met ahead of schedule with the final milestone on track to be met on schedule.
- **The sPHENIX project is performing very well on cost CPI=1.02. The SPI=0.83 is low primarily due to COVID delays but has been improving over the last few months as orders arrive.**
- We have lost 3.25 months in the early completion date over the last 15 months primarily due to COVID – related delays. The early completion date has been unchanged March-May 2021.
- We are on track to successfully complete all deliverables and meet the KPP's in time for PD-4. **The PD-4 date of Dec 2022 will be unaffected due to the 11 months of float** between early completion and PD-4.
- We are strongly supported by both BNL and DOE. We have been granted the BNL extraordinary overhead rate. We have received significant contributions from labor resources in PO, CAD, ATRO, PMC, PPM, ES&H, NSLS II.
- The sPHENIX MIE is supported by a large international collaboration of 80+ institutions, all awaiting the first run of sPHENIX in 2023.

Back Up

Monthly DOE-COVID Impact Spreadsheet

July 1, 2021

Office of Project Assessment
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COVID-19 Project Impact Worksheet

Current Project Stage / Most Recent Critical Decision:

If the most recent critical decision was CD-1 or CD-2, are remote capabilities sufficient to keep the project reasonably on schedule? Provide an overview of activities.

For projects beyond CD-3/CD-3(x) ONLY, provide the following:

- What are the current site conditions? BNL's work re-start is in Phase-2/Stage-B, which is "Limited Operations." sPHENIX has approximately 80% of our technical staff authorized to work on site at BNL. On average approximately 70% of our technical staff is on site on any one day. Visiting scientists and students from the collaborating universities have been given BNL permission to work on site on sPHENIX testing and assembly activities. Visitors follow all BNL ES&H protocols and NYS quarantine requirements.
- Identify any potential Safeguards and Security and/or Environmental, Health and Safety concerns: None. We are following all BNL ES&H protocols including those related to COVID risk mitigation.
- What type of work continues to be performed, identify whether remote, or onsite? On site work includes the fabrication and testing of sPHENIX EMCal and HCal components in the respective detector factories, the testing of electronics boards and the fabrication of custom cables. Work that continues to be performed remotely includes engineering, design, procurement, documentation, project management and fabrication at vendors. Work at all university collaborating institutions has restarted with the implementation of a low-density labor environment.
- What type of work has been stopped or delayed? What is the nature of the delay? All fabrication work at BNL and most work at universities had been delayed during the COVID work-pause. Fabrication and component testing have restarted both at BNL and collaborating universities since June 2020.
- Are the delays beyond the control of the contractors or vendors in performing the work scope? No.
- Can the impacts be readily quantified (cost/schedule impacts)? We have committed approximately \$1400k in contingency to date to mitigate COVID impacts to the schedule. If COVID impacts to the schedule increase, additional contingency will be committed to maintain the schedule. To date we have mitigated schedule impacts by hiring additional labor at BNL and the collaborating universities to increase assembly and testing rates of detector components and to make up for lost undergraduate labor. There is a potential for a future

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COVID-19 Project Impact Worksheet

cost impact due to efforts to maintain the project early completion date. The sPHENIX CPI is 1.02. The early completion date did not change in May 2021. There are 10.75 months of contingency remaining between the early project completion date and the PD-4 date. The SPI is 0.83. Mitigation strategies are being implemented to recover the lost schedule time and recover the early completion date to the original date. The mitigation plans include using budget contingency to increase the labor on the project and to buy additional equipment to speed up production at certain sPHENIX component production facilities.

- What are the potential impacts to the contract (possible REAs/draws on contingency)? None
- Are any delays resulting from supply chain disruption? Yes. Electronics and material deliveries had been delayed due to COVID-19 in April and May 2020, and again starting in November 2020 and continuing through March 2021. Schedules of vendor deliveries improved in April 2021 have continued to improve in May and June 2021.
- Are overseas vendors being impacted? Yes. Overseas vendor deliveries are experiencing delays due to COVID-19.
- Has the contractor demobilized? BNL was in minsafe mode from the end of March 2020 to the first week of June 2020. BNL is now in Phase-2/Stage B, "Limited Operations" mode.
- If project is in stand-by / shutdown status, provide a summary of what will be required to restart activities? BNL is in Phase-2/Stage B of the restart as of July 22, 2020.
- Any additional impacts to the DOE/SC mission not considered above? None

Charge Question # 6