

# MVTX Cost & Schedule (WBS 3.2)

Dave Lee/Ming Liu, LANL

April 9-11, 2019

BNL

# MVTX C & S - Assumptions



- Integrated into the sPHENIX schedule (P6)
  - Self contained project, funding from BNL
  - Technically driven schedule
  - Built-in resource hourly rates, fully burdened with escalation
  - Will implement Risk Based Contingency
  - Schedule not smoothed, ~6 months contingency in P6 prior to sPHENIX installation
- 
- Electronics ready for production on day-1 due to the successful LDRD effort, cost based on as built experience, FELIX and RU service boards, power system etc.
- 
- Staves and Readout Units (RU) not in P6, separate cost

# MVTX in sPHENIX P6 (fully Burd. & Esca.)



BROOKHAVEN NATIONAL LABORATORY												sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38												sPHENIX	
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19\$-M&S	Burd AYS- Labor	Burd AYS- M&S	Burd AYS- Total	2015	2016	2017	2018	2019	2020	2021	2022						
												FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22						
POM02B_3.02	POM02 sPHENIX WBS 3.02 Preliminary Baseline [MVTX]		1281	01-Feb-17 A	17-Mar-22	0	26695	1266751	\$2,760,452	\$1,569,754	\$4,330,205														
POM02B_3.02.3	Silicon Detectors		1281	01-Feb-17 A	17-Mar-22	0	26695	1266751	\$2,760,452	\$1,569,754	\$4,330,205														
POM02B_3.02.3.00	(Temporary) External Placeholder Milestones in WBS 3x		1169	01-Feb-17 A	01-Oct-21	112	0	0	\$0	\$0	\$0														
EXT100090	[External Activity] Initial Project Funding Release	Sourikova, Irina	0	01-Feb-17 A			0	0	\$0	\$0	\$0					01-Feb-17 A									
EXT317000	[External Activity] Design/Safety Reviews Complete, Internal Detector Structural Support Released for Production	Pontieri, Chris	0		19-Jul-19*	319	0	0	\$0	\$0	\$0						19-Jul-19*								
EXT101010	[External Activity] FY20 Funding Available	Sourikova, Irina	0	01-Oct-19*		417	0	0	\$0	\$0	\$0						01-Oct-19*								
EXT147100	[External Activity] Procure TPC DAM Felix 2.0 Boards - Contract Award(s)	Hemmick, Tom	0	06-Nov-19*		392	0	0	\$0	\$0	\$0						06-Nov-19*								
EXT101015	[External Activity] FY21 Funding Available	Sourikova, Irina	0	01-Oct-20*		362	0	0	\$0	\$0	\$0						01-Oct-20*								
EXT101016	[External Activity] FY22 Funding Available	Sourikova, Irina	0	01-Oct-21*		112	0	0	\$0	\$0	\$0							01-Oct-21*							
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POM02B_3.02.3.02.00.01	ALICE ITS Key Tasks		0	01-Apr-19	01-Apr-19	255	0	0	\$0	\$0	\$0														
S100000	ALICE ITS RU Production Start	Liu, Ming	0	01-Apr-19*		255	0	0	\$0	\$0	\$0					01-Apr-19*									
POM02B_3.02.3.02.00.02	MVTX Stave Production at CERN		248	01-Apr-19	26-Mar-20	169	0	0	\$0	\$0	\$0														
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POM02B_3.02.3.02.00.03	sPHENIX Milestones		0			0	0	0	\$0	\$0	\$0														
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S100700	Mechanical Integration Engineer	Liu, Ming	741	01-Apr-19	17-Mar-22	0	310	0	\$98,806	\$0	\$98,806														
S100800	Electronics Integration Engineer	Liu, Ming	741	01-Apr-19	17-Mar-22	0	310	0	\$98,806	\$0	\$98,806														
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S101400	MVTX Assembly Complete and Ready for Installation	Liu, Ming	0		17-Mar-22	0	0	0	\$0	\$0	\$0								17-Mar-22						
POM02B_3.02.3.02.02	MVTX Electronics		286	01-Apr-19	19-May-20	363	3863	395448	\$195,007	\$469,960	\$664,967														
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Actual Work

Critical Rem. Work

Remaining Work

Actual LoE

Remaining LoE

Milestone

TPC: \$4.3M

# MVTX Schedules and Milestones sPHENIX

sPHENIX:

★ CD1/3a

★ PD2/3

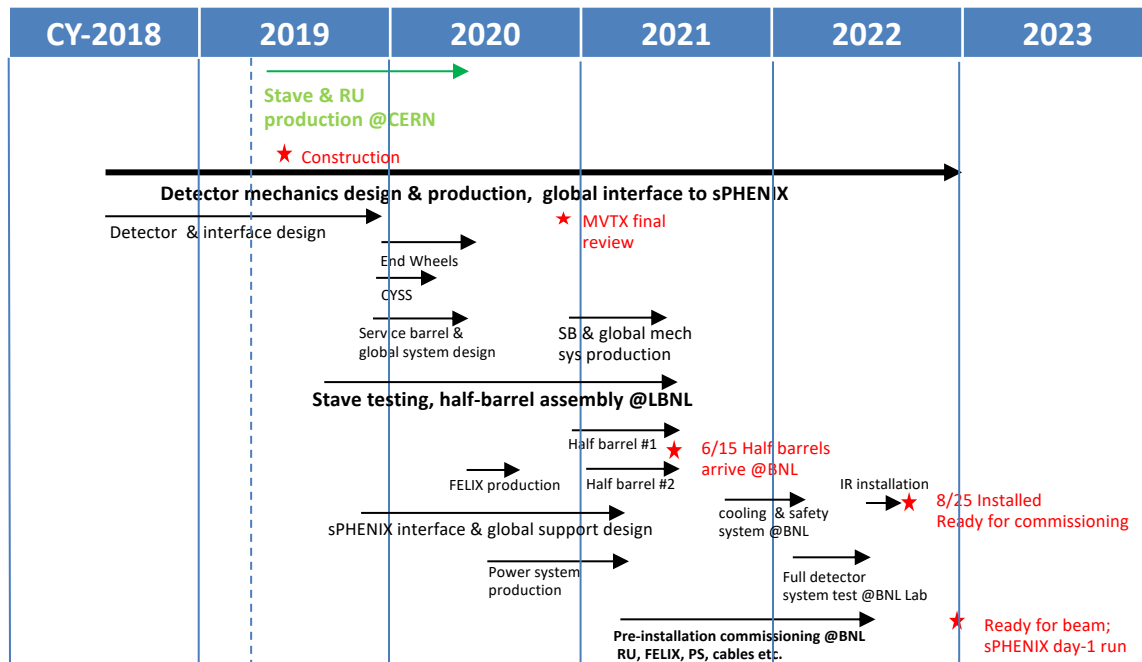
★ Installation

★ 1<sup>st</sup> collisions

Generic R&D  
Sensors for RHIC

MVTX

Feb. 2019, in P6



Today

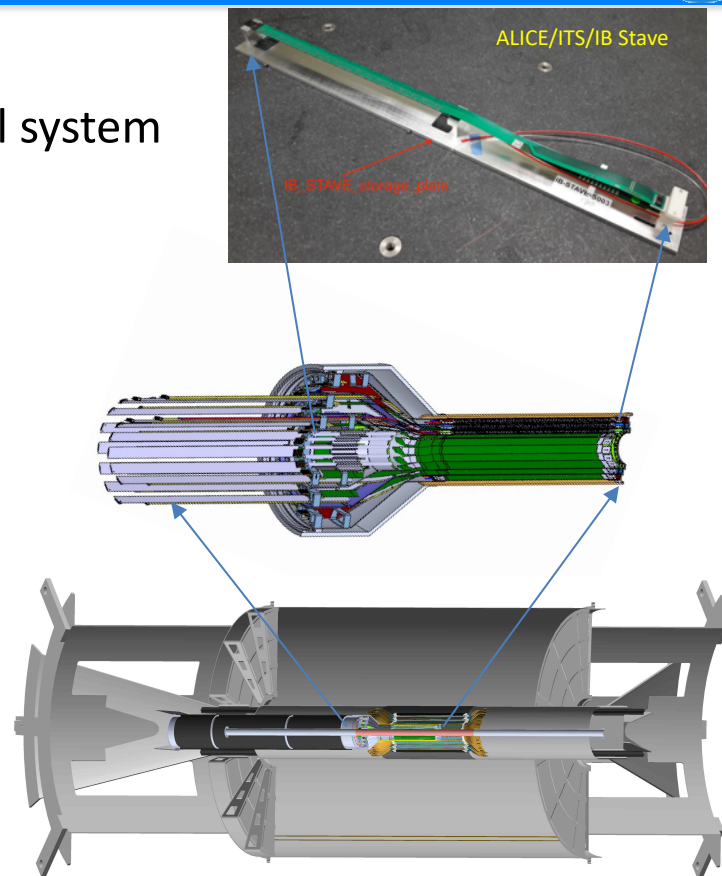


# Milestones

Milestone	Date
Start Construction	3 <sup>rd</sup> Qtr FY 2019
MVTX Final Design Review	1 <sup>st</sup> Qtr FY 2021
Half Barrels Assembled	3 <sup>rd</sup> Qtr FY 2021
Installation Finished	4 <sup>th</sup> Qtr FY 2022
Ready for Beam	1 <sup>st</sup> Qtr FY 2023

# Schedule Drivers

- Budget availability
  - Final engineering design of the mechanical system
  - Production of support structures
- Mechanical structures
  - Detector and interface system design
  - Carbon structure fabrication
- Detector assembly and test
  - Assembly jigs design and fabrication
  - Detector assembly & QA
  - Metrology
- Final installation in IR
  - Last detector to be installed



# Basis of Estimate & Resource-Loaded Schedules

- **Electronics: production**
  - FELIX: ATLAS/sPHENIX production, LANL/LDRD
  - RU services, cables: ALICE/ITS production, LANL/LDRD
  - Power boards: ALICE/ITS production, LANL/LDRD
  - CAEN bulk PS: Quotes from CAEN, ALICE/ITS production, LANL/LDRD
- **Mechanics & Integration: design and production**
  - CYSS, End wheels, Service barrel: ALICE/ITS
  - Integrations: Recent experience at RHIC, HFT/STAR, FVTX/PHENIX

WBS Number: 3.2.2.3 Backend Electronics - FELIX

## MVTX BoE Doc

### Technical scope:

This item contains all the backend readout electronics FELIX boards required for MVTX readout.

### Work statement:

Produce 8 FELIX boards to integrate MVTX readout electronics into the sPHENIX DAQ system.

### Assumptions used in developing estimate:

We will use the ATLAS FELIX v2.0 PCIe board developed by the BNL group for the ATLAS upgrade. The FELIX board production quote for sPHENIX was obtained in 2018, about \$8K per board. A total of 8 FELIX boards (6 + 2 spares) are required for MVTX.

### Cost Summary:

Total (K)	M&S	Labor	Contingency (average)
122	103	19	25%

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S110400	ship from CERN to LBNL - Batch 1	Liu, Ming	7	27-Jun-19	08-Jul-19	318	0	600	\$0	\$7,500	\$7,500	\$7,500	
S110500	ship from CERN to LBNL - Batch 2	Liu, Ming	7	25-Sep-19	03-Oct-19	268	0	600	\$0	\$7,564	\$7,564	\$7,564	
S110600	ship from CERN to LBNL - Batch 3	Liu, Ming	7	27-Dec-19	07-Jan-20	219	0	600	\$0	\$7,650	\$7,650	\$7,650	
S110700	ship from CERN to LBNL - Batch 4	Liu, Ming	7	27-Mar-20	06-Apr-20	169	0	600	\$0	\$7,650	\$7,650	\$7,650	
POM028_3.02.3.02.03.02	Carbon Structures		741	01-Apr-19	17-Mar-22	0	5774	368511	\$910,025	\$472,154	\$1,382,179		
POM028_3.02.3.02.03.02.01	Mechanics Detector Design		80	01-Apr-19	23-Jul-19	0	640	0	\$167,952	\$0	\$167,952		
S110800	Develop MAPS inner tracker mechanical model	Liu, Ming	80	01-Apr-19	23-Jul-19	0	640	0	\$167,952	\$0	\$167,952		
POM028_3.02.3.02.03.02.02	End Wheels		277	24-Jul-19	28-Aug-20	54	502	72000	\$73,964	\$90,875	\$164,839		
S110900	Design End-wheels	Liu, Ming	15	24-Jul-19	13-Aug-19	54	120	0	\$36,658	\$0	\$36,658		
S111000	Prototype End-wheels - M&S	Liu, Ming	30	14-Aug-19	25-Sep-19	54	0	10000	\$0	\$12,500	\$12,500		
S111100	Prototype End-wheels - Labor	Liu, Ming	30	14-Aug-19	25-Sep-19	54	12	0	\$2,305	\$0	\$2,305		

Carbon Structures

Labor, M&S

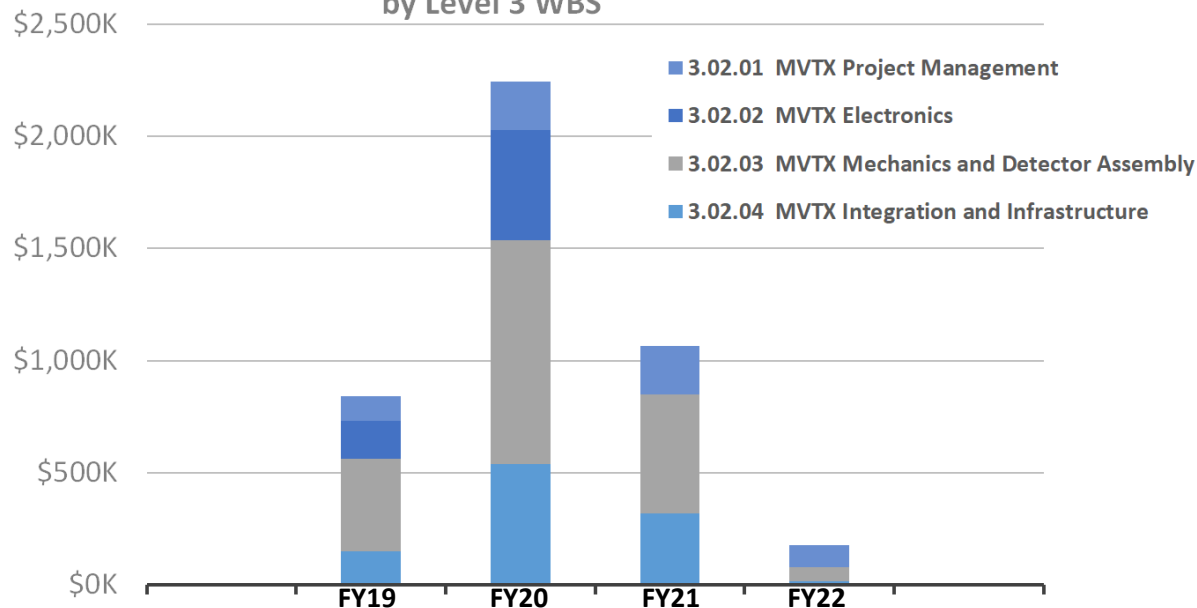
POM02B_3.02.3.02.02.02	FELIX 2.0	254	01-Apr-19	03-Apr-20	392	186	88400	\$18,588	\$103,640	\$122,229	
S103000	Produce Felix 2.0 first production unit - Labor	Liu, Ming	57	01-Apr-19	19-Jun-19	218	16	0	\$307	\$0	\$307
S103100	Procure Optical Fiber - Labor	Liu, Ming	121	01-Apr-19	19-Sep-19	414	2	0	\$307	\$0	\$307
S103200	Produce Felix 2.0 first production unit - M&S	Liu, Ming	57	01-Apr-19	19-Jun-19	218	0	20000	\$0	\$22,778	\$22,778
S103300	Procure Optical Fiber - M&S	Liu, Ming	121	01-Apr-19	19-Sep-19	414	0	50	\$0	\$63	\$63
S103400	Test/QA 1st Felix Unit and Fibers	Liu, Ming	10	20-Sep-19	03-Oct-19	414	40	0	\$0	\$0	\$0
S103500	Procure 7 Felix 2.0 Remaining Units - Provide Requirements to Procurement	Liu, Ming	5	06-Nov-19	13-Nov-19	392	6	0	\$1,187	\$0	\$1,187
S103600	Procure 57 Optical Fiber Sets - Labor	Liu, Ming	20	06-Nov-19	06-Dec-19	462	2	0	\$396	\$0	\$396
S103700	Procure 57 Optical Fiber Sets M&S	Liu, Ming	20	06-Nov-19	06-Dec-19	462	0	2850	\$0	\$3,634	\$3,634

Labor, M&S

# Cost Profile

TPC: \$4.3M

Summary MVTX Labor + M&S Cost Profile in Burdened At-Year \$  
by Level 3 WBS



WBS Code and Name	FY17	FY18	FY19	FY20	FY21	FY22	FY23	Burdened AY\$	Direct FY19\$
3.02.01 MVTX Project Management			\$ 110,219	\$ 216,751	\$ 216,269	\$ 98,244		\$ 641,483	\$ 373,537
3.02.02 MVTX Electronics			\$ 171,762	\$ 493,205				\$ 664,967	\$ 506,824
3.02.03 MVTX Mechanics and Detector Assembly			\$ 409,513	\$ 997,208	\$ 529,814	\$ 64,163		\$ 2,000,698	\$ 1,289,696
3.02.04 MVTX Integration and Infrastructure			\$ 150,963	\$ 538,325	\$ 317,878	\$ 15,892		\$ 1,023,058	\$ 651,708
Grand Total			\$ 842,457	\$ 2,245,489	\$ 1,063,961	\$ 178,298		\$ 4,330,205	\$ 2,821,765

# Major Cost Items

WBS	Task Name	Cost (K)
3.2.3.2.2	End Wheels (EW)	\$165
3.2.3.2.3.2	Cylindrical Structure(CYSS)	\$465
3.2.3.2.3.3	Service Barrel (SB)	\$428
3.2.2.2	RU Services	\$186
3.2.2.3	FELIX	\$122
3.2.2.4	Power System (PS)	\$357

## Examples of low contingency

	WBS	Cost (K)	Contingency	Basis
RU Services	3.2.2.2	\$186	25%	As Built*
FELIX	3.2.2.3	\$122	25%	As Built*
Power Board	3.2.2.4.1	\$219	25%	As Built*
Power Supply	3.2.2.4.2	\$138	25%	CAEN

Total Cost = \$665 K

- “As Built” means item is a production unit

# Carbon Structures

## Examples of high contingency

	WBS	Cost (K)	Contingency	Basis
End Wheels	3.2.3.2.2	\$165	45%	Previous experience
Cylindrical Structure	3.2.3.2.3.2	\$465	45%	Previous experience
Service Barrel	3.2.3.2.3.3	\$428	45%	Previous experience

Total Cost = \$ 1,058 K

# Status and Highlights

- MVTX integrated into P6 (2/2019)
  - TPC \$4.3M
- Latest Cost & Schedule update - following MVTX workshop at LBNL in 3/2019
  - Carbon structures
    - Design
    - Production
    - Schedule
  - Power system
  - Contingency
    - Electronics
    - Mechanics design
    - Mechanics fabrication
  - Rebalance work load among collaborators
    - LANL, MIT, LBNL, UT-A, BNL et al
- MVTX TPC updated, under review
  - Identified potential cost saving, ~\$600K
  - OPC, TEC assigned



## MVTX Workshop @LBNL, 2/28-3/2,2019

### Mechanical System Discussion Session:

- Discussed and updated major carbon structures' design & production cost & schedule, risks etc.
- LANL, MIT, BNL and LBNL engineers and physicists



- Budget availability
  - Final mechanical system design work, at MIT, LANL and LBNL
  - Early R&D required to reduce the high production contingency
- Carbon structure production cost & schedule
  - LBNL, other production plan/ATLAS
  - Exploring other companies in Italy, France, Korea ...
  - High contingency in design and production cost ~45%
- Global mechanical system integration
  - Inner volume design is good progress, in ceonuputal
  - High contingency in design and production, ~ 50%

- TPC in P6, \$4.3M, w/ burden and escalation
- About 6 months contingency in schedule
- Implemented Risk Based Contingency
- Recent scrubbing exercise, possible cost saving ~\$500K
- Plan to update P6 after this review
- Mechanical engineering design in progress
  - **Need budget now for the final engineering design work**
- Collaboration institutions ready to receive the project fund

# backup

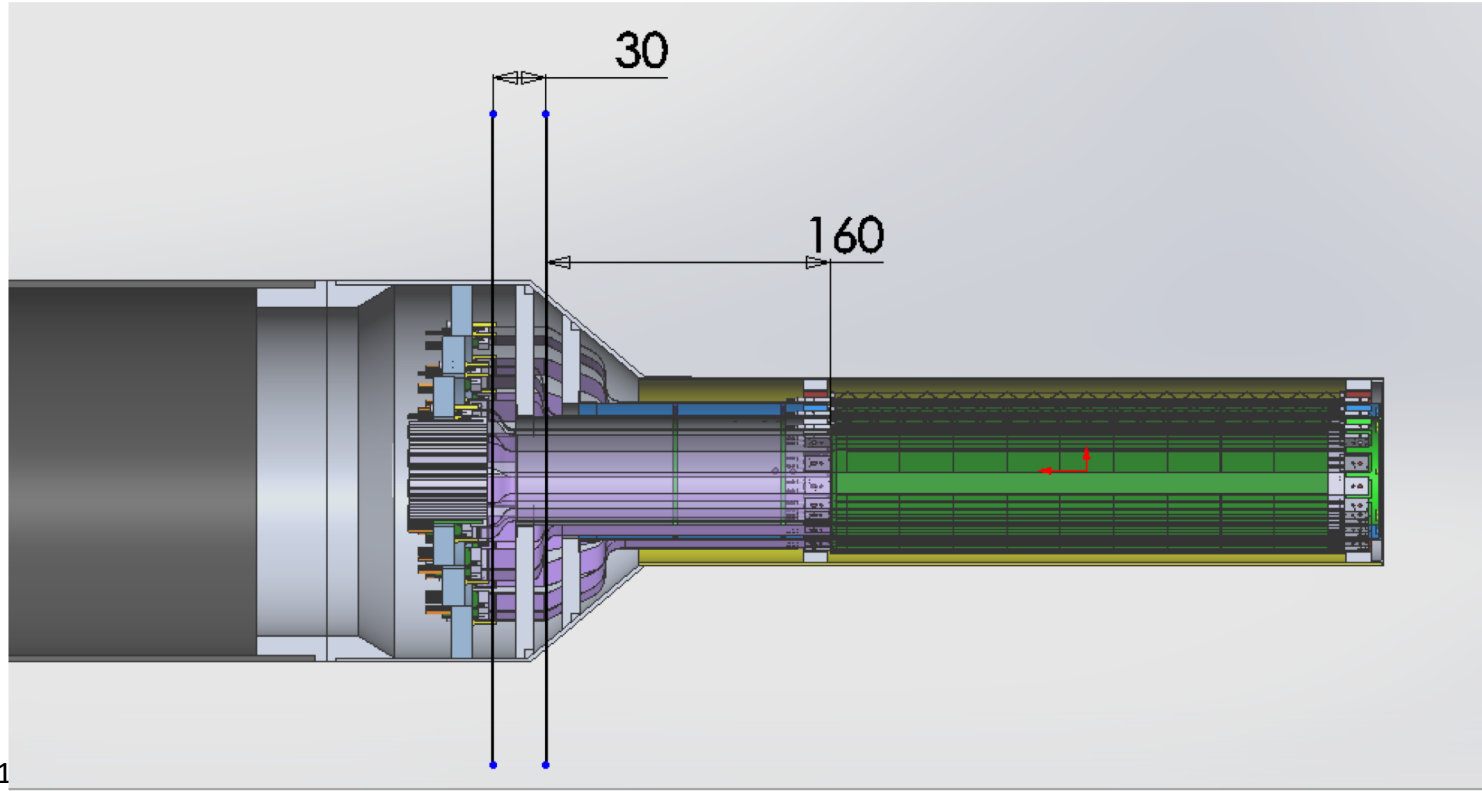
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- Mechanical structure design
    - Design & FEA, LANL/MIT
    - End Wheels
    - Cylindrical structure shells
    - Detector service half barrels
    - Service patch panels
    - Global interface
  - Mechanical structure fabrication
    - Composite structures, LBNL
    - Non-composite structures, MIT
    - Installation tooling etc., MIT/LANL/LBNL/BNL
  - Ancillary systems – “adopt” ALICE/ITS
    - Cooling plant, MIT/BNL
    - Slow control & monitoring etc., MIT/GSU
  - MVTX electronics
    - Backend FELIX and cables
    - Integration into sPHENIX DAQ
    - Power system
  - Detector assembly & test
    - Stave QA & half detector assembly @LBNL
    - System test & integration @LBNL/BNL
  - Installation & commissioning, by all
    - Pre-installation commissioning @BNL
    - Installation @IR
- Early generic R&D accomplished through LANL LDRD
- Readout integration
  - Detector conceptual design

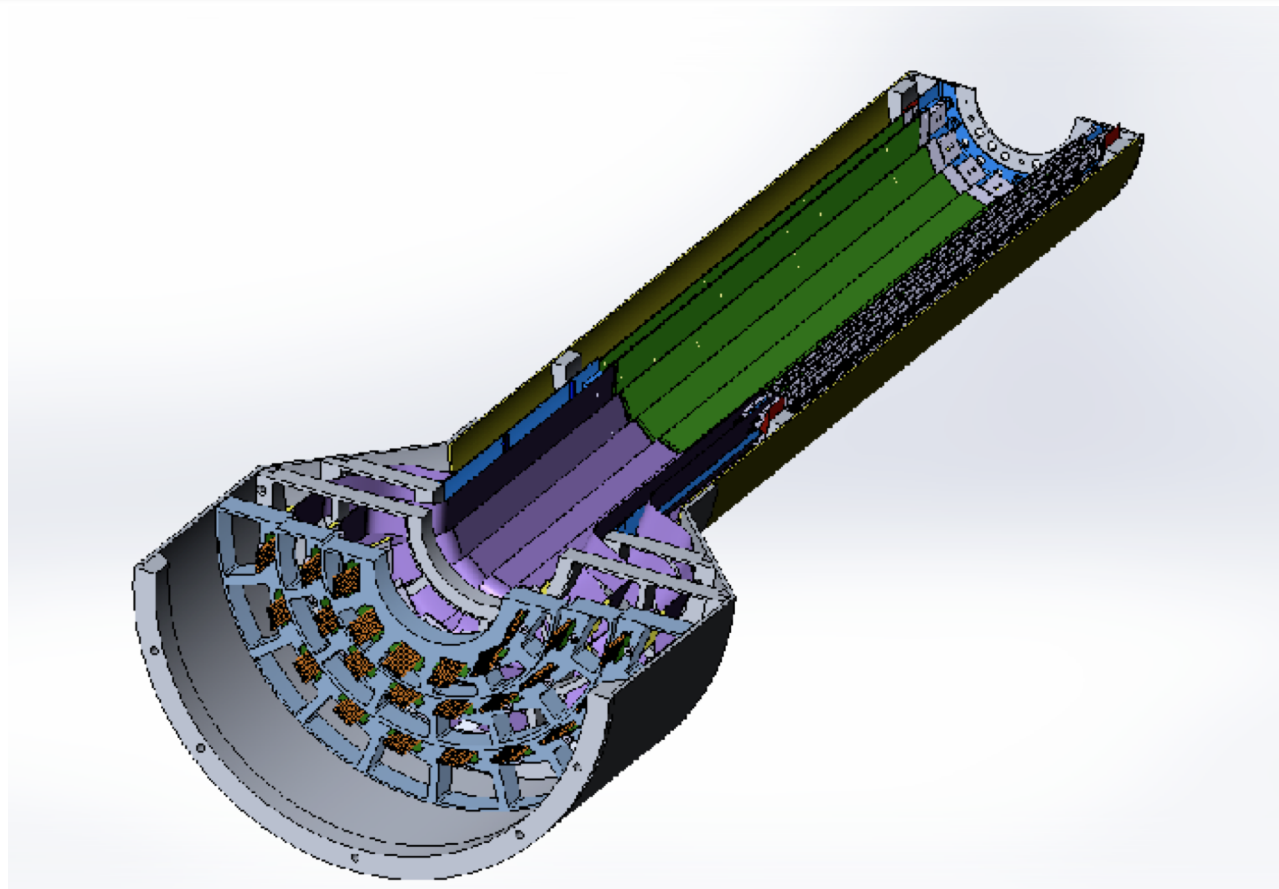
# Carbon Structures – Work in Progress

Ross' talk

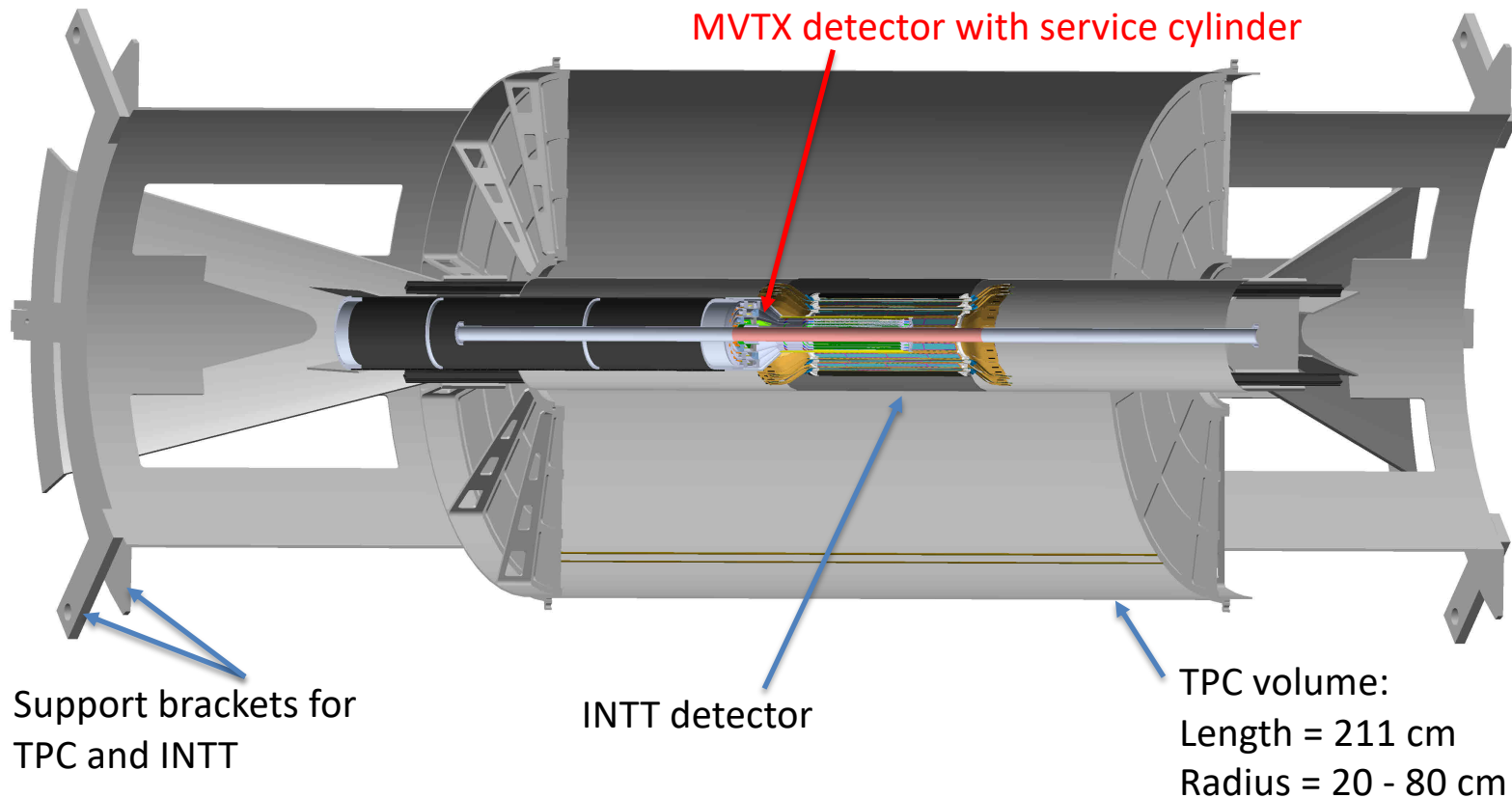
- Conical sectors are expensive!
- A new design under development to avoid the conical structures, MIT/LANL



# Half Barrel



# MVTX Detector in sPHENIX



# MVTX in P6: 1/11



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Actual Work

Critical Rem. Work

Remaining Work

Actual LoE

Remaining LoE

♦ Milestone



# MVTX in P6: 2/11



sPHENIX MVTX Project Detailed Schedule

Budgeted Cost Included

Data Date: 01-Oct-18 Published: 02-Apr-19 12:38

Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY15\$ - M&S	Burd AVS - Labor	Burd AVS - M&S	Burd AVS - Total	2015	2016	2017	2018	2019	2020	2021	2022
												5	FY16	FY17	FY18	FY19	FY20	FY21	FY22
S101500	Produce RU Cold Plate - Labor	Liu, Ming	20	01-Apr-19	26-Apr-19	255	60	0	\$5,400	\$0	\$5,400								
S101600	Procure Transition Board for RU	Liu, Ming	10	01-Apr-19	12-Apr-19	463	0	8716	\$0	\$10,895	\$10,895								
S101700	Produce RU Cold Plate - M&S	Liu, Ming	20	01-Apr-19	26-Apr-19	255	0	12104	\$0	\$15,130	\$15,130								
S101800	Procure Power Mezzanine for RU	Liu, Ming	10	01-Apr-19	12-Apr-19	463	0	22108	\$0	\$27,635	\$27,635								
S101900	Test/QA RU - Labor	Liu, Ming	18	29-Apr-19	22-May-19	453	112	0	\$3,600	\$0	\$3,600								
S102000	Test/QA RU - M&S	Liu, Ming	18	29-Apr-19	22-May-19	453	0	7500	\$0	\$9,375	\$9,375								
S102100	Procure 60 SamTec Cables -Provide Requirements to Procurement	Liu, Ming	5	23-May-19	30-May-19	453	5	0	\$922	\$0	\$922								
S102200	Procure 60 SamTec Cables -Prepare & Send Solicitation	Liu, Ming	20	31-May-19	27-Jun-19	453	0	0	\$0	\$0	\$0								
S102300	Procure 60 SamTec Cables -Vendor Responses	Liu, Ming	10	28-Jun-19	12-Jul-19	453	0	0	\$0	\$0	\$0								
S102400	Procure 60 SamTec Cables -Vendor Selection	Liu, Ming	10	15-Jul-19	26-Jul-19	453	0	0	\$0	\$0	\$0								
S102500	Procure 60 SamTec Cables -Contract Awards	Liu, Ming	0	29-Jul-19		453	0	0	\$0	\$0	\$0								
S102600	Procure 60 SamTec Cables -Contract/PO - Leadtime	Liu, Ming	60	29-Jul-19	22-Oct-19	453	0	0	\$0	\$0	\$0								
S102700	Procure 60 SamTec Cables - Delivery Acceptance	Liu, Ming	5	23-Oct-19	29-Oct-19	453	0	30000	\$0	\$34,850	\$34,850								
S102800	Test/QA SamTec Cables	Liu, Ming	40	30-Oct-19	30-Dec-19	453	960	0	\$75,360	\$0	\$75,360								
S102900	Ship RU & SamTec Cables to UT Austin	Liu, Ming	5	31-Dec-19	07-Jan-20	453	0	2000	\$0	\$2,550	\$2,550								
POM028_3.02.3.02.02.02	FELIX 2.0		254	01-Apr-19	03-Apr-20	392	186	88400	\$18,588	\$103,640	\$122,229								
S103000	Produce Felix 2.0 first production unit - Labor	Liu, Ming	57	01-Apr-19	19-Jun-19	218	16	0	\$3,073	\$0	\$3,073								
S103100	Procure Optical Fiber - Labor	Liu, Ming	121	01-Apr-19	19-Sep-19	414	2	0	\$307	\$0	\$307								
S103200	Produce Felix 2.0 first production unit - M&S	Liu, Ming	57	01-Apr-19	19-Jun-19	218	0	20000	\$0	\$22,778	\$22,778								
S103300	Procure Optical Fiber - M&S	Liu, Ming	121	01-Apr-19	19-Sep-19	414	0	50	\$0	\$63	\$63								
S103400	Test/QA 1st Felix Unit and Fibers	Liu, Ming	10	20-Sep-19	03-Oct-19	414	40	0	\$0	\$0	\$0								
S103500	Procure 7 Felix 2.0 Remaining Units -Provide Requirements to Procurement	Liu, Ming	5	06-Nov-19	13-Nov-19	392	6	0	\$1,187	\$0	\$1,187								
S103600	Procure 57 Optical Fiber Sets - Labor	Liu, Ming	20	06-Nov-19	06-Dec-19	462	2	0	\$396	\$0	\$396								
S103700	Procure 57 Optical Fiber Sets M&S	Liu, Ming	20	06-Nov-19	06-Dec-19	462	0	2850	\$0	\$3,634	\$3,634								

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Actual Work

Critical Rem. Work

Remaining Work

Actual LoE

Remaining LoE

Milestone

# MVTX in P6: 3/11



		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38																	
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY15 - M&S	Burd AY5 - Labor	Burd AY5 - M&S	Burd AY5 - Total	2015	2016	2017	2018	2019	2020	2021	2022
													FY16	FY17	FY18	FY19	FY20	FY21	FY22
S103800	Procure 7 Felix 2.0 Remaining Units -Prepare & Send Solicitation	Liu, Ming	20	14-Nov-19	13-Dec-19	392	0	0	\$0	\$0	\$0								
S103900	Procure 7 Felix 2.0 Remaining Units -Vendor Responses	Liu, Ming	10	16-Dec-19	30-Dec-19	392	0	0	\$0	\$0	\$0								
S104000	Procure 7 Felix 2.0 Remaining Units -Vendor Selection	Liu, Ming	10	31-Dec-19	14-Jan-20	392	0	0	\$0	\$0	\$0								
S104100	Procure 7 Felix 2.0 Remaining Units -Contract Awards	Liu, Ming	0	15-Jan-20		392	0	0	\$0	\$0	\$0					15-Jan-20			
S104200	Procure 7 Felix 2.0 Remaining Units -Contract/PO - Leadtime	Liu, Ming	40	15-Jan-20	12-Mar-20	392	0	0	\$0	\$0	\$0								
S104300	Procure 7 Felix 2.0 Remaining Units - Delivery Acceptance	Liu, Ming	5	13-Mar-20	19-Mar-20	392	0	56000	\$0	\$65,054	\$65,054								
S104400	Test/QA 7 Felix Units and Fibers - Labor	Liu, Ming	6	20-Mar-20	27-Mar-20	392	120	0	\$13,625	\$0	\$13,625								
S104500	Test/QA 7 Felix Units and Fibers - M&S	Liu, Ming	0	20-Mar-20	20-Mar-20	398	0	7500	\$0	\$9,563	\$9,563								
S104600	Ship Felix Units and Fibers to BNL	Liu, Ming	5	30-Mar-20	03-Apr-20	392	0	2000	\$0	\$2,550	\$2,550								
POM028_3.02.3.02.02.03	MAPS Power System		286	01-Apr-19	19-May-20	363	2541	224620	\$91,137	\$265,885	\$357,022								
POM028_3.02.3.02.03.01	Power Boards		225	01-Apr-19	24-Feb-20	413	2236	117320	\$79,666	\$139,821	\$219,487								
S104700	Review ALICE PB Design - Labor	Liu, Ming	30	01-Apr-19	10-May-19	140	588	0	\$19,050	\$0	\$19,050								
S104800	Fabricate PB Prototype - Labor	Liu, Ming	40	13-May-19	09-Jul-19	140	226	0	\$12,138	\$0	\$12,138								
S104900	Fabricate PB Prototype - M&S	Liu, Ming	40	13-May-19	09-Jul-19	140	0	5750	\$0	\$7,188	\$7,188								
S105000	Procure Power Distribution (Cables plus Connectors) - Labor	Liu, Ming	20	10-Jul-19	06-Aug-19	140	320	0	\$0	\$0	\$0								
S105100	Procure Power Distribution (Cables plus Connectors) - M&S	Liu, Ming	20	10-Jul-19	06-Aug-19	140	0	1000	\$0	\$1,250	\$1,250								
S105200	Test PB Prototype and Distribution - Labor	Liu, Ming	20	07-Aug-19	04-Sep-19	140	480	0	\$11,950	\$0	\$11,950								
S105300	Test PB Prototype and Distribution - M&S	Liu, Ming	20	07-Aug-19	04-Sep-19	140	0	1150	\$0	\$1,438	\$1,438								
S105400	Design Production Power Board - M&S	Liu, Ming	20	05-Sep-19	02-Oct-19	140	0	2000	\$0	\$2,505	\$2,505								
S105500	Design Production Power Board - Labor	Liu, Ming	20	05-Sep-19	02-Oct-19	140	400	0	\$19,241	\$0	\$19,241								
S105600	Hold Power system Review	Liu, Ming	5	03-Oct-19	09-Oct-19	140	96	0	\$2,980	\$0	\$2,980								
S105700	Fabricate Break Out Boards (qty?) - M&S	Liu, Ming	20	10-Oct-19	07-Nov-19	483	0	15000	\$0	\$19,125	\$19,125								
S105800	Fabricate PB to Stave Cables (qty?) - M&S	Liu, Ming	20	10-Oct-19	07-Nov-19	483	0	5000	\$0	\$6,375	\$6,375								
S105900	Procure Production PB -Provide Requirements to Procurement	Liu, Ming	5	10-Oct-19	17-Oct-19	413	86	0	\$8,871	\$0	\$8,871								
S106000	Fabricate Cold (Cooling) Plates - M&S	Liu, Ming	10	10-Oct-19	24-Oct-19	493	0	3420	\$0	\$4,361	\$4,361								

# MVTX in P6: 4/11



BROOKHAVEN NATIONAL LABORATORY		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38										sPHENIX							
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19\$ M&S	Burd AY\$ Labor	Burd AY\$ M&S	Burd AY\$ Total	2015	2016	2017	2018	2019	2020	2021	2022
S106100	Fabricate Cold (Cooling) Plates - Labor	Liu, Ming	10	10-Oct-19	24-Oct-19	493	40	0	\$5,436	\$0	\$5,436								
S106200	Procure Production PB -Prepare & Send Solicitation	Liu, Ming	20	18-Oct-19	15-Nov-19	413	0	0	\$0	\$0	\$0								
S106300	Procure Production PB -Vendor Responses	Liu, Ming	10	18-Nov-19	03-Dec-19	413	0	0	\$0	\$0	\$0								
S106400	Procure Production PB -Vendor Selection	Liu, Ming	10	04-Dec-19	17-Dec-19	413	0	0	\$0	\$0	\$0								
S106500	Procure Production PB -Contract Award	Liu, Ming	0	18-Dec-19	18-Dec-19	413	0	0	\$0	\$0	\$0								
S106600	Procure Production PB -Contract/PO - Leadtime	Liu, Ming	40	18-Dec-19	14-Feb-20	413	0	0	\$0	\$0	\$0								
S106700	Procure Production PB - Delivery Acceptance (qty?)	Liu, Ming	5	18-Feb-20	24-Feb-20	413	0	84000	\$0	\$97,580	\$97,580								
POM02B_3.02.3.02.02.03.02	Power Supplies		151	10-Oct-19	19-May-20	363	305	107300	\$11,471	\$126,064	\$137,535								
S106800	Procure and terminate PS-to-PB (cabling?) - M&S	Liu, Ming	30	10-Oct-19	22-Nov-19	473	0	10500	\$0	\$13,388	\$13,388								
S106900	Procure and Integrate Power -Provide Requirements to Procurement	Liu, Ming	5	10-Oct-19	17-Oct-19	363	209	0	\$4,024	\$0	\$4,024								
S107000	Procure and terminate PS-to-PB (cabling?) - Labor	Liu, Ming	30	10-Oct-19	22-Nov-19	473	40	0	\$1,943	\$0	\$1,943								
S107100	Procure and Integrate Power -Prepare & Send Solicitation	Liu, Ming	20	18-Oct-19	15-Nov-19	363	0	0	\$0	\$0	\$0								
S107200	Procure and Integrate Power -Vendor Responses	Liu, Ming	10	18-Nov-19	03-Dec-19	363	0	0	\$0	\$0	\$0								
S107300	Procure and Integrate Power -Vendor Selection	Liu, Ming	10	04-Dec-19	17-Dec-19	363	0	0	\$0	\$0	\$0								
S107400	Procure and Integrate Power -Contract Award	Liu, Ming	0	18-Dec-19		363	0	0	\$0	\$0	\$0								
S107500	Procure and Integrate Power -Contract/PO - Leadtime	Liu, Ming	90	18-Dec-19	27-Apr-20	363	0	0	\$0	\$0	\$0								
S107600	Procure and Integrate Power - Delivery Acceptance (power supplies?, qty?)	Liu, Ming	5	28-Apr-20	04-May-20	363	0	94800	\$0	\$110,126	\$110,126								
S107700	test PB with power supplies	Liu, Ming	5	05-May-20	11-May-20	363	40	0	\$4,857	\$0	\$4,857								
S107800	Document Power System	Liu, Ming	1	12-May-20	12-May-20	363	16	0	\$647	\$0	\$647								
S107900	Ship Power System to BNL - M&S	Liu, Ming	5	12-May-20	19-May-20	363	0	2000	\$0	\$2,550	\$2,550								
POM02B_3.02.3.02.03	MVTX Mechanics and Detector Assembly		741	01-Apr-19	17-Mar-22	0	16520	564177	\$1,279,337	\$721,361	\$2,000,698								
POM02B_3.02.3.02.03.01	Staves		411	01-Apr-19	17-Nov-20	225	2671	166852	\$160,245	\$211,462	\$371,707								
POM02B_3.02.3.02.03.01.01	Production		248	01-Apr-19	26-Mar-20	169	1447	57360	\$181	\$72,305	\$72,486								
S108000	Test/QA Staves at CERN	Liu, Ming	248	01-Apr-19	26-Mar-20	169	1440	0	\$0	\$0	\$0								
S108100	CERN Test System - M&S	Liu, Ming	20	01-Apr-19	26-Apr-19	367	0	7360	\$0	\$9,200	\$9,200								

# MVTX in P6: 5/11



BROOKHAVEN NATIONAL LABORATORY		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38										sPHENIX							
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19\$- M&S	Burd AVS - Labor	Burd AVS - M&S	Burd AVS - Total	2015	2016	2017	2018	2019	2020	2021	2022
												FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22
S108200	Travel and Per Diem at CERN - M&S	Liu, Ming	248	01-Apr-19	26-Mar-20	169	0	50000	\$0	\$63,105	\$63,105								
S108300	CERN Test System - Labor	Liu, Ming	20	01-Apr-19	26-Apr-19	367	7	0	\$181	\$0	\$181								
POM028_3.02.3.02.03.01.02	Stave Assembly Tooling		120	28-May-20	17-Nov-20	0	264	45000	\$59,738	\$57,715	\$117,453								
S108400	Stave Assembly Tooling - Design	Liu, Ming	10	28-May-20	10-Jun-20	0	80	0	\$18,076	\$0	\$18,076								
S108500	Stave Assembly Tooling - Prototype - M&S	Liu, Ming	30	11-Jun-20	23-Jul-20	0	0	20000	\$0	\$25,500	\$25,500								
S108600	Stave Assembly Tooling - Prototype - Labor	Liu, Ming	30	11-Jun-20	23-Jul-20	0	120	0	\$27,114	\$0	\$27,114								
S108700	Stave Assembly Tooling - Final Jig Design	Liu, Ming	20	24-Jul-20	20-Aug-20	0	40	0	\$9,038	\$0	\$9,038								
S108800	Stave Assembly Tooling - Procure Assembly Fixtures and Tooling - M&S	Liu, Ming	60	21-Aug-20	17-Nov-20	0	0	25000	\$0	\$32,215	\$32,215								
S108900	Stave Assembly Tooling - Procure Assembly Fixtures and Tooling - Labor	Liu, Ming	60	21-Aug-20	17-Nov-20	0	24	0	\$5,510	\$0	\$5,510								
POM028_3.02.3.02.03.01.03	Metrology		65	28-May-20	27-Aug-20	55	363	7000	\$78,445	\$8,925	\$87,370								
S109000	Metrology design	Liu, Ming	20	28-May-20	24-Jun-20	55	160	0	\$36,152	\$0	\$36,152								
S109100	Design jigs	Liu, Ming	20	25-Jun-20	23-Jul-20	55	160	0	\$36,152	\$0	\$36,152								
S109200	Procure jigs - M&S	Liu, Ming	20	24-Jul-20	20-Aug-20	55	0	5000	\$0	\$6,375	\$6,375								
S109300	Procure jigs - Labor	Liu, Ming	20	24-Jul-20	20-Aug-20	55	3	0	\$428	\$0	\$428								
S109400	ship to LBNL - Labor	Liu, Ming	5	21-Aug-20	27-Aug-20	55	40	0	\$5,712	\$0	\$5,712								
S109500	ship to LBNL - M&S	Liu, Ming	5	21-Aug-20	27-Aug-20	55	0	2000	\$0	\$2,550	\$2,550								
POM028_3.02.3.02.03.01.04	Shipping and Storage Containers		341	01-Apr-19	06-Aug-20	295	597	33492	\$21,882	\$42,153	\$64,034								
S109600	Design & Fabricate Storage Cabinets for Staves - M&S	Liu, Ming	39	01-Apr-19	23-May-19	341	0	6992	\$0	\$8,740	\$8,740								
S109700	Design shipping container for 21 staves	Liu, Ming	5	01-Apr-19	05-Apr-19	360	40	0	\$9,485	\$0	\$9,485								
S109800	Design & Fabricate Storage Cabinets for Staves - Labor	Liu, Ming	39	01-Apr-19	23-May-19	341	275	0	\$5,353	\$0	\$5,353								
S109900	Procure Stave Shipping Plate (84) - Labor	Liu, Ming	5	08-Apr-19	12-Apr-19	360	10	0	\$1,608	\$0	\$1,608								
S110000	Procure Stave Shipping Plate (84) - M&S	Liu, Ming	5	08-Apr-19	12-Apr-19	360	0	10000	\$0	\$12,500	\$12,500								
S110100	Ship Stave Shipping Devices to CERN	Liu, Ming	10	15-Apr-19	26-Apr-19	360	0	5000	\$0	\$6,250	\$6,250								
S110200	Design & Fabricate Shipping and Storage Containers (Half-Barrels) - M&S	Liu, Ming	50	28-May-20	06-Aug-20	295	0	11500	\$0	\$14,663	\$14,663								
S110300	Design & Fabricate Shipping and Storage Containers (Half-Barrels) - Labor	Liu, Ming	50	28-May-20	06-Aug-20	295	272	0	\$5,436	\$0	\$5,436								
POM028_3.02.3.02.03.01.05	Shipping the Staves from CERN to LBNL		193	27-Jun-19	06-Apr-20	169	0	24000	\$0	\$30,364	\$30,364								

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Actual Work

Critical Rem. Work

Remaining Work

Actual LoE

Remaining LoE

Milestone

# MVTX in P6: 6/11



**BROOKHAVEN**  
NATIONAL LABORATORY

sPHENIX MVTX Project Detailed Schedule  
Budgeted Cost Included  
Data Date: 01-Oct-18 Published: 02-Apr-19 12:38

sPHENIX

Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19\$ - M&S	Burd AY\$ - Labor	Burd AY\$ - M&S	Burd AY\$ - Total	2015	2016	2017	2018	2019	2020	2021	2022
													FY16	FY17	FY18	FY19	FY20	FY21	FY22
S110400	ship from CERN to LBNL - Batch 1	Liu, Ming	7	27-Jun-19	08-Jul-19	318	0	6000	\$0	\$7,500	\$7,500								
S110500	ship from CERN to LBNL - Batch 2	Liu, Ming	7	25-Sep-19	03-Oct-19	268	0	6000	\$0	\$7,564	\$7,564								
S110600	ship from CERN to LBNL - Batch 3	Liu, Ming	7	27-Dec-19	07-Jan-20	219	0	6000	\$0	\$7,650	\$7,650								
S110700	ship from CERN to LBNL - Batch 4	Liu, Ming	7	27-Mar-20	06-Apr-20	169	0	6000	\$0	\$7,650	\$7,650								
POM028_3.02.3.02.03.02	Carbon Structures		741	01-Apr-19	17-Mar-22	0	5774	368511	\$910,025	\$472,154	\$1,382,179								
POM028_3.02.3.02.03.02.01	Mechanics Detector Design		80	01-Apr-19	23-Jul-19	0	640	0	\$167,952	\$0	\$167,952								
S110800	Develop MAPS inner tracker mechanical model	Liu, Ming	80	01-Apr-19	23-Jul-19	0	640	0	\$167,952	\$0	\$167,952								
POM028_3.02.3.02.03.02.02	End Wheels		277	24-Jul-19	28-Aug-20	54	502	72000	\$73,964	\$90,875	\$164,839								
S110900	Design End-wheels	Liu, Ming	15	24-Jul-19	13-Aug-19	54	120	0	\$36,658	\$0	\$36,658								
S111000	Prototype End-wheels - M&S	Liu, Ming	30	14-Aug-19	25-Sep-19	54	0	10000	\$0	\$12,500	\$12,500								
S111100	Prototype End-wheels - Labor	Liu, Ming	30	14-Aug-19	25-Sep-19	54	12	0	\$2,305	\$0	\$2,305								
S111200	Procure Al Half Disks - Labor	Liu, Ming	5	14-Aug-19	20-Aug-19	311	4	0	\$555	\$0	\$555								
S111300	Procure Al Half Disks - M&S	Liu, Ming	5	14-Aug-19	20-Aug-19	311	0	1000	\$0	\$1,250	\$1,250								
S111400	Procure Half Rings - Labor	Liu, Ming	5	14-Aug-19	20-Aug-19	311	4	0	\$555	\$0	\$555								
S111500	Procure Half Rings - M&S	Liu, Ming	5	14-Aug-19	20-Aug-19	311	0	1000	\$0	\$1,250	\$1,250								
S111600	Experimental Tooling for Carbon Structure - Labor	Liu, Ming	80	26-Sep-19	24-Jan-20	54	186	0	\$28,859	\$0	\$28,859								
S111700	Experimental Tooling for Carbon Structure - M&S	Liu, Ming	0	26-Sep-19	26-Sep-19	134	0	25000	\$0	\$31,250	\$31,250								
S111800	Review End-wheels	Liu, Ming	2	27-Jan-20	28-Jan-20	54	16	0	\$5,034	\$0	\$5,034								
S111900	Procure End-wheels -Provide Requirements to Procurement	Liu, Ming	5	29-Jan-20	04-Feb-20	54	160	0	\$0	\$0	\$0								
S112000	Procure End-wheels -Prepare & Send Solicitation	Liu, Ming	20	05-Feb-20	04-Mar-20	54	0	0	\$0	\$0	\$0								
S112100	Procure End-wheels -Vendor Responses	Liu, Ming	10	05-Mar-20	18-Mar-20	54	0	0	\$0	\$0	\$0								
S112200	Procure End-wheels -Vendor Selection	Liu, Ming	10	19-Mar-20	01-Apr-20	54	0	0	\$0	\$0	\$0								
S112300	Procure End-wheels -Contract Award	Liu, Ming	0	02-Apr-20		54	0	0	\$0	\$0	\$0								
S112400	Procure End-wheels -Contract/PO - Leadtime	Liu, Ming	100	02-Apr-20	21-Aug-20	54	0	0	\$0	\$0	\$0								
S112500	Procure End-wheels - Delivery Acceptance	Liu, Ming	5	24-Aug-20	28-Aug-20	54	0	35000	\$0	\$44,625	\$44,625								
POM028_3.02.3.02.03.02.03	Mechanics Fabrication		741	01-Apr-19	17-Mar-22	0	4408	286511	\$614,456	\$368,529	\$982,985								

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■ Actual Work 
 ■ Critical Rem. Work 
 ■ Remaining Work 
 ■ Actual LoE 
 ■ Remaining LoE 
 ◆ Milestone

# MVTX in P6: 7/11



BROOKHAVEN NATIONAL LABORATORY		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38										sPHENIX							
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19\$ - M&S	Burd AYS - Labor	Burd AYS - M&S	Burd AYS - Total	2015 FY15	2016 FY16	2017 FY17	2018 FY18	2019 FY19	2020 FY20	2021 FY21	2022 FY22
S112600	Travel LBNL - FY19	Liu, Ming	128	01-Apr-19	30-Sep-19	0	0	17500	\$0	\$21,875	\$21,875								
S112700	Travel LBNL - FY20	Liu, Ming	251	01-Oct-19	30-Sep-20	0	0	17500	\$0	\$22,313	\$22,313								
S112800	Travel LBNL - FY21	Liu, Ming	250	01-Oct-20	30-Sep-21	0	0	17500	\$0	\$22,759	\$22,759								
S112900	Travel LBNL - FY22	Liu, Ming	112	01-Oct-21	17-Mar-22	0	0	17500	\$0	\$23,214	\$23,214								
POM028_3.02.3.02.03.01	Cylindrical Support Structure (CYSS)		291	24-Jul-19	21-Sep-20	180	2409	102871	\$333,977	\$131,161	\$465,137								
S11300C	Review CYSS Design-Fabrication Compatibility	Liu, Ming	40	24-Jul-19	18-Sep-19	0	371	0	\$12,141	\$0	\$12,141								
S11310C	Modify CYSS Design	Liu, Ming	40	19-Sep-19	15-Nov-19	0	320	0	\$85,991	\$0	\$85,991								
S11320C	Review CYSS Design for Fabrication (PRR)	Liu, Ming	15	18-Nov-19	10-Dec-19	0	118	0	\$13,884	\$0	\$13,884								
S11330C	Detail Design CYSS	Liu, Ming	15	11-Dec-19	02-Jan-20	0	120	0	\$27,114	\$0	\$27,114								
S11340C	Procure CYSS Material - M&S	Liu, Ming	5	03-Jan-20	09-Jan-20	251	0	15640	\$0	\$19,941	\$19,941								
S11350C	Procure CYSS Material - Labor	Liu, Ming	5	03-Jan-20	09-Jan-20	251	8	0	\$0	\$0	\$0								
S11360C	Production & Test CYSS - M&S	Liu, Ming	80	28-May-20	18-Sep-20	155	0	87231	\$0	\$111,220	\$111,220								
S11370C	Production & Test CYSS - Labor	Liu, Ming	80	28-May-20	18-Sep-20	155	1472	0	\$194,846	\$0	\$194,846								
S11380C	Milestone: Complete CYSS	Liu, Ming	0	21-Sep-20	21-Sep-20	180	0	0	\$0	\$0	\$0								
POM028_3.02.3.02.03.02	Service Barrel (SB)		291	03-Jan-20	04-Mar-21	155	2000	113640	\$280,479	\$147,208	\$427,688								
S11390C	Review SB Design-Fabrication Compatibility	Liu, Ming	40	03-Jan-20	02-Mar-20	0	91	0	\$12,505	\$0	\$12,505								
S11400C	Modify SB Design	Liu, Ming	30	03-Mar-20	13-Apr-20	0	240	0	\$54,228	\$0	\$54,228								
S11410C	Review SB Design for Fabrication (PRR)	Liu, Ming	15	14-Apr-20	04-May-20	0	112	0	\$14,809	\$0	\$14,809								
S11420C	Procure SB Material - M&S	Liu, Ming	5	05-May-20	11-May-20	246	0	15640	\$0	\$19,941	\$19,941								
S11430C	Procure SB Material - Labor	Liu, Ming	5	05-May-20	11-May-20	246	8	0	\$0	\$0	\$0								
S11440C	Production & Test SB - M&S	Liu, Ming	110	21-Sep-20	03-Mar-21	155	0	98000	\$0	\$127,267	\$127,267								
S11450C	Production & Test SB - Labor	Liu, Ming	110	21-Sep-20	03-Mar-21	155	1549	0	\$198,937	\$0	\$198,937								
S11460C	Milestone: Complete SB	Liu, Ming	0	04-Mar-21	04-Mar-21	155	0	0	\$0	\$0	\$0								
POM028_3.02.3.02.03.02.04	MVTX Final Design Review		16	05-May-20	27-May-20	0	224	10000	\$53,652	\$12,750	\$66,402								
S114700	MVTX Design Review - M&S	Liu, Ming	5	05-May-20	11-May-20	0	0	10000	\$0	\$12,750	\$12,750								
S114800	MVTX Design Review - Labor	Liu, Ming	5	05-May-20	11-May-20	0	64	0	\$8,942	\$0	\$8,942								

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BROOKHAVEN NATIONAL LABORATORY		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38										sPHENIX									
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY15 - M&S	Burd AVS - Labor	Burd AVS - M&S	Burd AVS - Total	2015 FY15	2016 FY16	2017 FY17	2018 FY18	2019 FY19	2020 FY20	2021 FY21	2022 FY22		
S114900	Incorporate MVTX Design Review Comments	Liu, Ming	10	12-May-20	26-May-20	0	144	0	\$40,239	\$0	\$40,239										
S115000	Complete Final MVTX Design Review	Liu, Ming	1	27-May-20	27-May-20	0	16	0	\$4,471	\$0	\$4,471										
POM02B_3.02.3.02.03.03	Barrel Assembly		556	05-Sep-19	29-Nov-21	75	8075	28814	\$209,067	\$37,745	\$246,812										
POM02B_3.02.3.02.03.03.01	Assembly and Testing		556	05-Sep-19	29-Nov-21	75	8075	28814	\$209,067	\$37,745	\$246,812										
S115100	Test and Rework Staves - Batch 1	Liu, Ming	12	05-Sep-19	20-Sep-19	277	276	0	\$5,234	\$0	\$5,234										
S115200	Test and Rework Staves - Batch 2	Liu, Ming	12	04-Oct-19	22-Oct-19	268	276	0	\$5,391	\$0	\$5,391										
S115300	Test and Rework Staves - Batch 3	Liu, Ming	12	08-Jan-20	24-Jan-20	219	276	0	\$5,391	\$0	\$5,391										
S115400	Milestone: Complete Reception of 84 Staves from CERN	Liu, Ming	0		06-Apr-20	169	0	0	\$0	\$0	\$0										
S115500	Test and Rework Staves - Batch 4	Liu, Ming	12	07-Apr-20	22-Apr-20	169	276	0	\$5,391	\$0	\$5,391										
POM02B_3.02.3.02.03.03.01.01	Layer Assembly and Test		140	18-Nov-20	11-Jun-21	0	2884	5336	\$69,916	\$6,939	\$76,856										
S115600	Test Installation of Staves onto Layer End-Wheels	Liu, Ming	20	18-Nov-20	17-Dec-20	0	368	0	\$7,208	\$0	\$7,208										
S115700	Hold Half-Detector Assembly Review (PRR)	Liu, Ming	5	18-Dec-20	24-Dec-20	0	96	0	\$2,729	\$0	\$2,729										
S115800	Install Staves Onto Layer End-Wheels To Form Layers - M&S	Liu, Ming	70	28-Dec-20	07-Apr-21	0	0	2760	\$0	\$3,589	\$3,589										
S115900	Install Staves Onto Layer End-Wheels To Form Layers - Labor	Liu, Ming	70	28-Dec-20	07-Apr-21	0	1484	0	\$34,303	\$0	\$34,303										
S116000	Test and Rework Layers After Assembly - M&S	Liu, Ming	30	08-Apr-21	19-May-21	0	0	2576	\$0	\$3,350	\$3,350										
S116100	Test and Rework Layers After Assembly - Labor	Liu, Ming	30	08-Apr-21	19-May-21	0	647	0	\$14,442	\$0	\$14,442										
S116200	Perform Half-Detector Metrology On Layers	Liu, Ming	15	20-May-21	10-Jun-21	0	289	0	\$11,234	\$0	\$11,234										
S116300	Milestone: Complete Layers	Liu, Ming	0	11-Jun-21	11-Jun-21	0	0	0	\$0	\$0	\$0										
POM02B_3.02.3.02.03.03.01.02	Half Barrel #1 Assembly and Test		95	11-Jun-21	26-Oct-21	5	2038	11739	\$57,980	\$15,373	\$73,353										
S116400	Assemble Layers and CYSS into Half Barrel #1 - M&S	Liu, Ming	20	11-Jun-21	09-Jul-21	0	0	2760	\$0	\$3,589	\$3,589										
S116500	Assemble Layers and CYSS into Half Barrel #1 - Labor	Liu, Ming	20	11-Jun-21	09-Jul-21	0	400	0	\$12,530	\$0	\$12,530										
S116600	Test and Rework Half Barrel #1 - M&S	Liu, Ming	30	12-Jul-21	20-Aug-21	15	0	2576	\$0	\$3,350	\$3,350										
S116700	Test and Rework Half Barrel #1 - Labor	Liu, Ming	30	12-Jul-21	20-Aug-21	5	679	0	\$18,794	\$0	\$18,794										
S116800	Perform Half Barrel #1 Metrology On Final Assembly - Labor	Liu, Ming	10	23-Aug-21	03-Sep-21	5	216	0	\$7,943	\$0	\$7,943										
S116900	Validation Of Final Assembly - M&S	Liu, Ming	20	07-Sep-21	04-Oct-21	5	0	2576	\$0	\$3,357	\$3,357										
S117000	Validation Of Final Assembly - Labor	Liu, Ming	20	07-Sep-21	04-Oct-21	5	568	0	\$13,723	\$0	\$13,723										

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BROOKHAVEN NATIONAL LABORATORY		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38										sPHENIX							
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19 - M&S	Burd AYS - Labor	Burd AYS - M&S	Burd AYS - Total	2015 FY15	2016 FY16	2017 FY17	2018 FY18	2019 FY19	2020 FY20	2021 FY21	2022 FY22
S11710C	Pack/Ship Final Assemblies of Half Barrel #1 To BNL - M&S	Liu, Ming	15	05-Oct-21	26-Oct-21	5	0	3827	\$0	\$5,077	\$5,077								
S11720C	Pack/Ship Final Assemblies of Half Barrel #1 To BNL - Labor	Liu, Ming	15	05-Oct-21	26-Oct-21	5	175	0	\$4,990	\$0	\$4,990								
POM02B_3.02.3.02.03.01.03	Half Barrel #2 Assembly and Test		95	12-Jul-21	29-Nov-21	75	2046	11739	\$59,762	\$15,433	\$75,195								
S11730C	Assemble Layers and CYSS Into Half Barrel #2 - M&S	Liu, Ming	20	12-Jul-21	06-Aug-21	0	0	2760	\$0	\$3,589	\$3,589								
S11740C	Assemble Layers and CYSS Into Half Barrel #2 - Labor	Liu, Ming	20	12-Jul-21	06-Aug-21	0	408	0	\$13,894	\$0	\$13,894								
S11750C	Test and Rework Half Barrel #2 - M&S	Liu, Ming	30	09-Aug-21	20-Sep-21	0	0	2576	\$0	\$3,350	\$3,350								
S11760C	Test and Rework Half Barrel #2 - Labor	Liu, Ming	30	09-Aug-21	20-Sep-21	0	679	0	\$18,794	\$0	\$18,794								
S11770C	Perform Half Barrel #2 Metrology On Final Assembly	Liu, Ming	10	21-Sep-21	04-Oct-21	0	216	0	\$7,991	\$0	\$7,991								
S11780C	Validation Of Final Assembly - M&S	Liu, Ming	20	05-Oct-21	02-Nov-21	0	0	2576	\$0	\$3,417	\$3,417								
S11790C	Validation Of Final Assembly - Labor	Liu, Ming	20	05-Oct-21	02-Nov-21	0	568	0	\$14,093	\$0	\$14,093								
S11800C	Pack/Ship Final Assemblies of Half Barrel #2 to BNL - M&S	Liu, Ming	15	03-Nov-21	24-Nov-21	0	0	3827	\$0	\$5,077	\$5,077								
S11810C	Pack/Ship Final Assemblies of Half Barrel #2 to BNL - Labor	Liu, Ming	15	03-Nov-21	24-Nov-21	0	175	0	\$4,990	\$0	\$4,990								
S11820C	Milestone: Complete Barrel (RR)	Liu, Ming	0	29-Nov-21	29-Nov-21	75	0	0	\$0	\$0	\$0								
POM02B_3.02.3.02.04	MVTX Integration and Infrastructure		741	01-Apr-19	17-Mar-22	0	4454	269365	\$693,269	\$329,789	\$1,023,058								
S118300	Clean Tert/Room - Provide Requirements to Procurement	Liu, Ming	5	01-Apr-19	05-Apr-19	643	0	0	\$0	\$0	\$0								
S118400	Clean Tert/Room - Prepare & Send Solicitation	Liu, Ming	20	08-Apr-19	03-May-19	643	0	0	\$0	\$0	\$0								
S118500	Clean Tert/Room - Vendor Responses	Liu, Ming	10	06-May-19	17-May-19	643	0	0	\$0	\$0	\$0								
S118600	Clean Tert/Room - Vendor Selection	Liu, Ming	10	20-May-19	03-Jun-19	643	0	0	\$0	\$0	\$0								
S118700	Clean Tert/Room - Contract Award	Liu, Ming	0	04-Jun-19		643	0	0	\$0	\$0	\$0								
S118800	Clean Tert/Room - Contract/PO - Leadtime	Liu, Ming	48	04-Jun-19	09-Aug-19	643	0	0	\$0	\$0	\$0								
S118900	Clean Tert/Room - Delivery Acceptance	Liu, Ming	5	12-Aug-19	16-Aug-19	643	0	50000	\$0	\$56,945	\$56,945								
POM02B_3.02.3.02.04.01	Cooling System		120	28-May-20	17-Nov-20	250	152	87000	\$26,091	\$111,421	\$137,513								
S119000	Cooling System - MIT Travel	Liu, Ming	120	28-May-20	17-Nov-20	250	0	25000	\$0	\$32,045	\$32,045								
S119100	Design Cooling (Modify ALICE Design)	Liu, Ming	5	28-May-20	03-Jun-20	205	40	0	\$9,038	\$0	\$9,038								
S119200	Mock up Testing - M&S	Liu, Ming	5	04-Jun-20	10-Jun-20	205	0	20000	\$0	\$25,500	\$25,500								
S119300	Mock up Testing - Labor	Liu, Ming	5	04-Jun-20	10-Jun-20	205	40	0	\$5,712	\$0	\$5,712								
S119400	Final Design of Cooling System	Liu, Ming	5	11-Jun-20	17-Jun-20	205	40	0	\$9,038	\$0	\$9,038								

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BROOKHAVEN NATIONAL LABORATORY		sPHENIX MVTX Project Detailed Schedule Budgeted Cost Included Data Date: 01-Oct-18 Published: 02-Apr-19 12:38										sPHENIX									
Activity ID	Activity Name	CAM	At Compl. Duration	Start	Finish	Total Float	Hours	Direct FY19 - M&S	Burd AY5 - Labor	Burd AY5 - M&S	Burd AY5 - Total	2015	2016	2017	2018	2019	2020	2021	2022		
												FY15	FY16	FY17	FY18	FY19	FY20	FY21	FY22		
S119500	Procure Cooling Plant - M&S	Liu, Ming	100	18-Jun-20	09-Nov-20	250	0	40000	\$0	\$51,275	\$51,275										
S119600	Procure Cooling Plant - Labor	Liu, Ming	100	18-Jun-20	09-Nov-20	250	32	0	\$2,303	\$0	\$2,303										
S119700	Ship Cooling Plant to BNL	Liu, Ming	5	10-Nov-20	17-Nov-20	250	0	2000	\$0	\$2,601	\$2,601										
POM02B_3.02.3.02.04.02	Safety Systems		140	18-Jun-20	11-Jan-21	205	986	35200	\$141,112	\$45,426	\$186,538										
S119800	Safety Systems - MIT Travel	Liu, Ming	140	18-Jun-20	11-Jan-21	205	0	25000	\$0	\$32,180	\$32,180										
S119900	Define MVTX Safety and Interlock requirements	Liu, Ming	10	18-Jun-20	01-Jul-20	205	120	0	\$9,038	\$0	\$9,038										
S120000	Review Sensors & Interlocks with BNL ES&H	Liu, Ming	10	02-Jul-20	16-Jul-20	205	80	0	\$9,038	\$0	\$9,038										
S120100	Design Electronics Safety System	Liu, Ming	20	17-Jul-20	13-Aug-20	205	288	0	\$26,383	\$0	\$26,383										
S120200	Design Cooling Interlocks	Liu, Ming	30	14-Aug-20	25-Sep-20	205	120	0	\$27,114	\$0	\$27,114										
S120300	Procure Safety Systems - M&S	Liu, Ming	40	28-Sep-20	24-Nov-20	205	0	10000	\$0	\$12,986	\$12,986										
S120400	Procure Safety Systems - Labor	Liu, Ming	40	28-Sep-20	24-Nov-20	205	58	0	\$12,009	\$0	\$12,009										
S120500	Test Safety Systems	Liu, Ming	15	25-Nov-20	17-Dec-20	205	161	0	\$27,145	\$0	\$27,145										
S120600	Ship Safety Systems to BNL	Liu, Ming	5	18-Dec-20	24-Dec-20	205	0	200	\$0	\$260	\$260										
S120700	Test Safety Systems at BNL	Liu, Ming	10	28-Dec-20	11-Jan-21	205	160	0	\$30,385	\$0	\$30,385										
POM02B_3.02.3.02.04.03	Stave Support Frame & MVTX Interface to sPHENIX		741	01-Apr-19	17-Mar-22	0	2020	97165	\$455,487	\$115,997	\$571,483										
S120800	Travel FY19	Liu, Ming	128	01-Apr-19	30-Sep-19	112	0	2560	\$0	\$3,200	\$3,200										
S120900	Design Interface to sPHENIX	Liu, Ming	100	19-Jul-19	12-Dec-19	319	800	0	\$178,076	\$0	\$178,076										
S121000	Travel FY20	Liu, Ming	251	01-Oct-19	30-Sep-20	112	0	5000	\$0	\$6,375	\$6,375										
S121100	Procure Support Structure -Provide Requirements to Procurement	Liu, Ming	5	13-Dec-19	19-Dec-19	469	8	0	\$1,142	\$0	\$1,142										
S121200	Procure Support Structure -Prepare & Send Solicitation	Liu, Ming	20	20-Dec-19	21-Jan-20	469	0	0	\$0	\$0	\$0										
S121300	Procure Support Structure -Vendor Responses	Liu, Ming	10	22-Jan-20	04-Feb-20	469	0	0	\$0	\$0	\$0										
S121400	Procure Support Structure -Vendor Selection	Liu, Ming	10	05-Feb-20	19-Feb-20	469	0	0	\$0	\$0	\$0										
S121500	Procure Support Structure -Contract Award	Liu, Ming	0	20-Feb-20		469	0	0	\$0	\$0	\$0										
S121600	Procure Support Structure -Contract/PO - Leadtime	Liu, Ming	40	20-Feb-20	15-Apr-20	469	0	0	\$0	\$0	\$0										
S121700	Procure Support Structure - Delivery Acceptance	Liu, Ming	5	16-Apr-20	22-Apr-20	469	0	40000	\$0	\$46,467	\$46,467										

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