Intermediate Silicon Tracker Overview

RIKEN/RBRC

Itaru Nakagawa

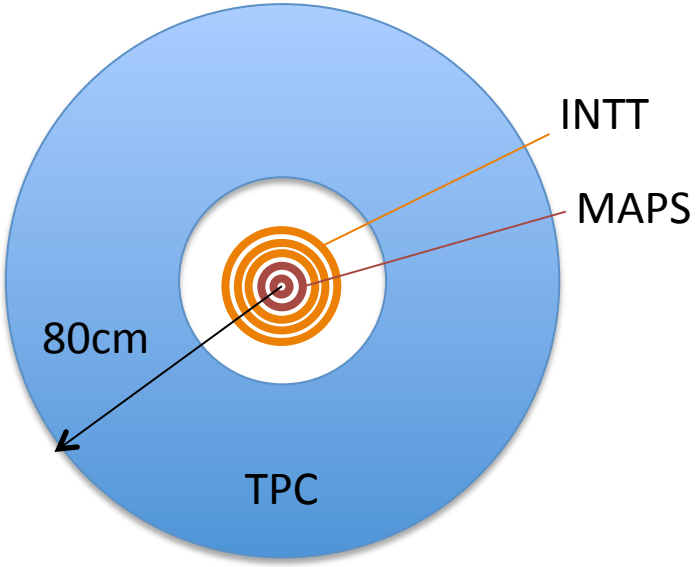
Outline

- Role of the intermediate tracker (INTT)
- INTT concept
  - Configuration
  - Technology
  - Cost

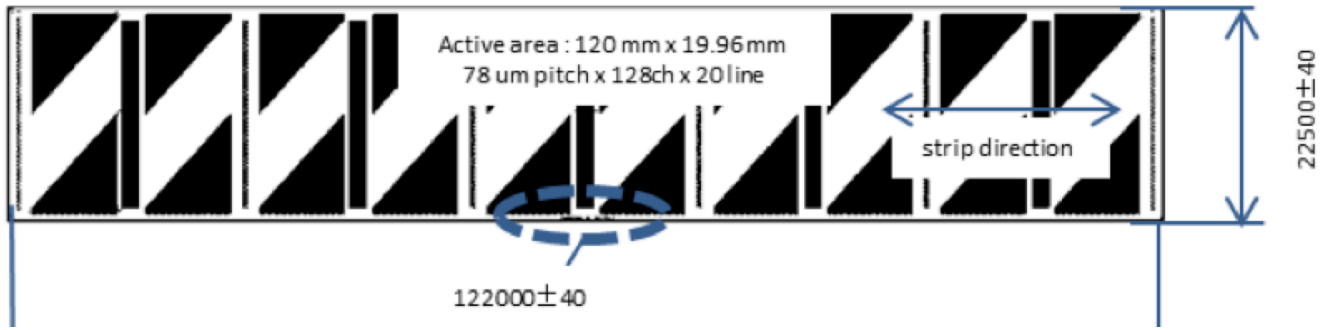
Role of INTT

1. DCA measurements
   - Compensates track finding of MAPS
2. Pile-up
   - Improve track finding efficiency in central Au-Au
3. TPC Calibration
   - Identify track position for the space-time calibration of TPC
4. Back-up for MAPS<3 layers scenario

Quick Overview of Intermediate Silicon Tracker (INTT)



	R [cm]
MAPS	3
	4
	5
INTT	6
	8
	10
	12
TPC	30 ~ 80



Managements

- Project manager (Itaru Nakagawa)
- deputy manager (Rachid Nouicer)
- Subsystem managers
  - Detector assembly and construction (Rachid Nouicer)
  - Mechanical and integration (Rob Pisani)
  - Electronics and readouts (Eric Mannel and Takashi Hachiya)
  - Software (Gaku Mitsuka)
  - LV + HV and Slow control (Yorito Yamaguchi)

Collaboration

- RIKEN (Y. Akiba, I. Nakagawa)
- RBRC (T. Hachiya, G. Mitsuka,Y. Yamaguchi)
- BNL (J. Huang, M. Lenz, E. Mannel, R. Nouicer, R. Pisani)
- Rikkyo (H. Masuda, Kazu Kurita?)
- Nara woman's university (M. Shimomura)
- LANL (M. Brooks, M. Liu)
- New Mexico (D. Field*)
- J-Parc (S. Hasegawa, H. Sako)
- Tsukuba (S. Esumi)

*FVTX expert

Basic Project Philosophy

Basic Design Philosophy

Technology

- Employ existing technology
- Employ technology we are familiar with

Man Power

- Collaborate with Institutes which have the experience and infrastructure

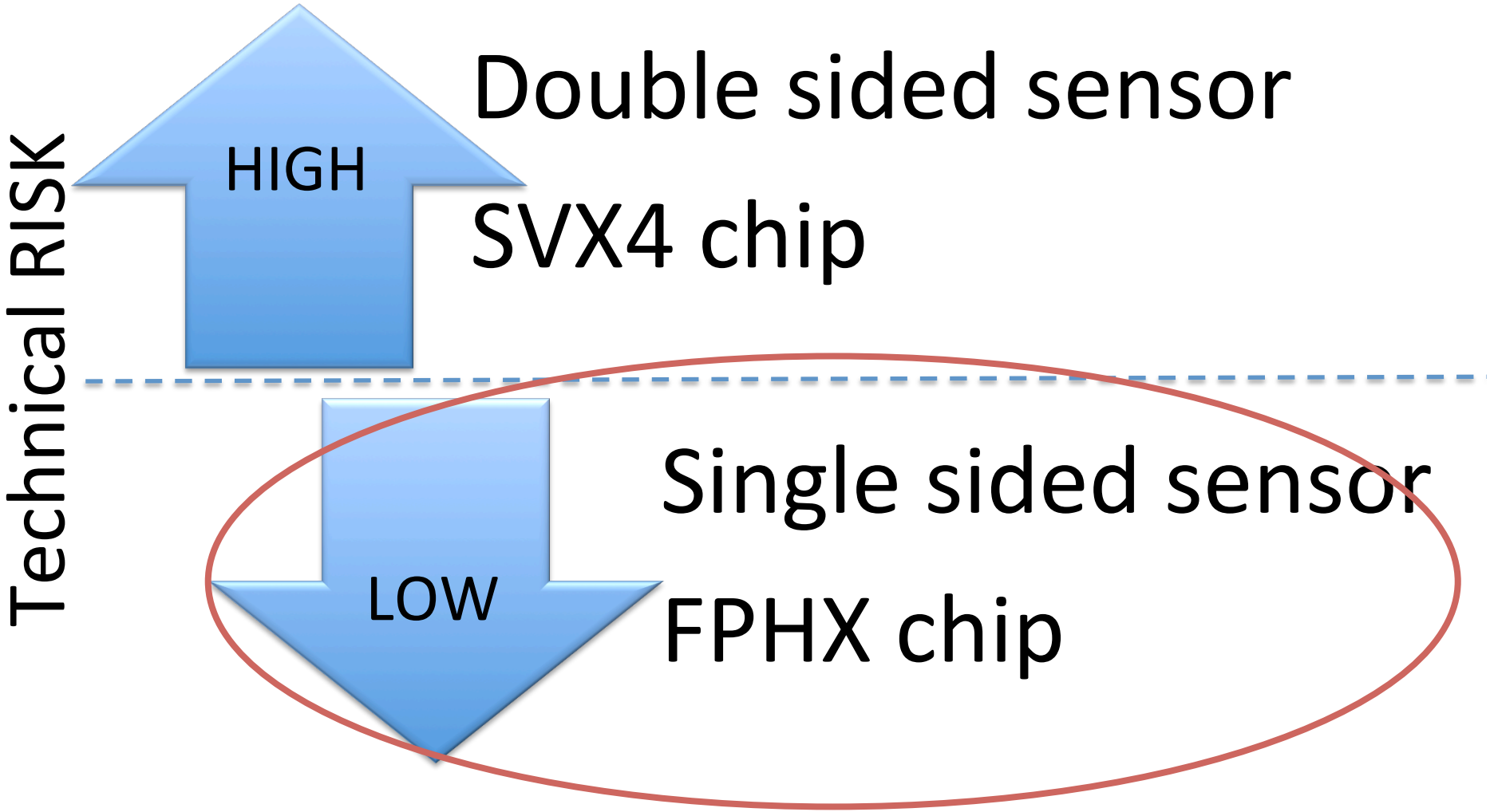
Minimum Cost

- Little “R” and rather focus on “D”
- As compact as possible

Schedule

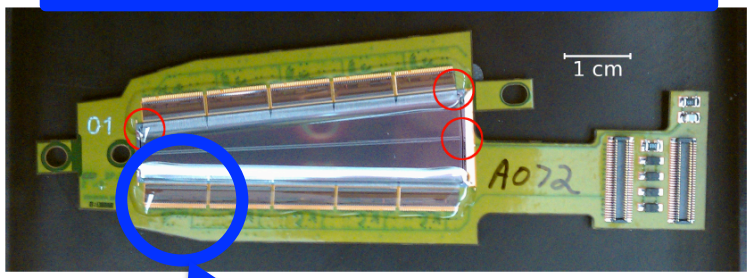
- **To be in time for 2022**

Technological Choice

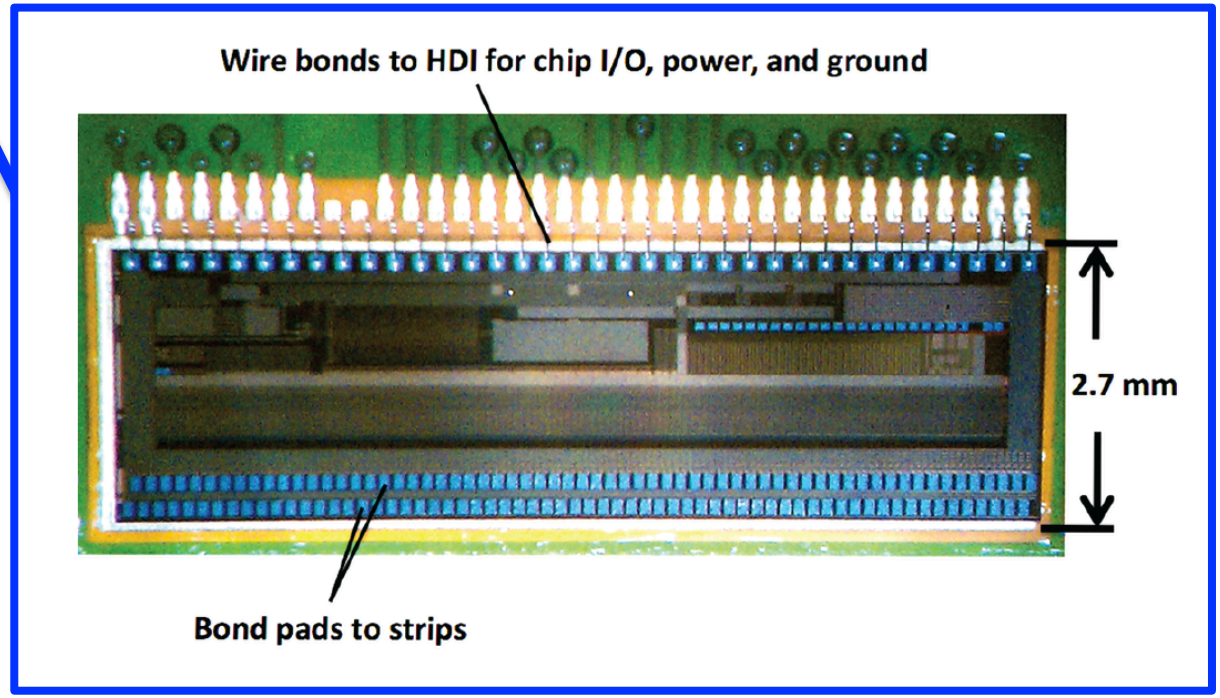


FPHX Chip

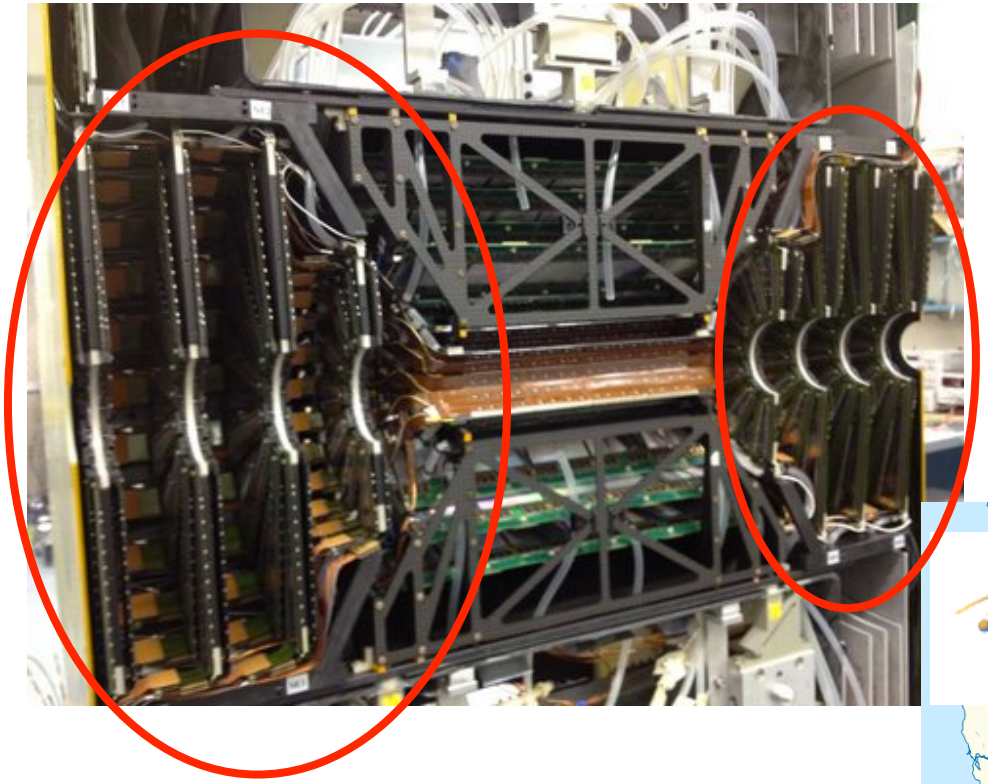
FVTX Silicon Module for PHENIX



Developed for Forward Vertex Detector for PHENIX at Fermi Lab.

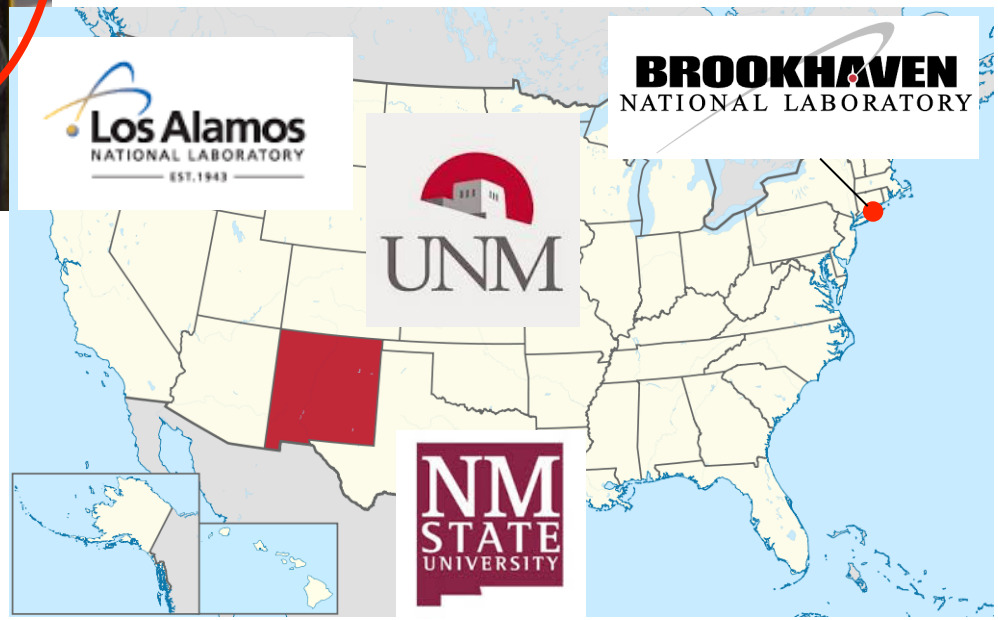


Existing FVTX Detector



FVTX Project	2006 - 2008	2008 - 2011
R &D	→	
Construction		→

Technology and Resources are still in New Mexico & BNL



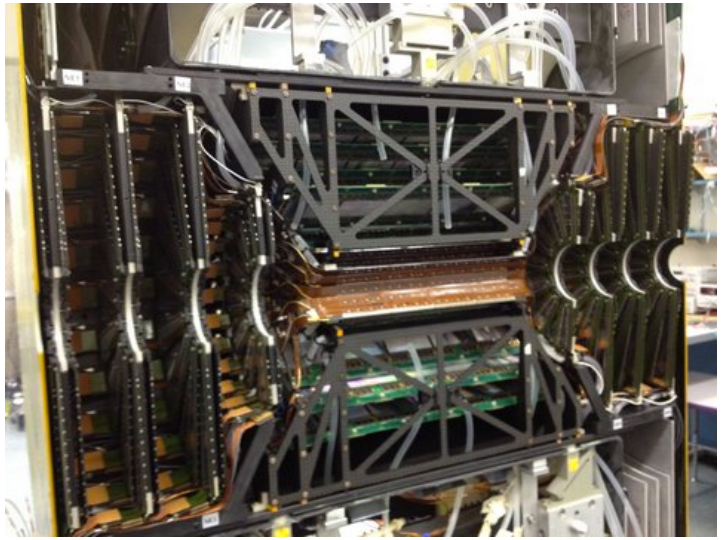
FPHX vs SVX4

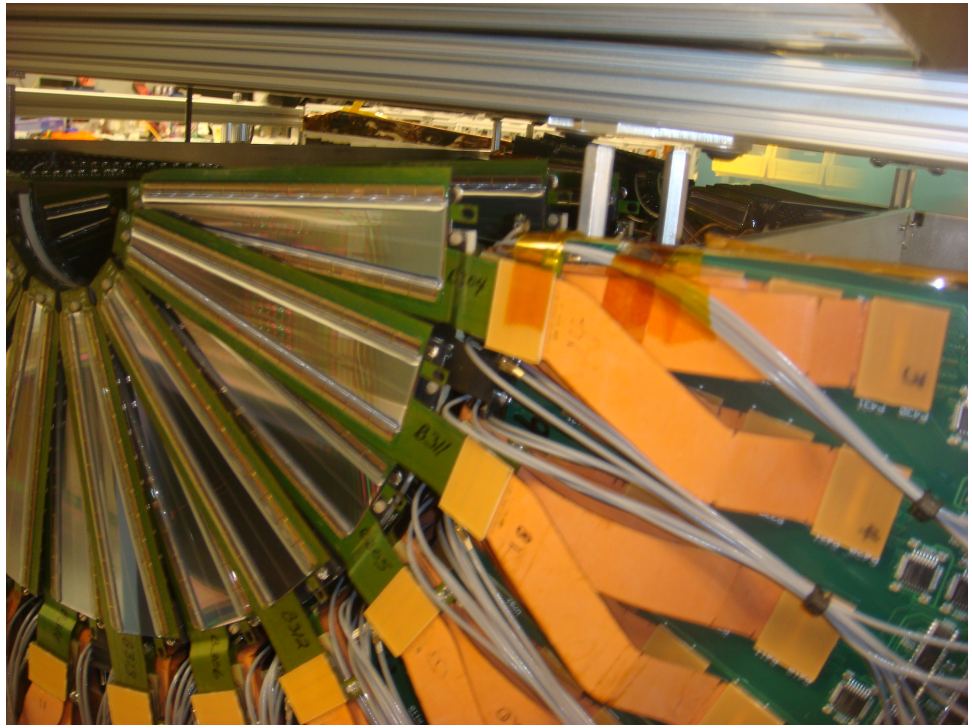
Specification	FPHX	SVX4
ADC/channel	3 bits	8 bits
Power Consumption	64 mW	300 mW
Cooling	Air or Solid*	Liquid

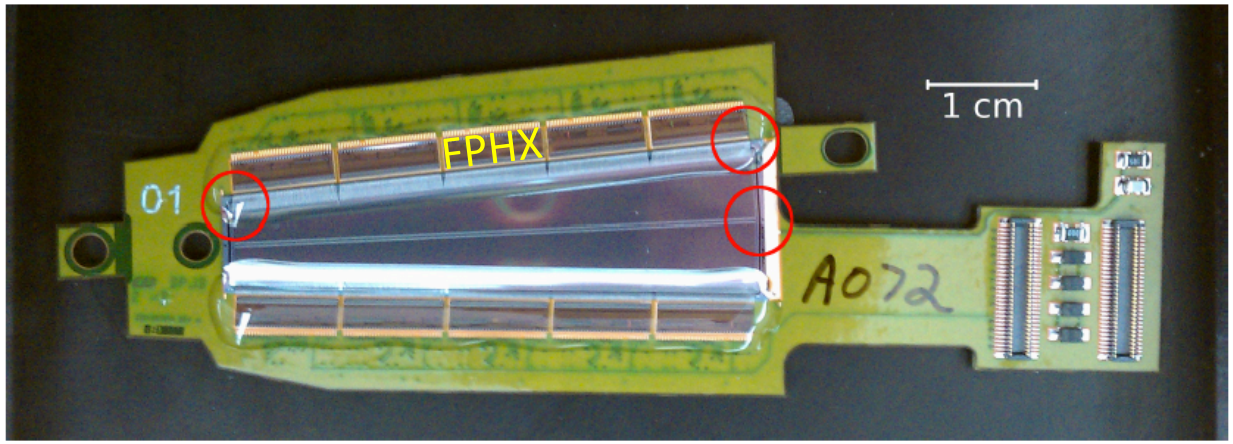
Material	Less	More
Cooling Operation	Less risky	More risky

*Solid : High Thermal Conductivity Plate

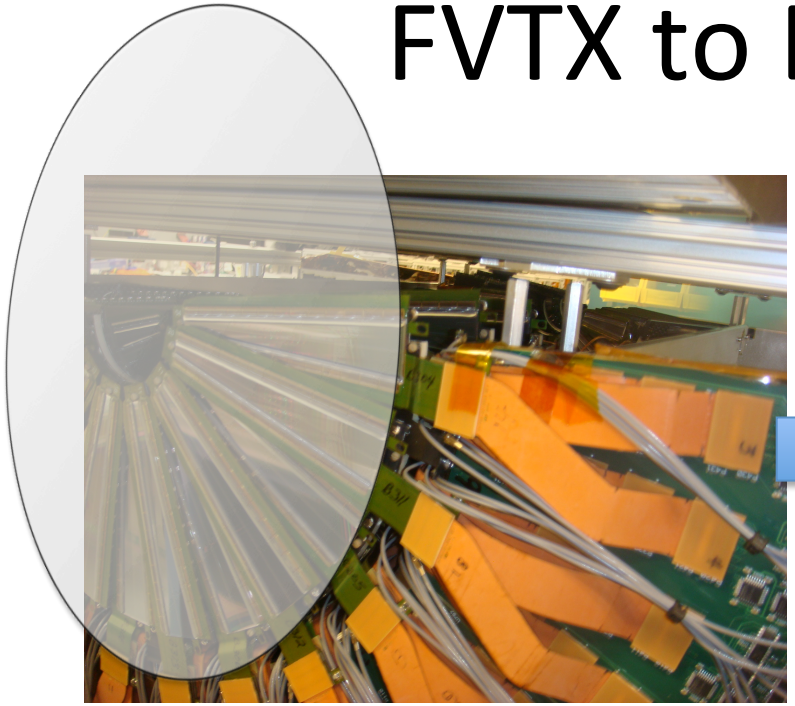
FVTX Detector



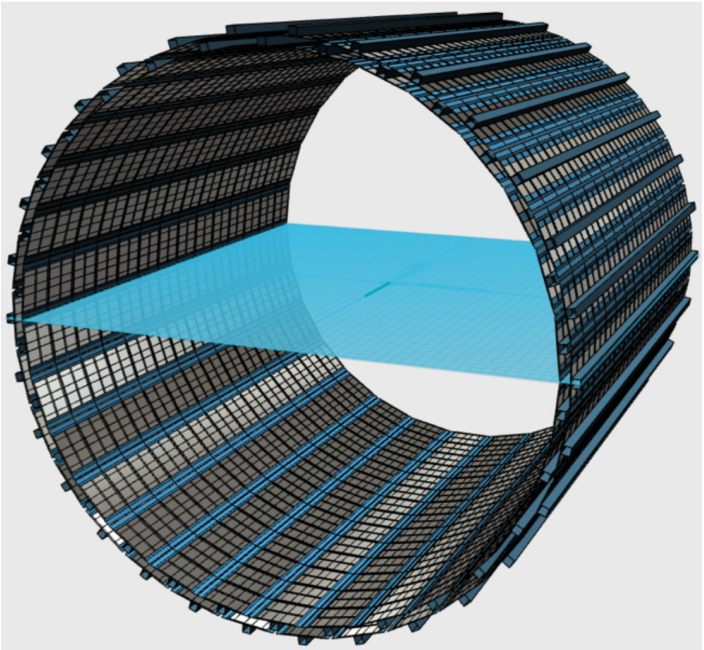




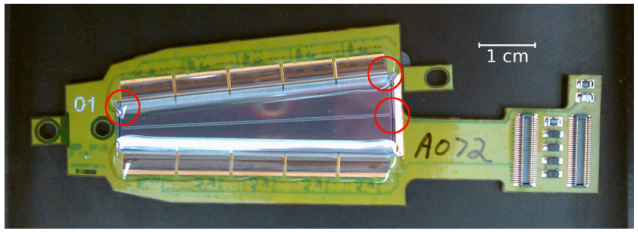
FVTX to Barrel Tracker



Disk



Barrel

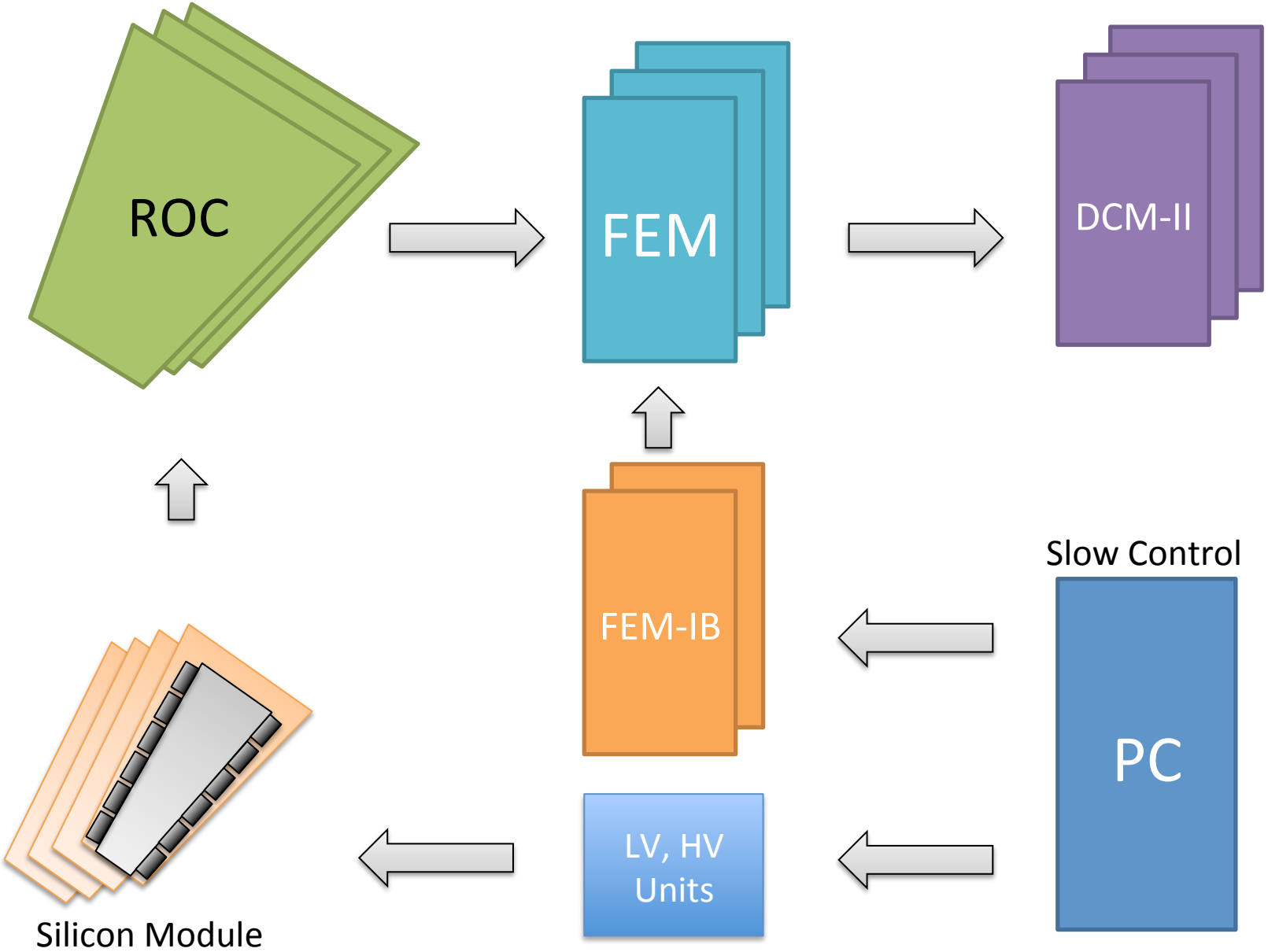


Trapezoid

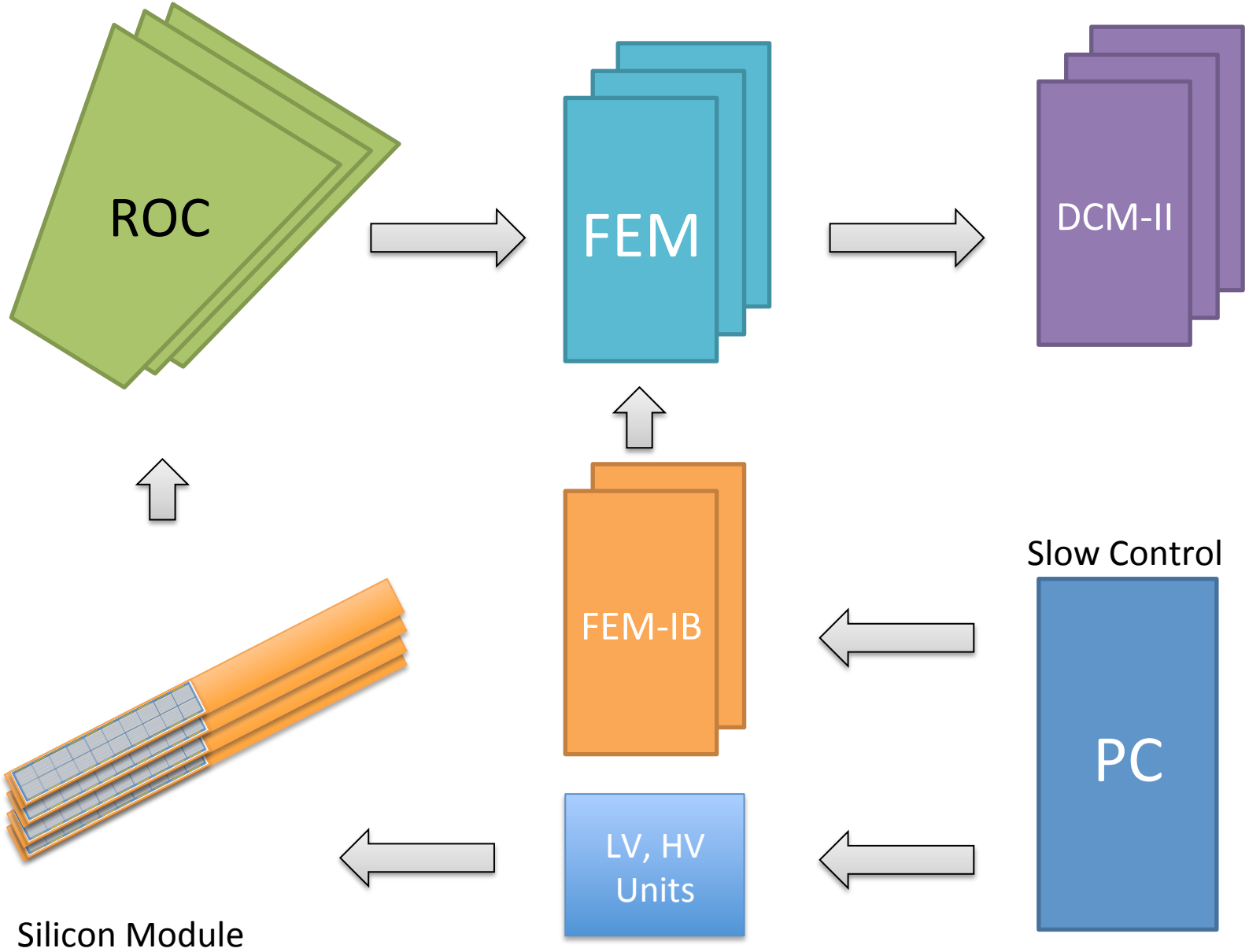
Rectangular

Geometry needs to be changed, but **electrical design** could be the same.

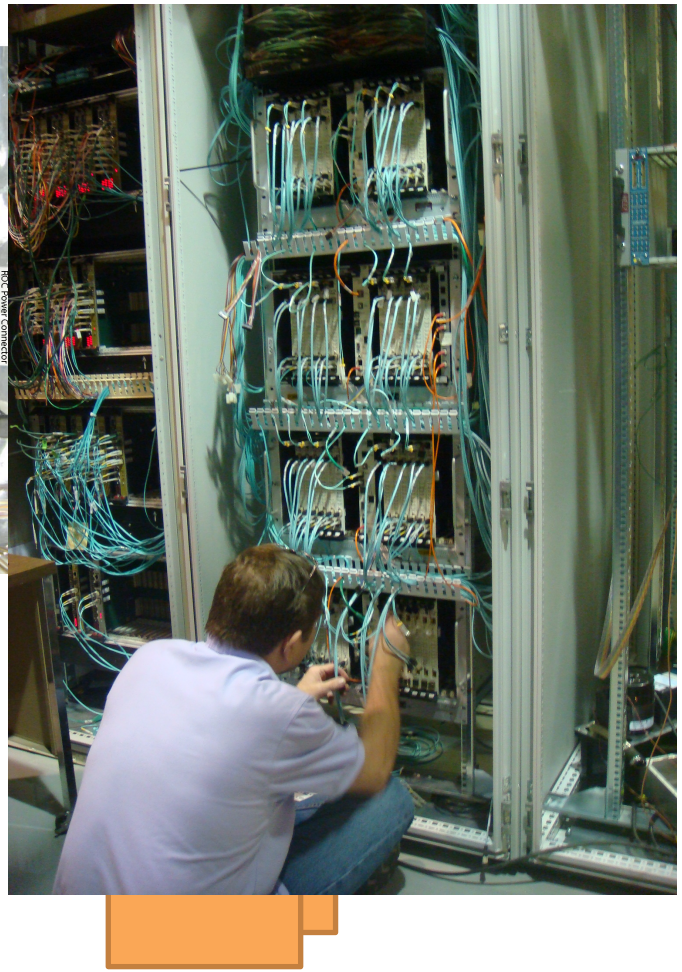
FVTX System


ROC
FEM
DCM-II
FEM-IB
Slow Control
PC
LV, HV
Units
Silicon Module

INTT System


ROC
FEM
DCM-II
FEM-IB
Slow Control
PC
LV, HV
Units
Silicon Module

INTT System

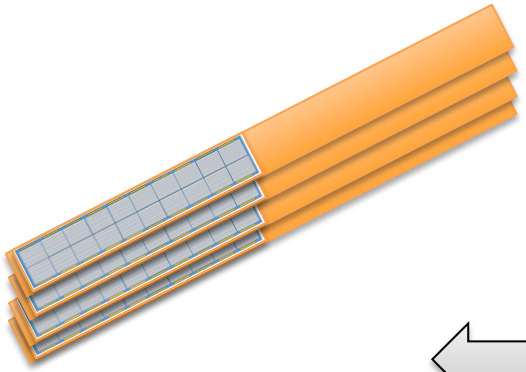


DCM-II

Slow Control

PC

LV, HV Units

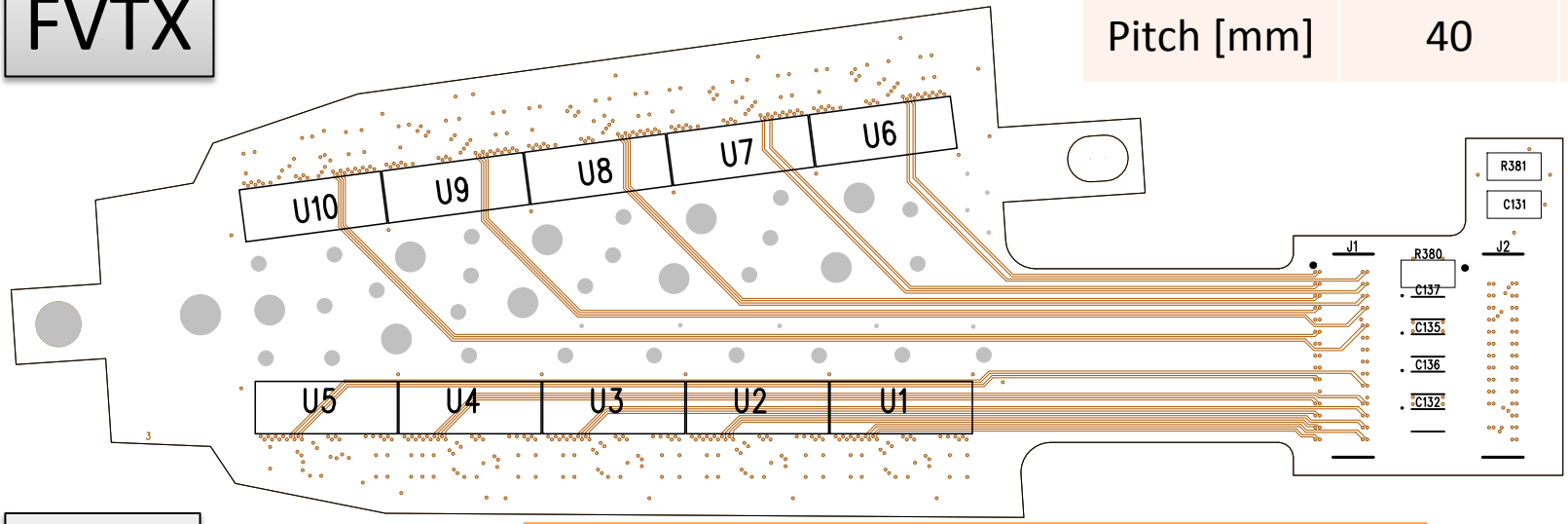


Silicon Module

HDI Design

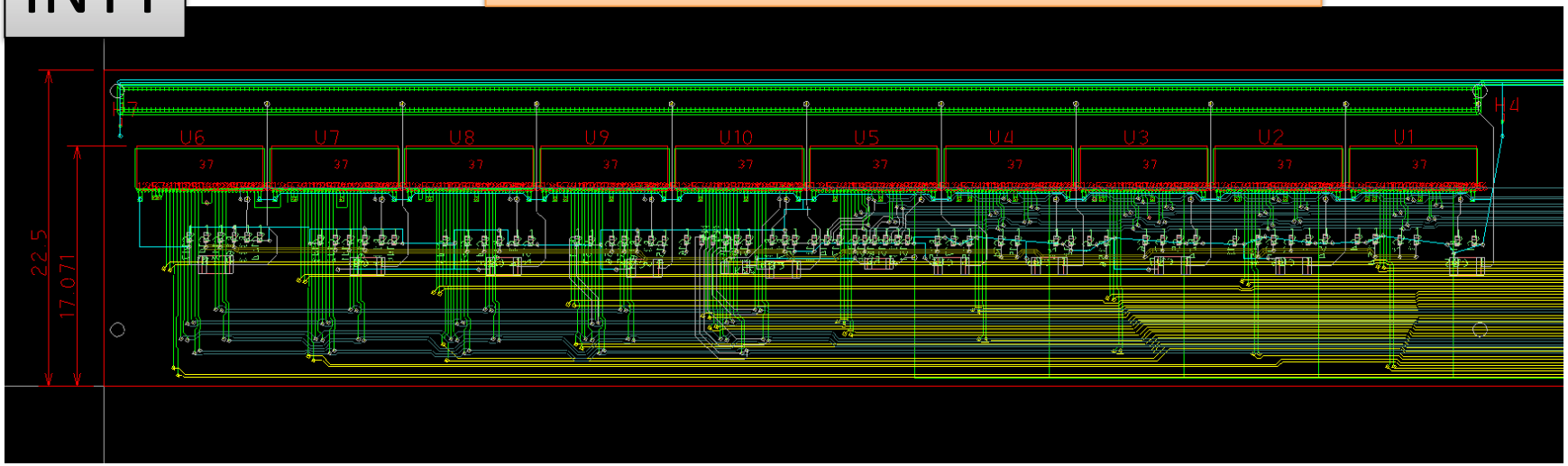
	FVTX	INTT
# Layers	7	7
Pitch [mm]	40	60 -> ?

FVTX



INTT

Different Shape, but electrically same design.



Total Number of Channels

Radius [cm]	Ladder	# z-segments	Total # of SM	# Spare SM (20%)	Total # SM
6	24	2	48	10	58
8	32	2	64	13	77
10	40	2	80	16	96
12	48	2	96	19	115
Total	**144**		**288**	**58**	**346**

Cost Estimate

- Total estimate : $0.3M
- Details are given by Y. Akiba

Summary

Radiation Length of Present VTX support structure and cooling

Current VTX Stripixel Stave	
Carbon Face Sheet	0.43%
Al Tube (square 0.014" walls)	0.45%
Novec	0.39%
Carbon Foam	0.20%
Total	**1.47%**

VTX Stave w/ Stainless steel & Carbon Foam	
Carbon Face Sheet	0.43%
Stainless Steel Tube (3/16" ID .007" walls)	0.40%
Novec	0.39%
Carbon Foam	0.20%
Total	**1.42%**

VTX Stave w/ Carbon-loaded PEEK	
Carbon Face Sheet	0.43%
Novec (Same volume as current stave)	0.39%
Carbon Loaded PEEK (L_rad=28 cm)	1.04%
Total	**1.86%**