

Taiwan Instrumentation and Detector Consortium

Rong-Shyang Lu
National Taiwan University

Introduction

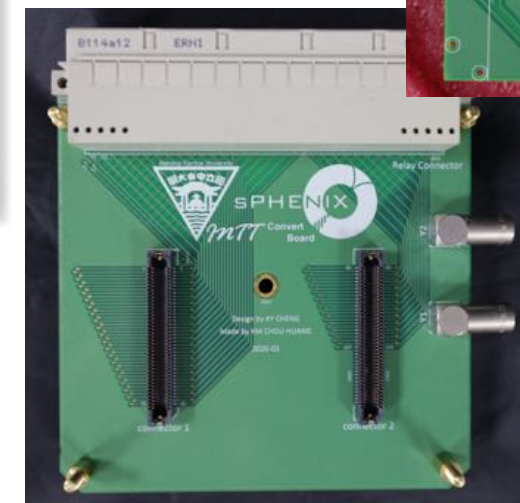
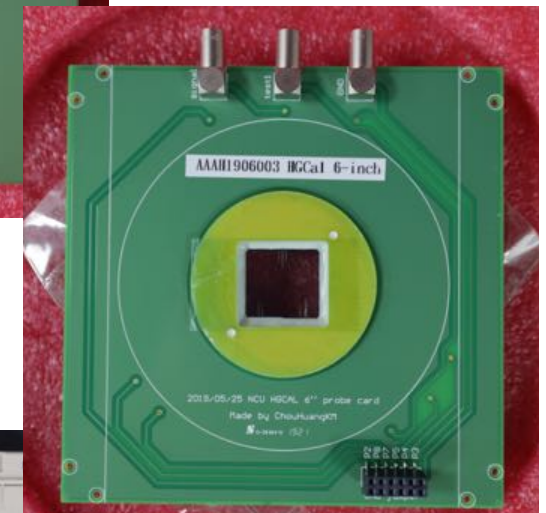
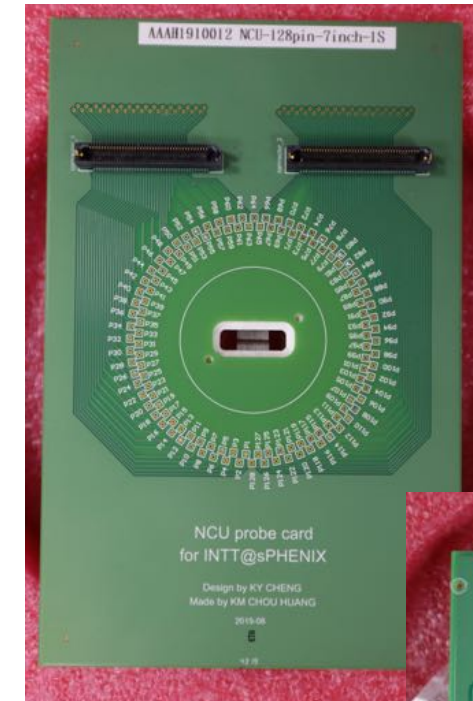
- 2019 年提出科技部構想案，聯合三個機構實驗室（中研院，台大，中央）合作大強子對撞機升級計畫（2018 科技部與歐洲核子研究組織簽訂合作備忘錄之新增附錄的十年合作計劃）。2020 加入清大。同年加入成大，合作布魯克海汶實驗計畫。
 - ◆ **中研院**：抗輻射測試，電子電路設計，金工廠，網格計算中心
 - ◆ **中央大學**：矽晶片電性測量無塵室，渺子偵測
 - ◆ **台灣大學**：矽偵測器組裝無塵室，測試實驗室，電子電路設計，治具設計
 - ◆ **清華大學**：偵測器原型的束流實驗數據分析
 - ◆ **成功大學**：矽偵測器與閃爍體測試實驗室，偵測器結構設計與製作
- 2022 年升級為科技部核心設施 台灣偵測器聯合實驗室, Taiwan Detector and Instrumentation Consortium (TIDC)

- Silicon Detectors.
 - ◆ Taiwan HEP has long tradition of silicon based detector involvements. Including
 - ❖ Sensor design and production for RHIC-Phobos-SiliconD and LHC-CMS-Preshower
 - ❖ Readout electronics Tevatron-CDF-SVX, KEKB-Belle-SVD
 - ❖ Most recently, constructing silicon detector modules of RHIC-STAR-FST, RHIC-sPHENIX-INTT, and LHC-CMS-HGCAL
 - ❖ R&D in LGAD technology (See Prof. R-H Yeh's talk)
- Crystal Calorimeters
 - ◆ HEP has participated LEP-L3-EMCAL and built a KEKB-Belle-EFC both based on homogeneous BGO crystals
 - ◆ Also various applications with photosensors technology, such as medical application and recent LYSO investment for HL-LHC-MTD detector.
- Electronics, Firmware, OPT-Readout (Dr. Suen Hou's talk), Computing, ..., etc.

Hybrid Style Silicon Detector

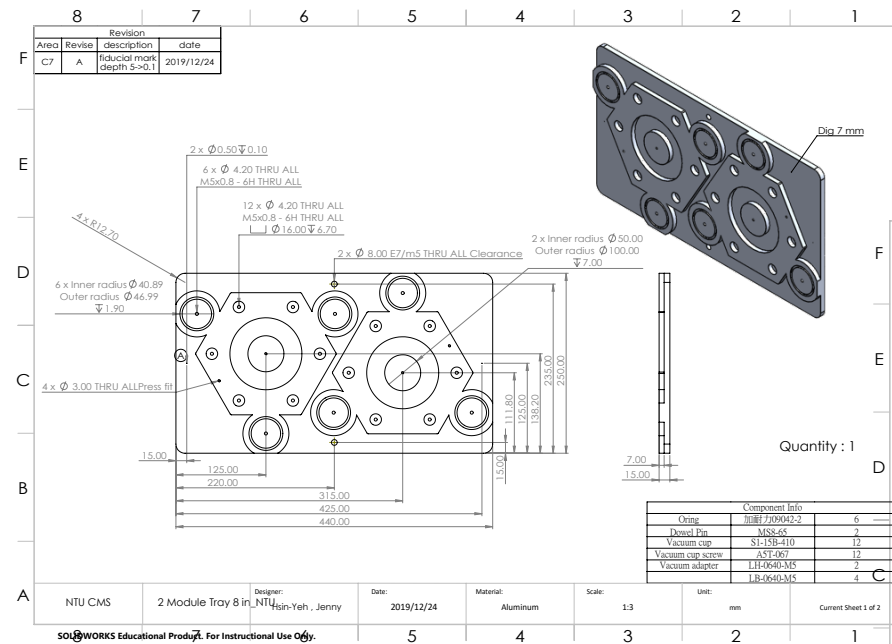
- Recent projects has formed a production flow as
 - ◆ Silicon sensor probed (QA/QC) in NCU
 - ◆ Assembly jigs design in NTU and fabricated in AS
 - ◆ Silicon module assembled and tested (QA/QC) in
- Completed STAR-FST hybrid and sPHENIX-INTT ladder production. On-going CMS-HGCAL module production project until 2026

INTT Silicon Sensor QC

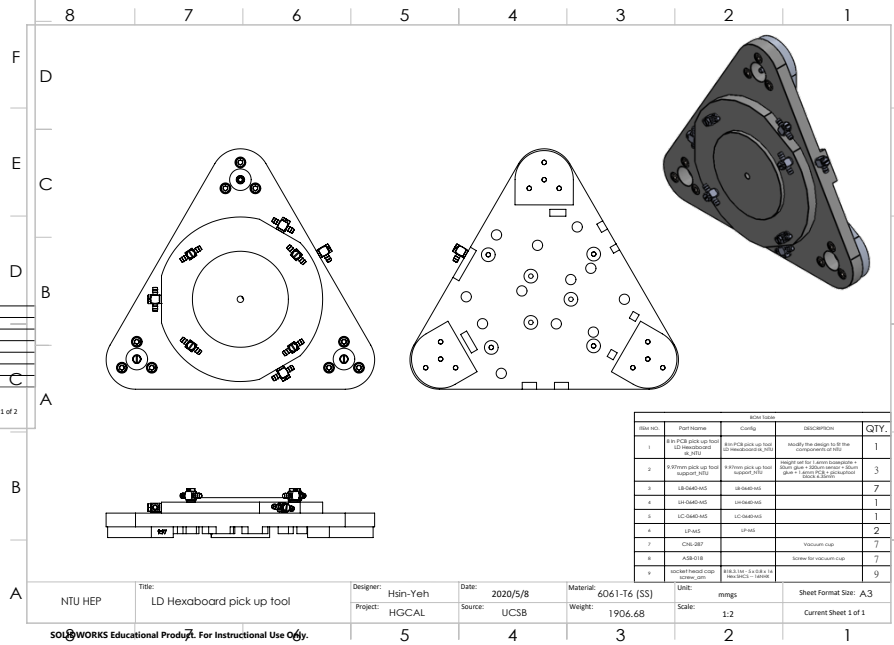


- procedures, probe cards and database were all designed by Taiwan-sPHENIX team
- The majority of the INTT silicon sensors were electrically measured in NCU

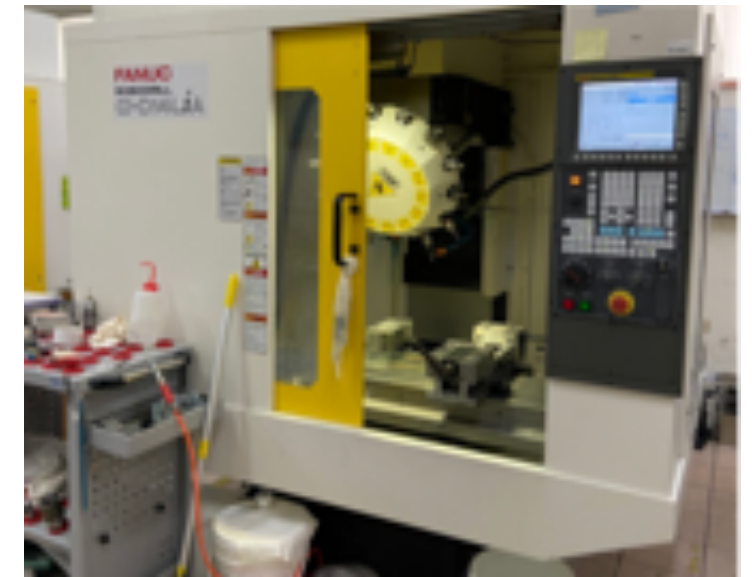
Jig design and production



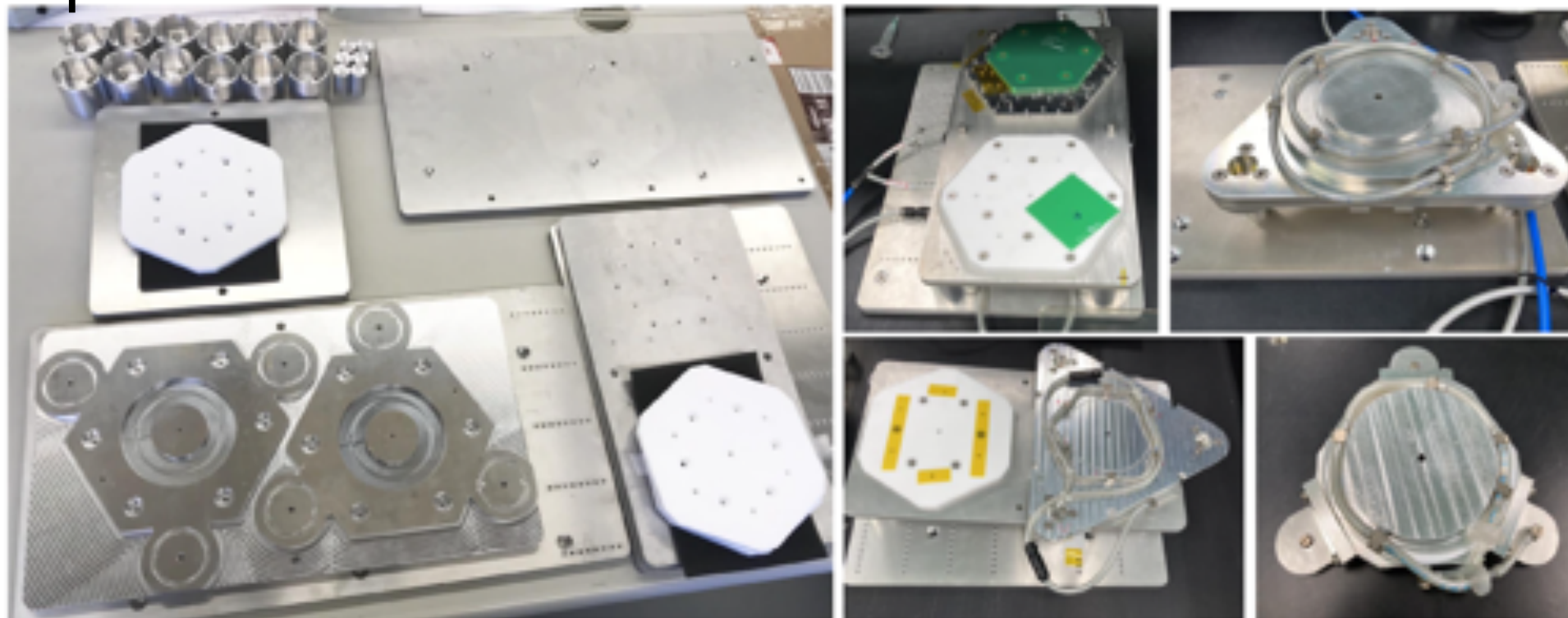
NTU Design



中研院金工廠部分儀器



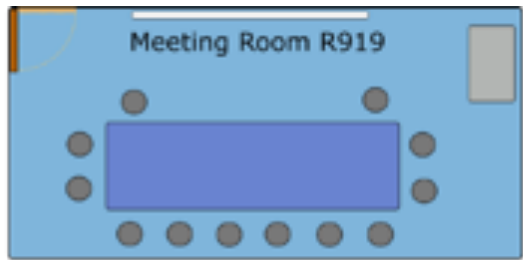
AS production



Assembled jigs in NTU lab

NTU Facility

- Complete the cleanroom (915) setup including robotic gantry, wire-bonder, probe station and services in spring 2019.
- Setup testing lab (923) with test-stands, climate chamber in 2020.
- Acquired a buffer room (910) in 2021 until 2025.

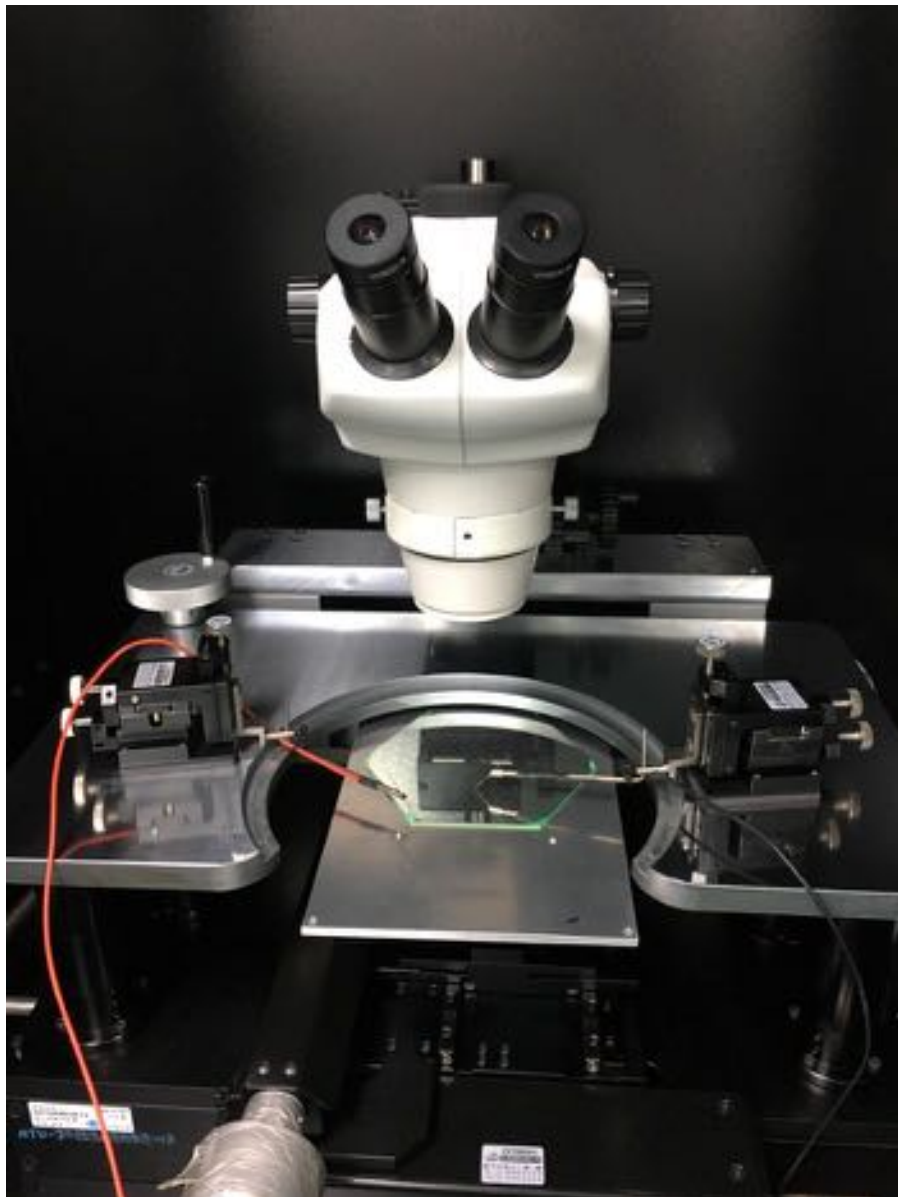


923 Outlets
T : Telephone
N : Net
R : UPS
V : 110V
Area: 990 * 660 cm²
~64 m²

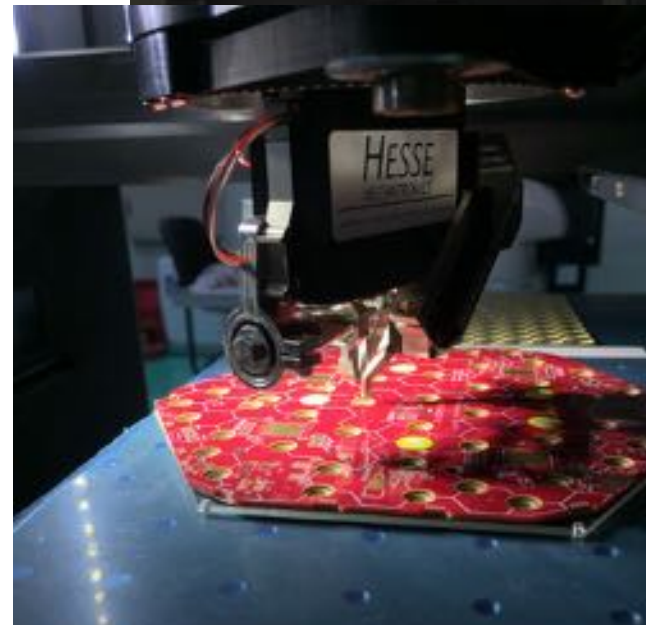
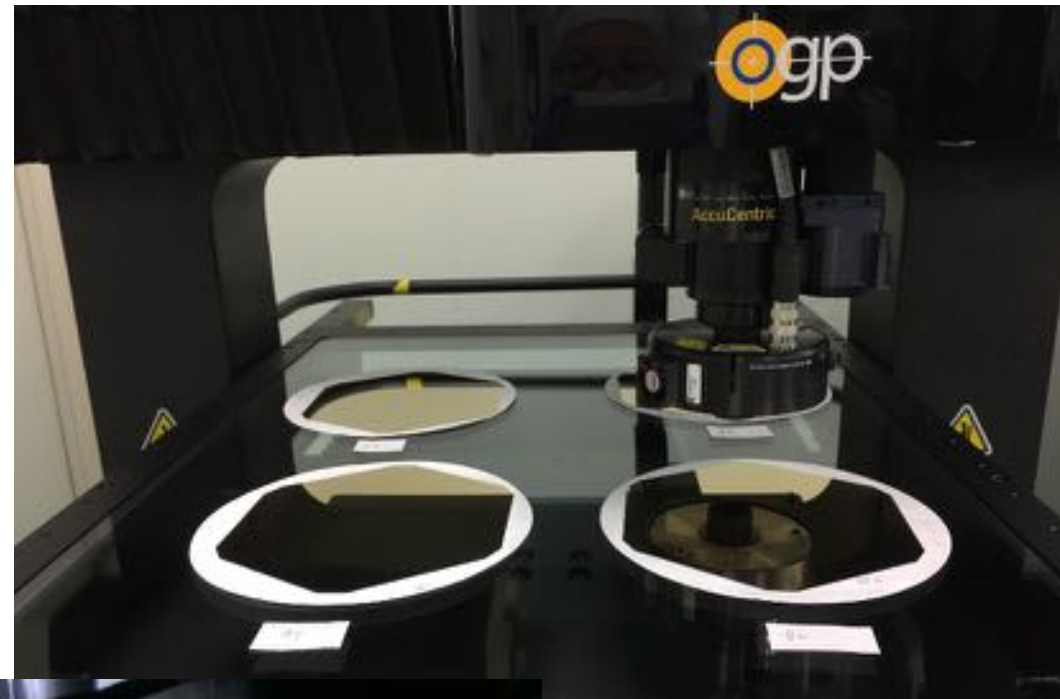


Lab equipments

- We have equipped robotic gantry, wirebonder, pull tester, probe station, NI crates, OGP optical measuring system, scopes, HV/LV supplies ... etc. Essential equipments needed to build silicon detector.

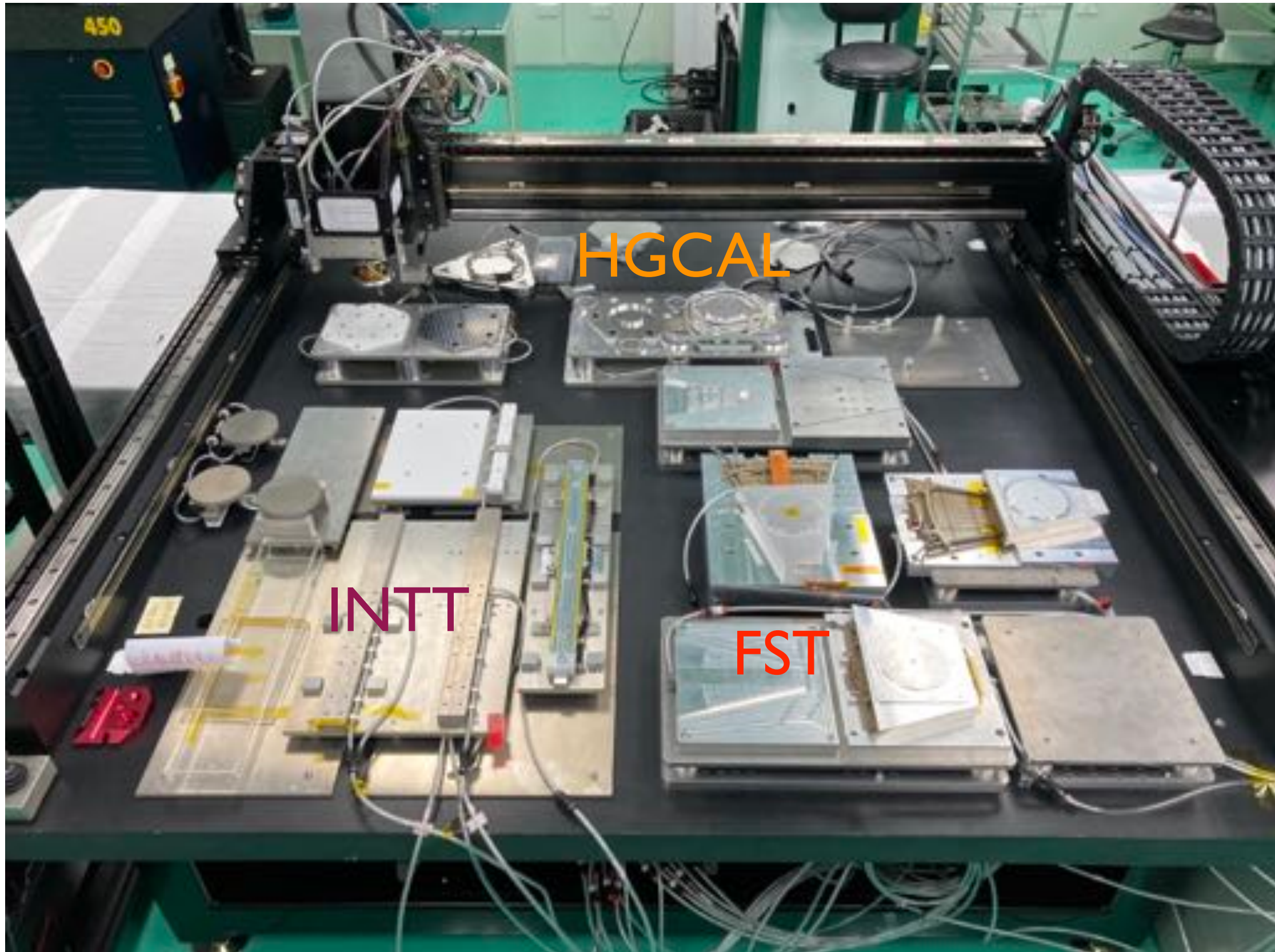


EIC Workshop

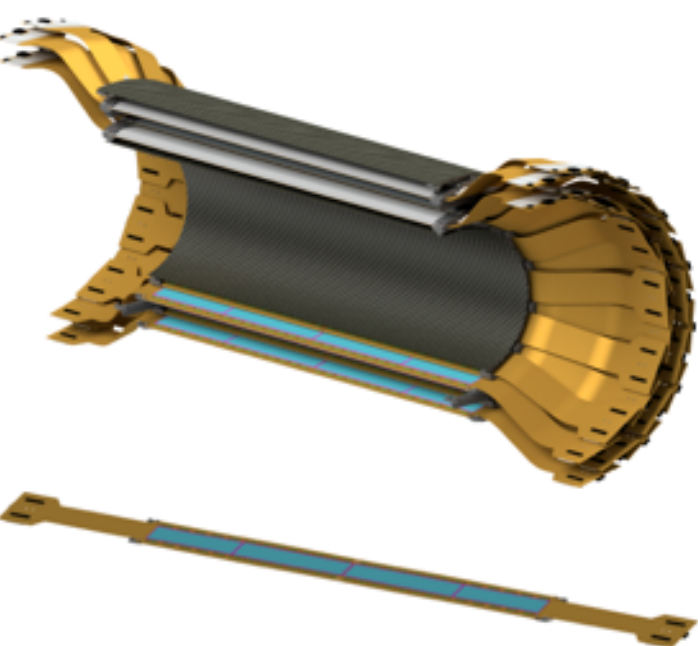


Aug 17~18, 2022

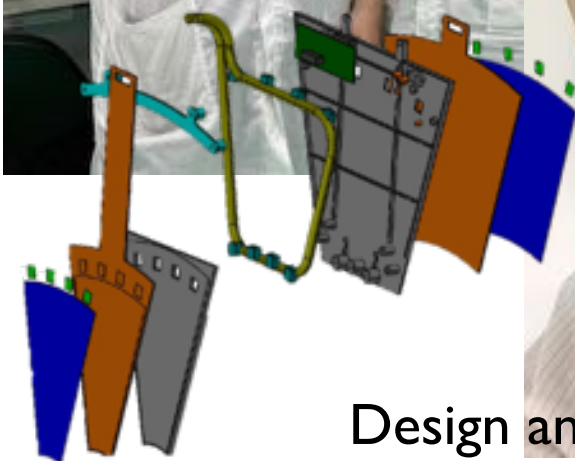
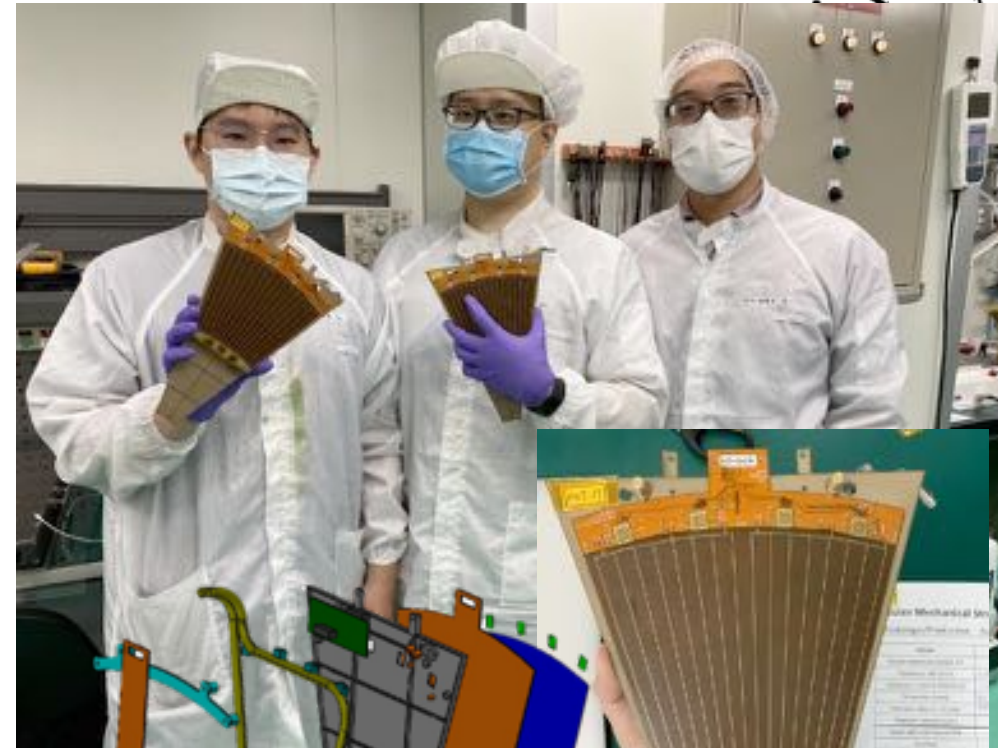
Main Gantry for Assembly



Assembled Silicon Modules

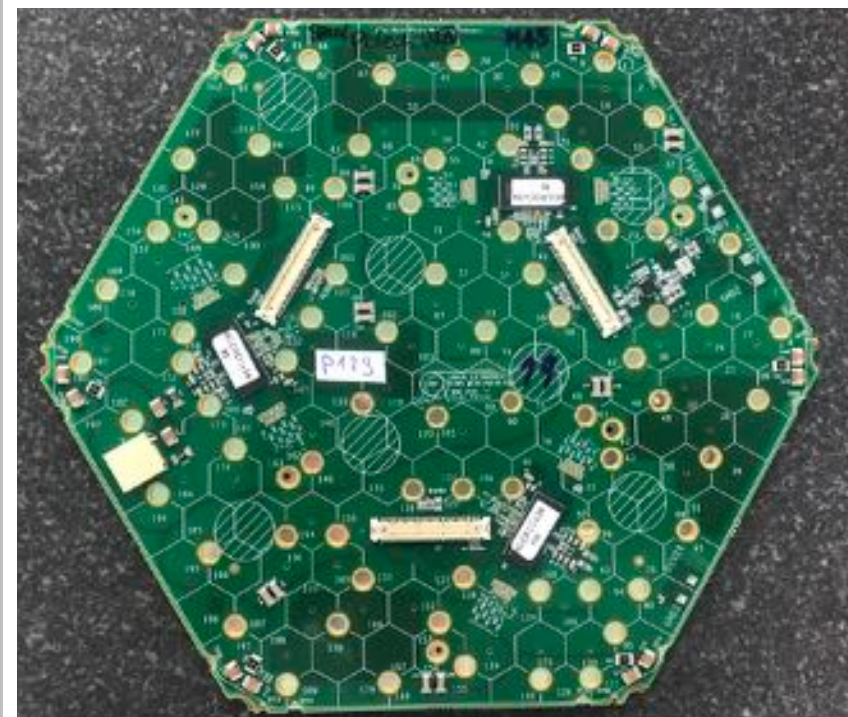
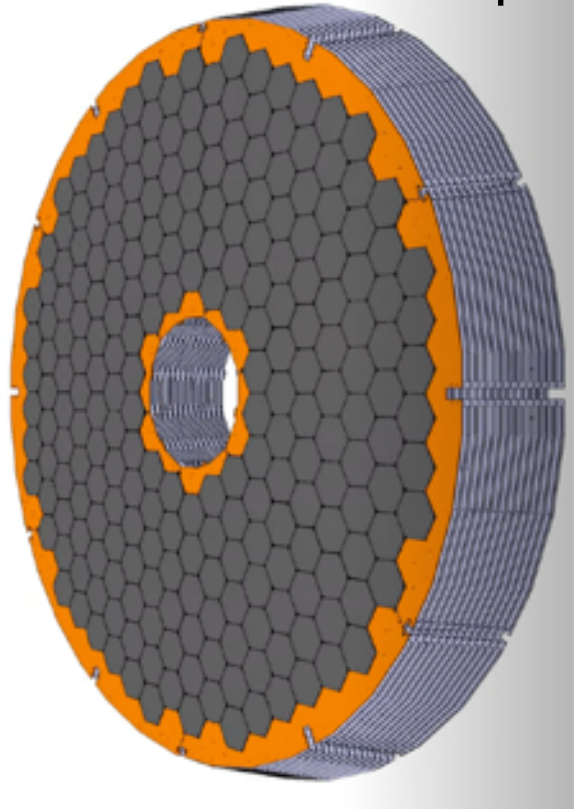


Assembly of INTT ladders

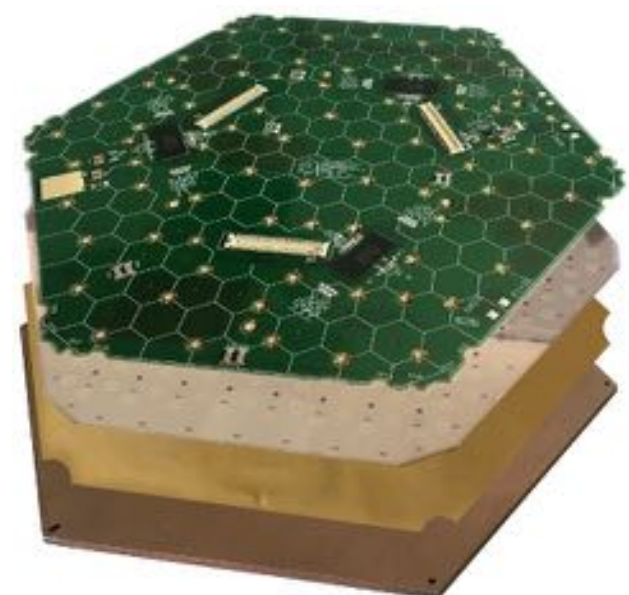


Design and Fabrication of STAR FST hybrids

CMS CE-E Endcap



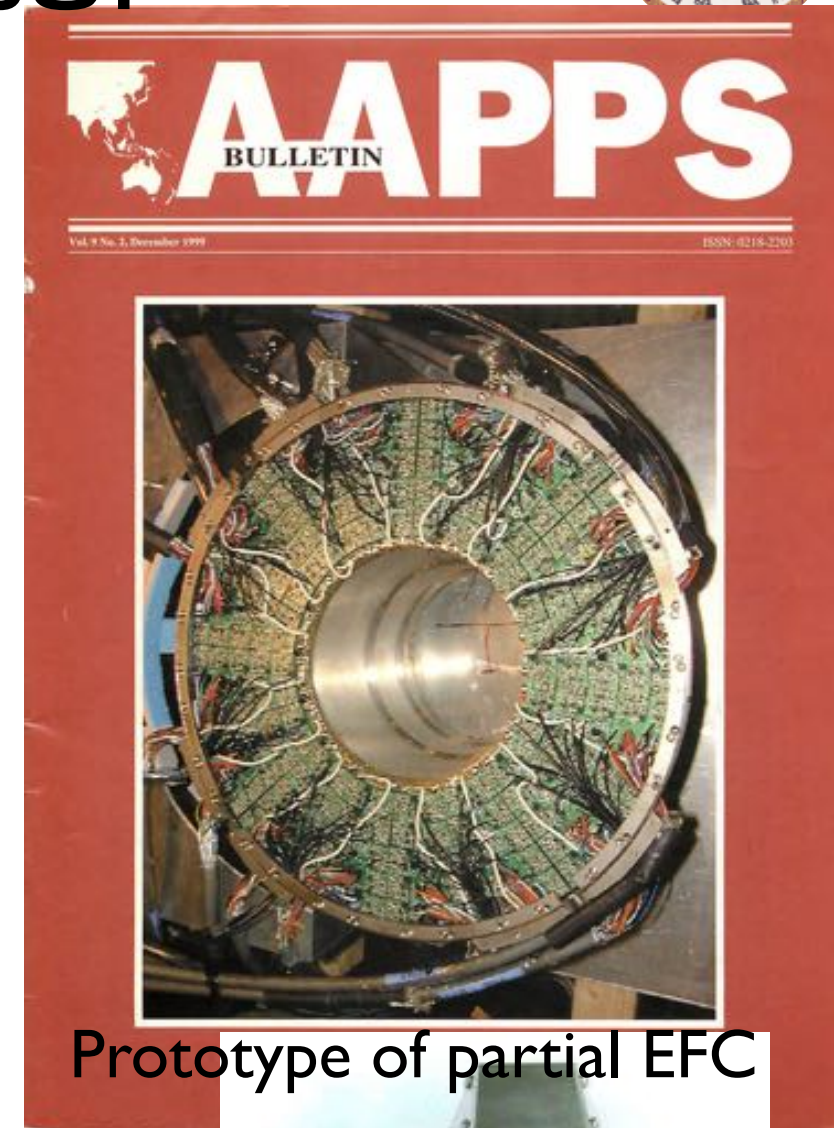
Assembly of HGCAL modules



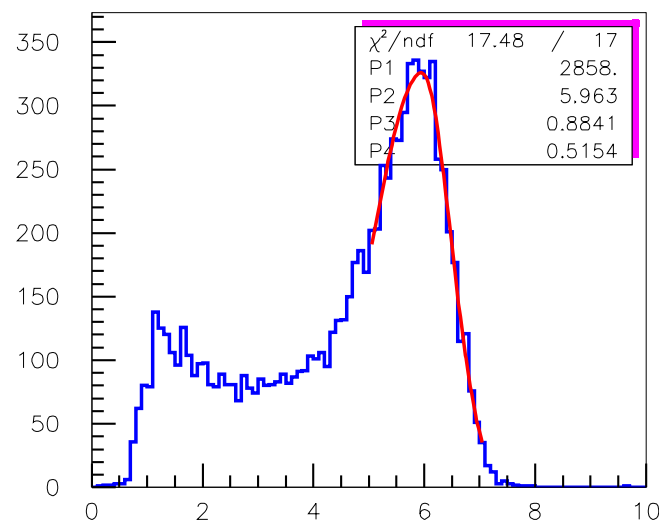
Rong-Shyang Lu / NTU

Crystal Calorimeter

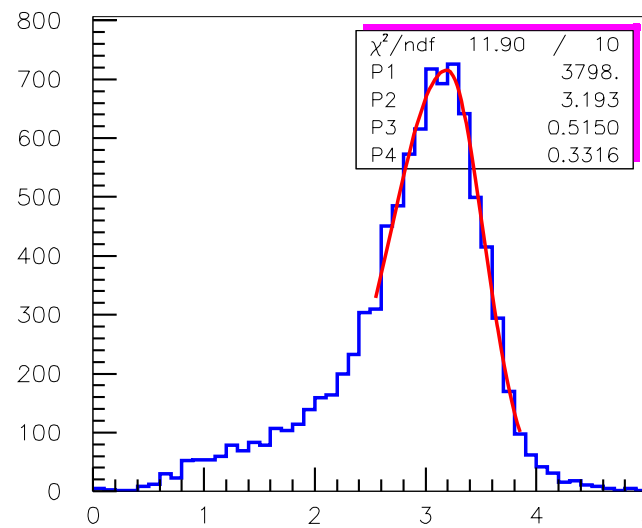
- NTU designed and built a BGO crystal small angle Calorimeter in Belle.
- Provided :
 - ◆ luminosity measurement in Bhabha Scattering;
 - ◆ extend the fiducial coverage for τ analysis.



Energy Spectrum of EFC Bhabha



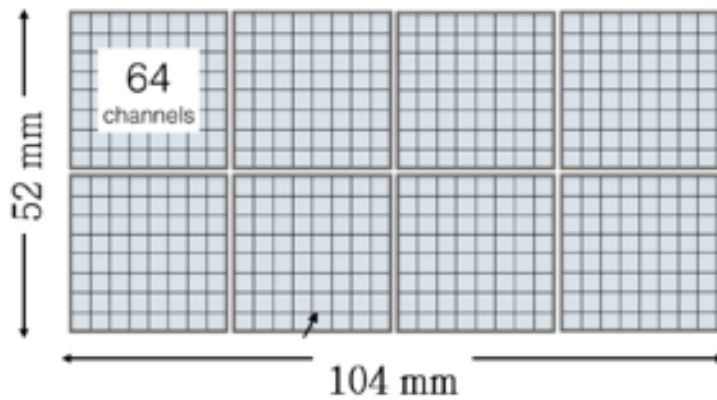
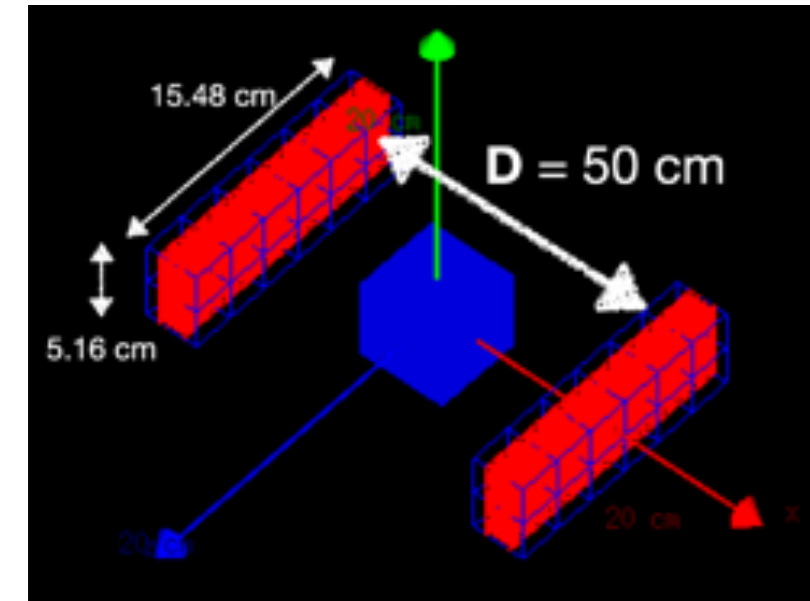
E FFC



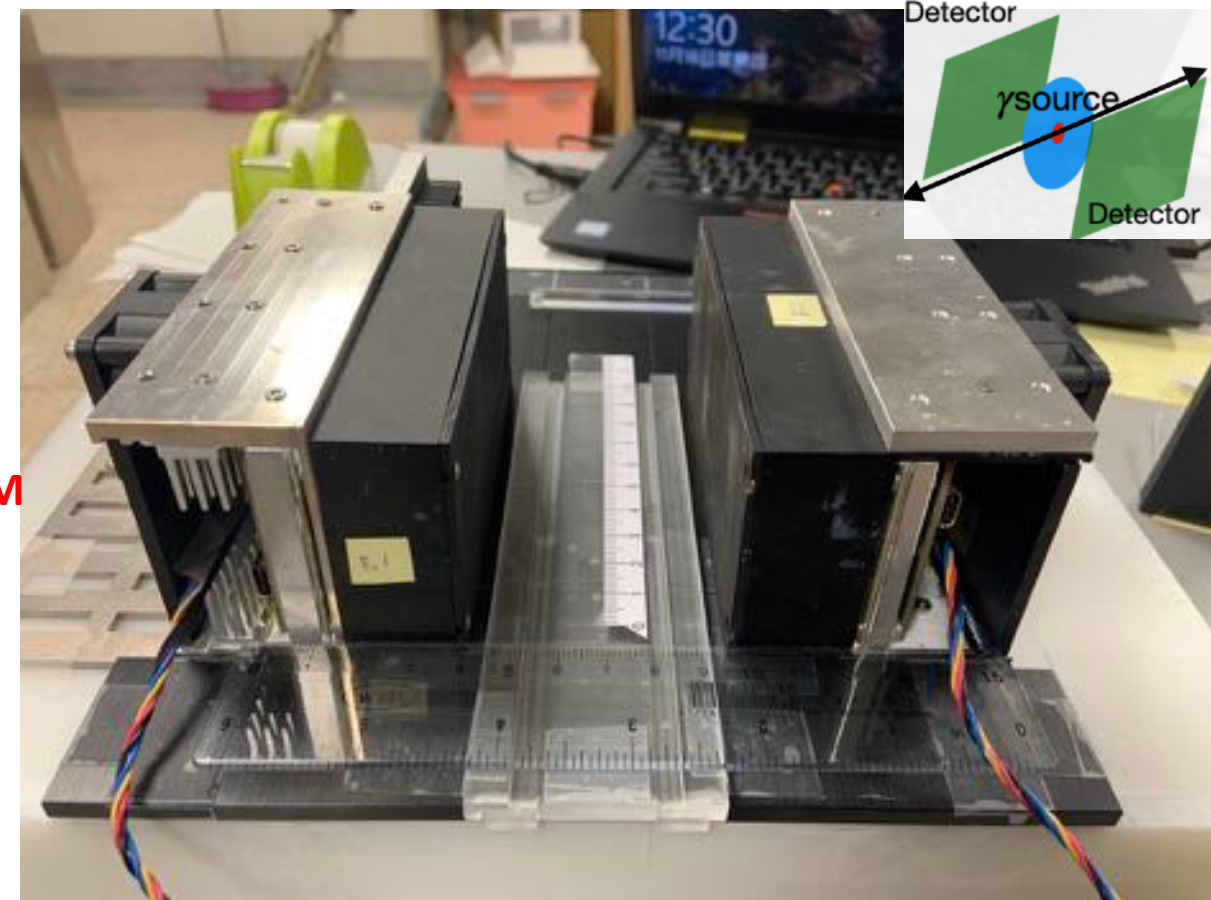
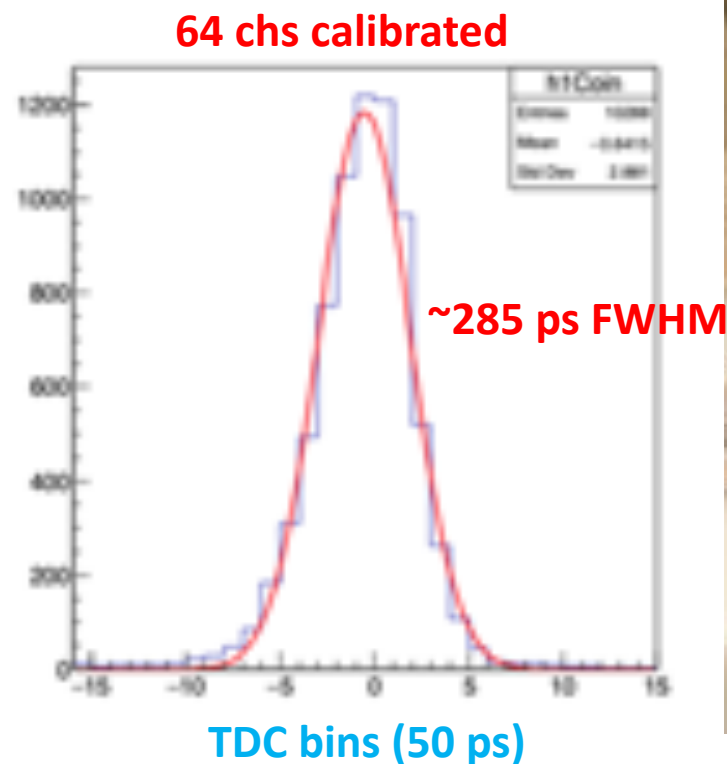
E BEFC



- Photons with timing forms “vertex”
- AS is developing ToF-PET Detector for medical imaging
- Light readout by SiPM to have fast response

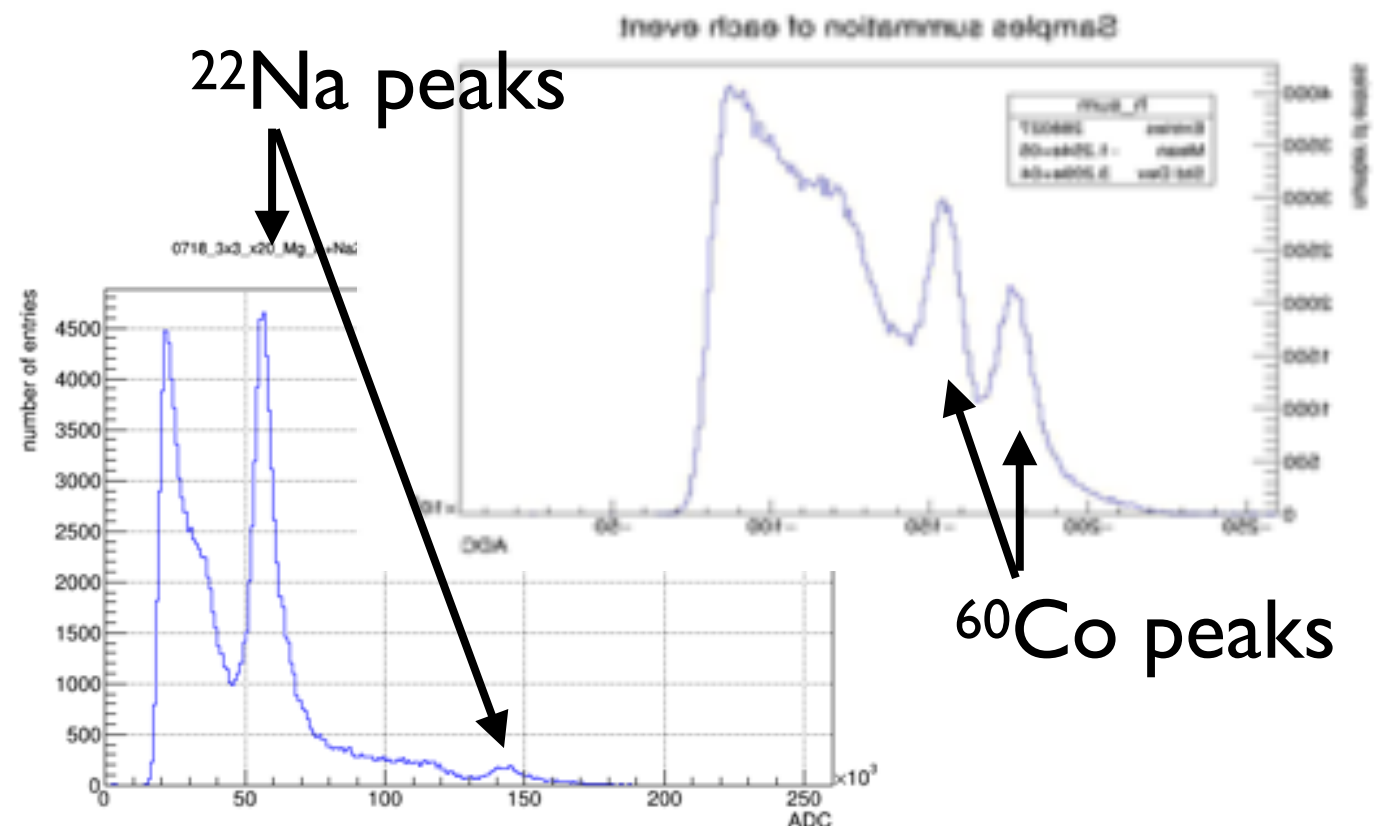
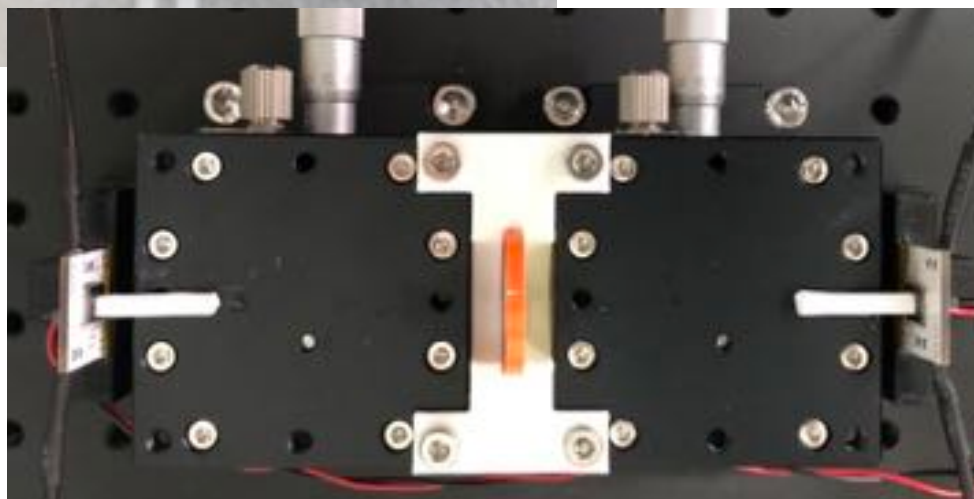
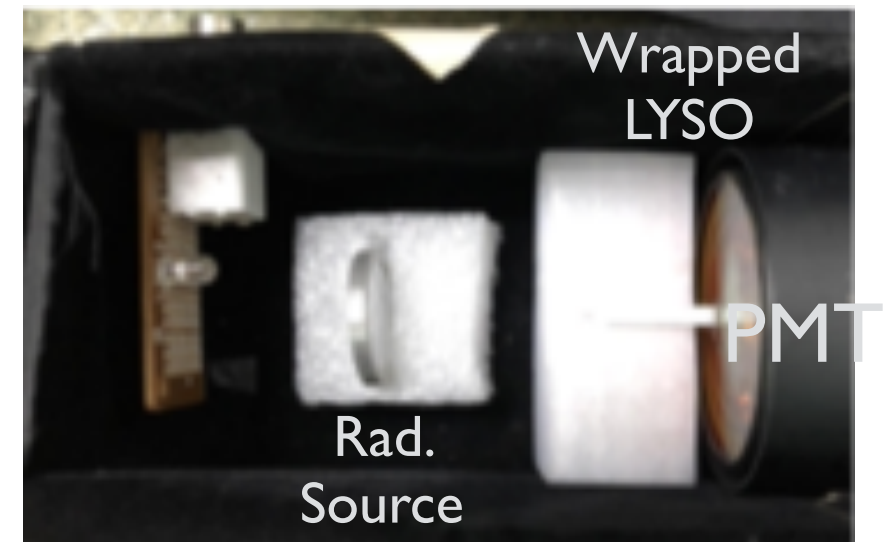
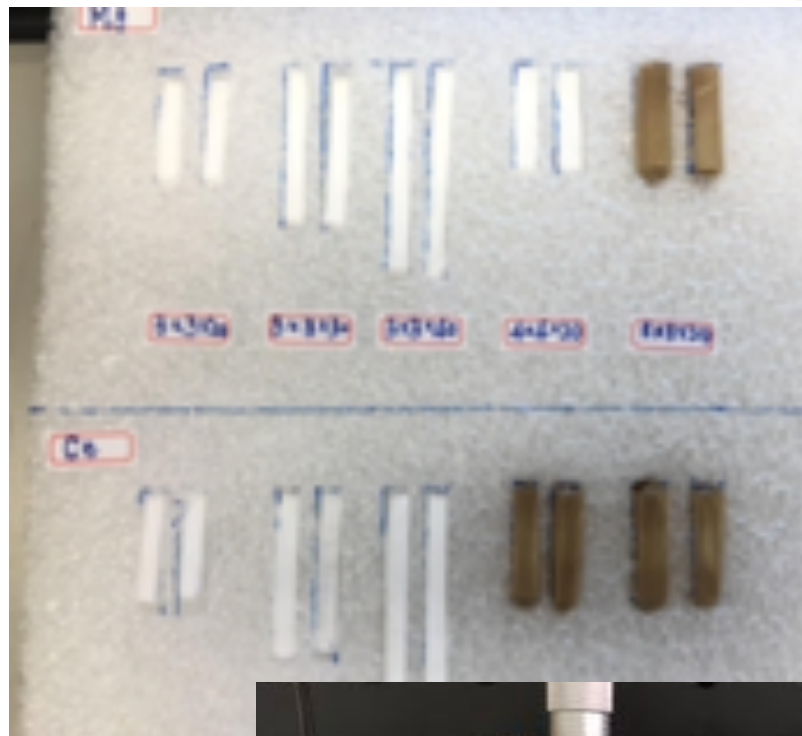


- 512 channels per module
- 8 pcs of 8x8 LYSO array
Pixel size = 3 x 3 x 20 mm³
- 8 pcs of 64 ch FE ASICs



Collaboration with TCECM

- NTU is setting up measurements for
 - ◆ Absolute light yield of LYSO crystal using PMTs
 - ◆ Time resolution of LYSO using SiPM
 - ◆ Reach $\sigma \sim 130$ ps CTR

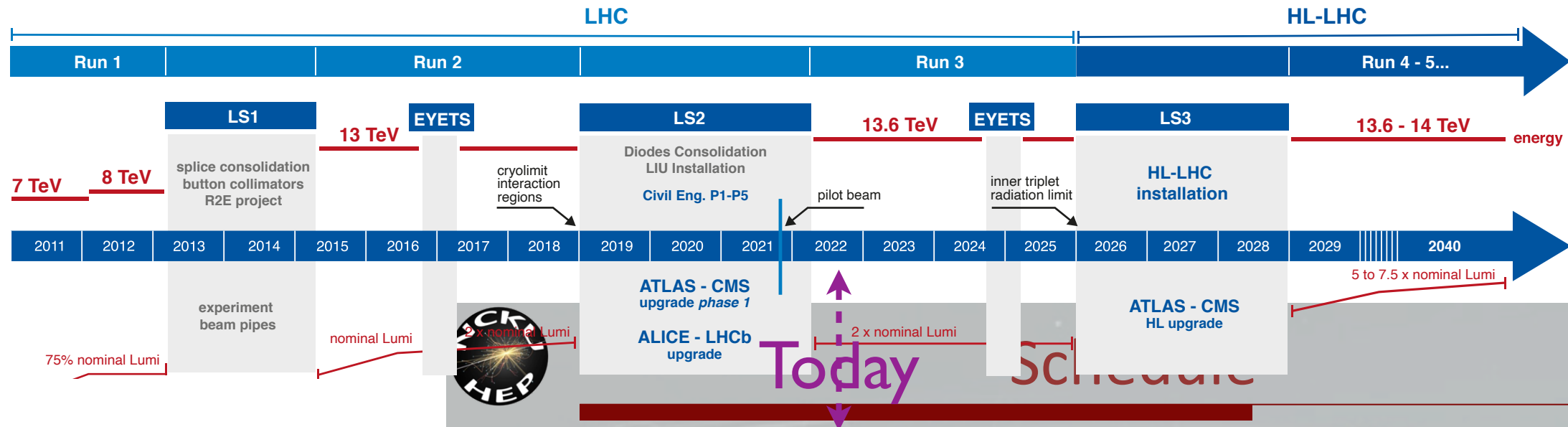


Summary

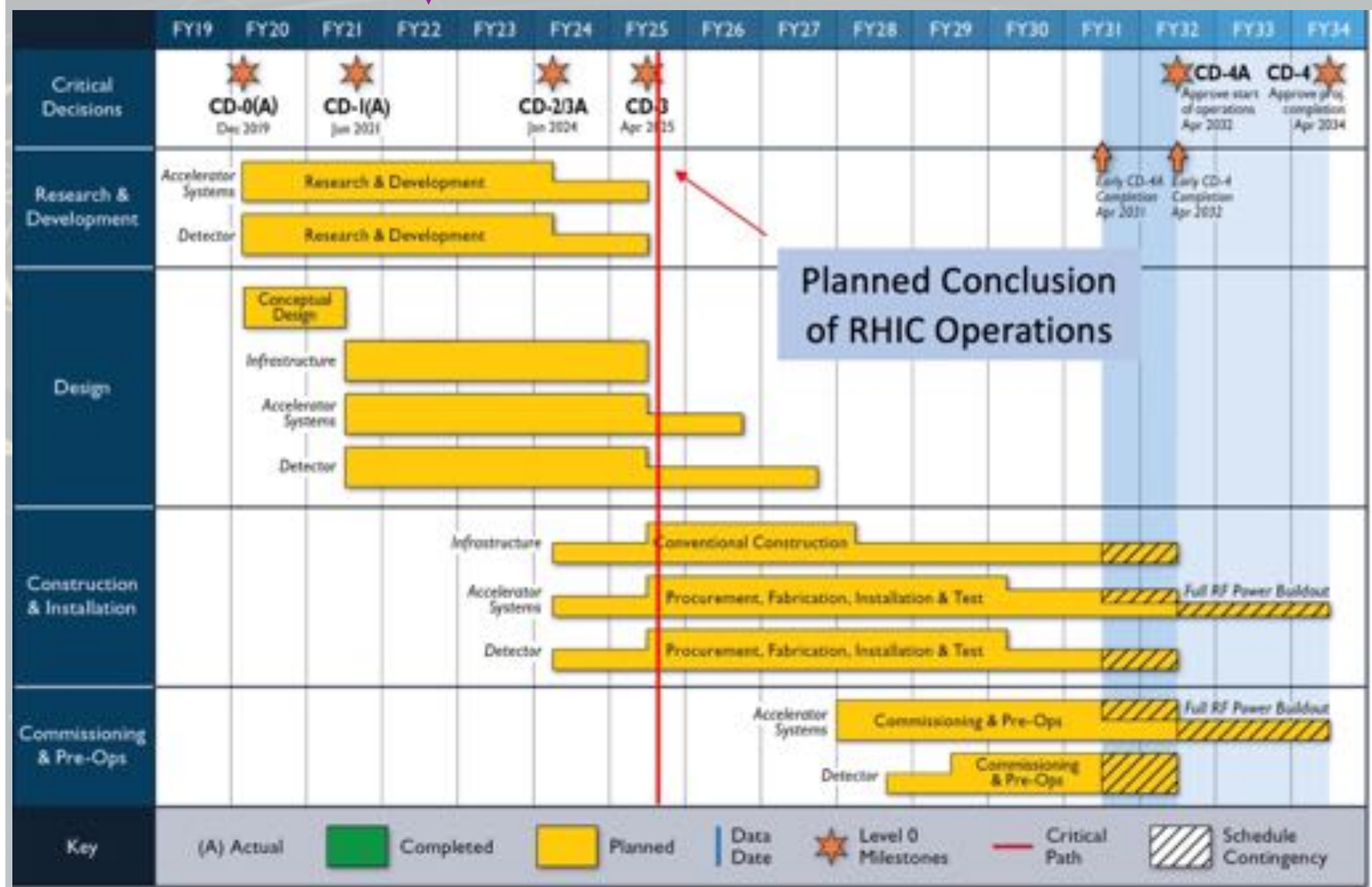
- After the HL-LHC upgrade, the next hardware project is likely to be with EIC.
- TW-HEP have expertises in Silicon detector and is progressing R&D of LGAD. We can definitely contribute to either/both silicon tracker and PID-ToF.
- There may be other opportunities such as Calorimeter, electronics, and computing.

Timeline

<https://hilumilhc.web.cern.ch/content/hl-lhc-project>



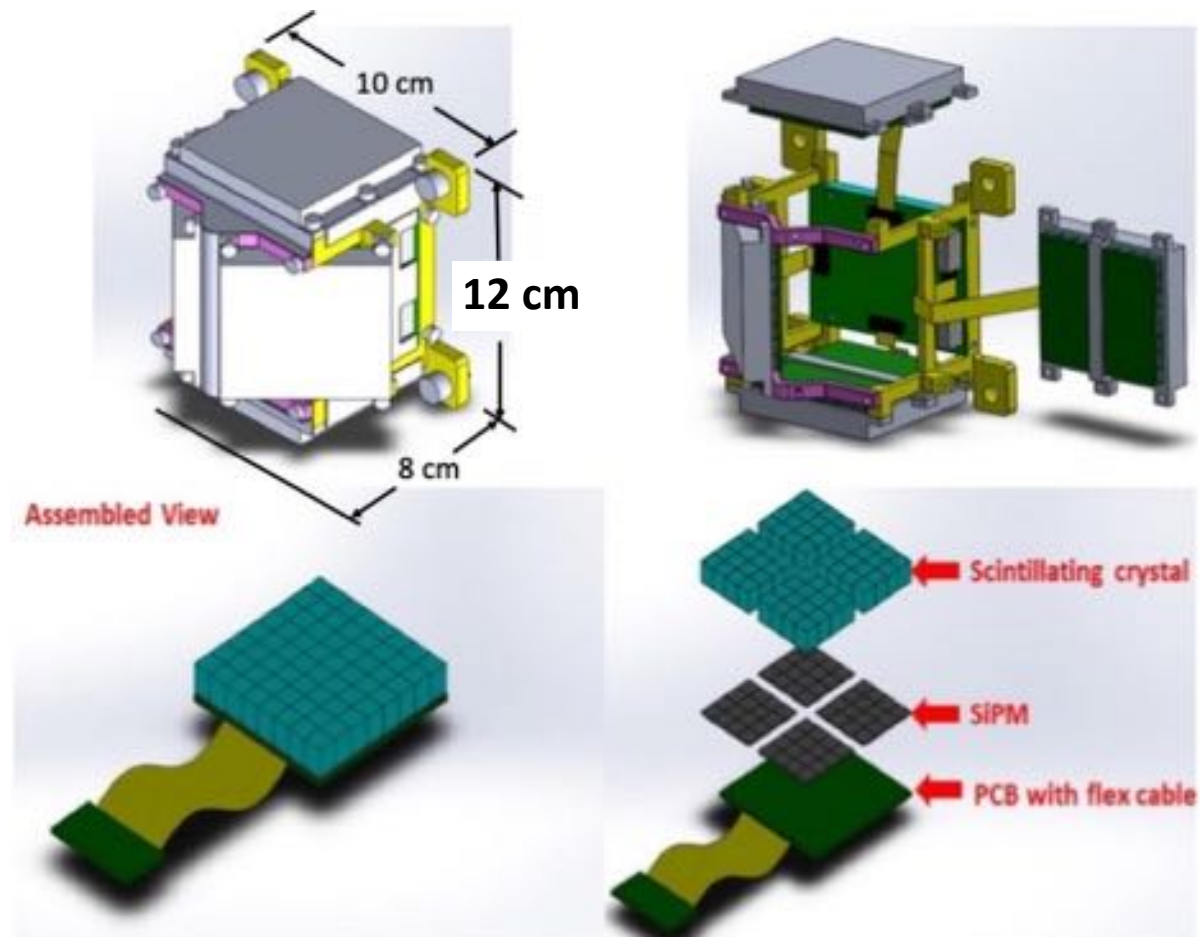
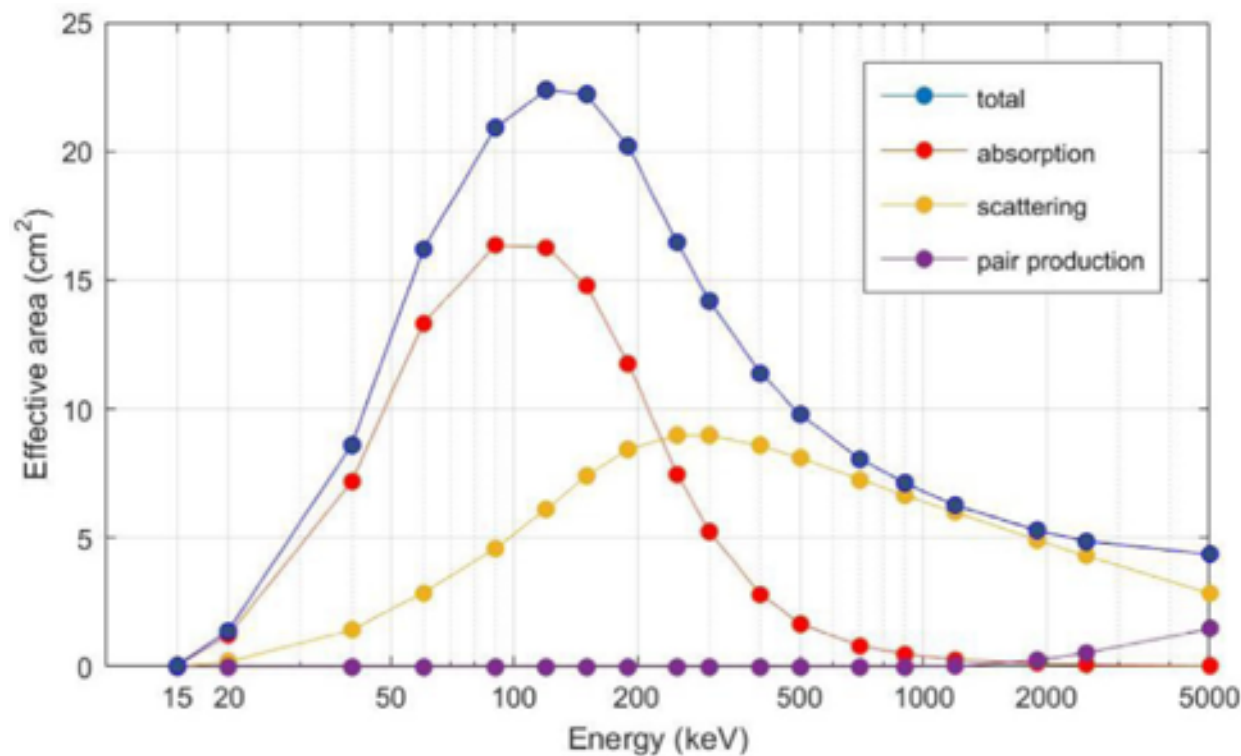
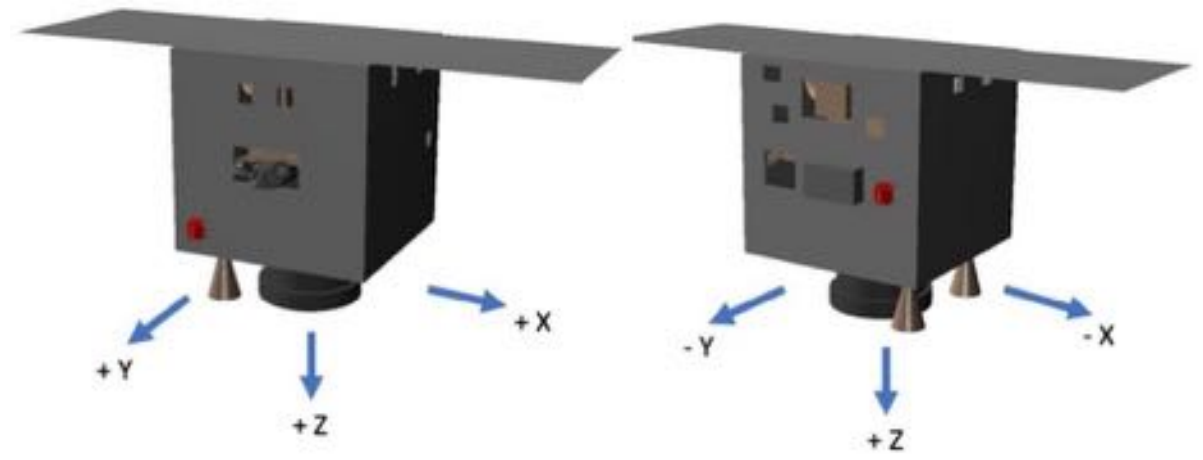
Today



Backup Slides

Gamma-ray Transients Monitor (GTM)

- Monitor GRBs and other bright gamma-ray transients in the energy range from 50 keV to 2 MeV
- Science payload of Taiwan Formosat-8B (FS-8B)
- Lead by Prof. H.K Chang of NTHU



GTM Engineer Model

