

MVTX Status

Ming Liu

For the MVTX Group

7/13/2019

MVTX Director's Review: 7/19-20, 2018 @BNL

- sPHENIX overview – Dave/Gunther
 - Compelling science
- MVTX overview –Ming
 - Status and highlights
- Readout integration – Alex/Sho
 - #1, 2, 3
- Staves – Leo/Grazyna
 - #1, 3, 4, 5, 6, 7, 8
- Readout Units – Jo
 - #1, 3, 4, 5, 6, 7, 8
- INTT overview – Rachid
 - Important for tracking
- Mechanical integration – Walt/Dan
 - #10
- Tracking simulation – Tony
 - #9
- Summary – Ming
 - **YES, we are ready, #1, 8**

Associate Laboratory Director for Nuclear and Particle Physics



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www.bnl.gov

Review of the sPHENIX pixel vertex detector, MVTX

July 19-20, 2018
Charge to the review committee

The purpose of the review is to evaluate the maturity of the design of the sPHENIX pixel detector, MVTX, and the readiness for procurement of the Staves and Readout Units.

In carrying out its charge, the review committee is requested to evaluate the following specific items:

1. Does the current design demonstrate that the MVTX Staves and Readout Units will be compliant with its specifications?
2. Can the data from MVTX staves be extracted, readout and integrated into sPHENIX Data Acquisition System?
3. Are the electrical interfaces of the Staves and Readout Units to other sPHENIX components at a proper level of understanding?
4. Has the responsibility for fabrication, tests and acceptance for the Staves and Readout Units been defined?
5. Has a QA plan and acceptance tests for the Staves and Readout Units been clearly defined and documented?
6. Has the inspection/test records archive plan been clearly defined and is the information easily accessible?
7. Is the design of the Staves and Readout Units final?
8. Are the Staves and Readout Units ready for procurement?

The review committee is also requested to evaluate the following specific items concerning the maturity of the design and its integration within sPHENIX:

9. Status of the simulation to optimize the MVTX and INTT for tracking in sPHENIX and timescale for its completion
10. Status of the mechanical integration between the MVTX, INTT and other sPHENIX components and timescale for a final design

Reviewers may additionally, at their discretion, comment on any other notable issues and/or concerns which they identify.

A report from the committee is expected to be submitted to me by July 27, 2018.

I very much appreciate your willingness to lend your time and expertise in this important process and look forward to receiving your assessment.

Berndt Mueller
Associate Laboratory Director for Nuclear and Particle Physics
Brookhaven National Laboratory

Scope of the MVTX Project

• MAPS Staves & Electronics

- Readout Integration R&D (**LANL LDRD**)

- Frontend: ALICE/ITS, RU
- Backend: ATLAS FELIX
- Reprogram RU & FELIX for sPHENIX

Alex & Sho

- Production:

- **84 ALICE/ITS-IB staves from CERN**

- Acceptance test @LBNL
48+spares(36)

- **58 ALICE/ITS-RU from CERN**

- Acceptance test @UT-Austin, 48+spares(10)
 - Reproduce 8 ATLAS/FELIX
 - Acceptance @LANL
 - Final assembly and test in US
 - LBNL and BNL

Leo

Jo

- Ancillary systems, “adopt” ALICE system

• Mechanics & Cooling

- **Some changes** to ALICE/ITS inner tracker mechanical structures,

- End Wheels
- Cylindrical structure shells
- Detector half barrels
- Detector and Service half barrels

Walt

- Mechanical Integration,

- Conceptual design by LANL LDRD
- Prototype by sPHENIX R&D, MIT/LANL
- Design integration frames
- Carbon frames etc., LBNL
- Installation tooling etc.

Walt & Dan

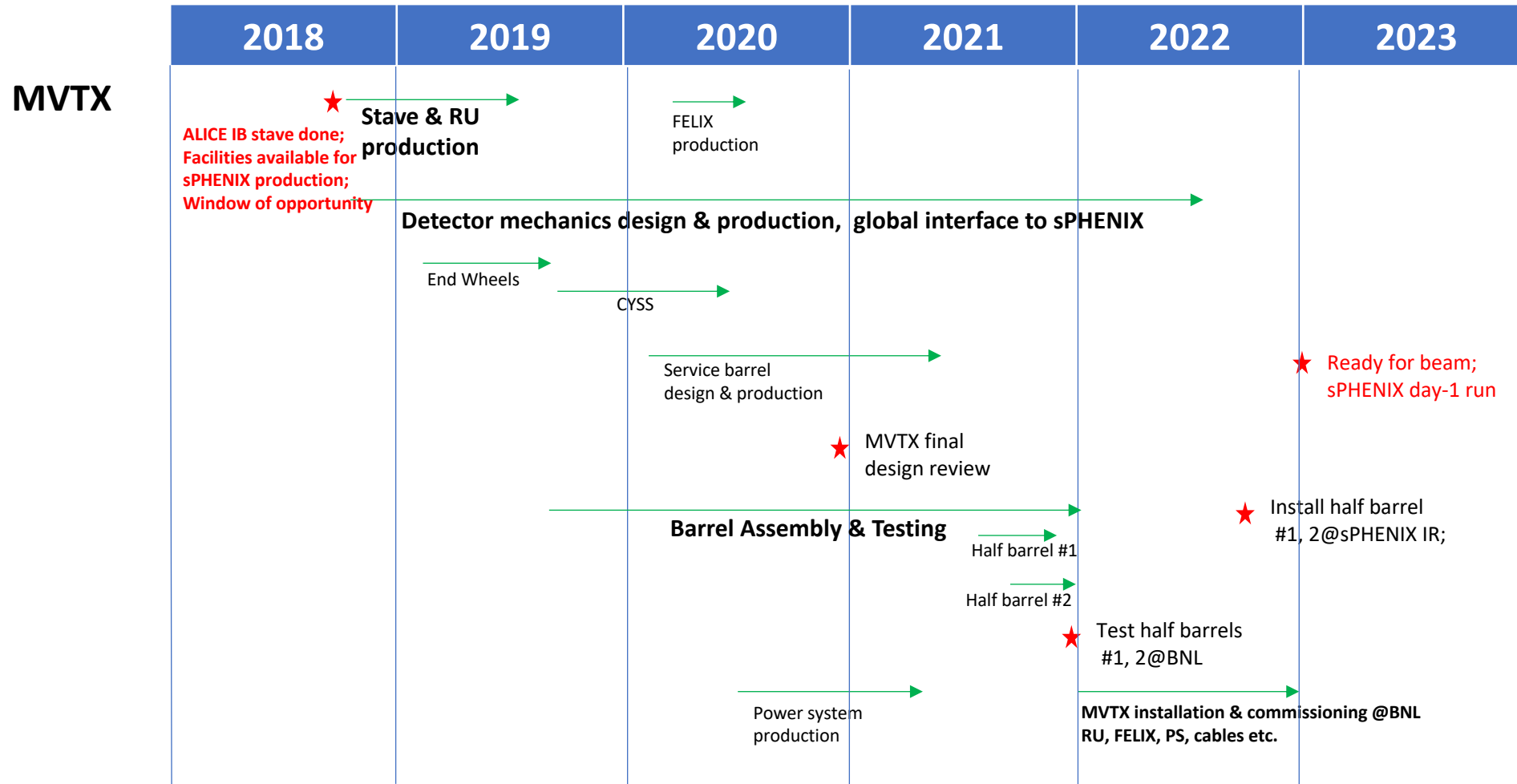
- Adopt ALICE cooling plant design

- Minor modification to fit sPHENIX
- Smaller heat load than ALICE ITS

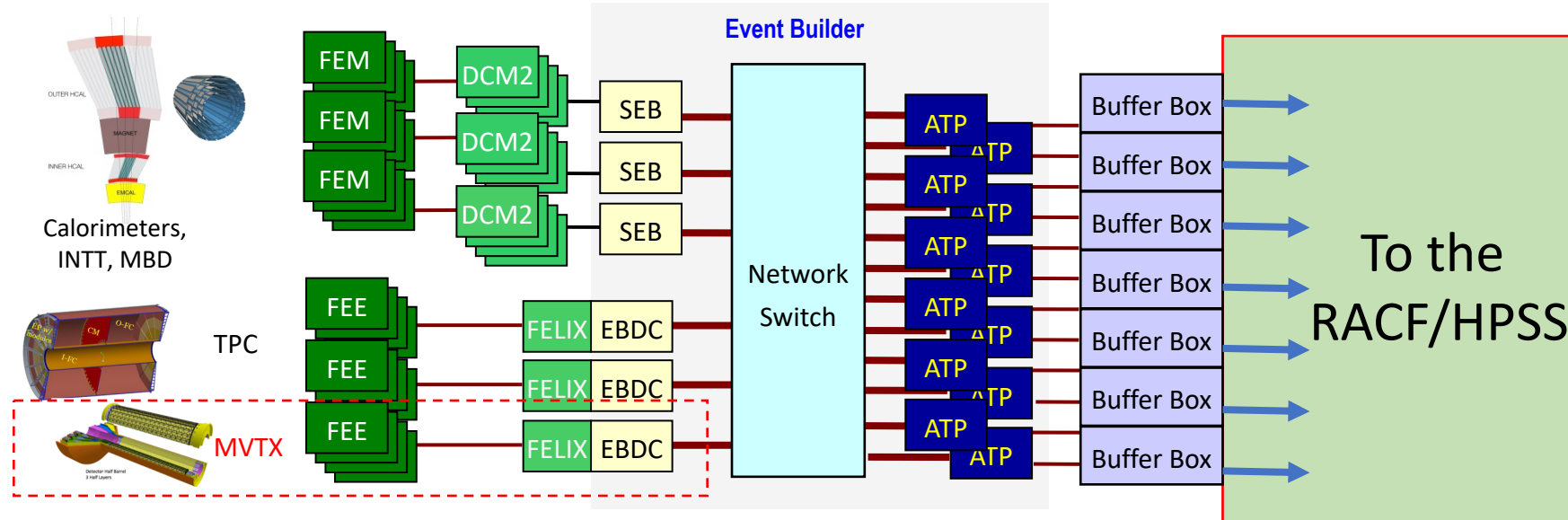
- Early R&D by LANL LDRD, \$5M, FY17-19, readout, mechanical design and physics
- Established LANL-ALICE MoU in 12/2016 for joint R&D for MVTX

Schedules and Milestones

sPHENIX: ★CD1 ★CD2 ★Installation ★1st collisions

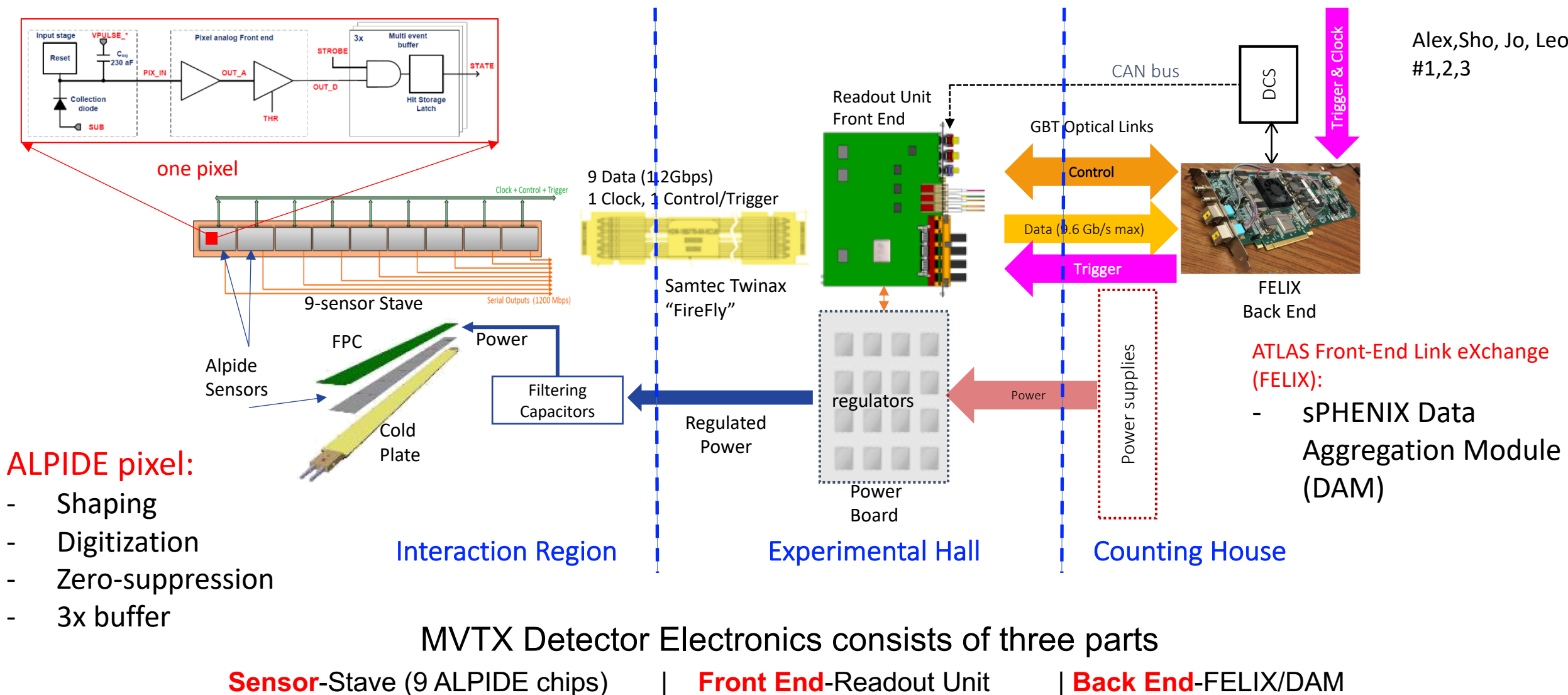


sPHENIX DAQ Architecture



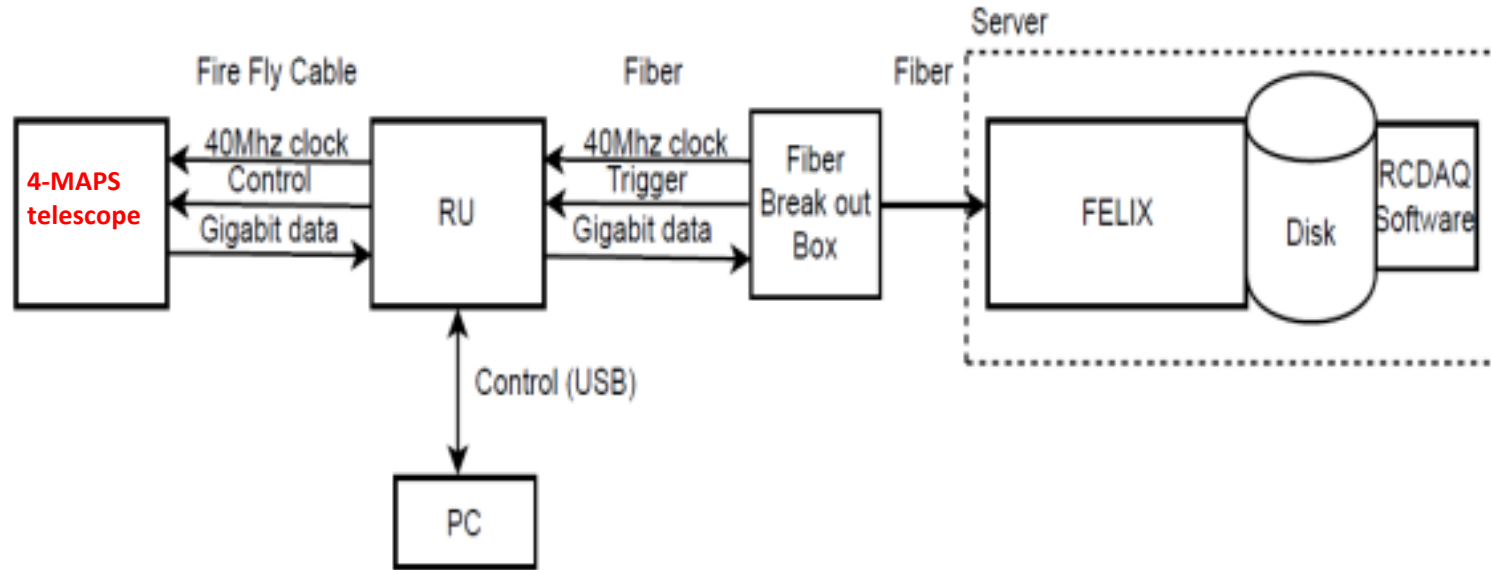
- SEB Sub-Event Buffer
- EBDC Event Buffer and Data Compressor
- ATP Assembles events and compresses data
- Buffer Box data interim storage before sending data to the computing center

MVTX Readout, Power and Controls

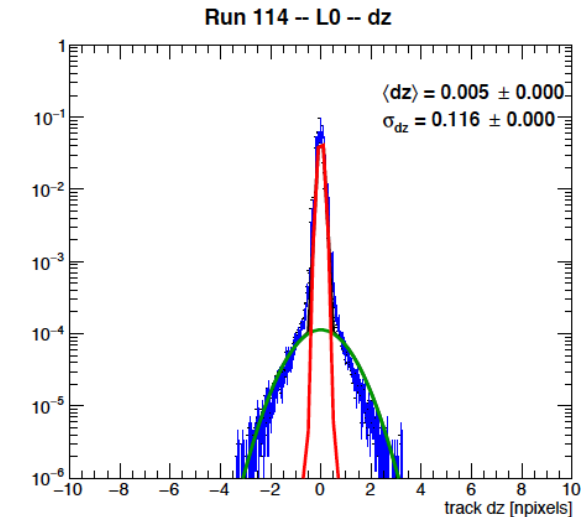


Alex, Sho, Jo, Leo
#1,2,3

MVTX Full Readout Chain Demonstrated

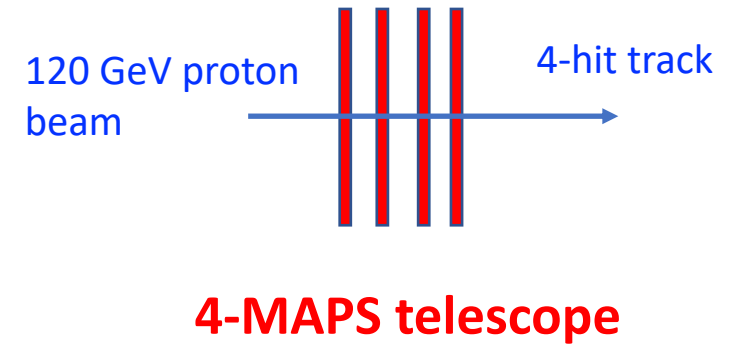


Fermilab Test Beam: Feb-Mar, 2018



Alex & Sho
#1,2,3

Tracking spatial resolution
achieved: $<5 \mu\text{m}$



Projected Radiation Level after 5-year Runs

<http://www.rhichome.bnl.gov/RHIC/Runs/RhicProjections.pdf>

sPH-TRG-2018-001

Leo
#1

Year	Species	Energy [GeV]	Phys. Wks	Rec. Lum.	Samp. Lum.	Samp. Lum. All-Z
Year-1	Au+Au	200	16.0	7 nb ⁻¹	8.7 nb ⁻¹	34 nb ⁻¹
Year-2	p+p	200	11.5	—	48 pb ⁻¹	267 pb ⁻¹
Year-2	p+Au	200	11.5	—	0.33 pb ⁻¹	1.46 pb ⁻¹
Year-3	Au+Au	200	23.5	14 nb ⁻¹	26 nb ⁻¹	88 nb ⁻¹
Year-4	p+p	200	23.5	—	149 pb ⁻¹	783 pb ⁻¹
Year-5	Au+Au	200	23.5	14 nb ⁻¹	48 nb ⁻¹	92 nb ⁻¹

Projected sPHENIX integrated luminosities after 5-year operation

- AuAu: Lum. = 214 nb⁻¹
- pp+pAu: Lum. = 1340 pb⁻¹

PHENIX study
arXiv: 0710.2676 [nucl-ex]

Projected sPHENIX MVTX L0 fluence: TID = 1060 krad

$$\text{NIEL} = 6 \times 10^{12} \text{ N}_{\text{eq}}/\text{cm}^2$$

Outer layers:

$$\text{L1} = 0.6 \times \text{L0}; \text{L2} = 0.4 \times \text{L0}$$

Sensors tested to full MVTX NIEL and ~1/2 TID @ALICE

Stave and RU Production QA Plan

Leo & Jo
#4,5,6,7,8

Staves

- Purchase 84 staves from ALICE production
 - 48 + 28(spares for 2 inner layers) + 8 spares
 - Production following the completion of ALICE ITS/IB
 - Starting ~Oct. 2018, last 6-12 months
 - Fully tested at CERN before shipping to US
 - All Gold/Silver staves (same ~ALICE IB standard)
 - A LANL postdoc (Dr. Yasser Morales) oversees production QA at CERN
- Acceptance QA at LBNL
 - Full test and QA
 - Electrical
 - Mechanical
 - Detector assembly at LBNL

Readout Units

- Purchase 58 RUs from ALICE
 - 48 + 10 spares(20%)
 - To be part of ALICE production
 - Cost saving
 - Minimize technical risks
 - Initial test at CERN
- QA at UT-Austin
 - Full test
 - LANL as the 2nd test site

#5, Has a QA plan and acceptance tests for the Staves and Readout Units been defined?

- Yes!

- Both stave and RU QAP documents are available.

Leo & Jo

**Detector-Specific Quality Assurance Plan
for MVTX Stave Acceptance/Detector
Construction
for the sPHENIX Experiment at RHIC**

**Lawrence Berkeley National Laboratory
Berkeley, CA**

**Revision 1.0
July 4, 2018**

sPHENIX Project

DETECTOR-SPECIFIC QUALITY ASSURANCE PLAN

sPHENIX Detector QAP: MVTX Stave Acceptance/Detector Construction Rev 1.01 of 20

**Detector-Specific Quality Assurance Plan
For MVTX Readout Unit Production/Acceptance
For the sPHENIX Project**

**Physics Department
University of Texas
Austin, Texas**

**Revision 1.0
July 2, 2018**

sPHENIX Project

DETECTOR-SPECIFIC QUALITY ASSURANCE PLAN

Approved by:

Joachim J. Schambach
sPHENIX L3 Manager for MVTX RU production
University of Texas at Austin

Date _____

Accepted by:

Edward O'Brien
sPHENIX Project Director
Brookhaven National Laboratory

Date _____

James Mills
sPHENIX Project Manager - Engineering
Brookhaven National Laboratory

Date _____

Glenn Young
sPHENIX Project Manager
Brookhaven National Laboratory

Date _____

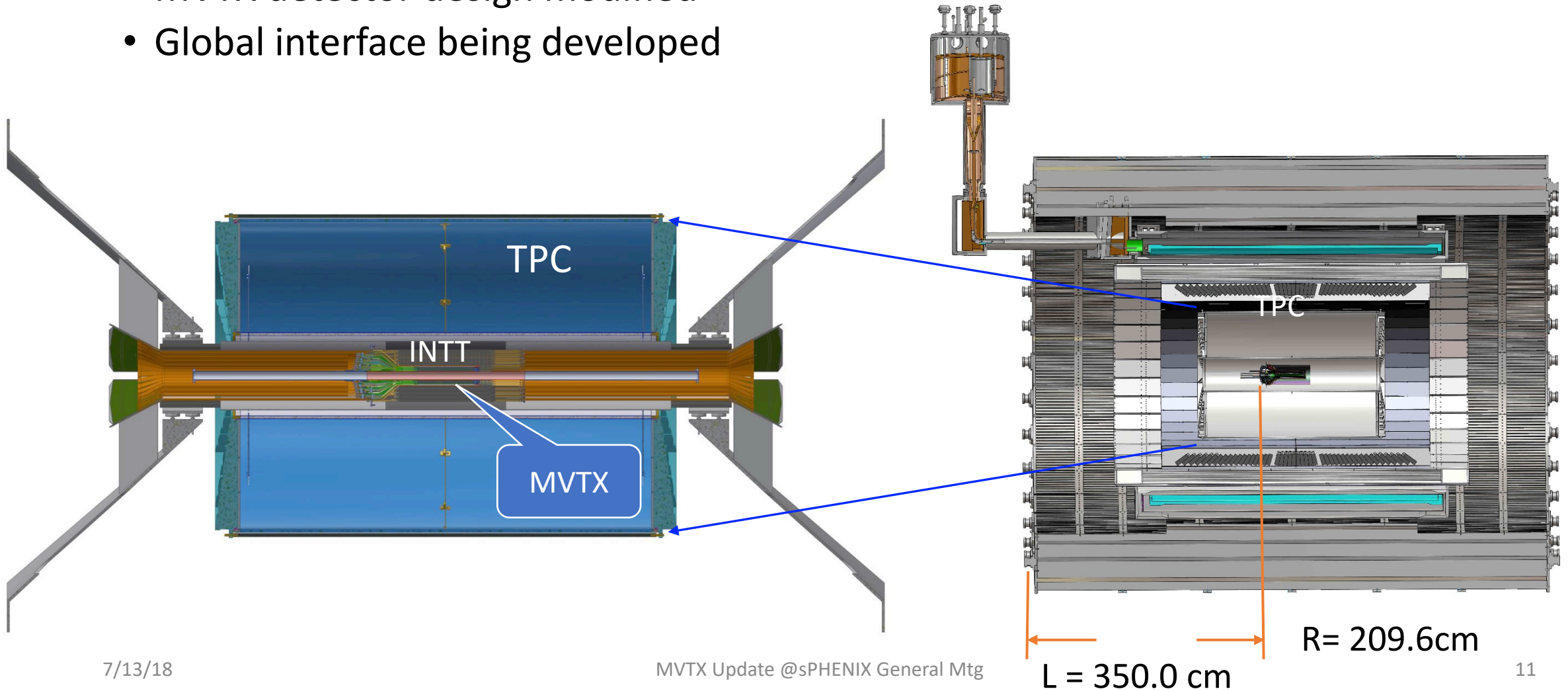
sPHENIX Detector QAP: Readout Unit Production Rev 1.0

1 of 13

Mechanical Integration

- MVTX, INTT and TPC
 - MVTX detector design modified
 - Global interface being developed

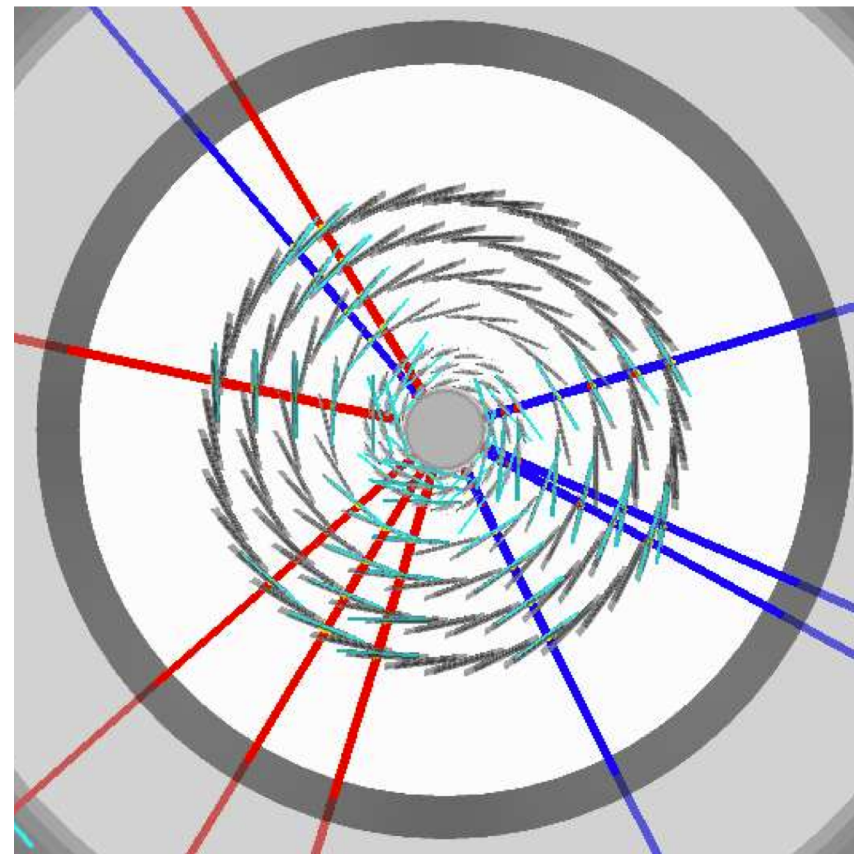
Walt & Dan
#10



Simulations for Optimization

Tony & Rachid
#9, 10

- Task force formed
 - Goals and deadline defined
 - Evaluate tracking with different INTT layers & geometry
- Complementary roles in global tracking:
 - MVTX:
 - Precision DCA and vertexing
 - INTT:
 - Matching in-time hits of MVTX and TPC
 - Important for p+p and p+A, pileups



MVTX Review Agenda Page:

<https://indico.bnl.gov/event/4729/>

- Presentation slides
- RU QA plan document
- Stave QA plan document

All practice review slides & QA documents

<https://indico.bnl.gov/event/4806/>

Send your comments/suggestions

8:30 AM	→ 8:45 AM	Welcome	🕒 15m	📎
8:45 AM	→ 9:15 AM	sPHENIX Overview Speakers: David Morrison (BNL), Gunther Roland (MIT)	🕒 30m	📎
9:15 AM	→ 9:45 AM	Overview of MVTX Speaker: Ming Liu (Los Alamos)	🕒 30m	📎
9:45 AM	→ 10:20 AM	Integration of staves and Readout Units into sPHENIX <ul style="list-style-type: none">■ electrical integration, interfaces■ integration with sPHENIX DAQ system■ beam test results■ steps for final integration Speakers: Sho Uemura (Los Alamos National Laboratory), alex tkatchev (Los Alamos National Laboratory)	🕒 35m	📎
10:20 AM	→ 10:40 AM	Break	🕒 20m	
10:40 AM	→ 11:15 AM	MVTX Staves <ul style="list-style-type: none">■ specification and design■ fabrication■ QA tests■ responsibilities Speakers: Grazyna Odyniec (LBNL), Leo Greiner (LBNL)	🕒 35m	📎
11:15 AM	→ 11:50 AM	MVTX Readout Units <ul style="list-style-type: none">■ design and specification■ prototypes■ QA■ responsibilities Speaker: Joachim Schambach (University of Texas at Austin)	🕒 35m	📎
11:50 AM	→ 1:00 PM	Lunch	🕒 1h 10m	
1:00 PM	→ 1:25 PM	Overview of INTT Speaker: Rachid Nouicer (Brookhaven National Laboratory)	🕒 25m	📎
1:25 PM	→ 1:55 PM	Mechanical integration of INTT and MVTX <ul style="list-style-type: none">■ modifications w.r.t. ALICE design■ mechanical interfaces■ timescale for a final design Speakers: Dan Cacace (BNL), Walter Sondheim (Los Alamos National Laboratory)	🕒 30m	📎
1:55 PM	→ 2:25 PM	Tracking Simulations Speaker: Anthony Frawley (Florida State University)	🕒 30m	📎
2:25 PM	→ 2:40 PM	MVTX Summary Speaker: Ming Liu (Los Alamos)	🕒 15m	📎
2:40 PM	→ 3:00 PM	Break	🕒 20m	
3:00 PM	→ 4:00 PM	Executive session	🕒 1h	📎
4:00 PM	→ 5:00 PM	Q&A	🕒 1h	📎