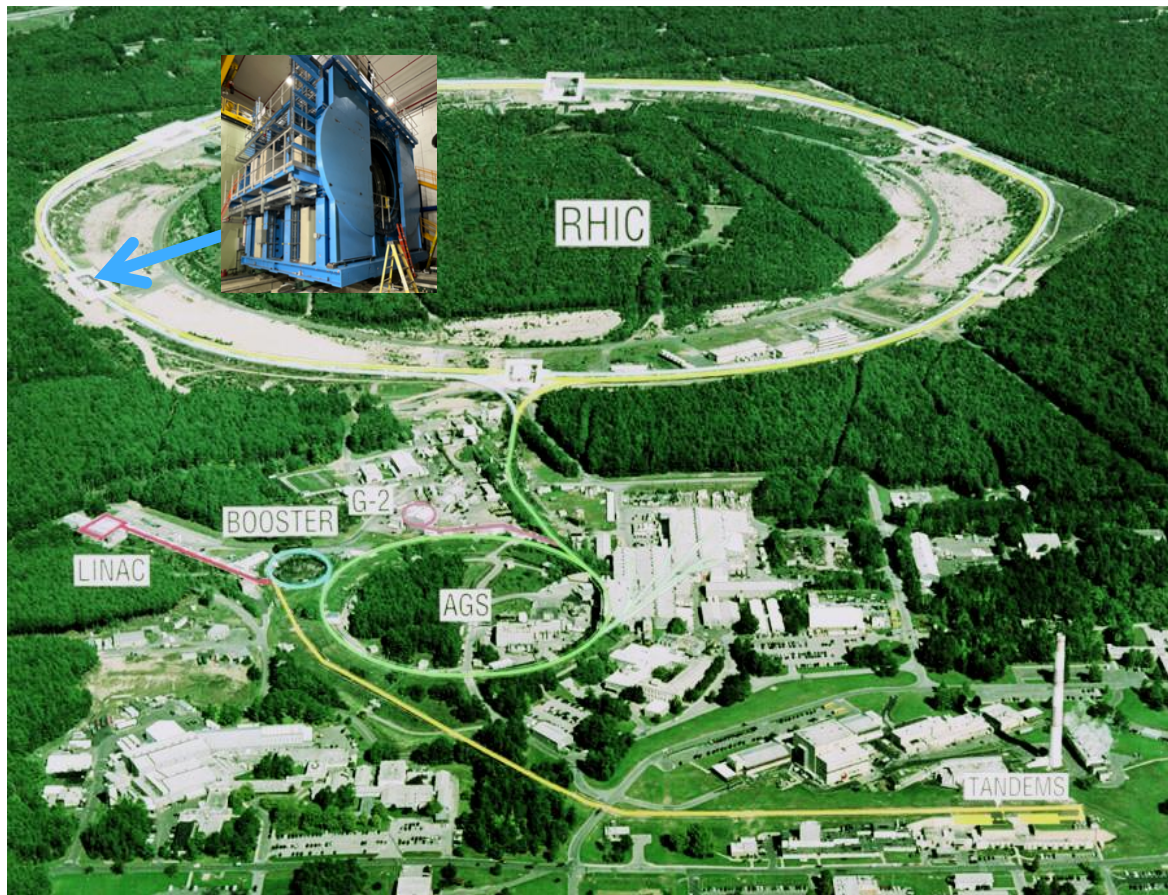


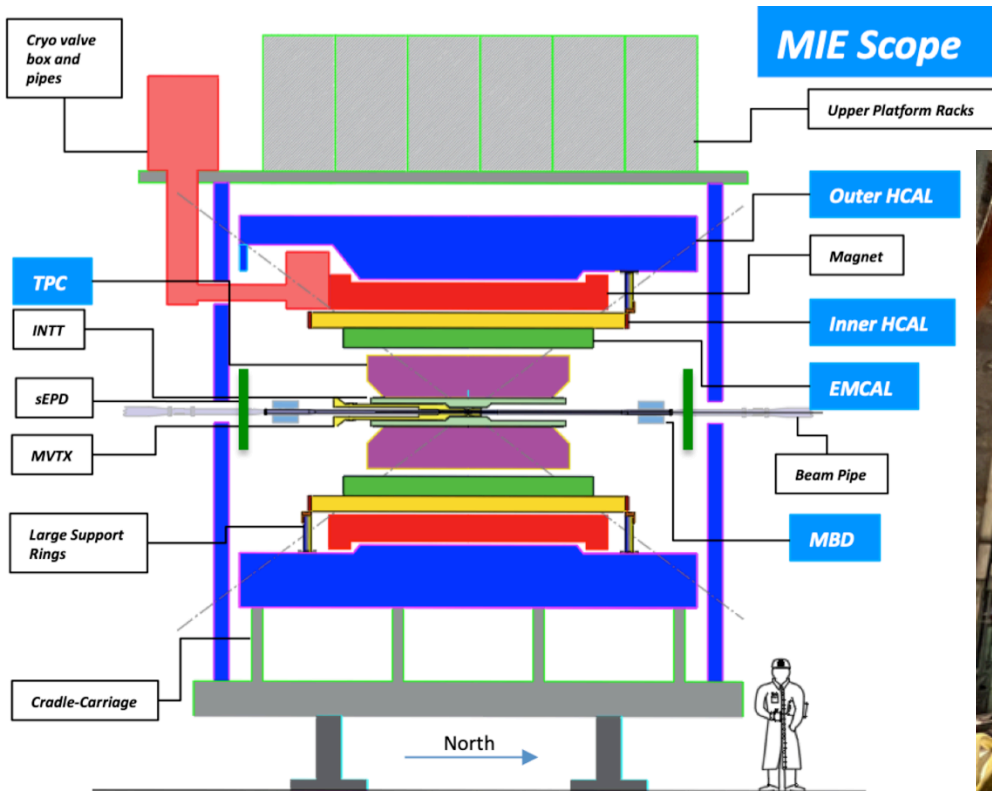
What is sPHENIX?



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.

sPHENIX Components: Vertical Slice and Actual



sPHENIX MIE Project Overview



TPC	Project Director	Last CD Achieved	% Complete	CPI	SPI
\$26.5M	Edward O'Brien	PD-2/3	100% BCWP/BAC@ 10/31/2022	1.00	1.00

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

- CD-0 received Sept 2016
- CD-1/3A received Aug 2018
- PD-2/3 received Sept 2019
- PD-4 approval Dec 2022

Cost

- **\$26.5M AY TPC ~\$300k remains of uncommitted funds**



MIE Scope

- 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.

- BNL has granted the sPHENIX MIE/ 1008 I&F 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 contributed labor from RHIC Ops (\$27.97M AY as of 10/31/22)** (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 full current at BNL 2018 & 2022.
- Collaborator contributed labor (subsystem assembly and testing, QA, calibration, commissioning)

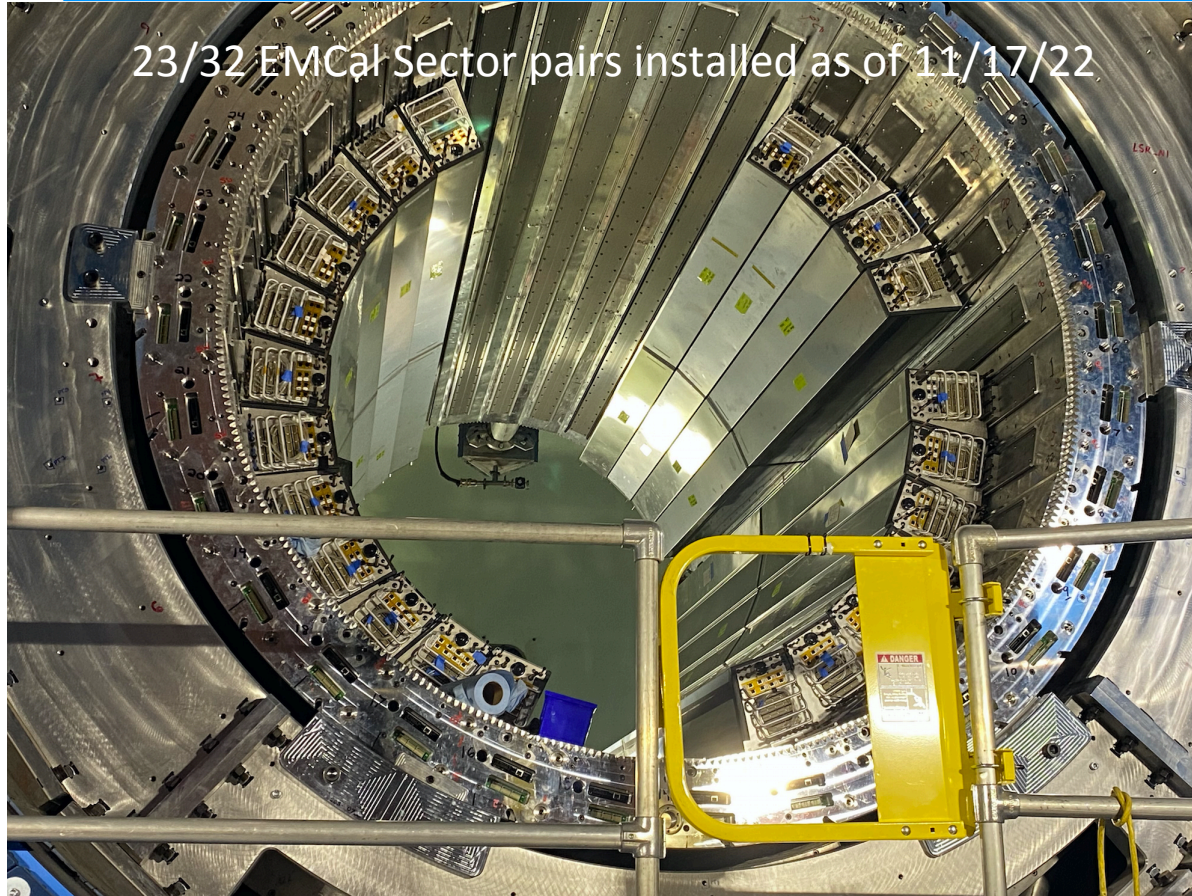
Other detector subsystems

- **Si strip detector (INTT)** primary funding from RIKEN Lab –Japan with additional US and international contributions.
- **Extended (in eta) EMCal coverage to $(-1.1 < \eta < 1.1)$** primarily funded by Chinese collaborating Inst with additional US contributions.
- **Inner HCal Instrumentation** is a BNL funded capital project (**\$1.68M**)
- **Time Projection Outer Tracker (TPOT)** is a French-US Combined funded capital project (**BNL contribution \$0.63M**)
- **sPHENIX Event Plane Detector (sEPD)** is an NSF-funded MRI for an (**\$0.99M**)

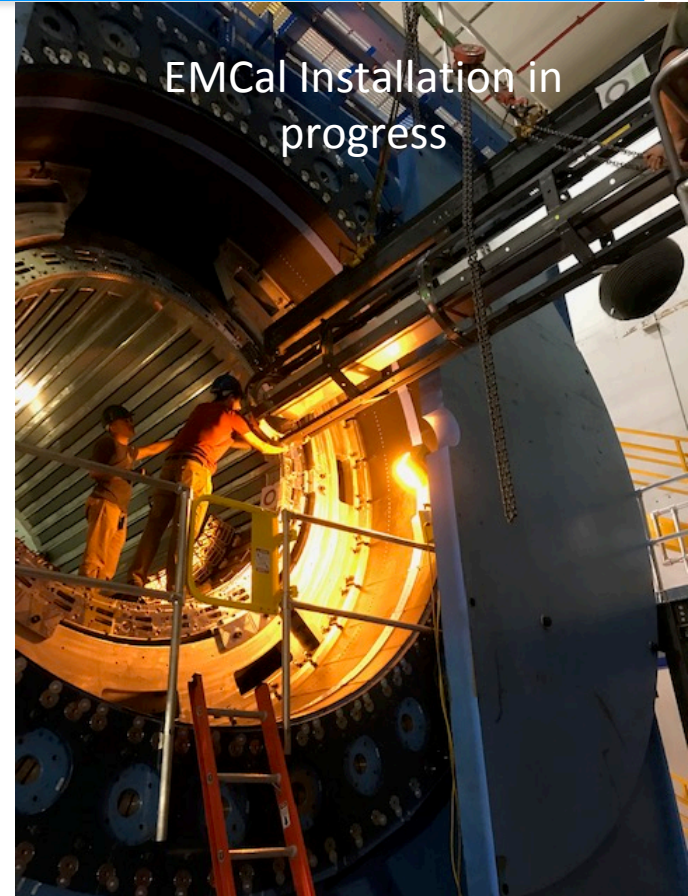
sPHENIX Installation Status



23/32 EMCal Sector pairs installed as of 11/17/22



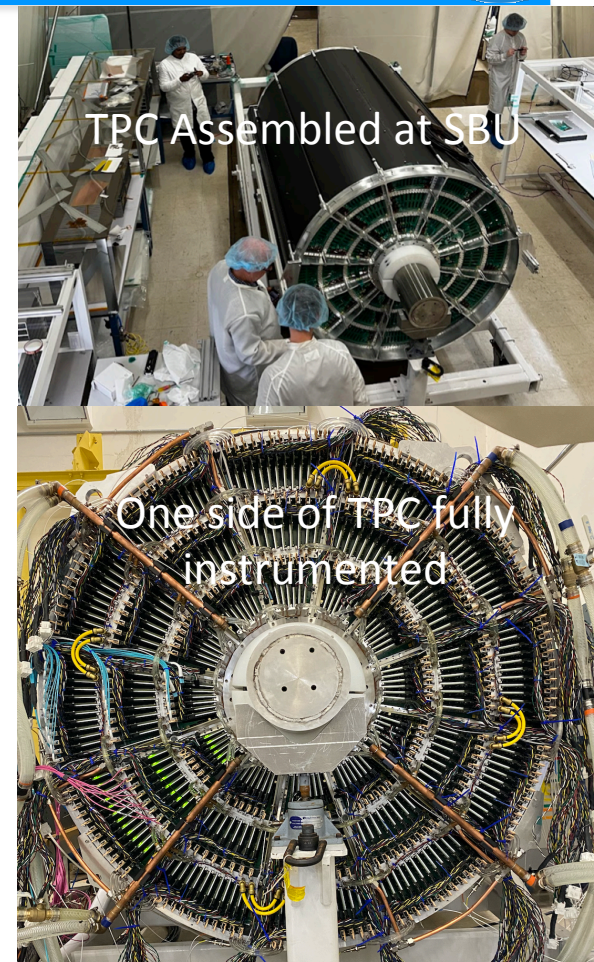
EMCal Installation in progress



sPHENIX MIE Deliverable and KPP Status



- All OHCAL sectors complete, installed, tested.
- All IHCAL sectors complete, installed, tested.
- All EMCAL sectors complete, preinstall tested, 72% installed
- All Calorimeter electronics complete, tested.
- TPC Assembled at SBU. TPC performance tests ongoing
- TPC electronics Fee & FELIX boards complete.
- All DAQ/Trigger components complete.
- All MBD detector and electronics components complete.
- **Everything in the MIE WBS dictionary has been delivered**
 - TPC controller board **not in the dictionary** 33% done. All boards delivered by Dec 8.
- **All KPPs met except:**
 - TPC live channel count (Glenn's talk) is ½ done. Complete by 11/23
 - TPC mip complete by 12/2



TPC Assembled at SBU

One side of TPC fully instrumented

Performance Metrics: sPHENIX MIE KPP's



System	Demonstration or Measurement	Threshold KKP's	Objective KPP's
Time Projection Chamber	Preinstall, Bench tests	$\geq 90\%$ live channels based on laser, pulser, cosmics	$\geq 95\%$ live channels based on laser, pulser, cosmics
Time Projection Chamber	Preinstall, Bench tests	Ion back flow $\leq 2\%$ per GEM module avgd over active area of ea GEM module	Same
Time Projection Chamber	Preinstall, Bench tests w/ cosmics	$\geq 90\%$ single hit efficiency/mip track, averaged over active TPC volume	$\geq 95\%$ single hit efficiency/mip track, averaged over active TPC volume
Time Projection Chamber Front End Electronics	Preinstall, Fee stand alone bench tests	Cross talk $\leq 2\%$ per channel averaged over all channels	Same
EM Calorimeter	Preinstall, Bench tests	$\geq 90\%$ live channels based on LED, cosmics	$\geq 95\%$ live channels based on LED, cosmics
Hadronic Calorimeter	Preinstall, Bench tests	$\geq 90\%$ live channels based on LED, cosmics	$\geq 95\%$ live channels based on LED, cosmics

Performance Metrics: sPHENIX MIE KPP's



System	Demonstration or Measurement	Threshold KPP's	Objective KPP's
EM Calorimeter	Preinstall, Bench tests	Each sector w/ an absolute energy precalibration of $\leq 35\%$ RMS	Same
Hadronic Calorimeter	Preinstall, Bench tests	Each sector w/ an absolute energy precalibration of $\leq 20\%$ RMS	Same
Min Bias Trigger Detector	Preinstall, Bench tests	$\geq 90\%$ live channels based on laser. 120 ps/channel timing resolution w/ bench test	$\geq 95\%$ live channels based on laser. 100 ps/channel timing resolution w/ bench test
DAQ/Trigger	Event rate	10 kHz w/ random pulser	15 kHz w/ random pulser
DAQ/Trigger	Data Logging rate	10 Gbit/s with pulser	Same

Summary



- The sPHENIX MIE proceeded very well despite challenges due to the COVID pandemic and supply chain issues.
- The scope of the \$26.499M project is 100% complete based on EV with a CPI=1.0 and an SPI=1.0. Approximately \$300k is budget remains uncommitted though the final accounting has not yet been completed.
- All deliverables in the WBS dictionary are complete
- All KPPs as defined in the PMP are complete with the exception of the:
 - **TPC live channel count. Ongoing (50% complete) with end date expected to be 11/23**
 - **TPC minimum ionizing track measurement with end date expected 12/2**
- All deliverable and KPP details available in Glenn's presentation

Back Up



From the sPHENIX MIE PMP approved by DOE/BNL Sept 2019

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

Scope Reduction to the MIE

Request in scope reduction to MIE made in Sept 2022 due to supply chain issues that made certain components very delays or impossible to obtain.


- Remove DCMII
 - PO 396499 line item 2, Columbia U contract, \$140,000 direct
- Remove 5/6 of diffuse laser
 - PO 405031 w/ RPMC. One of six laser delivered.
 - Balance commits \$239415 direct
- Remove fiber splitter from the MIE, **\$69,000** not yet placed

Total direct \$ to remove : \$379,415 in commits, \$69,000 in unallocated budget both from Cat A.

Including overhead $1.11703 * (448,415) = \$500,893$ TPC reduction

Requested Revised TPC = \$26,499,000

Proposed Reduction in MIE Total Project Cost

sPHENIX MIE			
			
Project Change Request			
PCR #: PCR_sPHENIX_1X_22-036	Title: TPC Reduction	Date: 8/22/2022	
WBS Nos. MIE Project			
BCP Type: Cost <input checked="" type="checkbox"/>	PCR Level: 3		
Schedule <input type="checkbox"/>	Directed Change? <input type="checkbox"/>		
Scope <input type="checkbox"/>	Freeze Period Exception (explain in description): <input type="checkbox"/>		
Administrative <input checked="" type="checkbox"/>	Use of Contingency or Management Reserve <input checked="" type="checkbox"/>		
Exception to 2-month freeze period 1) Contract and/or PO award <input type="checkbox"/> 2) Rate Change <input type="checkbox"/> 3) Scope Omission <input type="checkbox"/> 4) Customer Approved Change <input checked="" type="checkbox"/> 5) Correcting Error <input type="checkbox"/>			
Description and Justification: Documentation of TPC and contingency reduction due to scope removed in PCR034 (Diffuse Lasers, Diffuse Lasers Fiber Coupling, and Fiber Splitters and DCM-Is). There is no backup documentation associated with this PCR.			
Schedule Impact: None			
Cost Impact: TPC and Contingency Reduction			
WBS	CURRENT BASELINE	PROPOSED BASELINE	CHANGE
WBS 1.1 sPHENIX Project Management	\$1,951,679	\$1,951,679	0
WBS 1.2 sPHENIX Time Projection Chamber	\$5,676,429	\$5,676,429	0
WBS 1.3 sPHENIX EMCal	\$6,275,614	\$6,275,614	0
WBS 1.4 sPHENIX HCal	\$4,099,592	\$4,099,592	0
WBS 1.5 sPHENIX Calorimeter Electronics	\$6,290,621	\$6,290,621	0
WBS 1.6 sPHENIX DAQ & Trigger	\$1,123,588	\$1,123,588	0
WBS 1.7 sPHENIX MinBias Trigger Detector	\$170,170	\$170,170	0
Total Baseline Cost PMB	\$25,587,692	\$25,587,692	0
MIE Contingency	\$1,412,307	\$911,415	(\$500,893)
Total Costs and Contingency	\$27,000,000	\$26,499,107	(\$500,893)