sPHENIX-INTT/EIC Silicon Detector Introduction

RIKEN/RBRC

Itaru Nakagawa

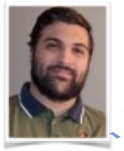
INTT Group





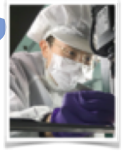
















TIRI
Takashi Kondo

BNL
Rachid Nouicer, Dan Cacace, Connor Miraval, Robert Pisani, Steven Andrade, Donald Pinelli, Antonio Vederosa, Sioan Zohar

Rikkyo Univ.
Hikaru Imai, Genta Nakano, Yusuke Nakamura

JAEA
Shoichi Hasegawa

Purdue Univ.
Wei Xie, Milan Stojanovic, Han-Sheng Li

National Taiwan Univ.
Rong-Shyang Lu, Lian-Sheng Tsai, Jenny Huang, Ou-Wei Cheng

RIKEN, RBRC
Yasuyuki Akiba, Itaru Nakagawa, Genki Nukazuka

National Central Univ.
Chia-Ming Kuo, Kai-Yu Cheng, Cheng-Wei Shih, Wei-Che Tang

Nara Women's Univ.
Takashi Hachiya, Maya Shimomura, Miu Morita, Mika Shibata, Runa Takahama, Yumika Namimoto, Yuka Sugiyama

NEW MEMBERS

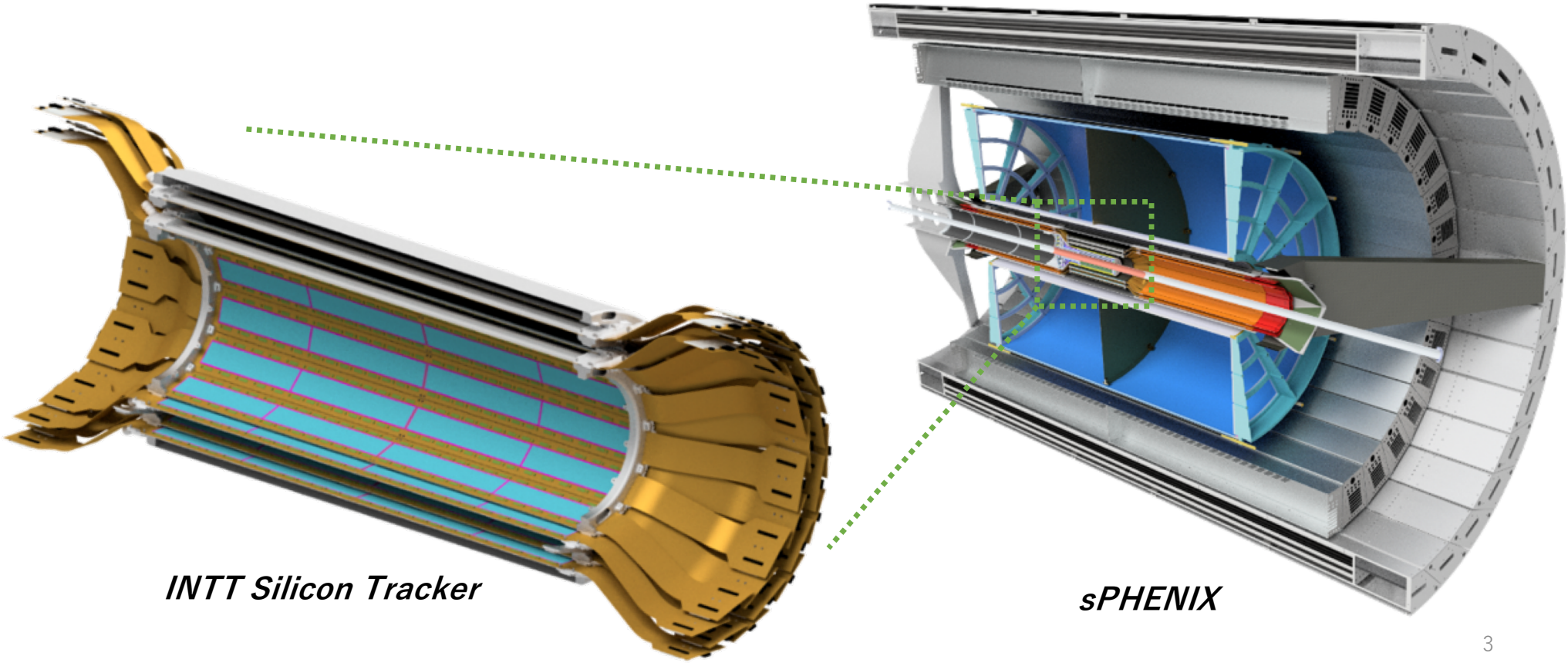

Sioan Zohar


Yusuke Nakamura


Yuka Sugiyama


Genta Nakano

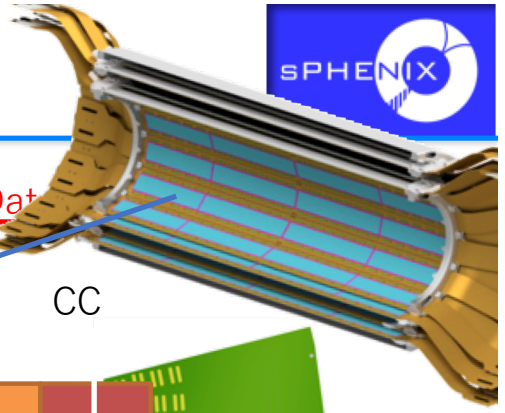
INTT Silicon Tracker



INTT Silicon Tracker

sPHENIX

Executive Summary of INTT Components

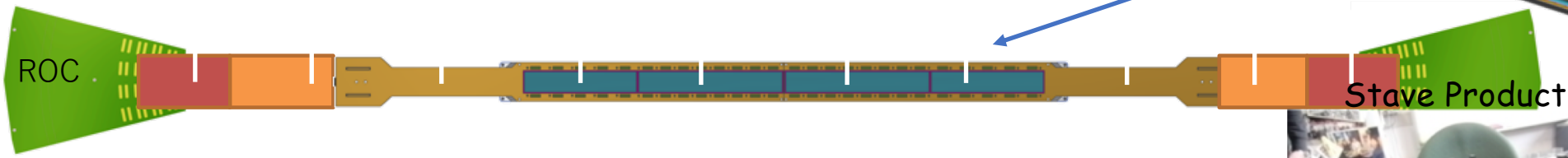


Ladder

Data Silicon module

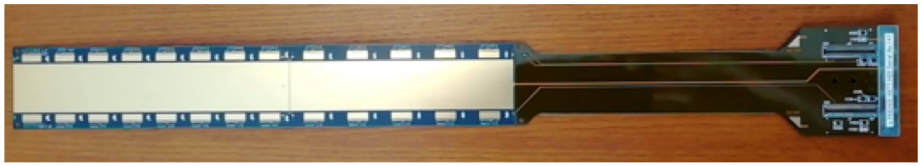
Silicon module Dat

CC BEX HDI SSS SSS SSS SSS HDI BEX CC



Stave Production

HDI Production



Silicon Production

1.2 m Bus Extender (BEX) Preproduction

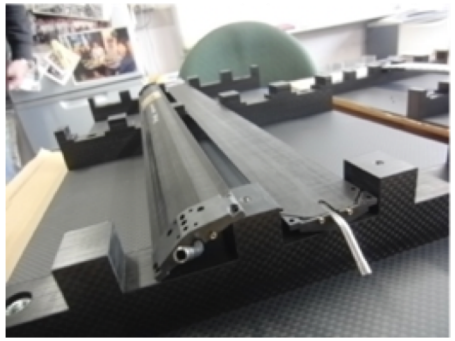
FPHX Production

Conversion Cable (CC) Pre-Production

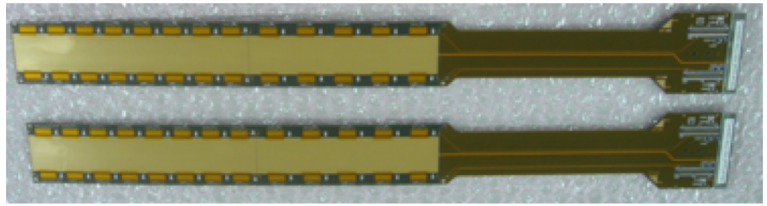
Ladder Component Production

Bus Extender

Stave



HDI



Silicon

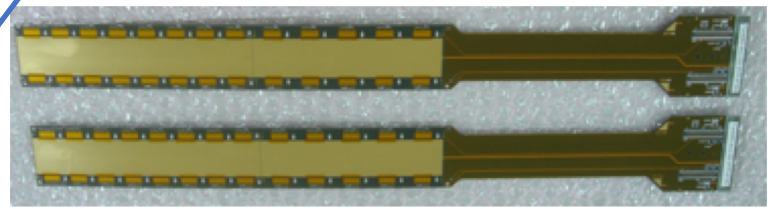
Ladder Component Production

Nara Women's University

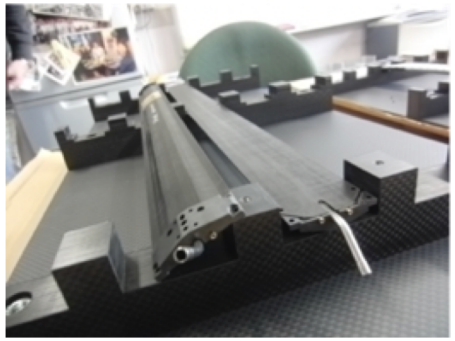
Bus Extender

RIKEN

HDI

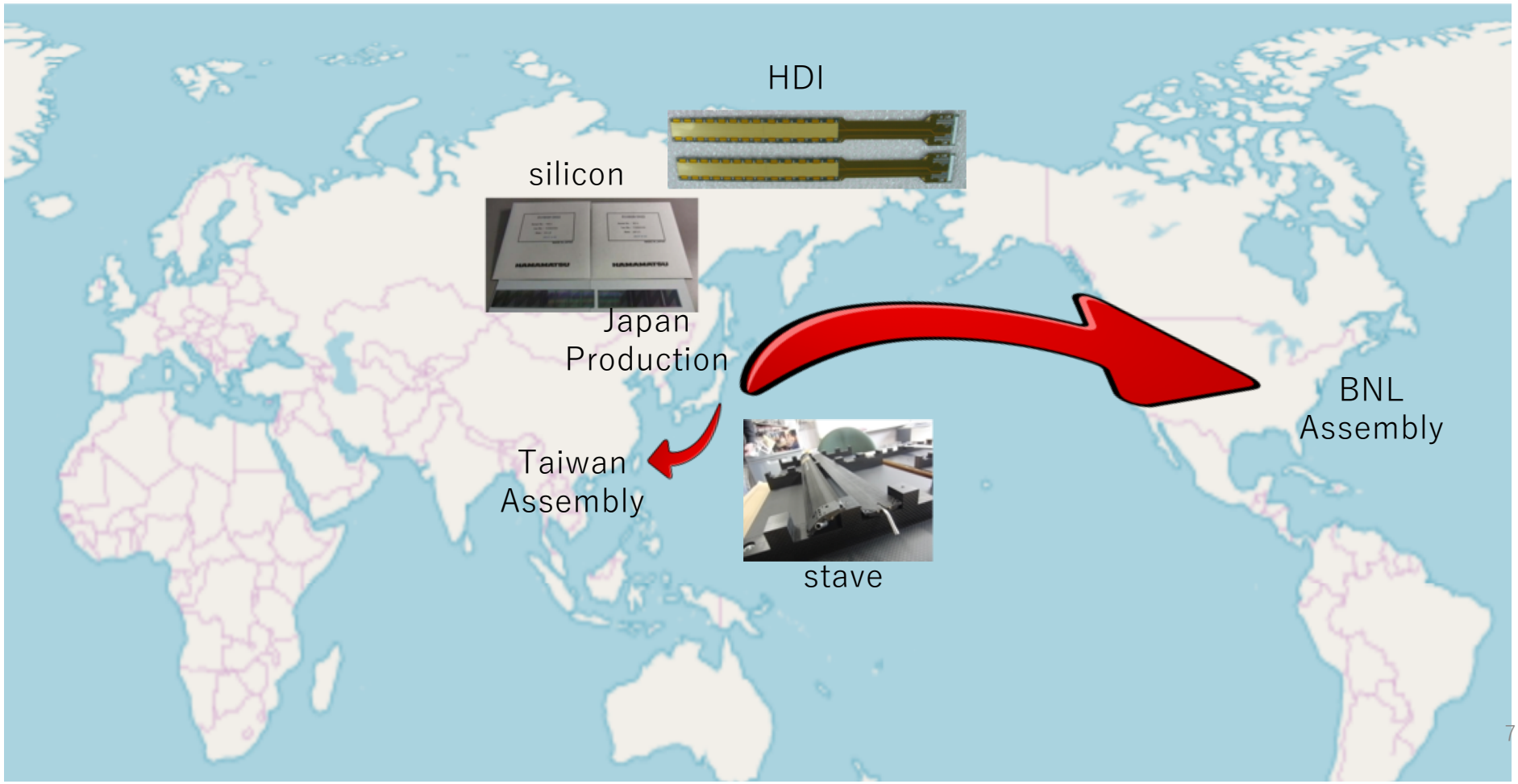


Stave



Silicon

Ladder Assembly System



Silicon Ladder Assembly in Taiwan

臺灣大學
National Taiwan University

Stathes Paganis (PI)

Rong-Shyang Lu (PI)

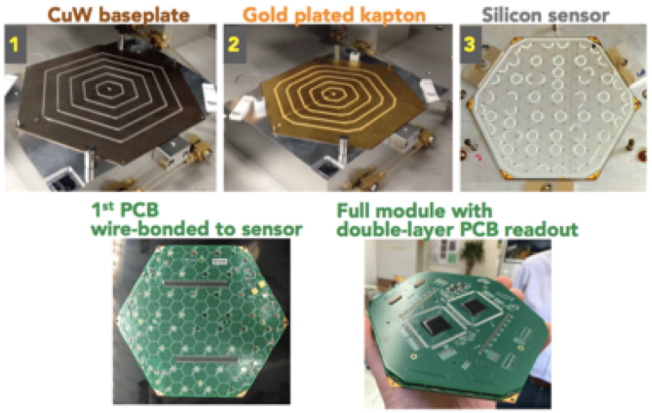
Jenny Huang (Laboratory Head Eng.)

Hsin-Yeh Wu (MSc)

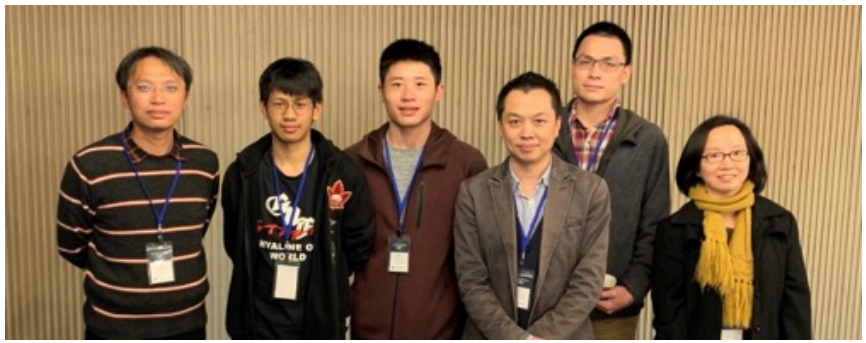
Jia-Hao Li (MSc)

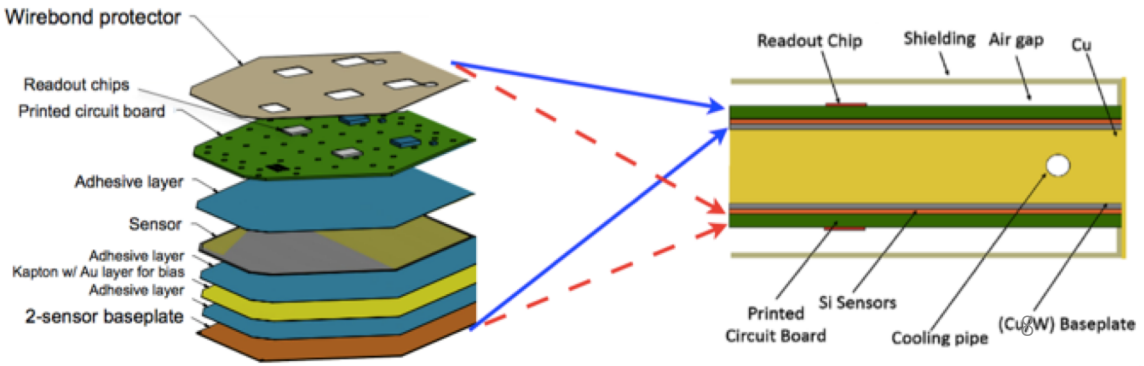
Liu Chien-Hung (Computing)

Chou CH (Technical Support)



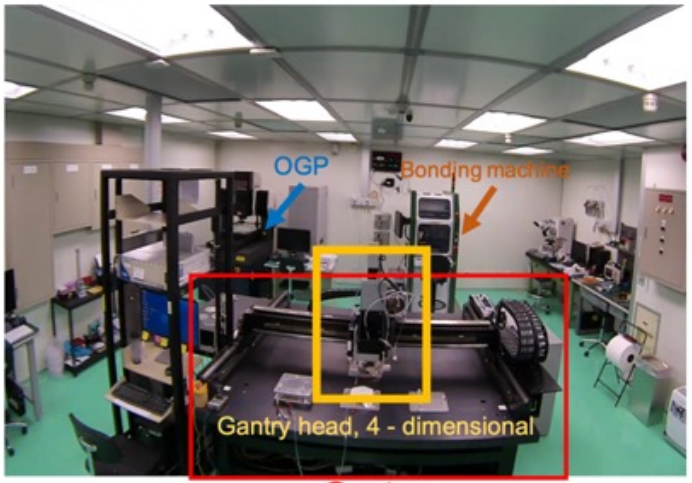
CMS HGCal Assembly





Ladder Assembly & Silicon Test in Taiwan

Taiwan Silicon Detector Facility (TSiDF)



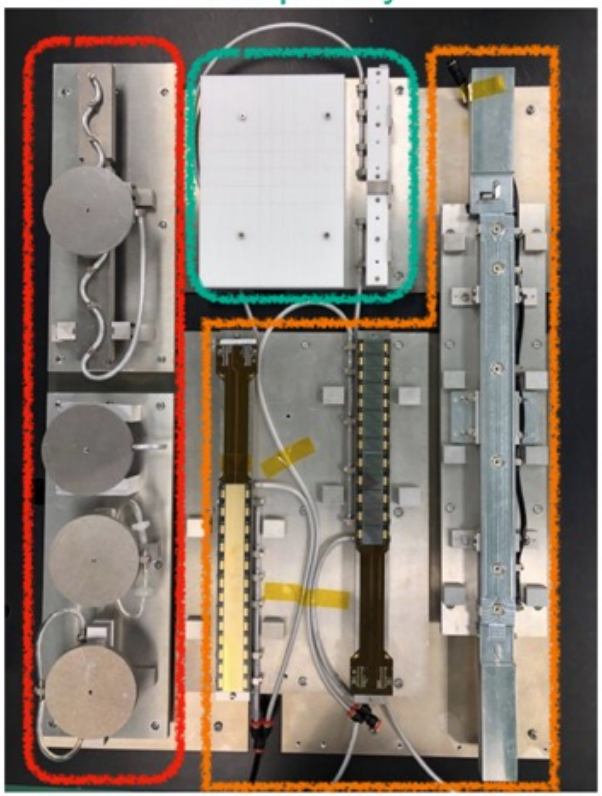
Gantry

Assembly Unit : Module

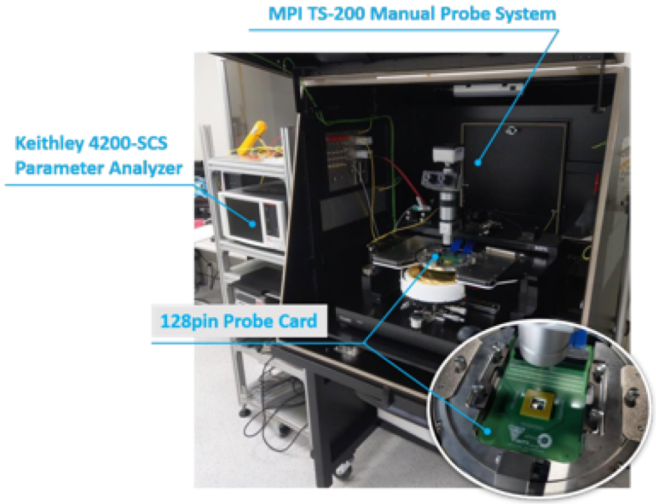
- Module assembly procedures :
  1. Chips to HDI
  2. Sensors to HDI
  3. Encapsulation glue to HDI
  4. Thermal cycle test
- Ladder assembly procedures :
  - 2 Modules to Stave

INTT assembly family on Gantry

Sample tray

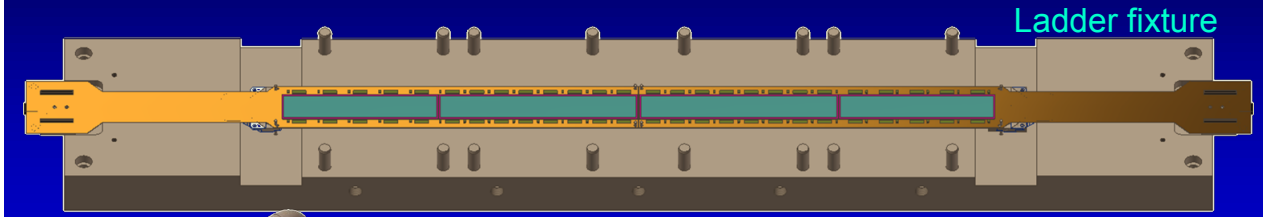


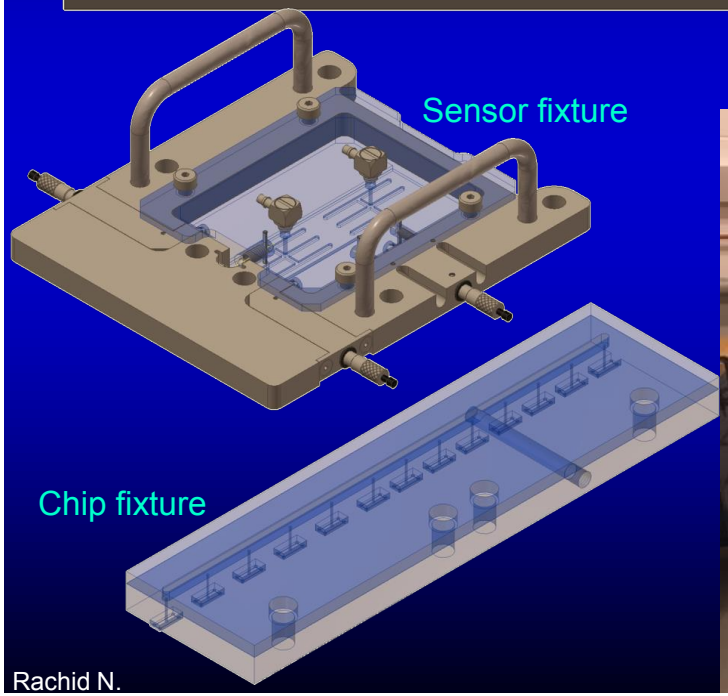
Pick up tools Assembly tray



Ladder Assembly in BNL

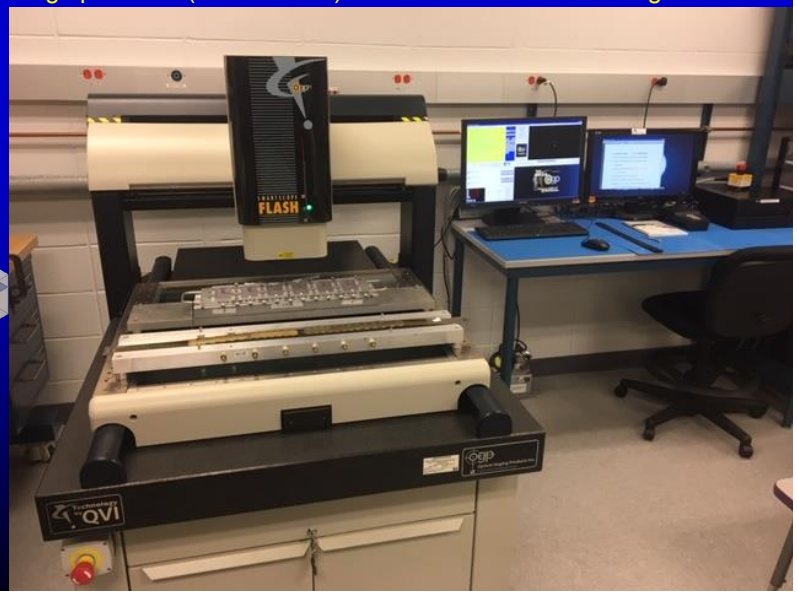
Ladder Mass Production 0.25 FTE → 0.5 FTE

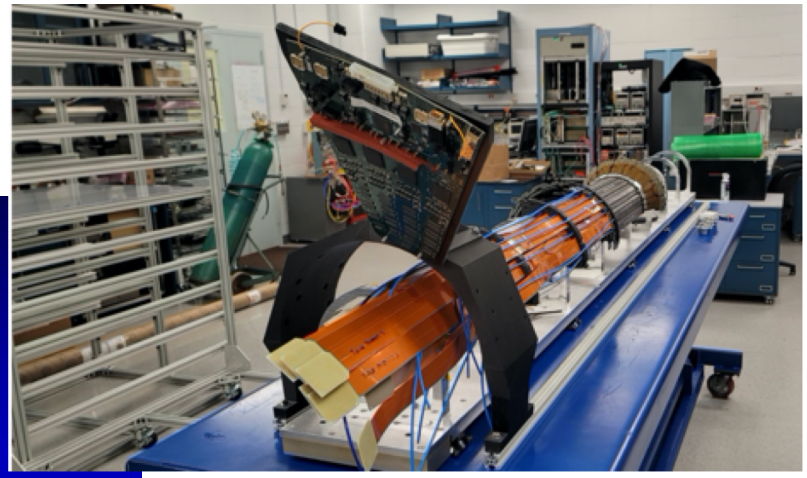




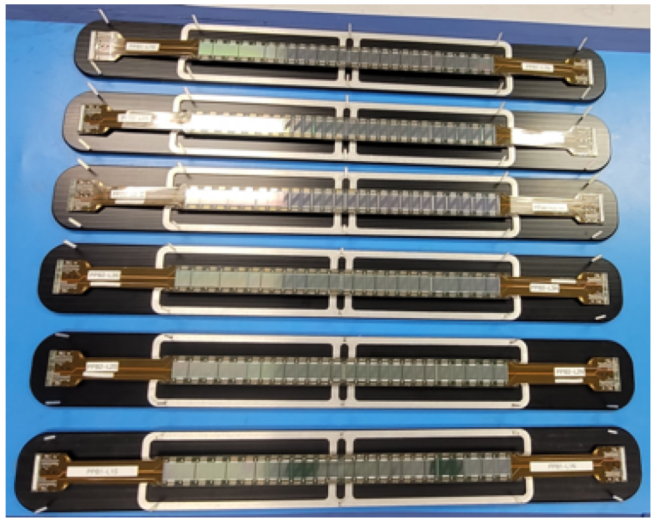
Rachid N.

OGP 500 : assembly machine with laser:
high precision (4 um /30 cm) to measure flatness and alignment





Barrel Assembly



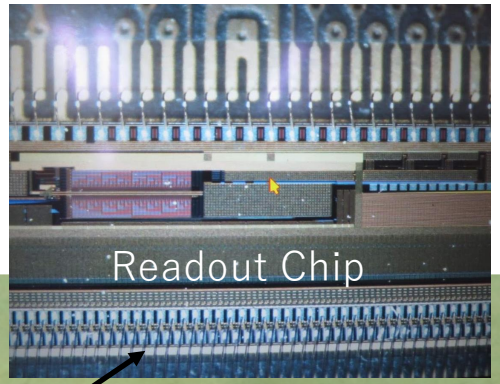
Assembled Ladders

Schedule

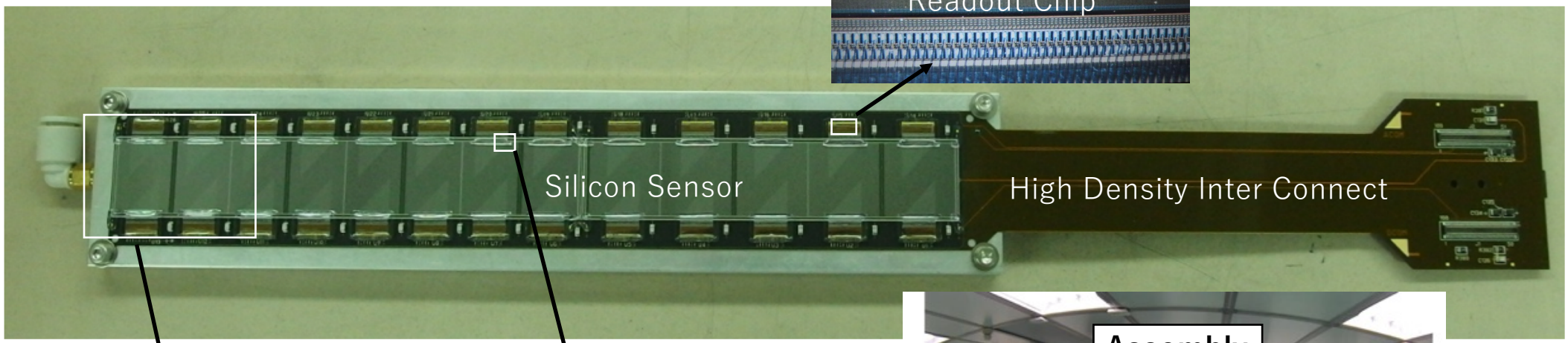
- Ladder Assembly Completion by JFY2021 Summer
- Barrel Assembly JFY2021 Fall
- Barrel Test JFY2021 Fall ~ Winter
- Possible Beam Test in Tohoku University in Japan this Winter

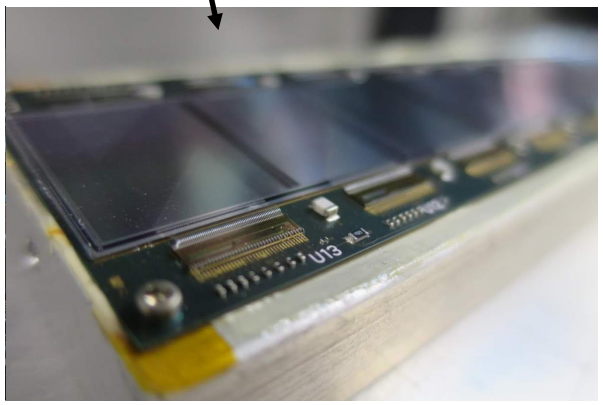
Silicon Sensor Collaboration in Japan Towards EIC

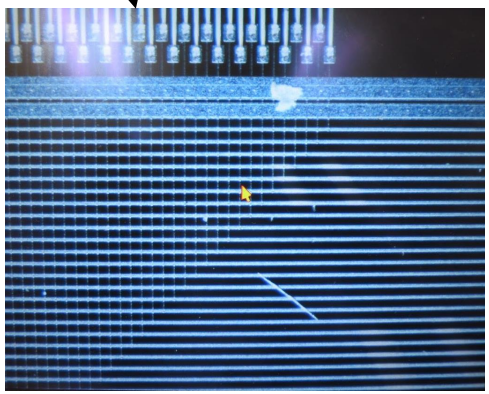
Conventional Technology

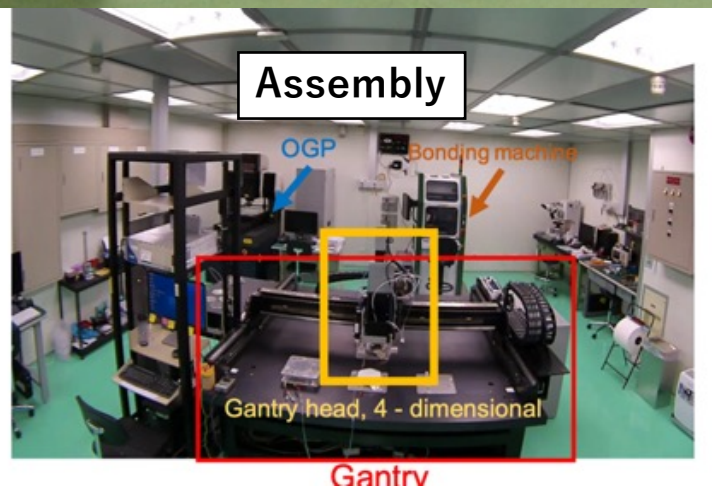


FPHX Readout Chip
- Developed for PHENIX FVTX
- 3 bits ADC
- 65 mW/chip
- …



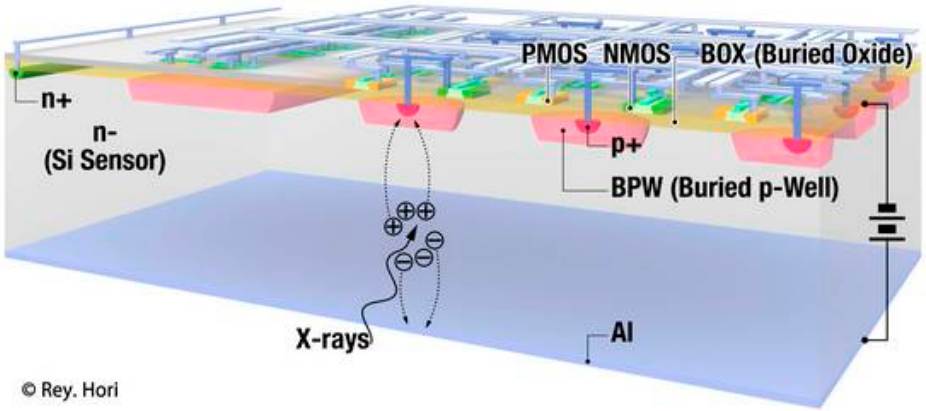






Cutting Edge Technology for Silicon Sensor

SOI:Silicon-On-Insulator Technology



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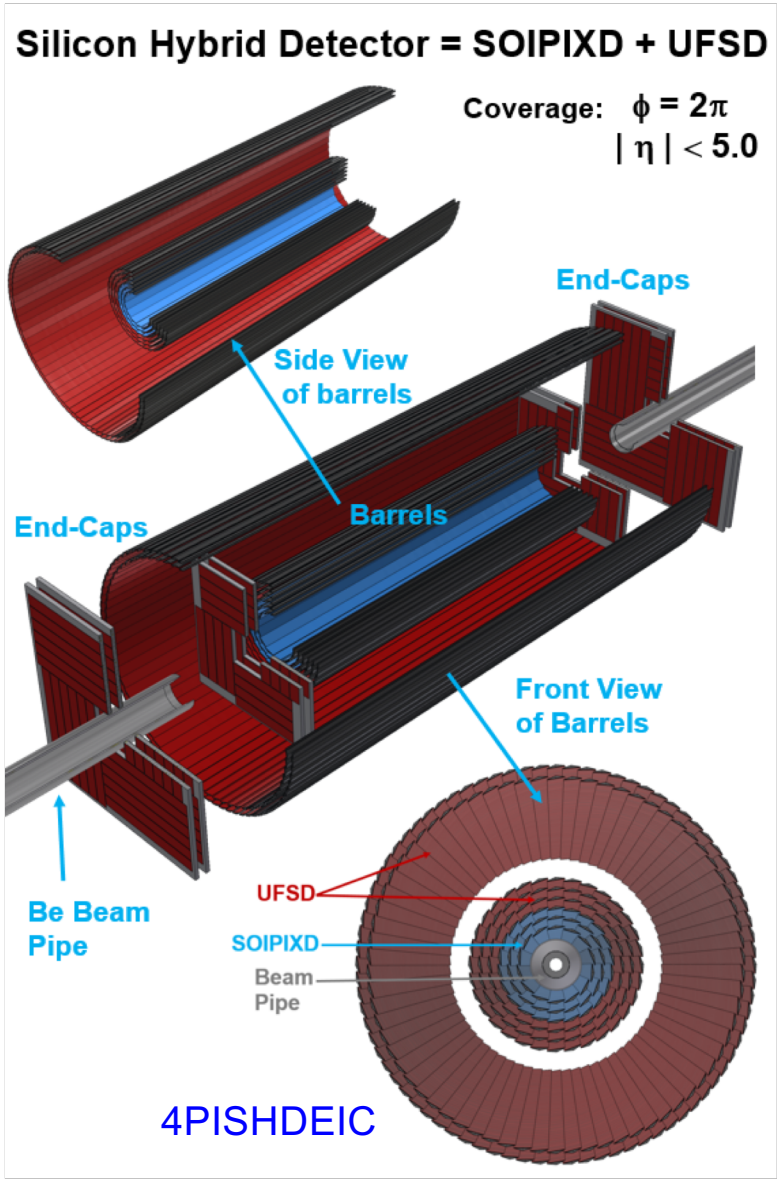
To be discussed details in Prof. Tsuboyama's Talk

Lead by KEK



EIC Expression of Interest

4π Silicon Hybrid Detector with Charged Particle Identification and Highest Position Resolution for an Experiment at EIC

R. Nouicer[2], Y. Akiba[4], Y. Arai[3], W. Armstrong[1], D. Cacace[2], G. Gabriele[2], Y. Goto[4], J. Haggerty[2], K. Hara[7], Y. Ikegami[3], A. Ishikawa[3], M. Jadhav[1], S. Joosten[1], I. Kurachi[3], D. Lynn[2], E. Mannel[2], S. Mazza[6], J. Metcalfe[1], Z. Meziani[1], T. Miyoshi[3], I. Nakagawa[4], G. van Nieuwenhuizen[2], R. Pisani[2], H. Sadrozinski[6], B. Schumm[6], Abraham Seiden[6], M. Togawaand[3], T. Tsuboyama[3], and M. Yamada[5]

[1]Argonne National Laboratory, 9700 S. Cass Avenue, Lemont, IL 60439, United States
[2]Brookhaven National Laboratory, Upton, NY 11973, United States
[3]High Energy Accelerator Research Organization KEK, Tsukuba, 305-0801 Japan
[4]RIKEN, 2-1 Hirosawa, Wako, Saitama, 351-0198, Japan
[5]Tokyo Metropolitan College of Industrial Technology, Tokyo, Japan
[6]University of California, 1156 High Street Santa Cruz, CA 95064, United States
[7]University Tsukuba, Tsukuba, Japan

October 6, 2020

Abstract

The authors present here a 4π silicon hybrid detector for future experiment at EIC. The 4π silicon hybrid detector uses state-of-the-art of silicon detector technology covering 2π azimuth angle, and pseudorapidity range $|\eta| \leq 5$. It consists of an inner vertex silicon tracker, outer vertex silicon tracker and silicon end-caps. The inner vertex silicon tracker is based on silicon-on-insulator monolithic pixel sensors' technology. It achieved world's best tracking position resolution of 0.68 ± 0.006 μm in a silicon detector which it obtained with proton beam test at 120 GeV. Radiation hardness has been continuously improved and showing more than 10 Mrad(Si) tolerance in a device. The outer vertex silicon tracker and silicon end-caps are built using ultra fast silicon detectors, which are silicon-based low gain avalanche diodes read out via broad-band amplifiers. Recent results from a proton beam test at 120 GeV using three planes of ultra fast silicon detectors with silicon sensors of 35 μm thick measured 15 ps time resolution. Ultimately, this device will measure high time resolution of $\sim$ 10 ps enabling charged particle identification.

Expression of Interest - <SOISensor>

Please indicate the name of the contact person for this submission:

Yuji Goto <goto@bnl.gov>

Please indicate all institutions collectively involved in this submission of interest:

High Energy Accelerator Research Organization KEK, University Tsukuba, Tokyo Metropolitan College of Industrial Technology, and RIKEN

Please indicate the items of interest for potential equipment cooperation:

- Silicon sensor based on silicon-on-insulator monolithic pixel detectors (SOIPIXD) technology which has been developed by KEK group.
- The SOIPIXD demonstrated world's best tracking resolution of 0.68 ± 0.006 μm in a silicon detector using 120 GeV FNAL's test beam.
- The SOIPIXD is employed as the inner vertex detector of 4π silicon hybrid detector (4PISHDEIC) proposed by ANL and BNL Collaborators.
- To be developed in collaboration with 4PISHDEIC group.

Expression of Interest - <NAME>

Opportunities for engagement of other groups

- The team is open for new collaborators. Following collaborators are particularly welcome:
- Physics interest in heavy flavor using vertex silicon sensors
- Experty in silicon sensors in general, readout electronics, signal transmission, mechanical/electrical engineering, slow control systems, etc.
- Eastern Asian institutes taking geographical advantage

Additional information you think may be useful for the community to know about your expression of interest.

- SOI integrates both silicon sensor and readout electronics in the same wafer which is considered as the next generation silicon sensor technology.
- The team is open to collaborate with other collaborators who are interested in developing silicon sensor detector using SOI technology other than 4PISHDEIC.

Summary

- INTT Silicon Tracker for sPHENIX construction is on schedule
- INTT Barrel Assembly and Testing Start this Fall
- Collaboration with US Group (Argonne & BNL) to develop EIC detector based on SOI Technology developed in KEK.

Collaboration Photo

After this talk, please don’t hung up yet!