

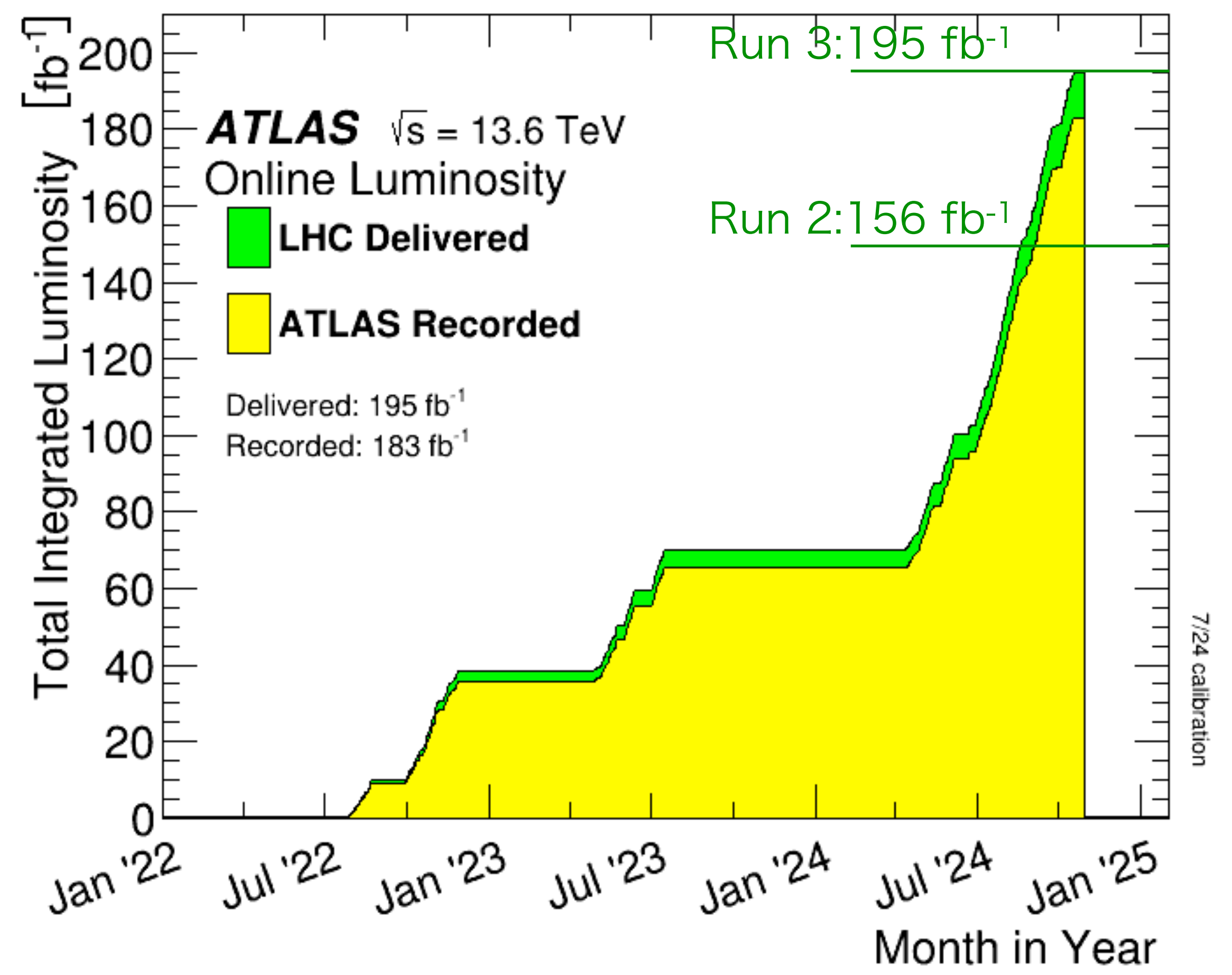
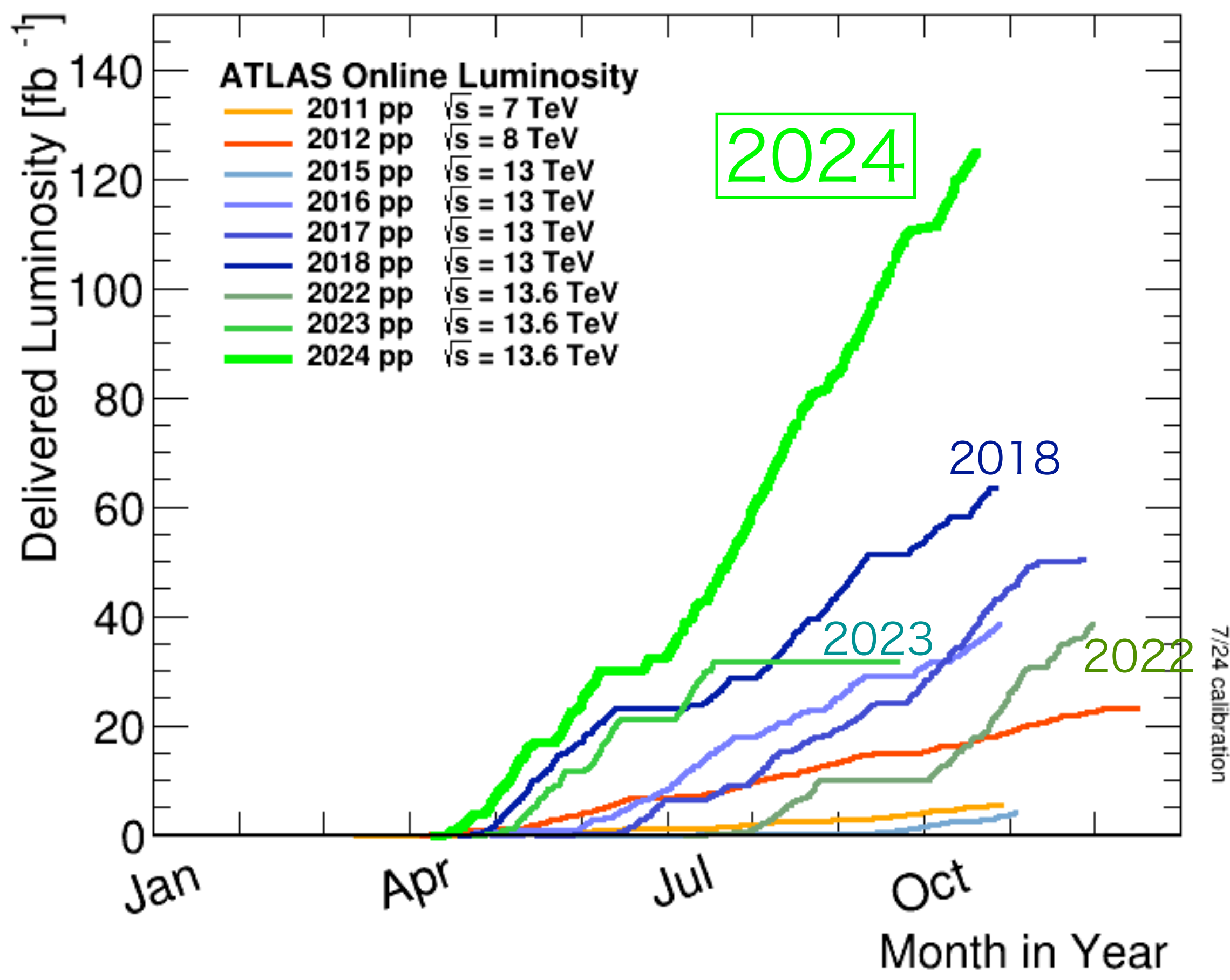
Status report on ATLAS

Focused on KEK/Japanese activities

Makoto Tomoto, KEK IPNS

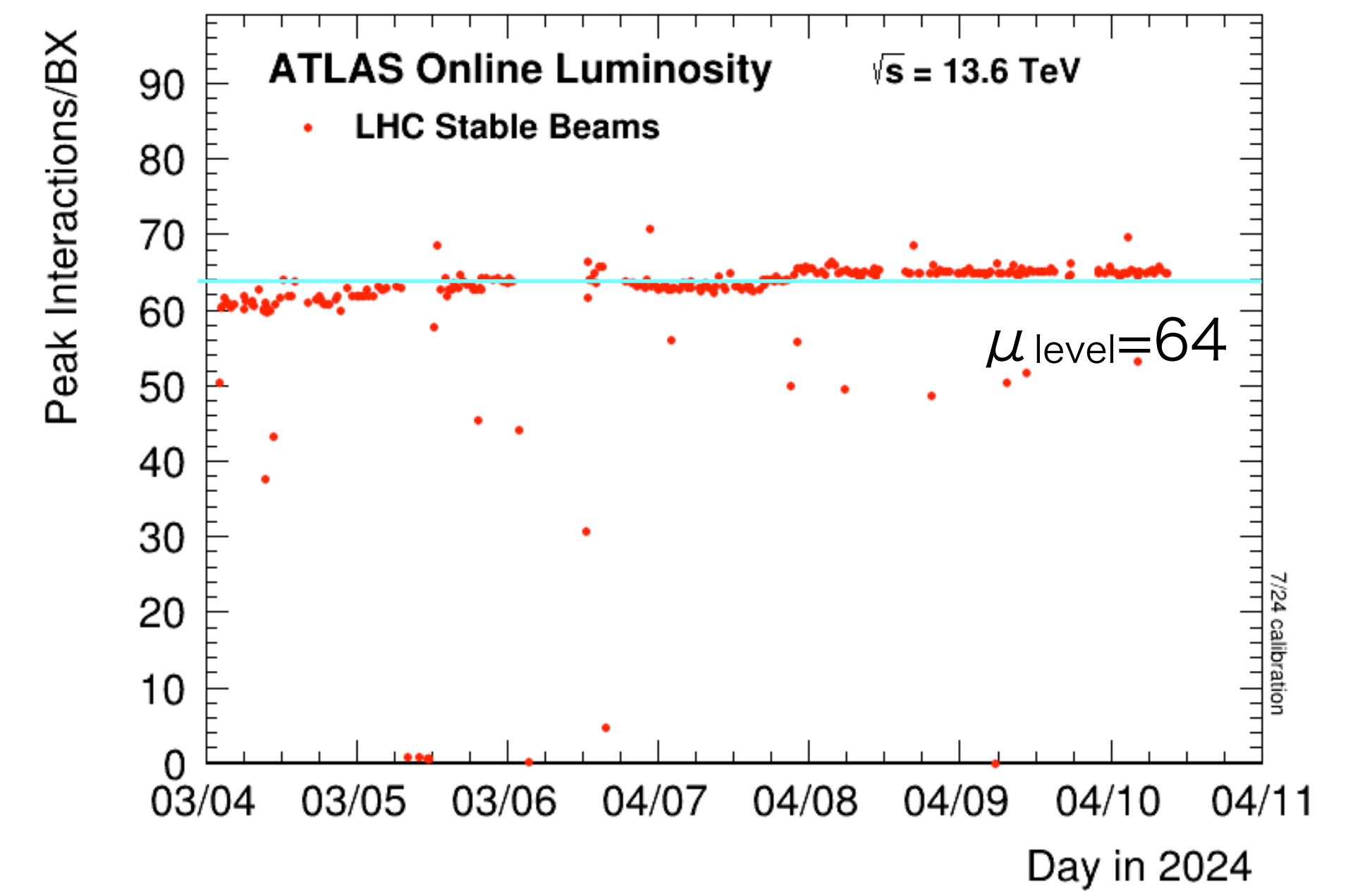
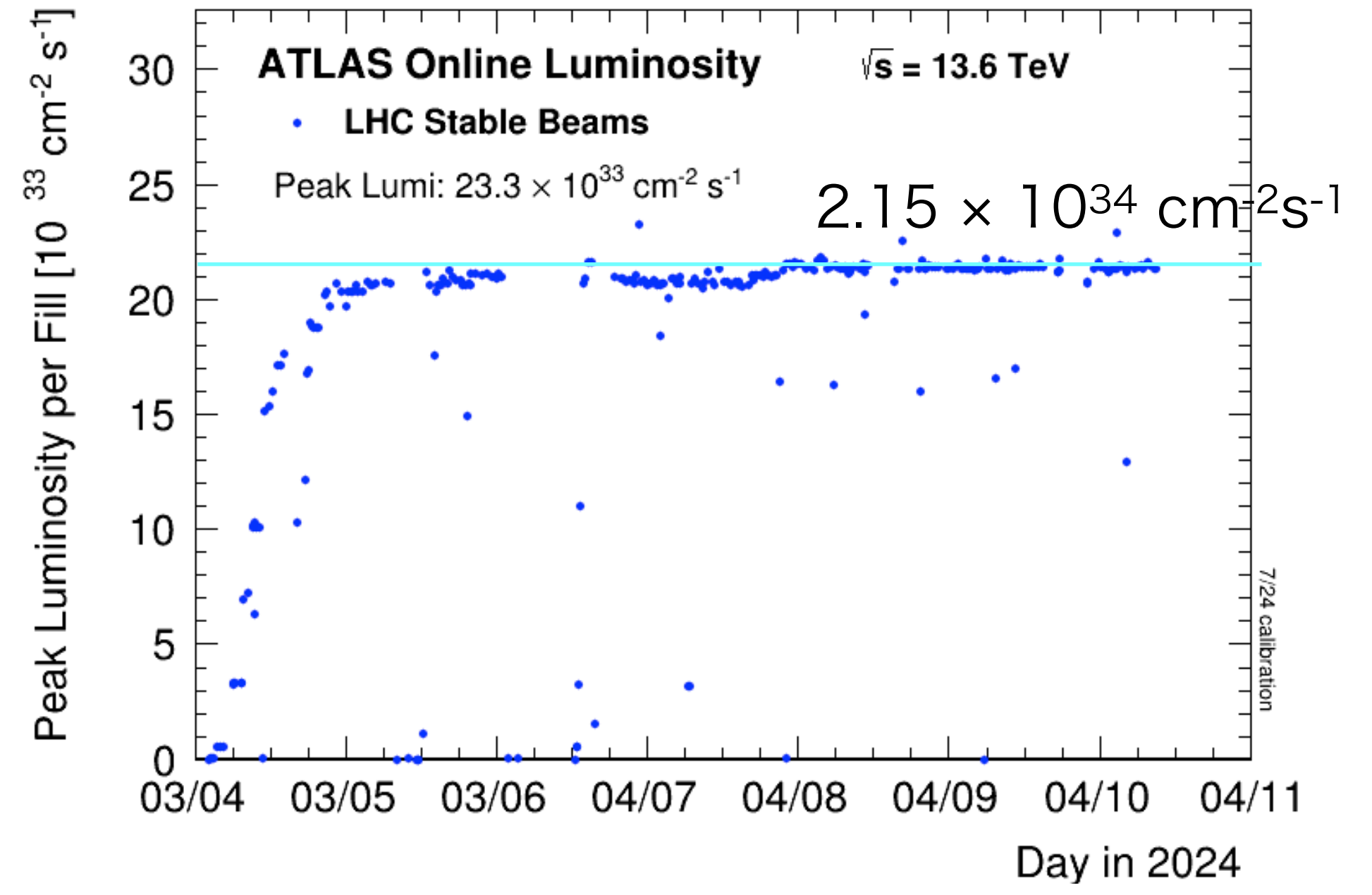
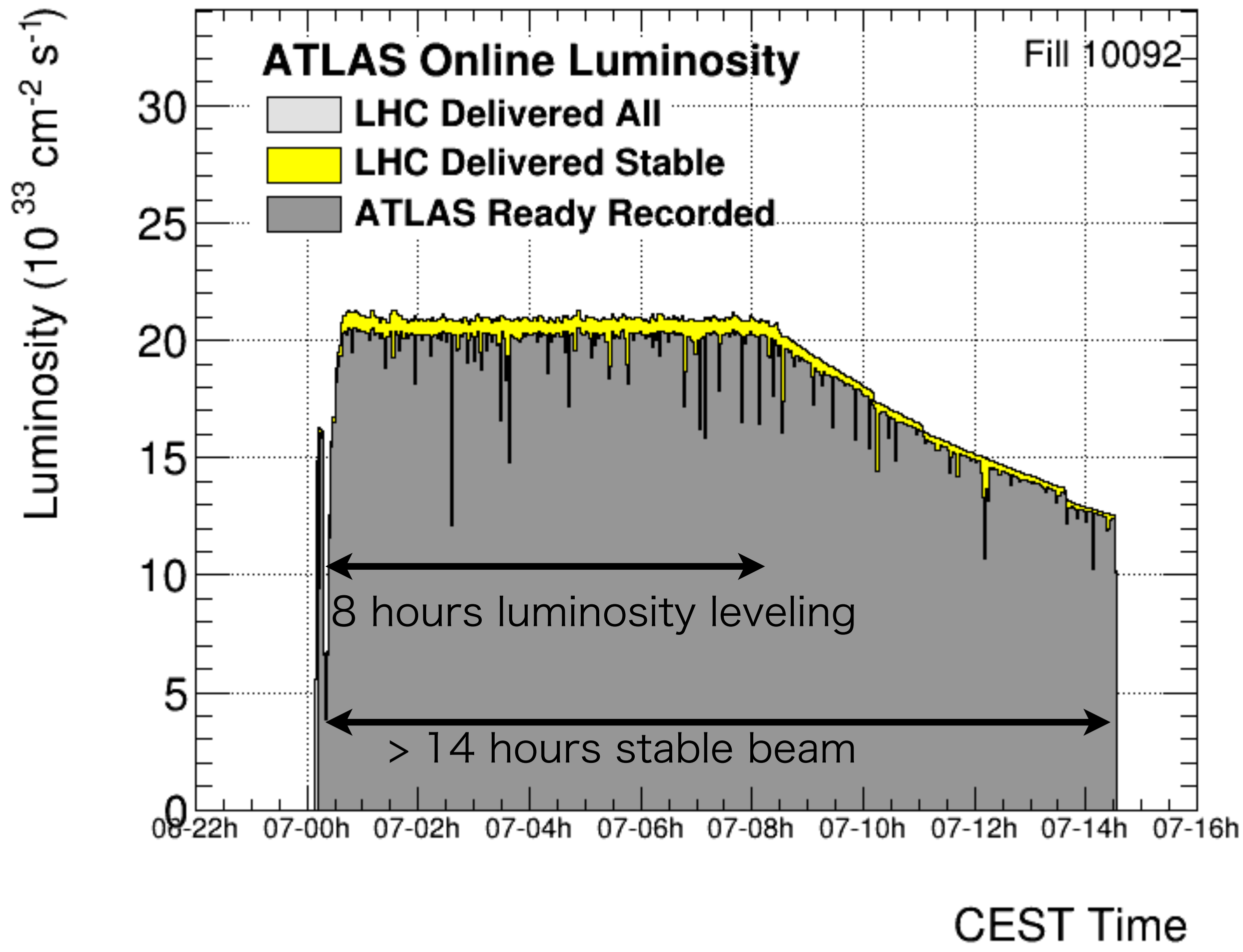
Third year of Run 3 ... an excellent year!

124.7 fb⁻¹ delivered (c.f. target 110 fb⁻¹), 117.6 fb⁻¹ recorded , 94.3% efficiency



Typical fill in 2024

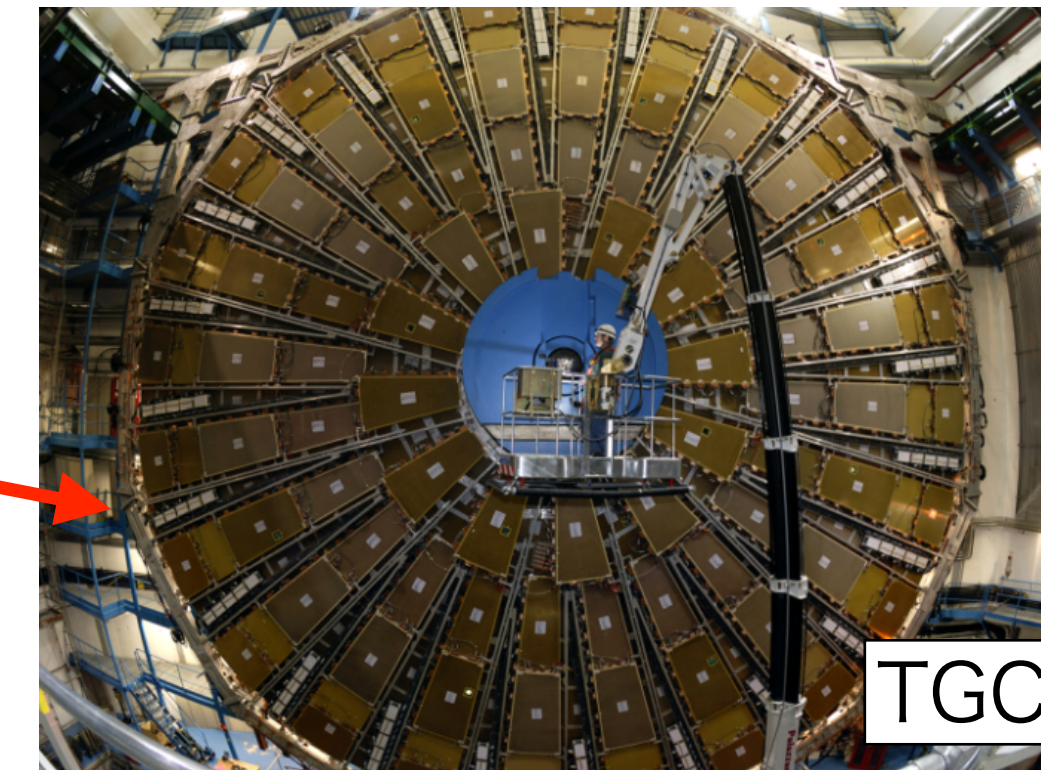
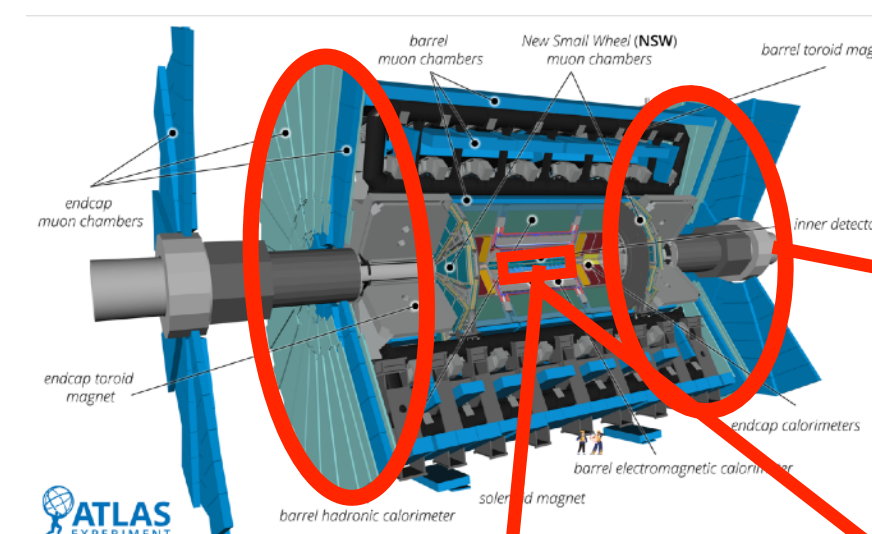
Maximum number of colliding bunches in ATLAS/CMS : 2340
 Peak beam intensity : 1.6×10^{11} protons/bunch
 beta* leveling between 120 and 30 cm



ATLAS Japan

- One of the largest groups in the Japanese high energy physics community
 - 13 institutes
- KEK**, Tsukuba U., U. Tokyo, Waseda U., Science Tokyo, Tokyo Metropolitan U., Ochanomizu U., Shinshu U., Nagoya U., Kyoto U., Osaka U., Kobe U., Kyushu U.
- 70 scientists, ~30 ph.D. and ~50 master students (total ~150 members)
- 85 doctor theses, 416 master theses (by FY2023)
- Contributes to:
 - Construction/Operation of current system
 - Pixel, SCT, (LAr), TGC, HLT
 - Phase-II upgrade
 - ITK-Pixel, ITK-Strip, Endcap muon trigger, HLT
 - Physics analysis and (computing)
- Has close collaboration with the KEK cryogenic center, who contributes to LHC/HL-LHC accelerator magnets and ATLAS solenoid magnet

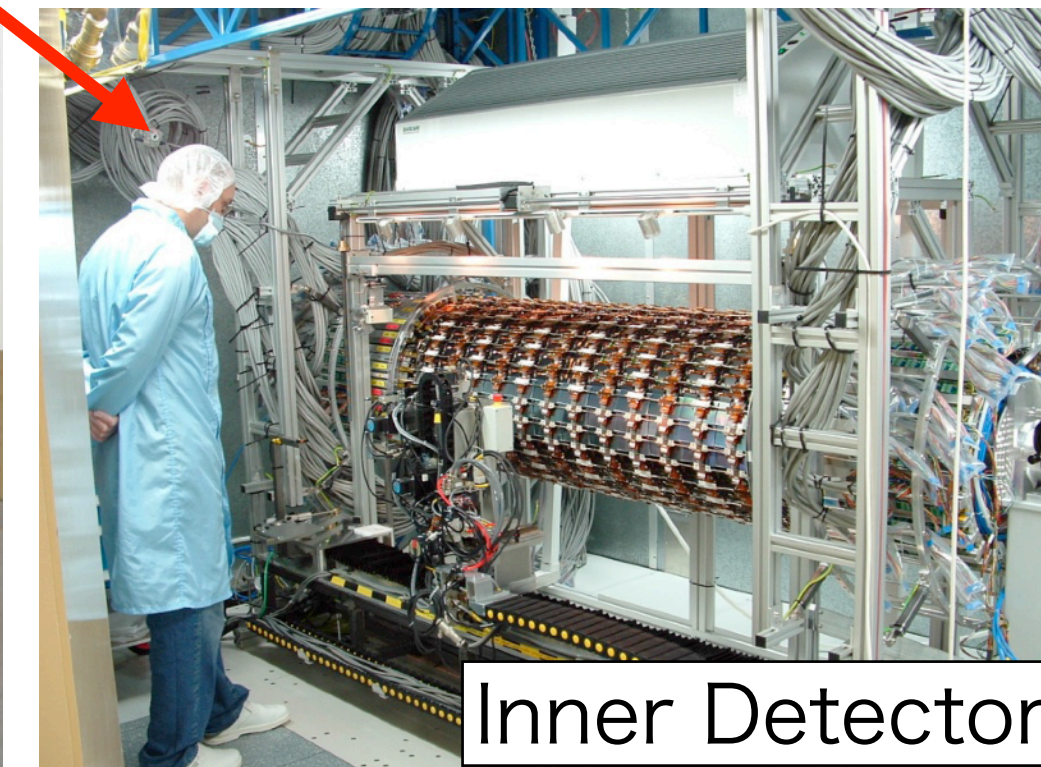
Detector



TGC



Solenoid



Inner Detector



Grid Tier 2 @U. Tokyo

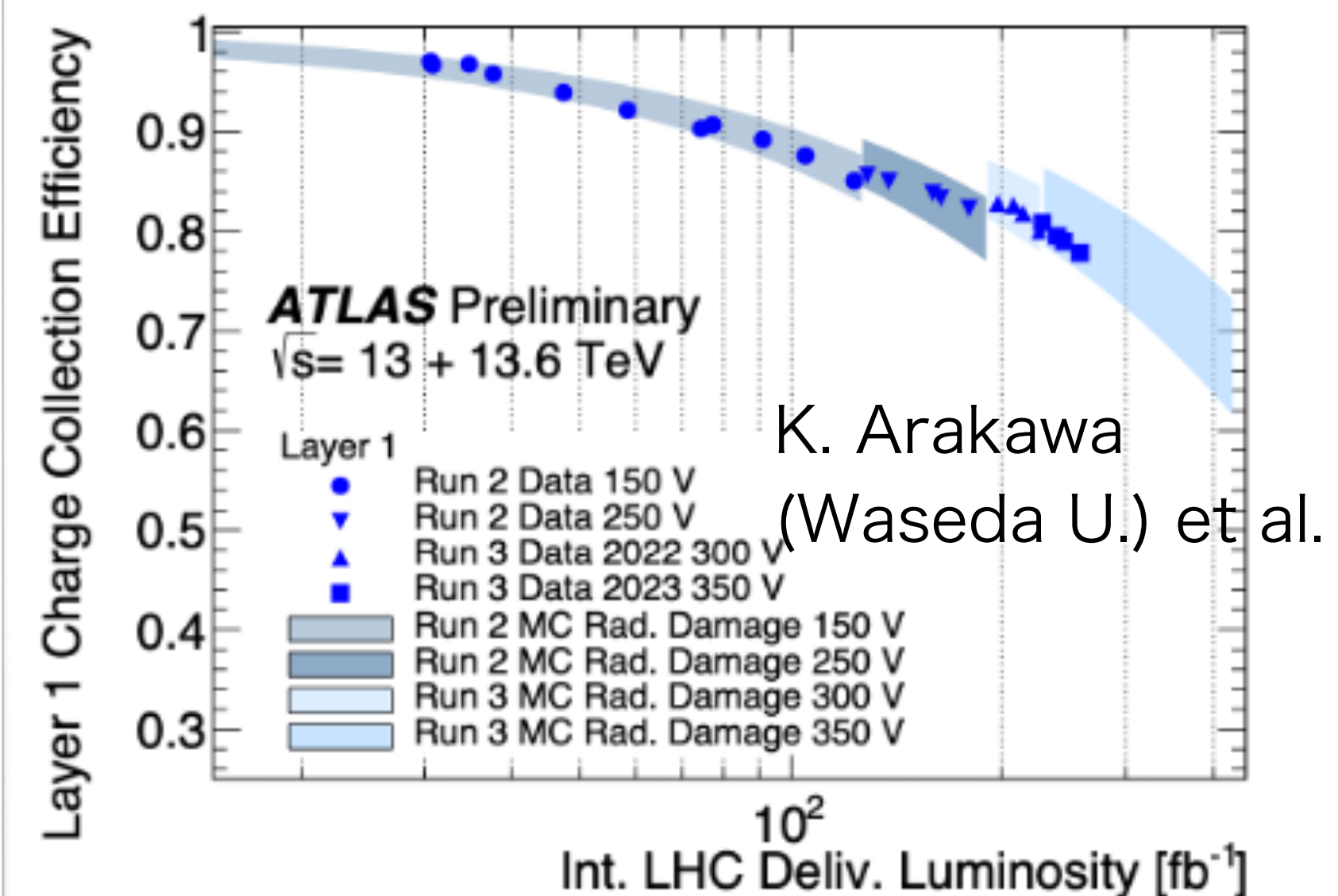


Accelerator

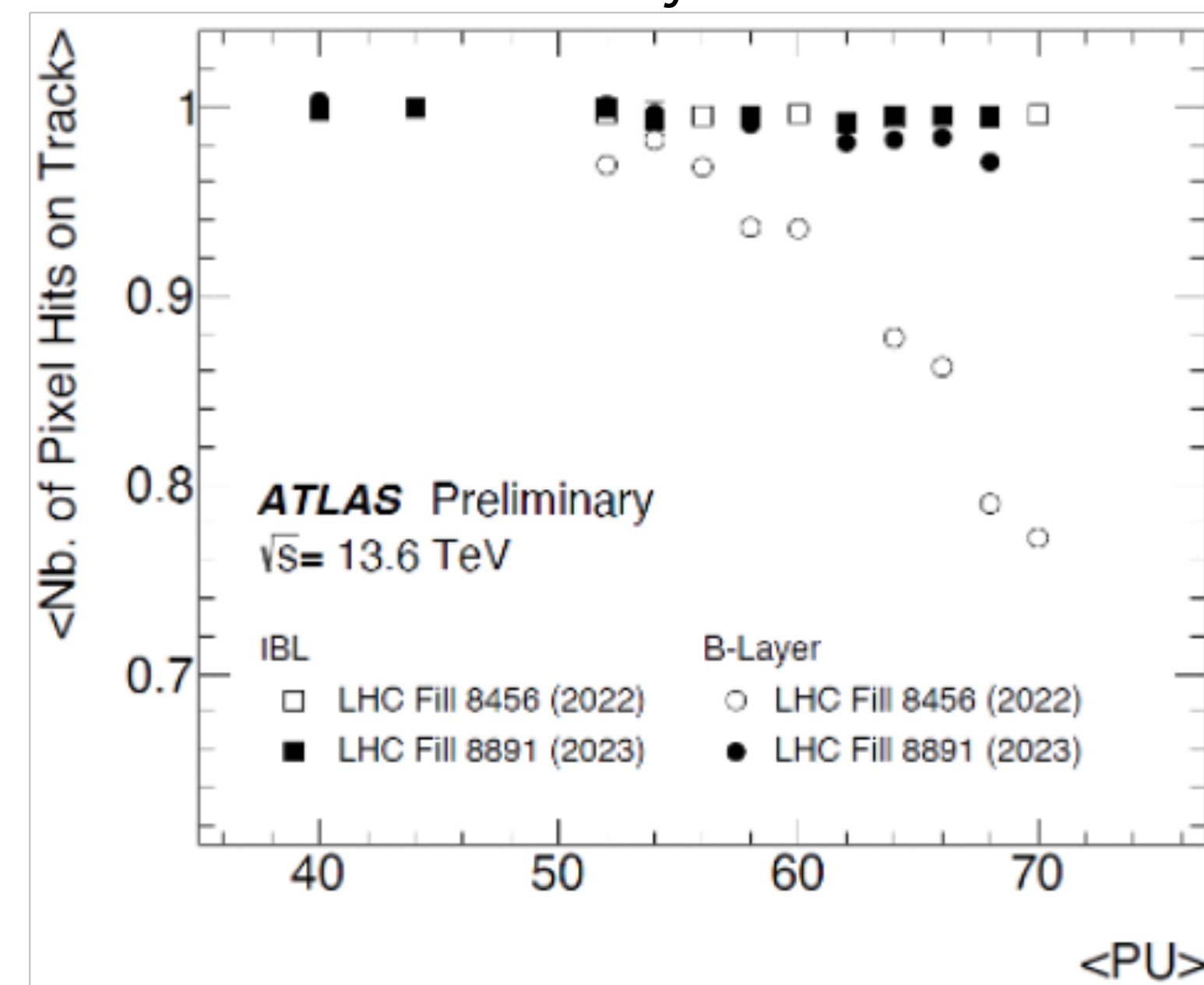
Pixel

- KEK and Japanese institutes lead Data Quality (DQ) and offline software
 - Y. Takubo (KEK, Pixel DQ coordinator)
 - S. Tsuno (KEK, Pixel offline coordinator)
 - Cooperation with Science Tokyo, Ochanomizu U., Waseda U., Tokyo Metropolitan U. is essential.
- Following studies have been done as class-3 tasks and a qualification task
 - Development of Pixel-DQ infrastructure
 - Study of effect of the radiation damage on dE/dx and Lorentz angle
 - Pixel status monitoring with Byte Stream Errors
 - Reduction of the de-synchronization errors at the readout by implementing new functionality
 - Timing adjustment of the whole Pixel module to trigger

Charge Collection efficiency in Run2-3



Reduction of the de-synchronization errors



SCT

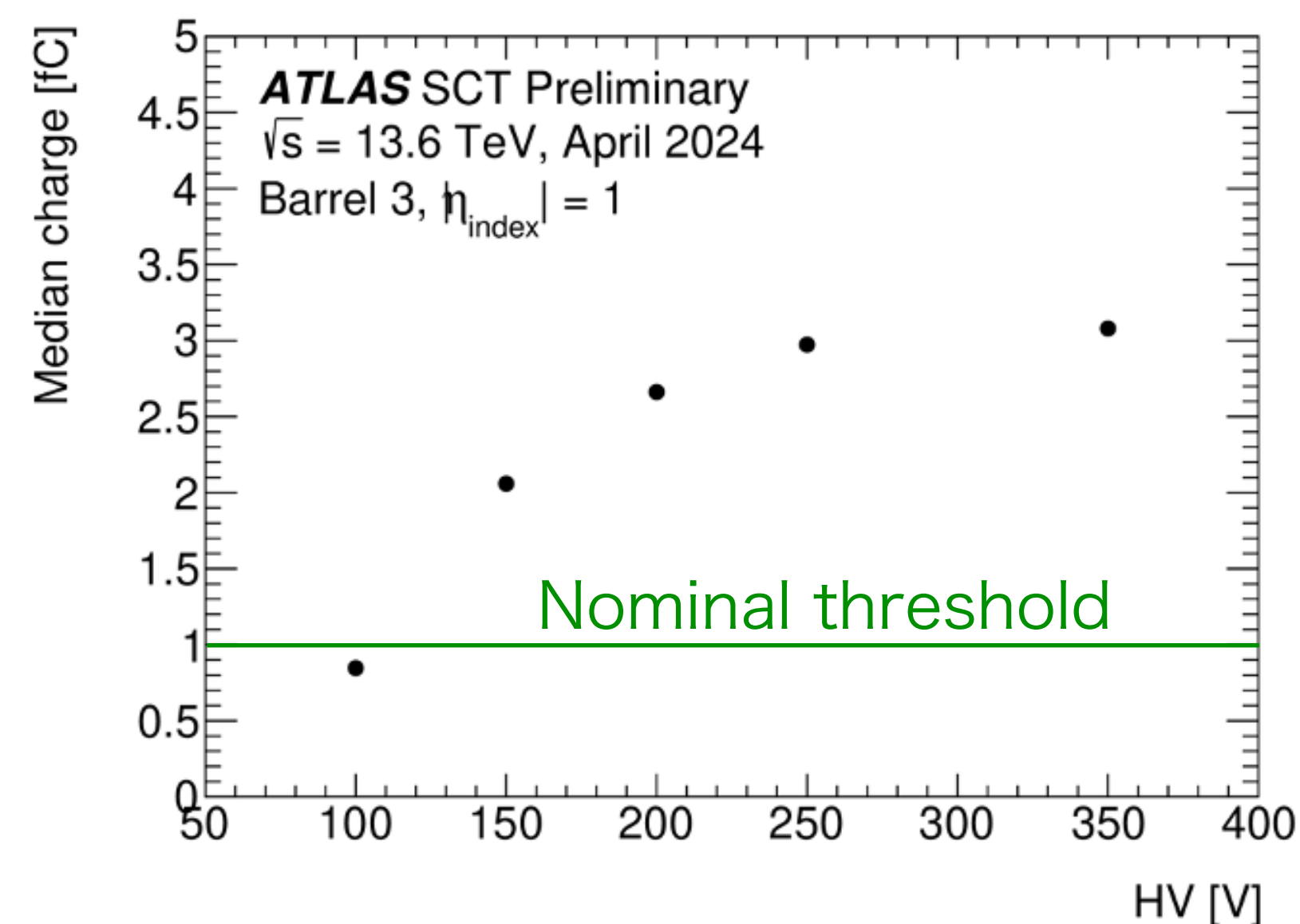
Continuous effort from 6 Japanese institutes for the successful operation in 2024

- Two students based at CERN commit on daily operation and performance evaluation
 - Daiya Akiyama (Waseda)
 - Sayuka Kita (Tsukuba)
- A few more students based in Japan participate in depth offline analysis
- Significant shifts both on-call and remote has been taken
 - Fraction covered by Japanese institutes is quite high
DAQ/DCS on-call : 60%, DQ remote : 23%, DQ expert : 97%



Achieved DAQ/DQ efficiency as high as more than 99% in 2024

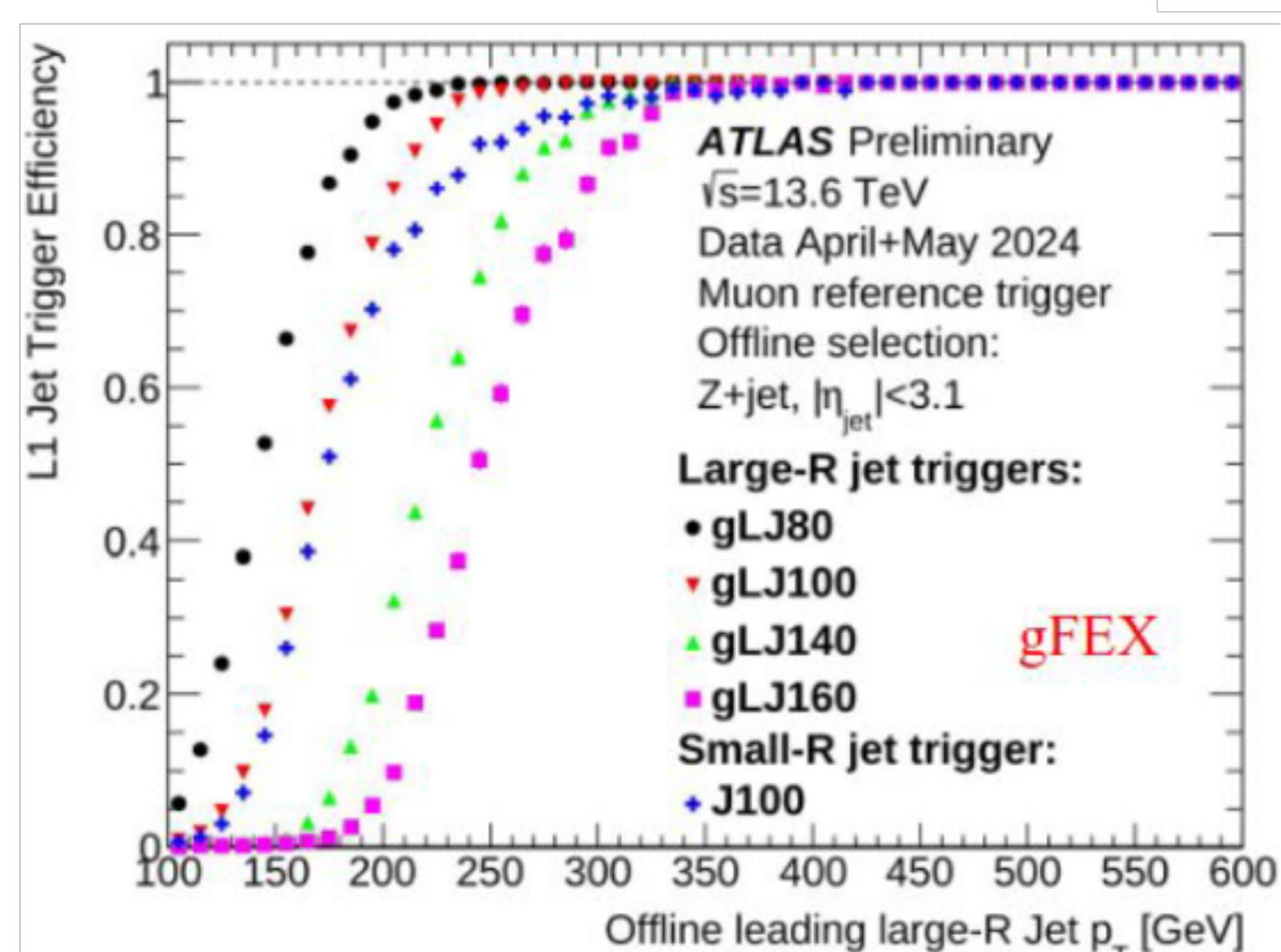
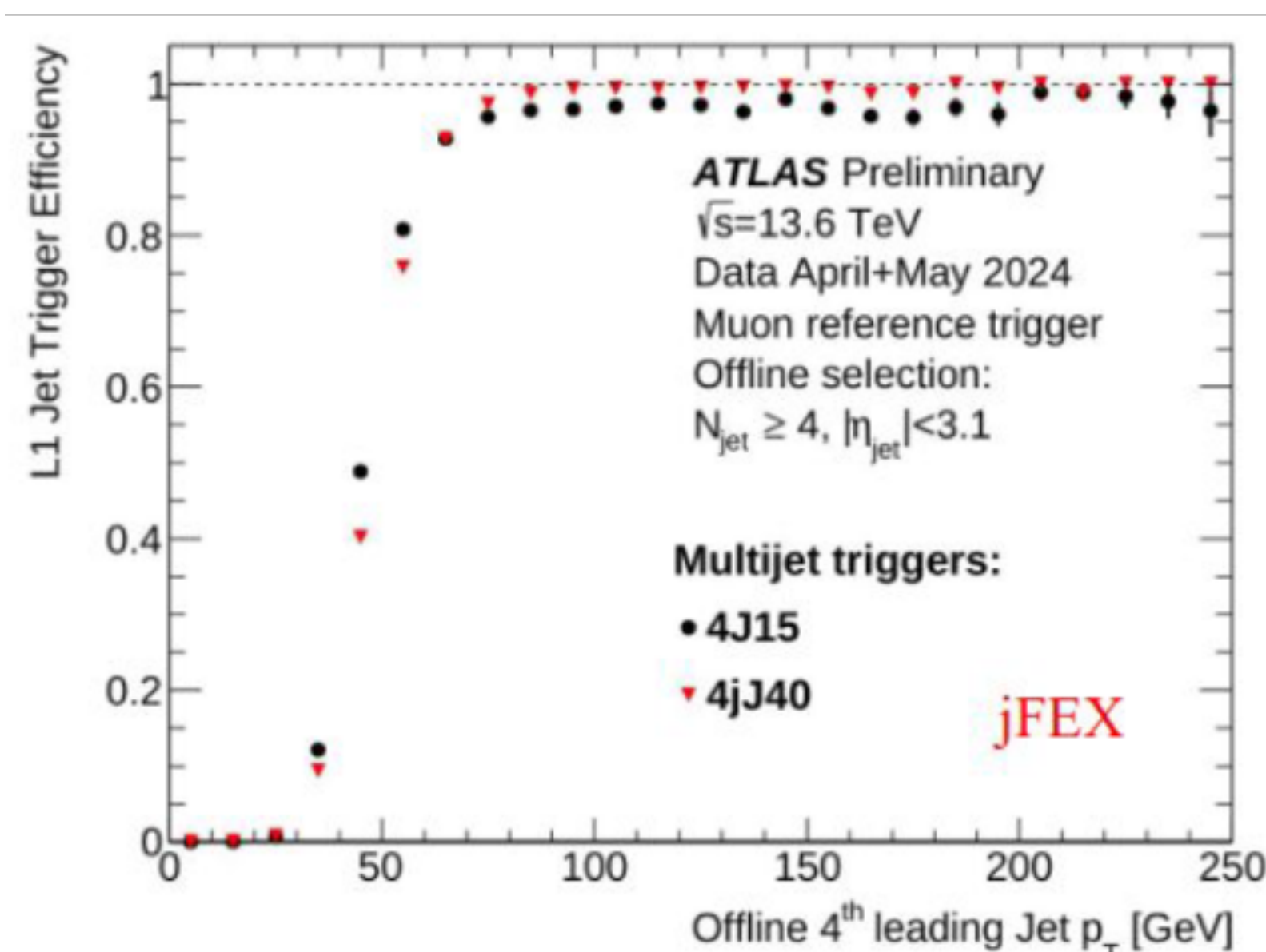
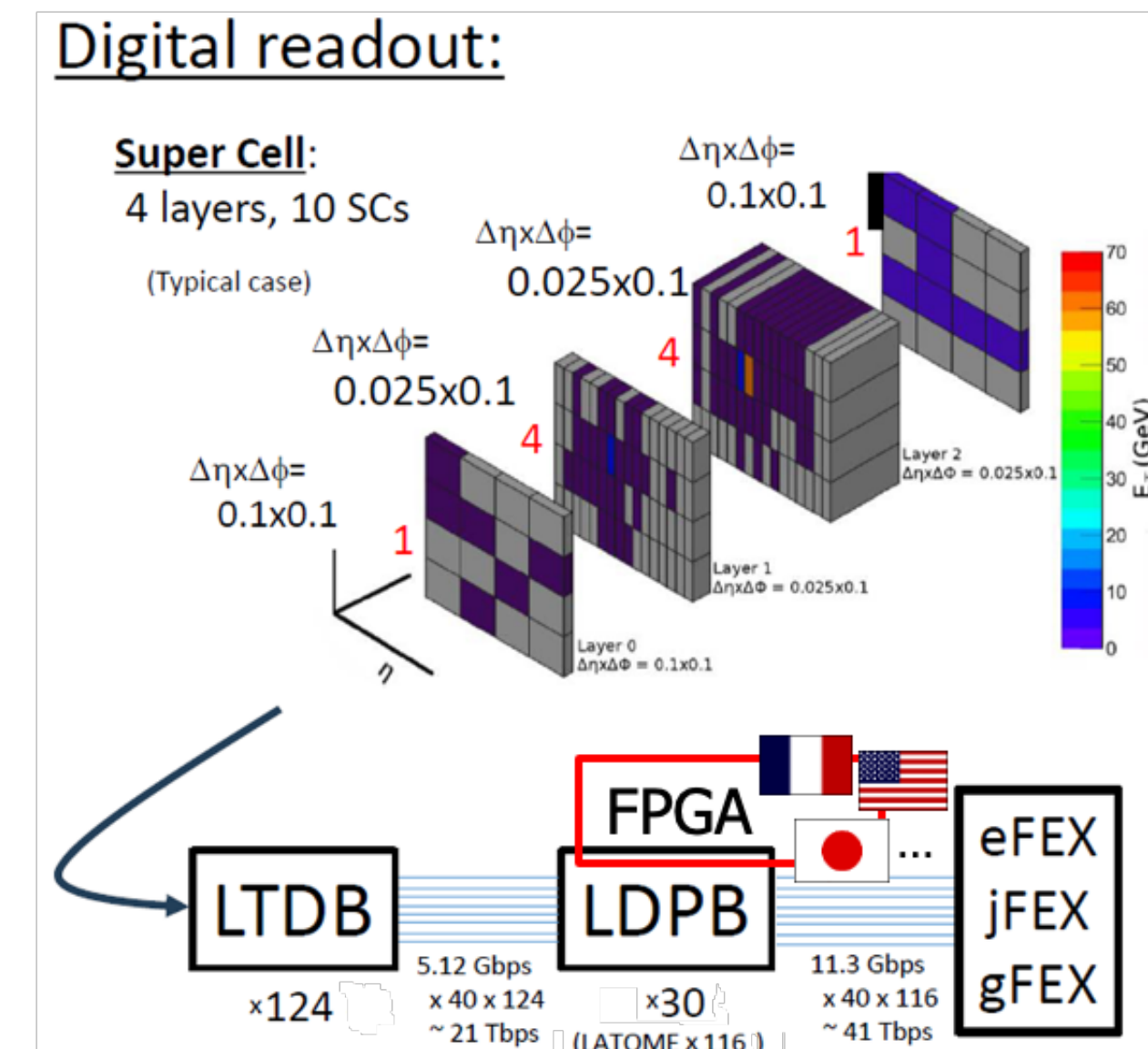
- Resolve intermittent ROD busy(s) by narrowing down the root cause in TTC Interface module (TIM) (fixed end of August)
- Find and improve several bugs/features of treatment Byte Stream errors, both in DQ and offline
- Keep track of radiation damage effect by regular or special calibrations toward end of Run 3
- Develop web based support tools (PAT) integrating useful calibrations toward end of Run 3



LAr Calorimeter Digital Trigger

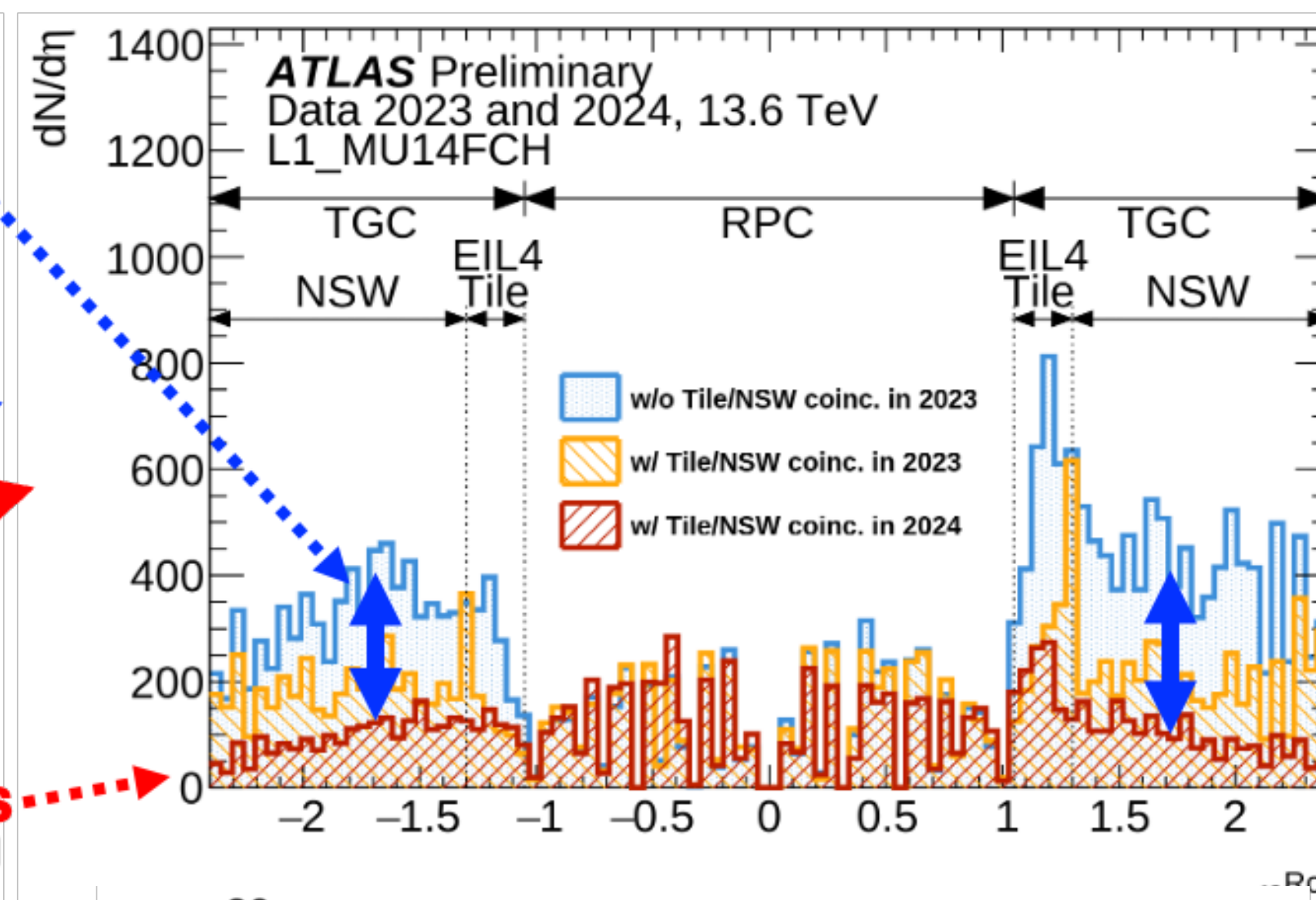
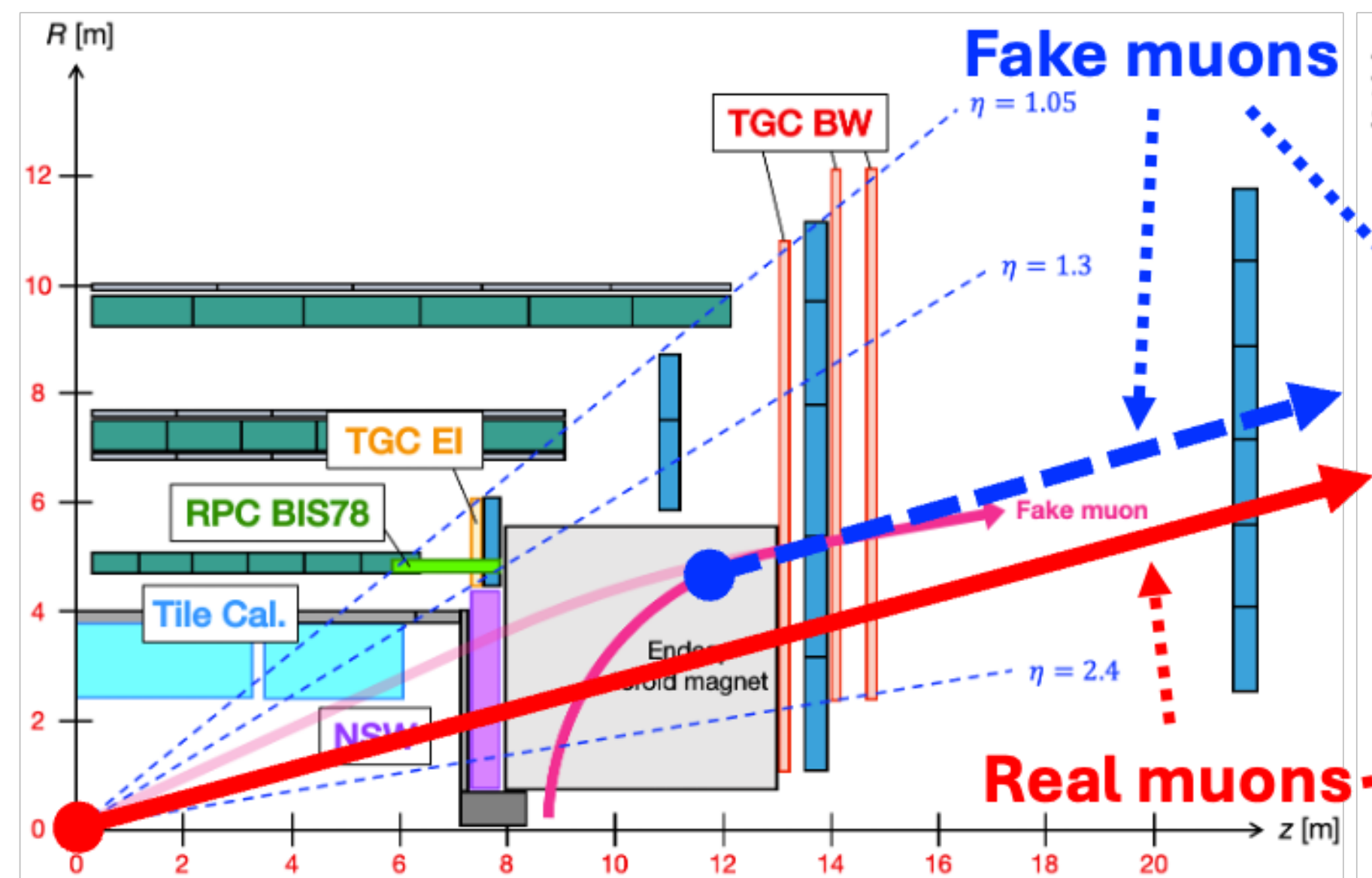
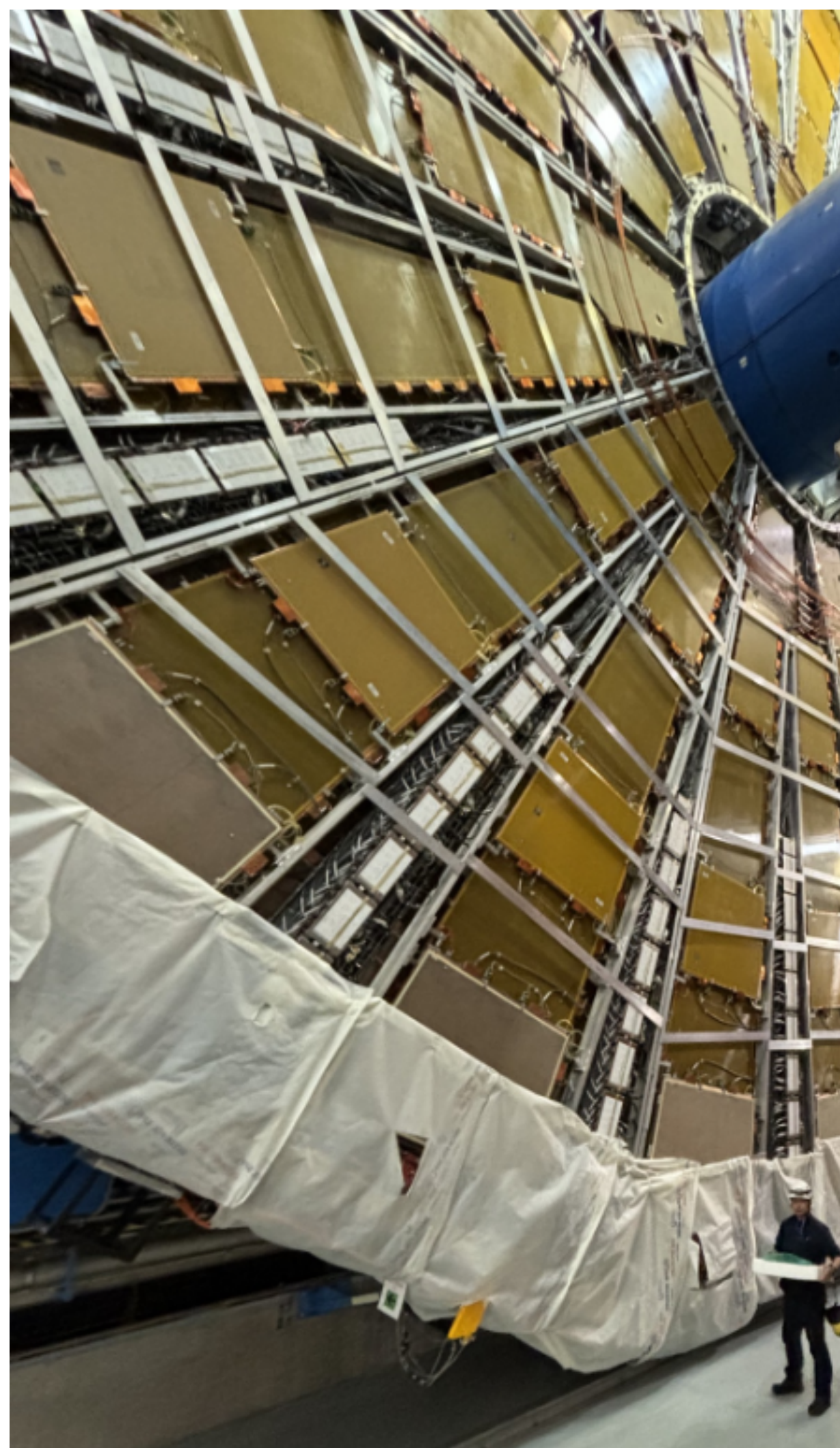
U.of Tokyo works for the LAr Calorimeter operation including R&D improvement
Operation

- The **digital trigger** system has become the default in 2024.
 - eFEX ... super cell, for electron/gamma from 2023
 - jFEX ... combined to 0.1×0.1 , for small-R jet **from 2024**
 - gFEX ... combined to 0.2×0.2 , for MET, large-R jet **from 2024**
 - Many shifts taken by CERN-based graduate students from Japan
 - Software on-call: Zang, Furukawa, ACR: Zhang, Zang, Furukawa, Wu
- FPGA firmware of the digital trigger for Heavy Ion runs**

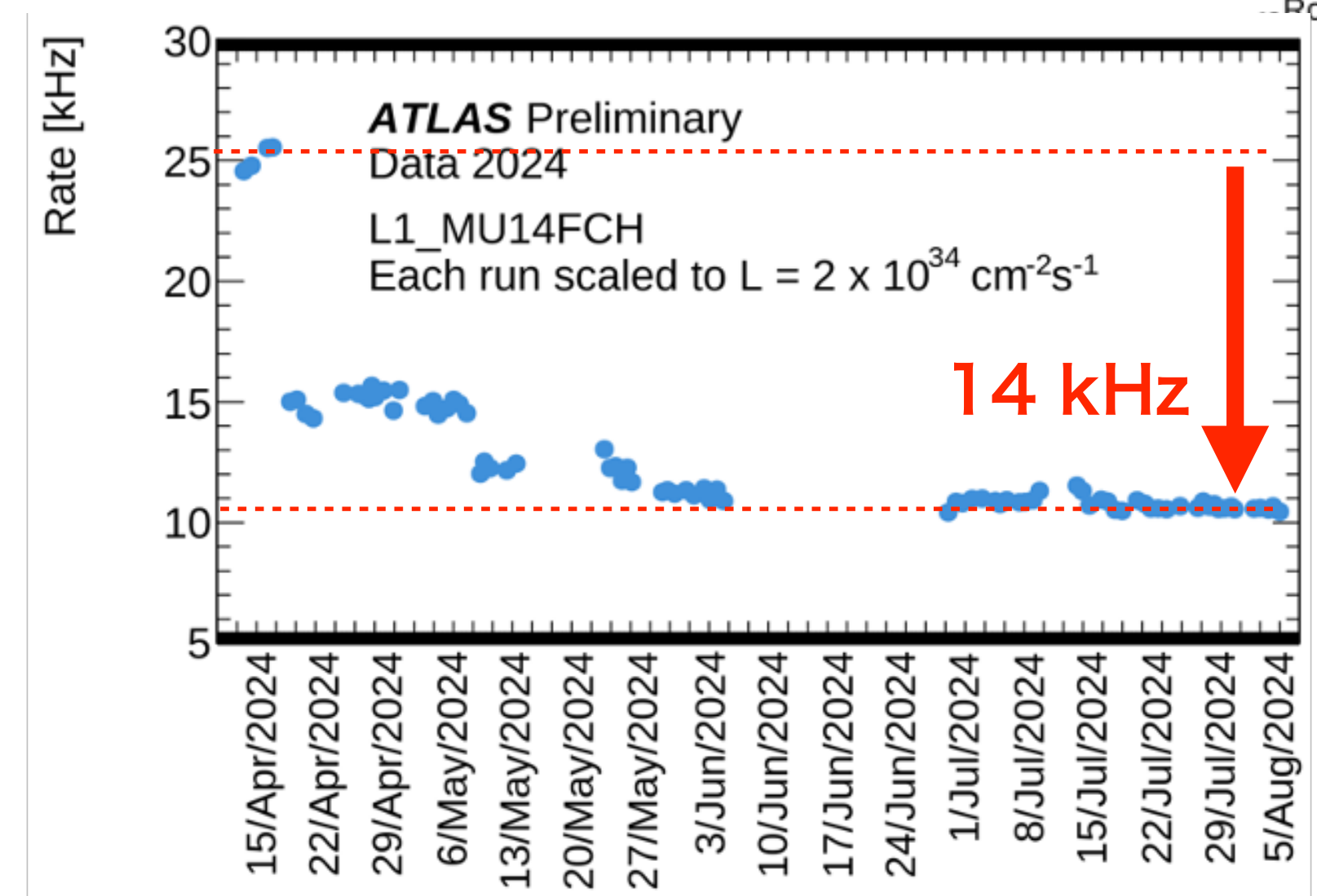


Endcap Muon Trigger

Japan is responsible for the operation of the TGC detector and the endcap muon trigger



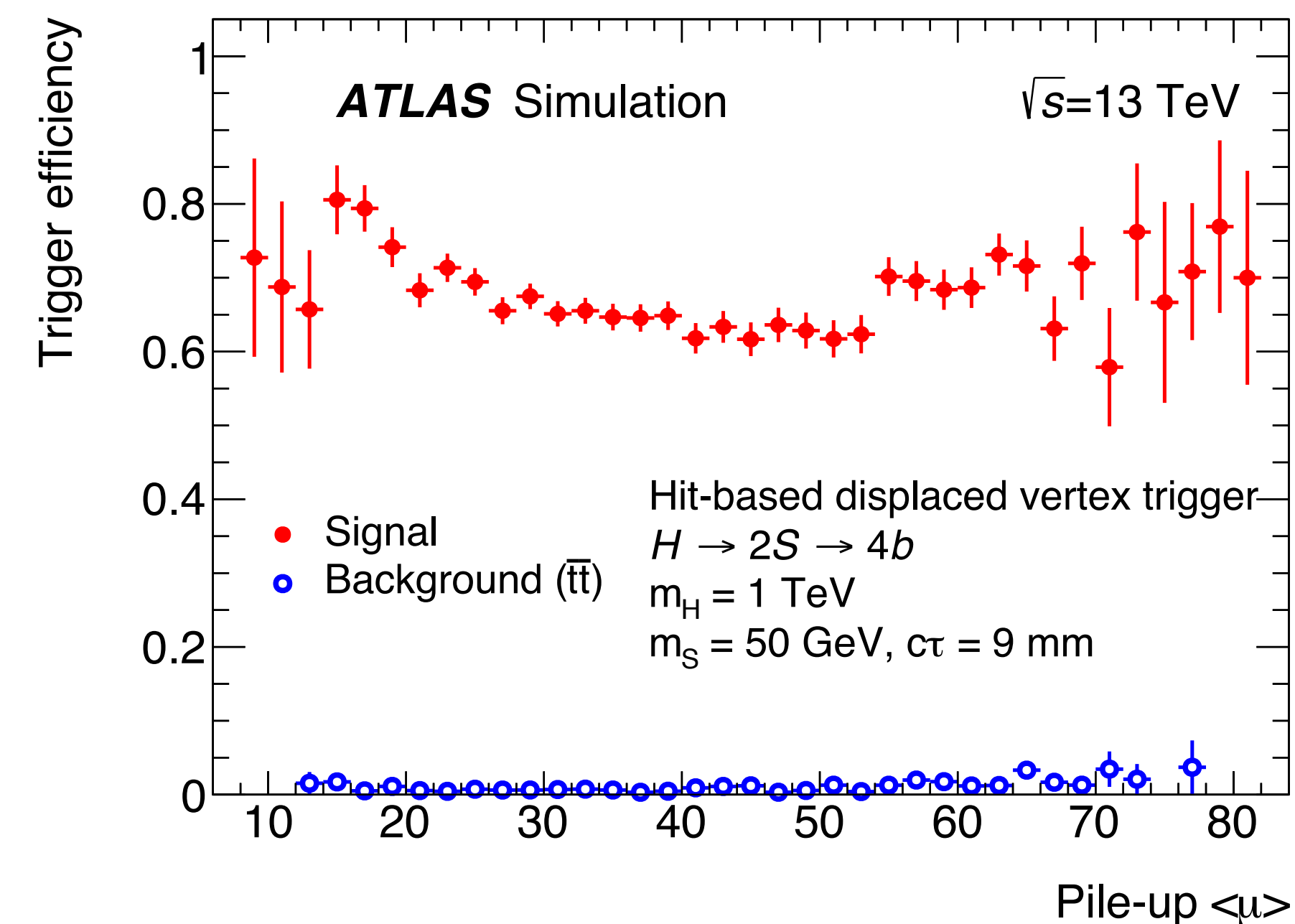
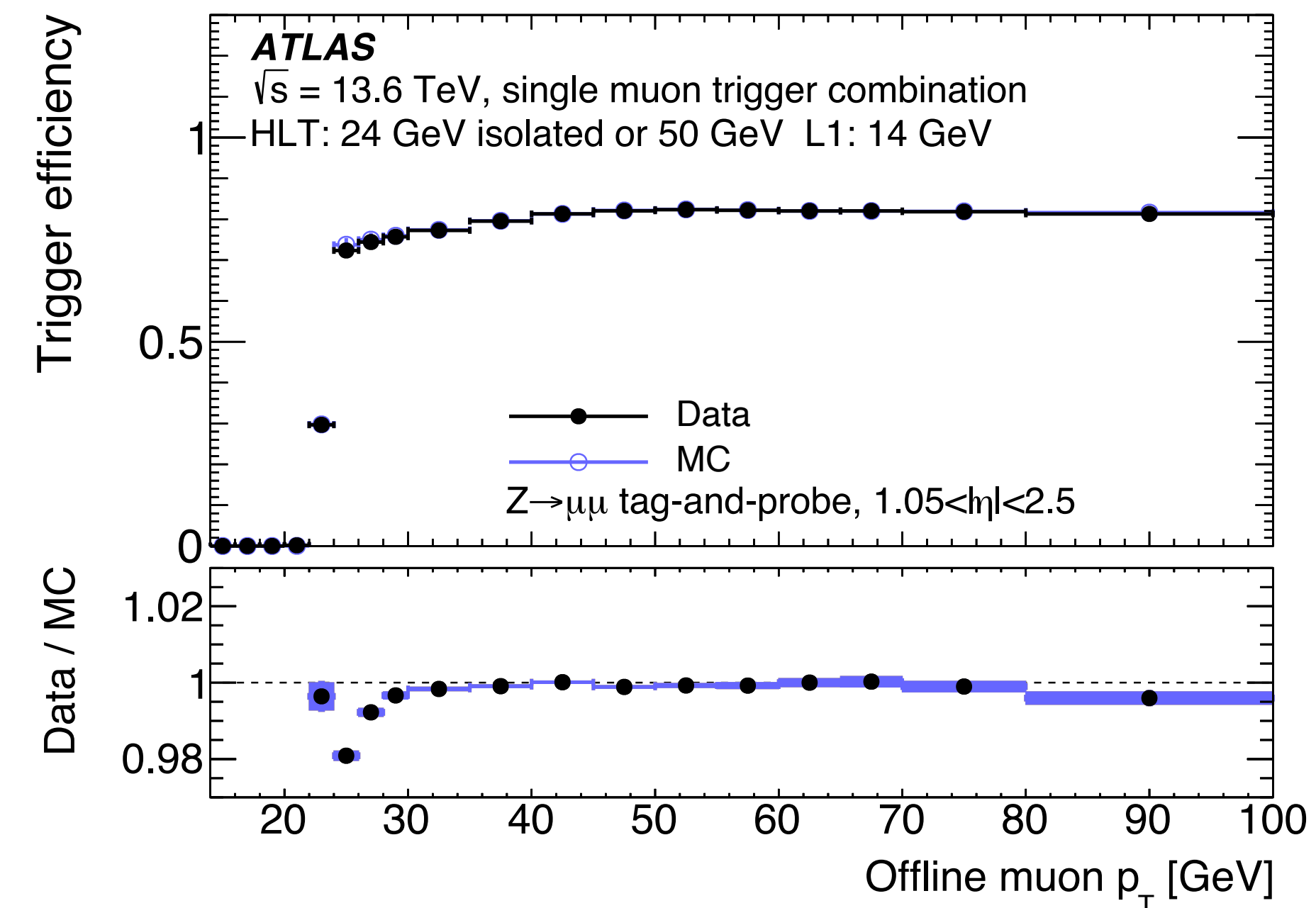
- 100% activation of TGC-NSW coincidence is achieved (c.f. 70% in 2023)
- Reducing L1A rate by 14 kHz enables ATLAS to safely run at a higher μ of 64



High Level Trigger

ATLAS Japan has been significantly contributing to:

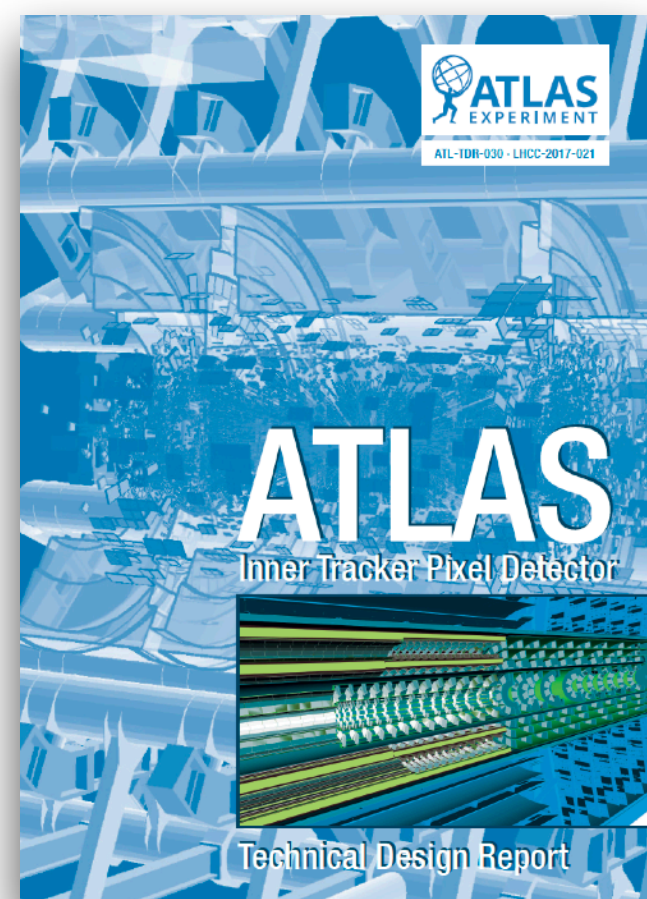
- High-Level muon trigger
 - Fast muon-standalone reconstruction algorithm development and operation
- Inner Detector Tracking Trigger
- Physics-motivated trigger developments
 - Track triggers for long-lived particles
 - $HH \rightarrow bbbb$, $bb \tau \tau$ triggers with the delayed stream
- Coordination roles in various areas
 - Muon trigger signature convener
 - Trigger Operation coordinator



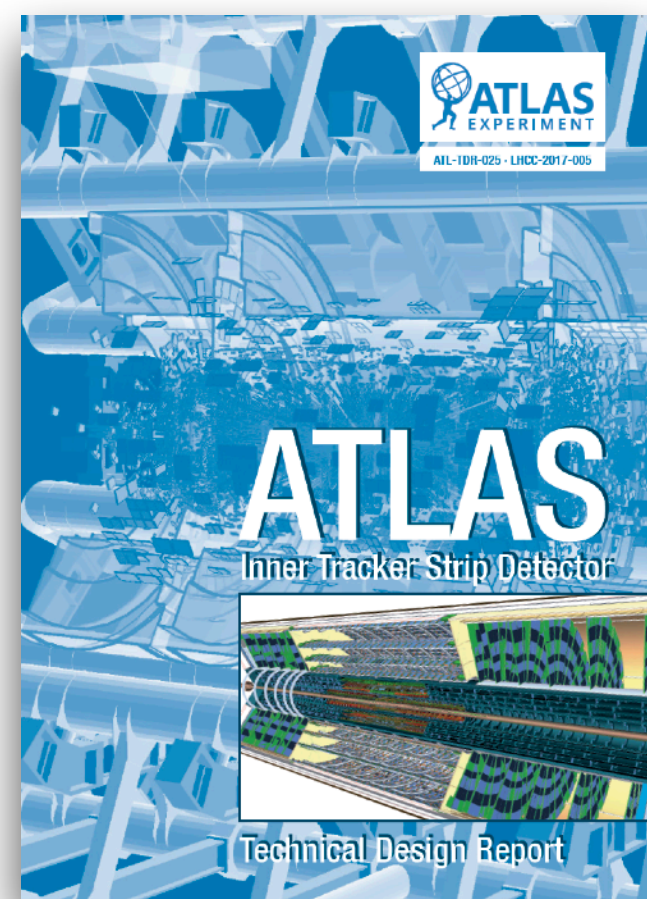
Phase-II upgrade

Contributed by Japan

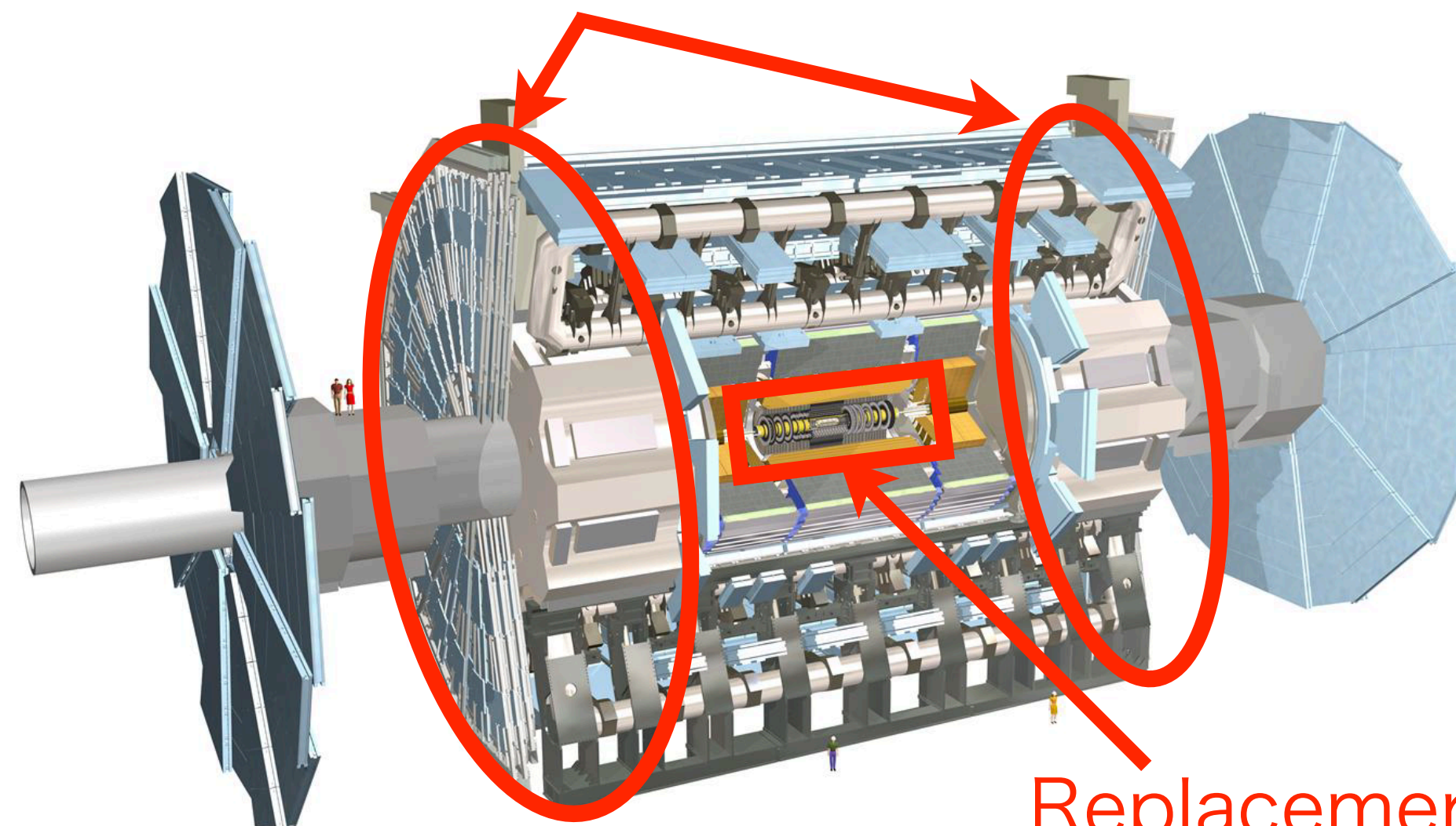
Replacement of the endcap muon trigger electronics



Pixel: 482 page



Strip: 556 page

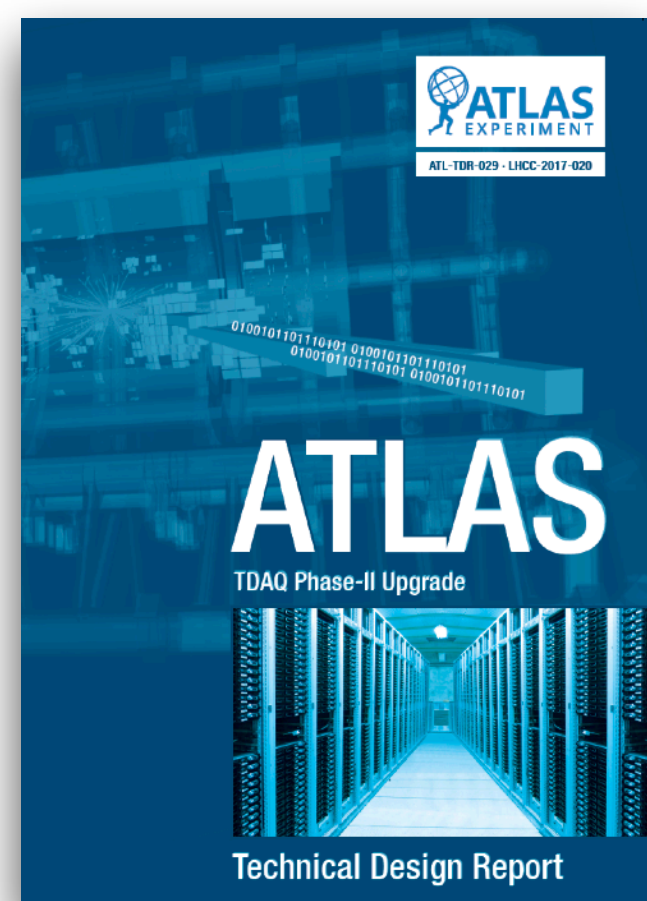


High Level Trigger Upgrade (Muon, Tracking)

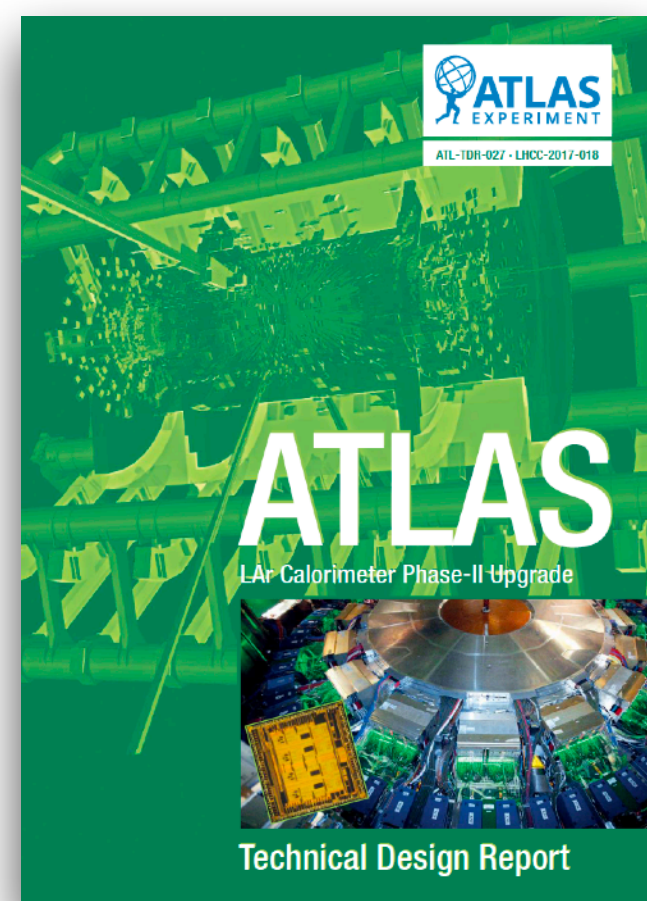
Replacement of the Inner Tracker



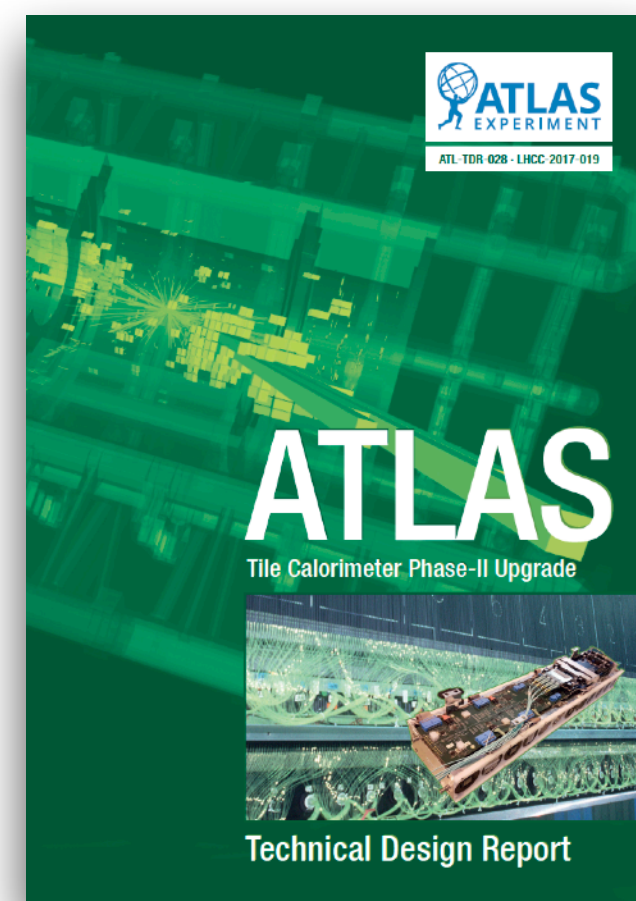
Muon: 408 page



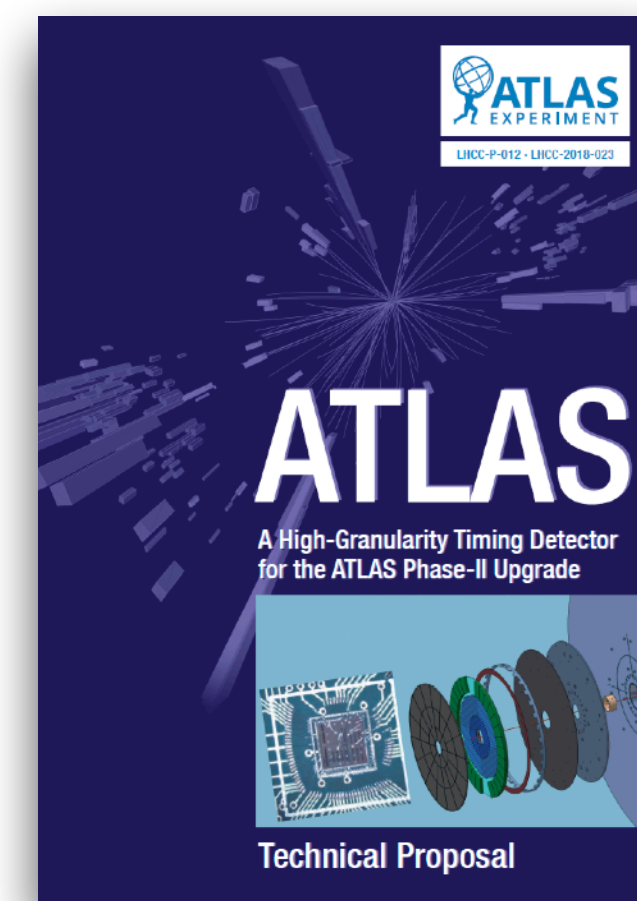
TDAQ: 608 page



LAr: 271 page



Tile: 300 page

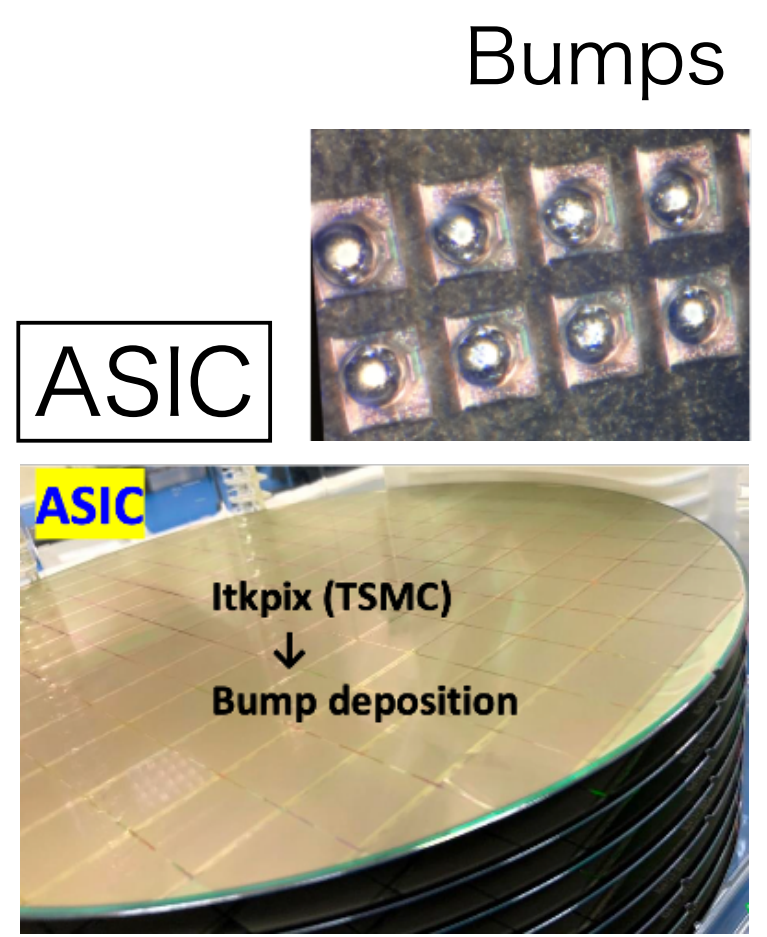


HGTD: 154 page

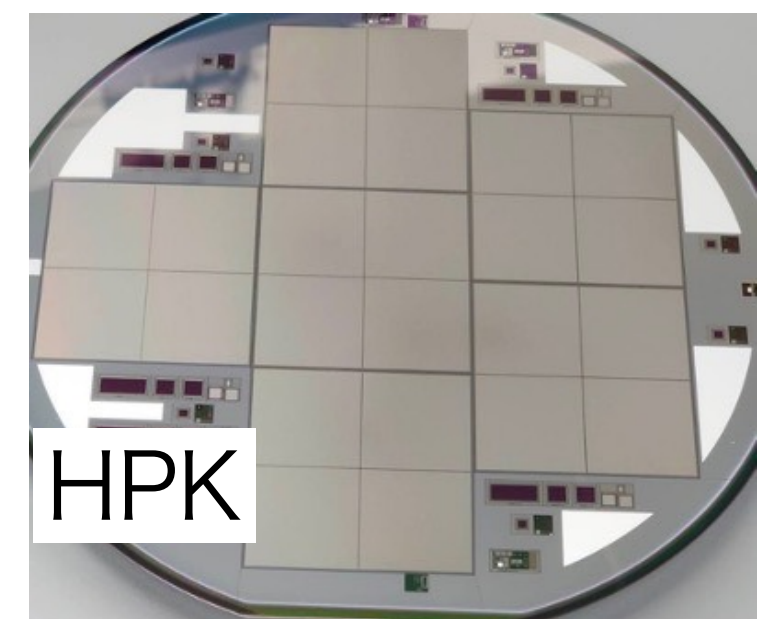
ITK Pixel module production flow

Japan will make ~2,800 modules
→ 7 modules / day in production

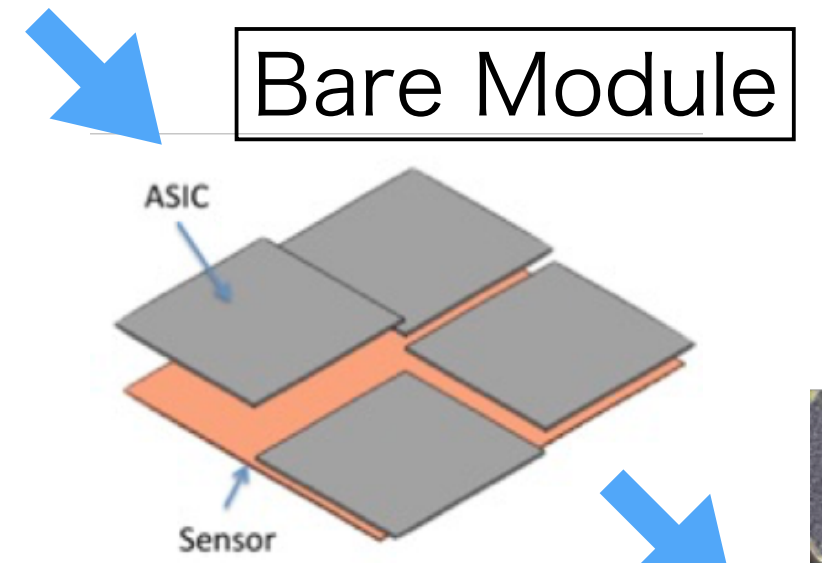
“Hybridization”
PRR was passed
Production has been
started carefully for
bump deposition



Assembly by company

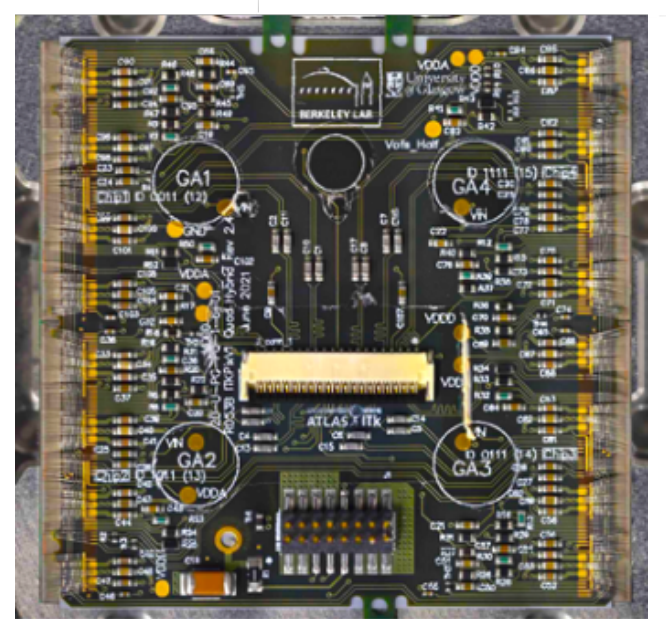


In production
~80% finished

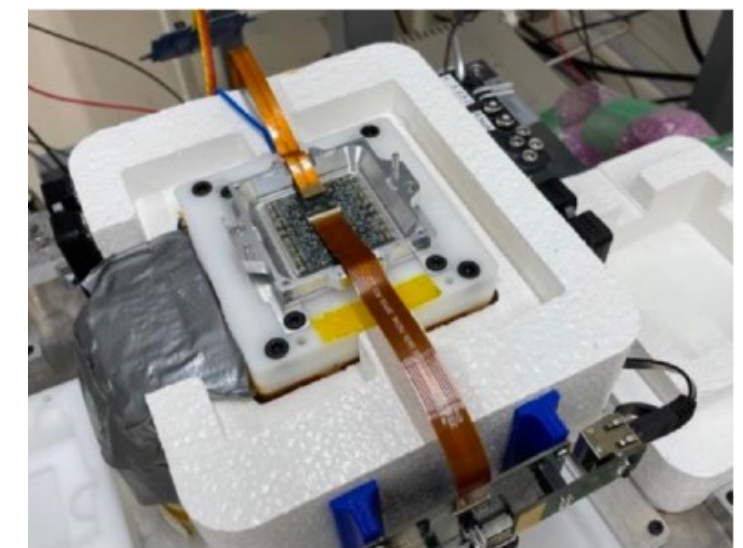


Flex PCB

“Assembly”
Preparation for the
production

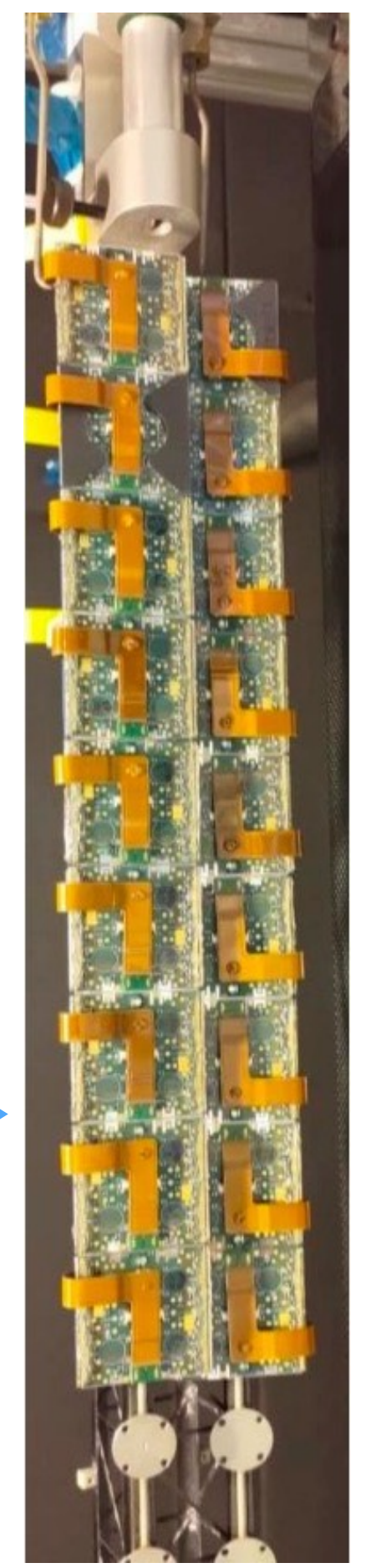


transport to CERN



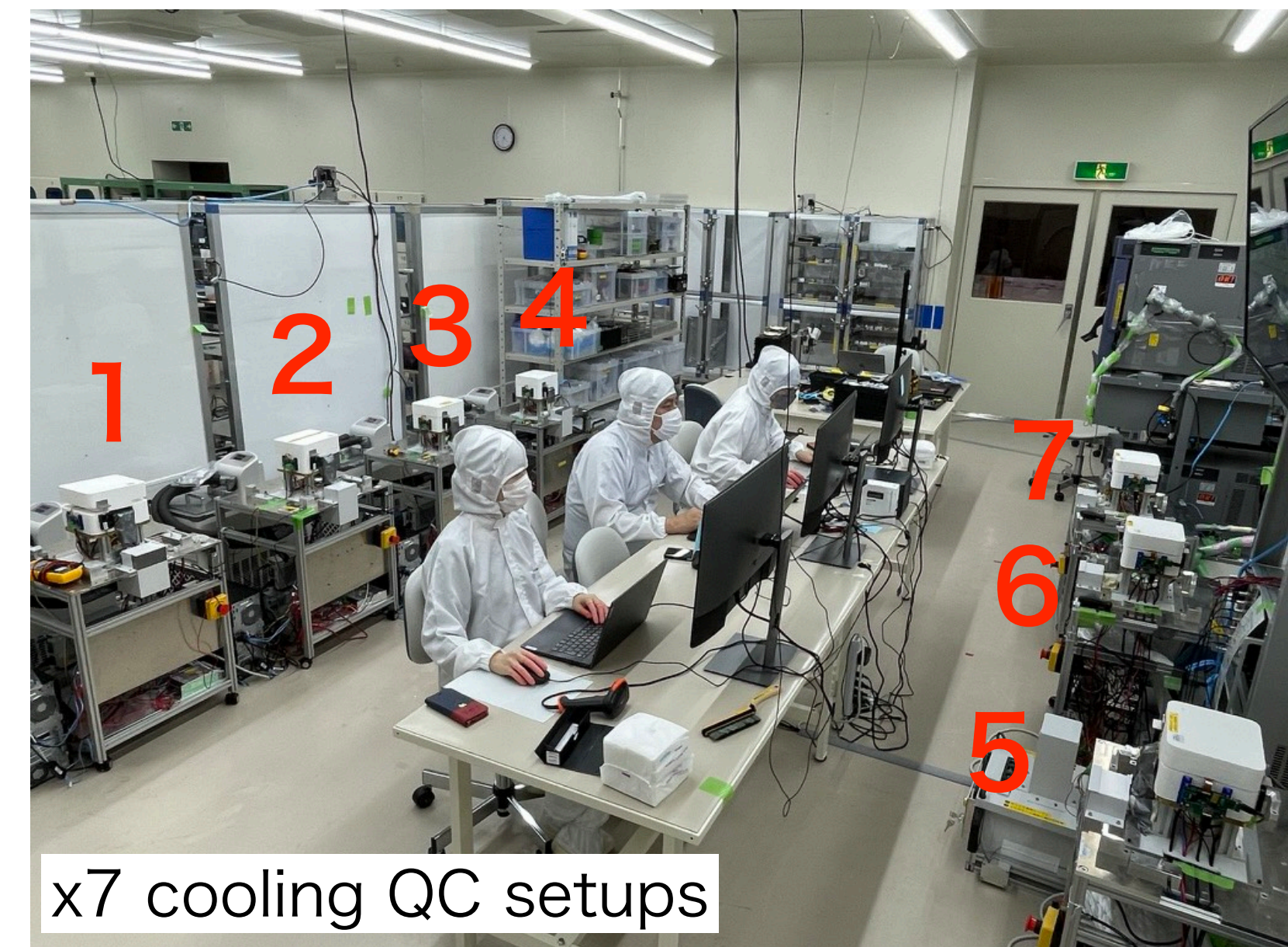
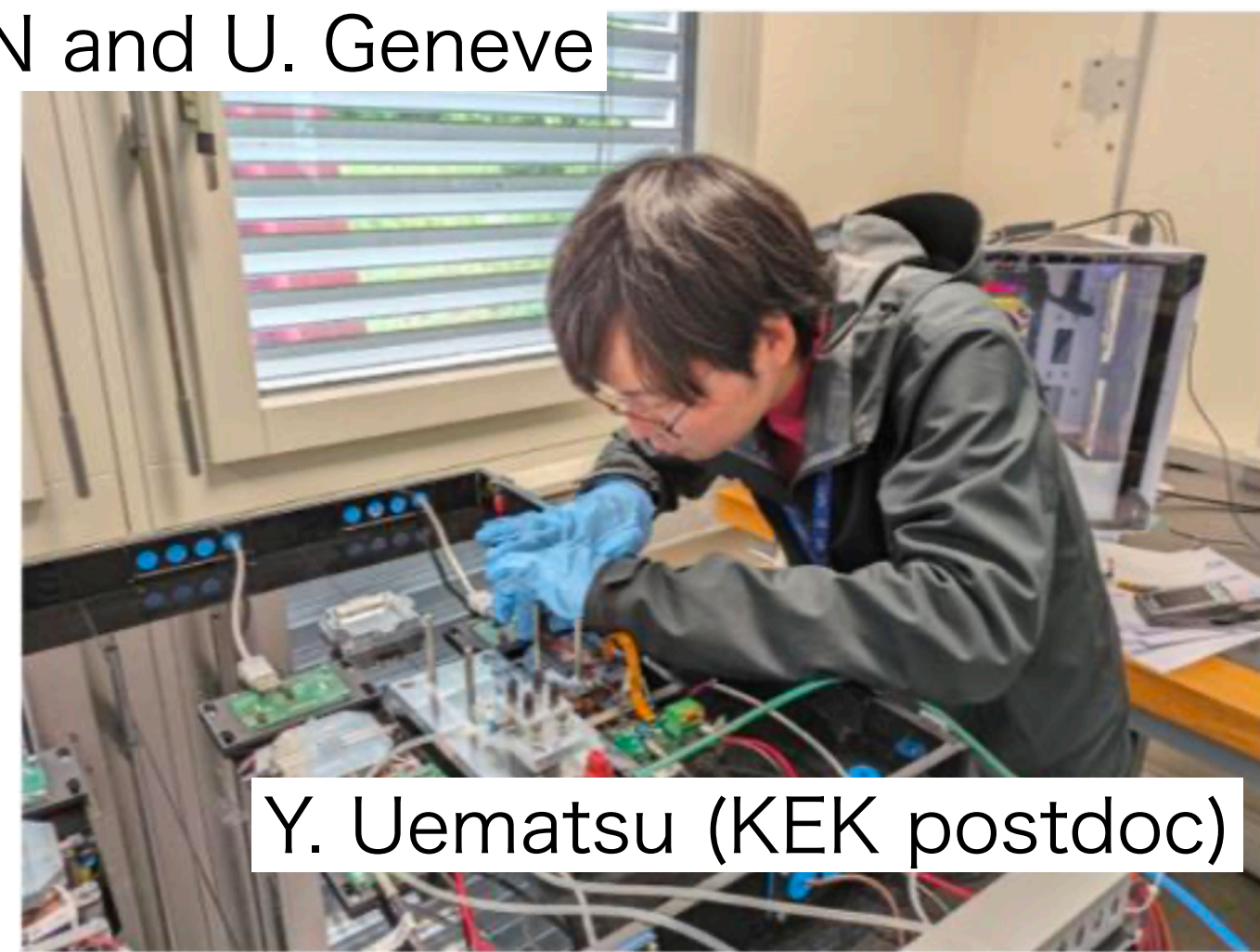
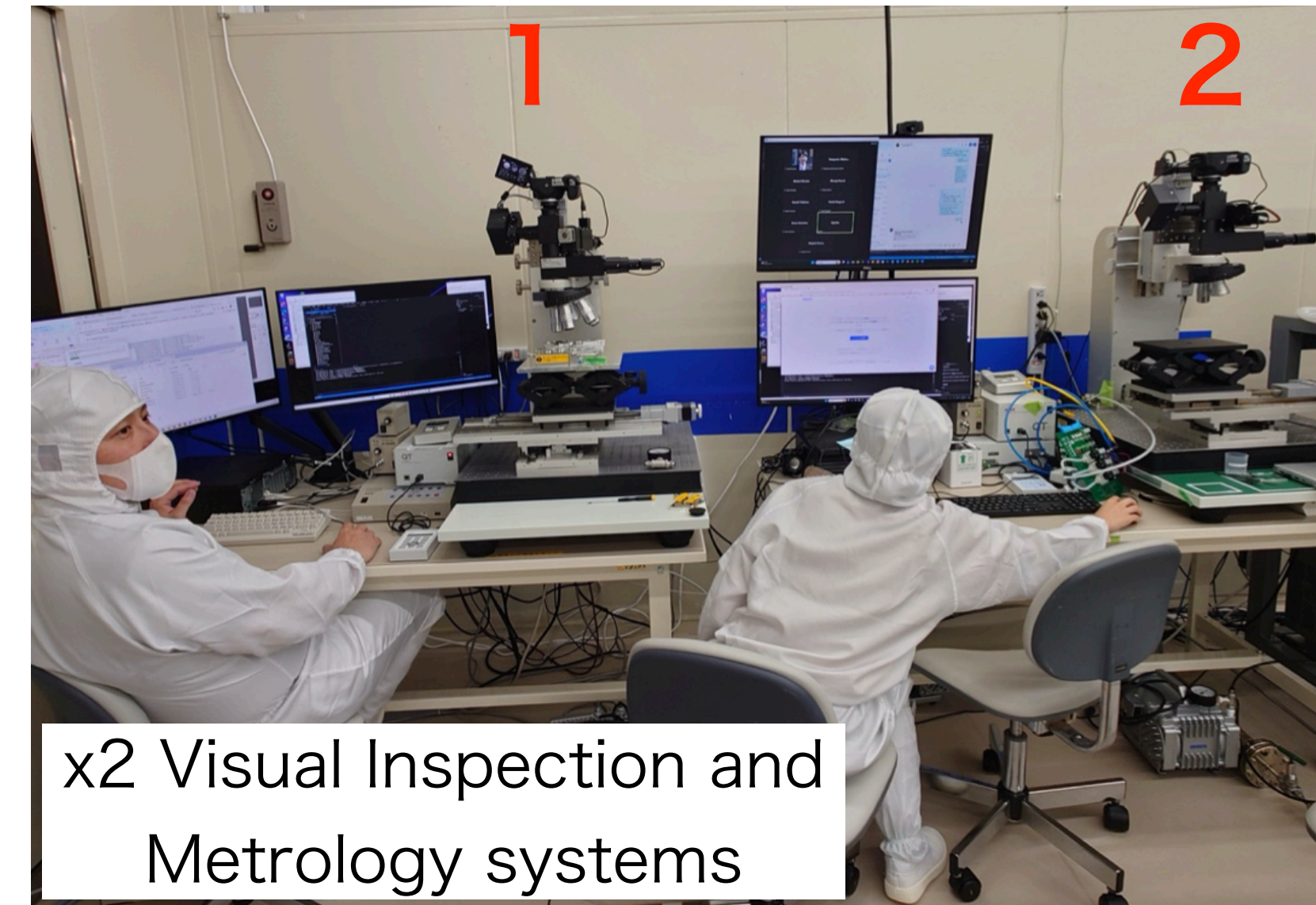
QC by scientists

Loading to Support



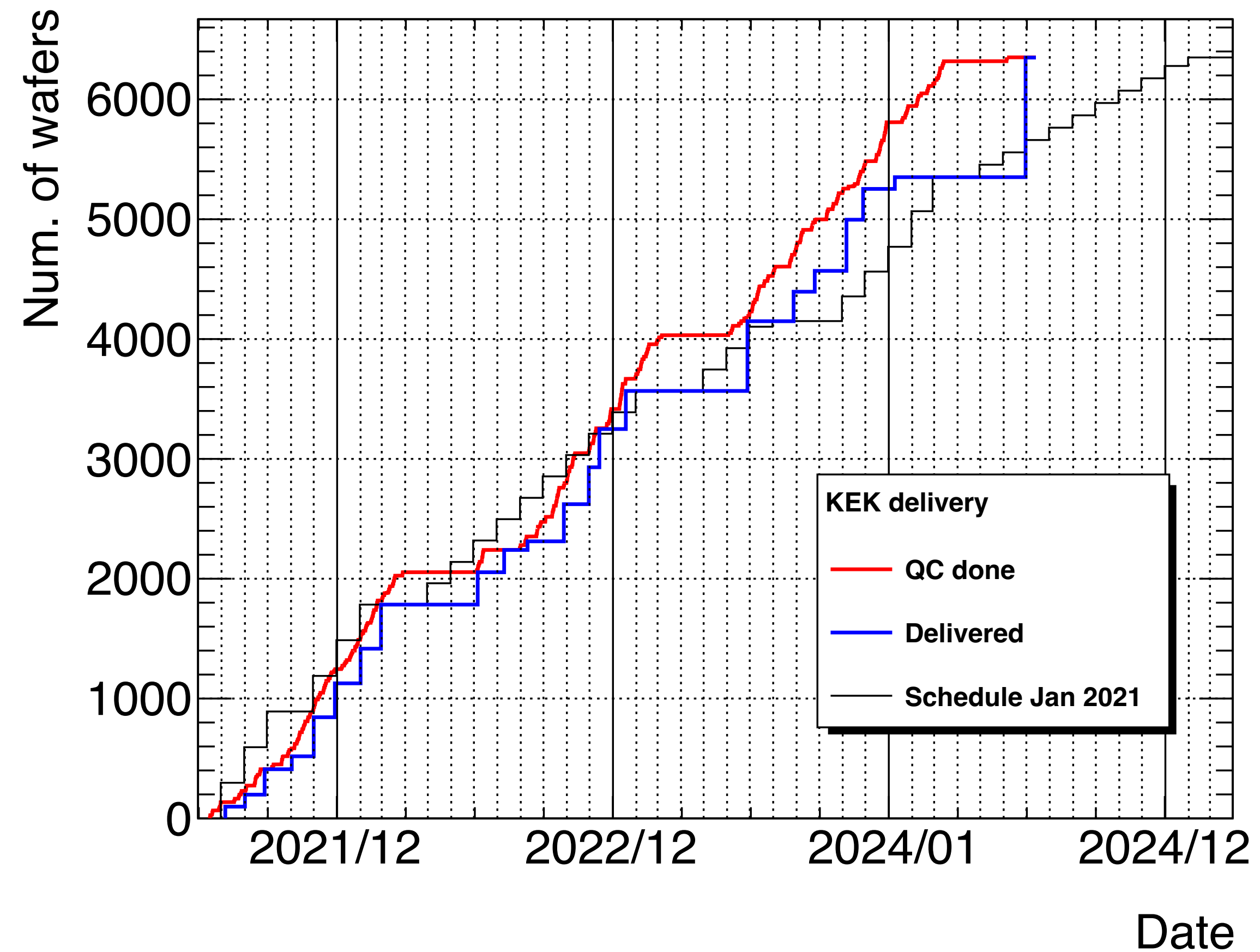
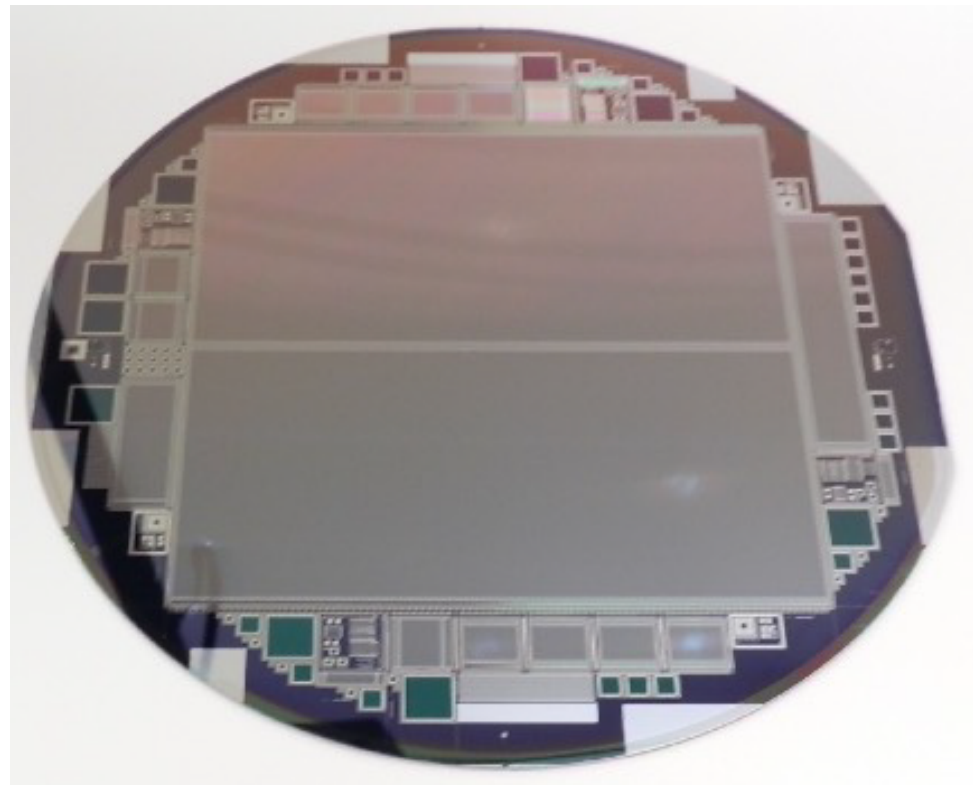
ITK Pixel module production status

- Preproduction has been finished
 - 121 modules were assembled by company
 - QC tests have been done by scientists
 - 3 modules/day was achieved
 - Some modules were sent to CERN for system test
- Preparation for production is started
 - Increasing infrastructures handles 7 modules/day
- Activities at CERN and U. Geneve is ongoing
 - The module reception and following test toward system test



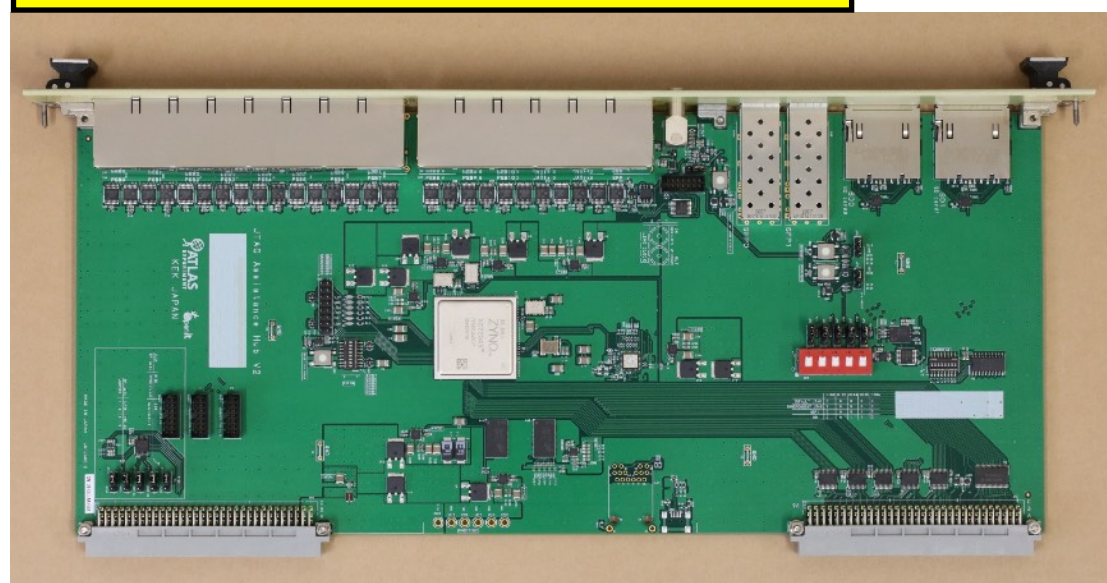
ITK Strip

- Japan is responsible to provide half of barrel sensors
- Production of all 6,350 sensors has been finished successfully
- Irradiation of neutron beam at CYRIC, Tohoku U. is scheduled on January 2025 for QA



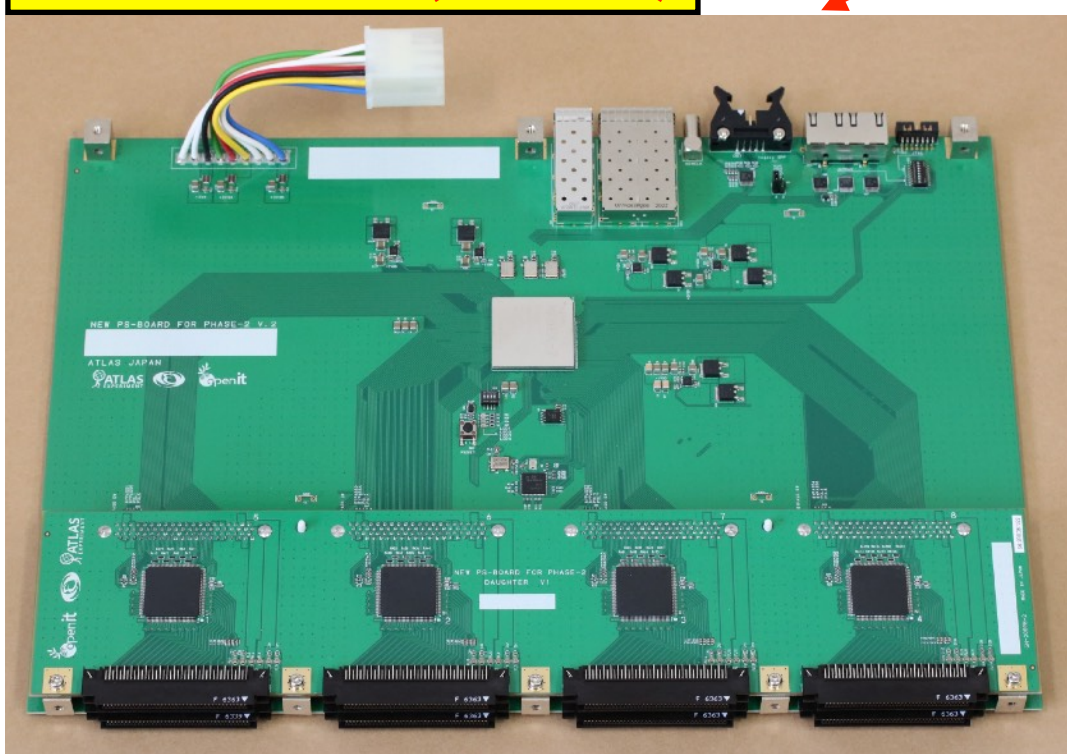
Endcap Muon Trigger

JATHub board (150)

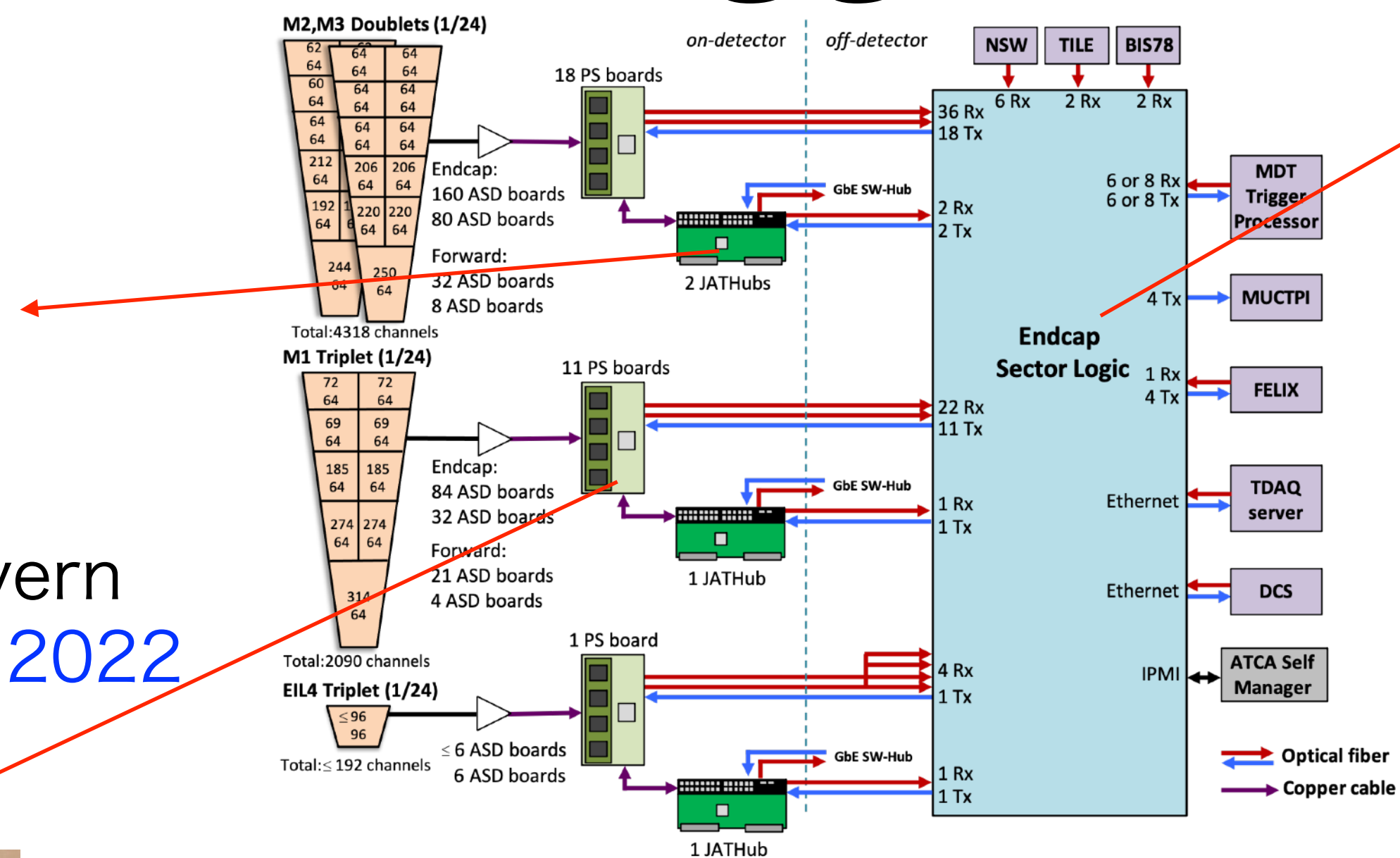


- Controls FPGAs in Cavern
- Production finished in 2022

PS board (1500)



- Synchronizes TGC hit signals
- Sends signals to the back-end board
- Production on going and will be finished at the end of March 2025

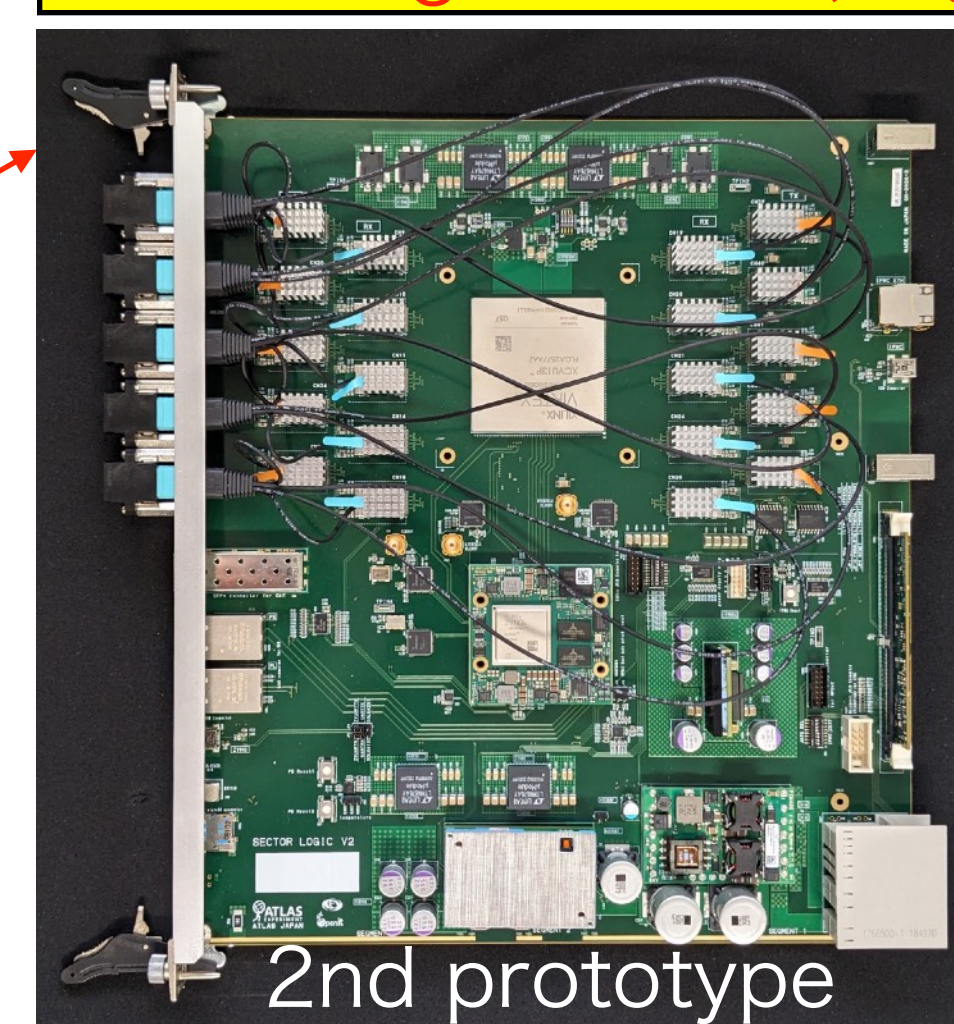


Others



- Production of the other minor boards has been finished
- Purchase of optical fibers and fiber patch panels are ongoing
- SFP+ optical modules will be purchased in 2025
- HV/LV modules will be purchased from 2026

Secor Logic board (50)



- Reconstructs outer segment
- Makes inner-outer coincidence
- Provides endcap muon trigger
- Reads out all TGC hits
- 2nd prototype board produced
- Several bugs figured out

PS board production

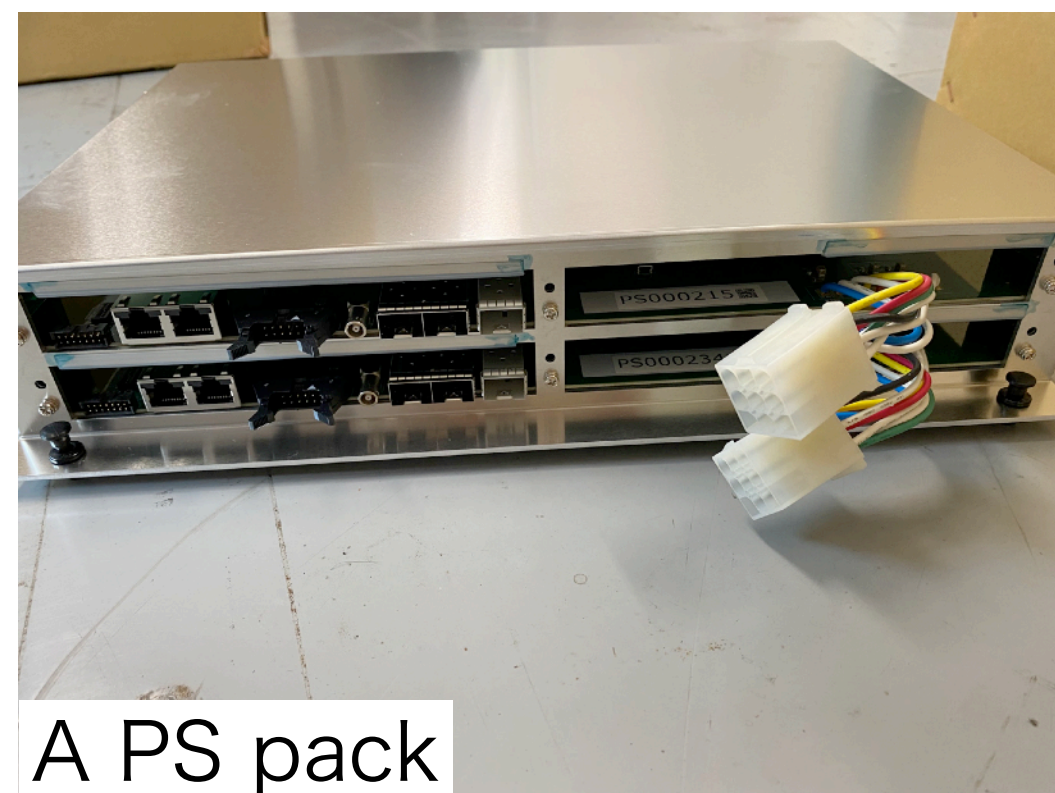
- PS boards are produced by the company
 - Production rate : a few hundred boards per month
- PS boards are tested at KEK by mostly students and a few staffs
 - 36 boards are tested at the same time
 - About 1% of PS boards fail the QAQC test

QAQC period	number of boards
7/22-7/24	100
8/6-8/9	200
9/10-9/12	200
9/30-10/4	350
11/11-11/14	200

- Tested boards are sent back to the company
- PS packs are delivered to KEK



PS packs packed in boxes



A PS pack

Summary

Third year of Run 3 is an excellent year

Japan contributes to

- Operation of the current system
 - Pixel, SCT, LAr, TGC, HLT
- R&D, production, and construction for HL-LHC system
 - Preparation for Pixel module production is ongoing
 - Strip sensor production has been completed
 - Production of the endcap muon trigger system is in good shape

We are devoting all our efforts to continue achieving good physics results from the ATLAS experiment !