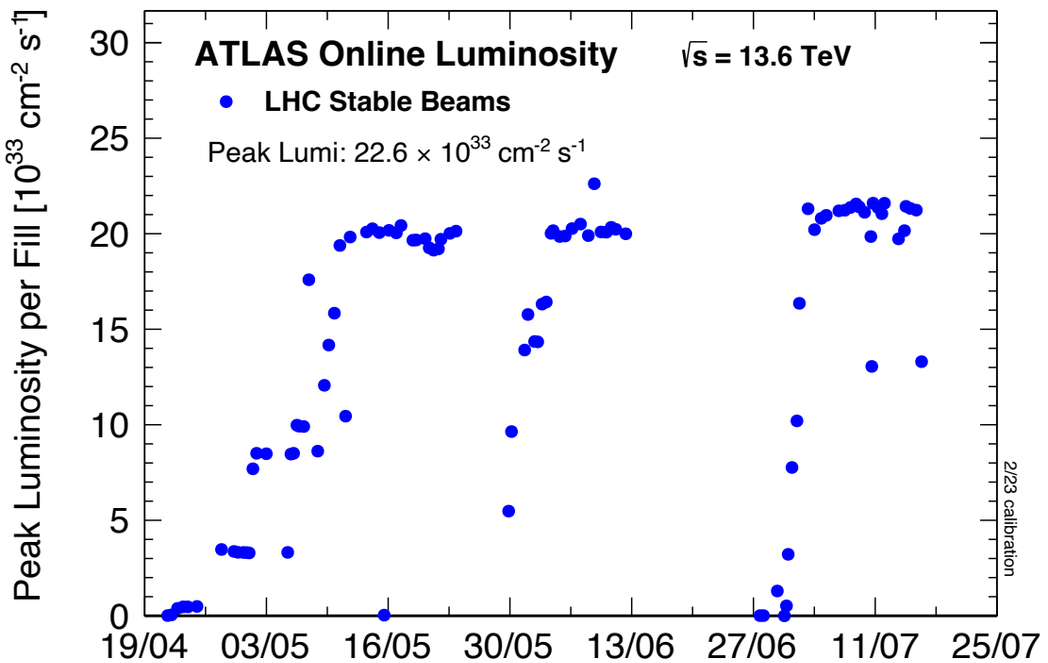
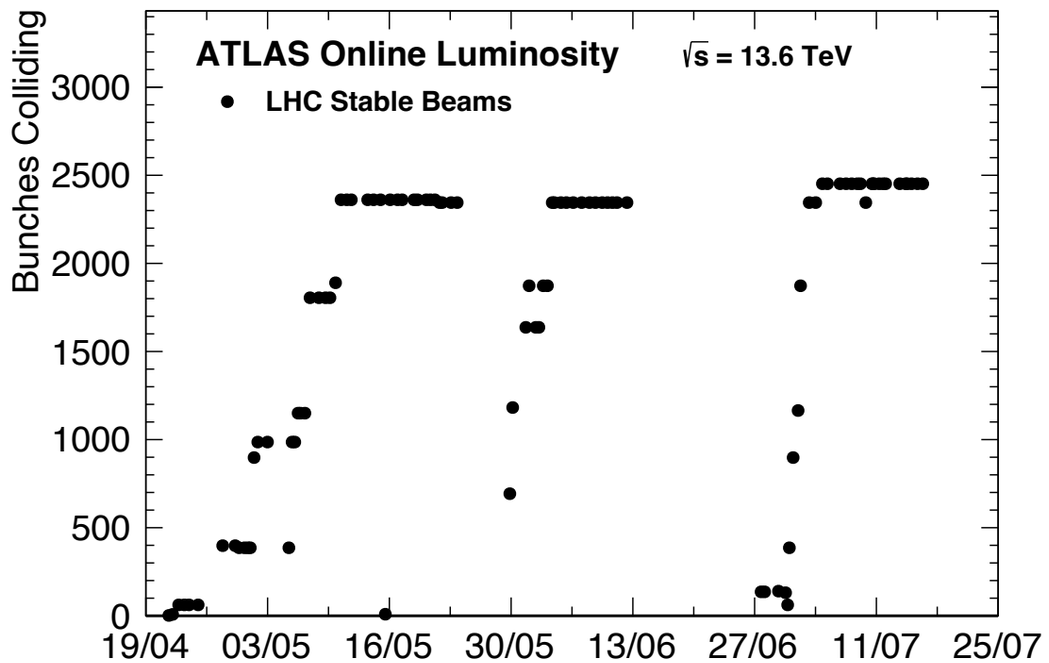
ATLAS

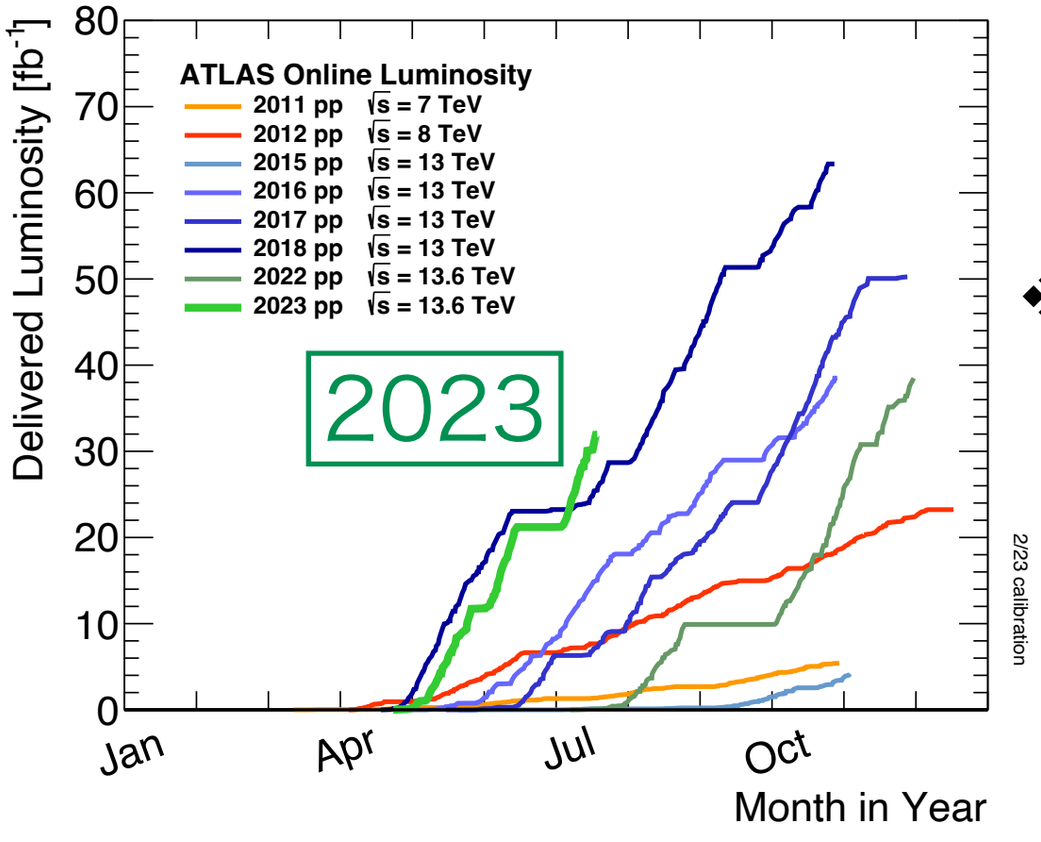
～ Focus on KEK (+Japanese) Activities ～

Kazunori Hanagaki (KEK)

Run 3 in good progress until July

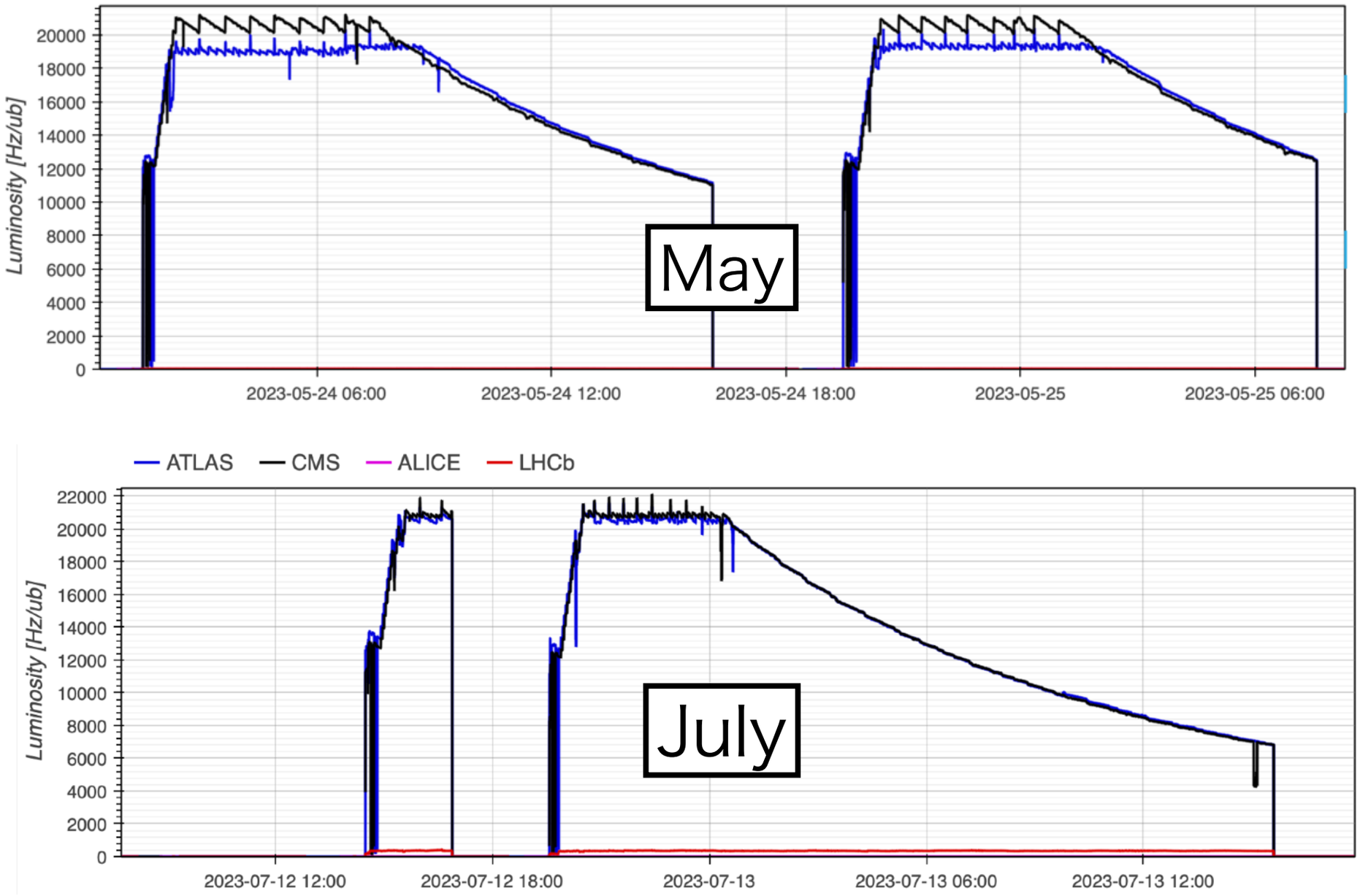






- Smooth start-up
  - Luminosity leveling set at around 2E34

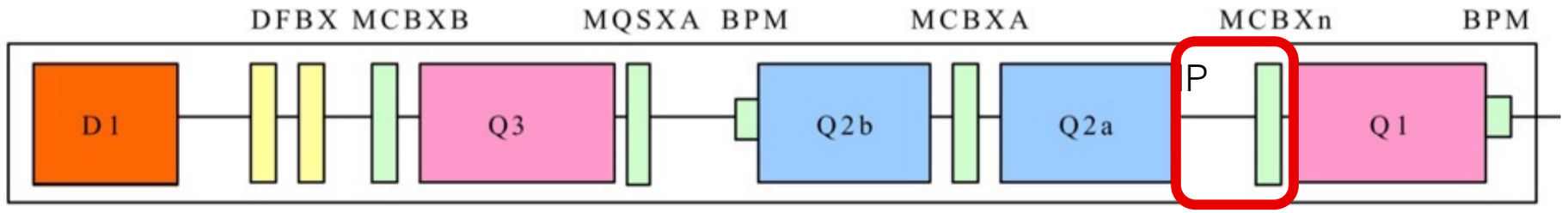
Luminosity Leveling



- β^* and separation leveling now both for ATLAS and CMS
- ATLAS leveling from 1.9E34 to 2.1E34
  ← Introduction of LAr trigger and NSW (mention later)

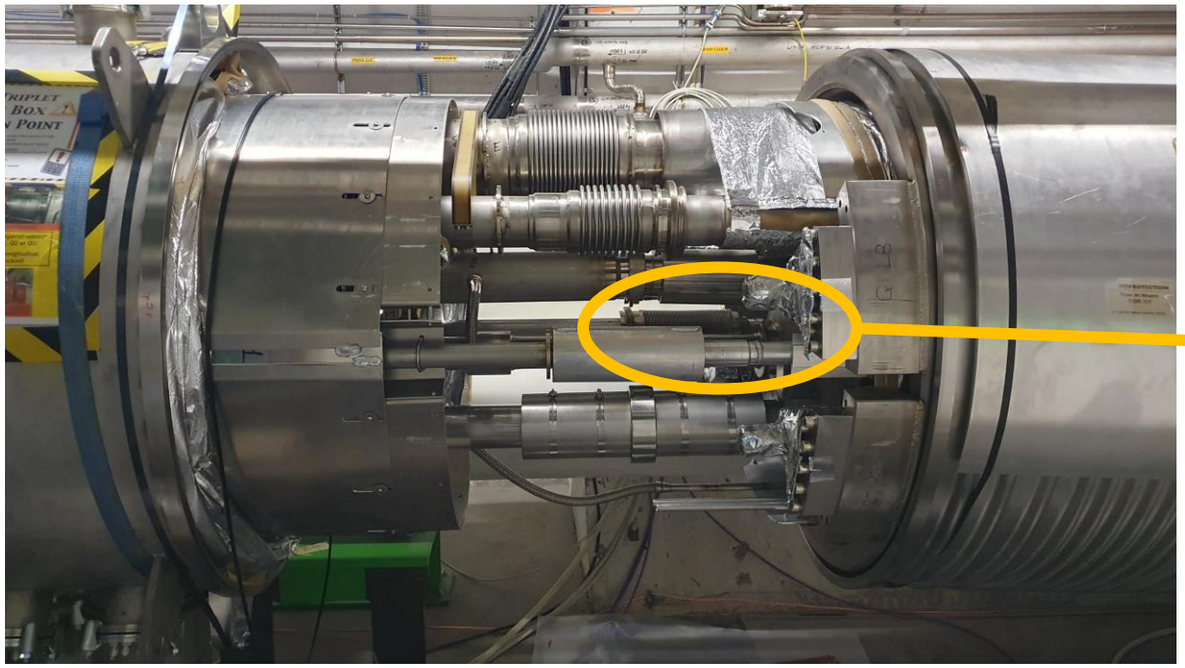
Incident on July 17

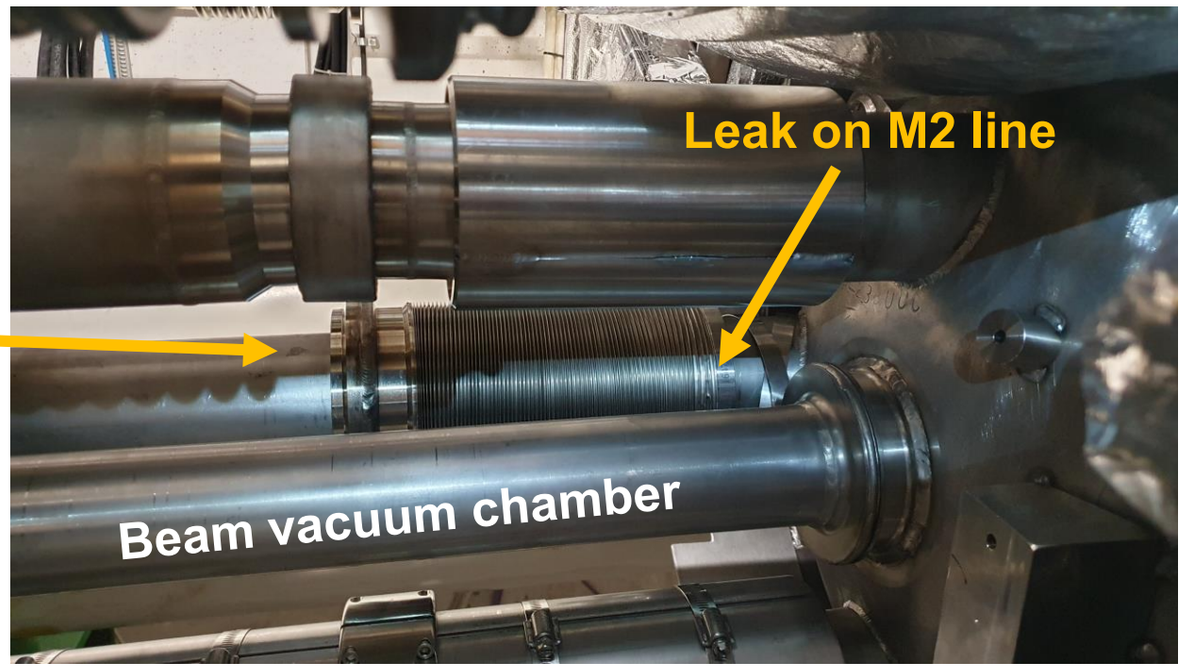
- Helium leak at Q1-Q2 interconnection
  - Electrical noise → Quench → Helium gas leak
- Recovery was fast
  - Heavy ion collision was possible although we loose p-p runs

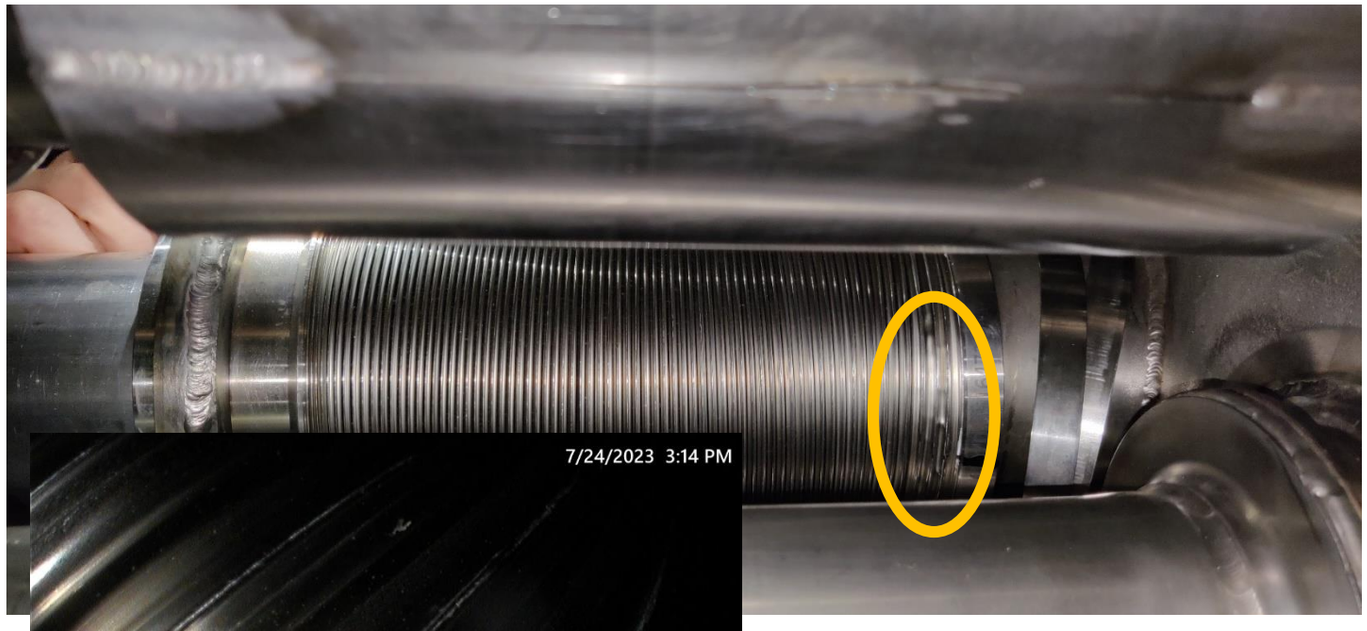


Schema of IR8 inner triplet

Q1–Q2 interconnect







Monday evening: decision to **replace** the bellow

Spare bellow – tested to 20 bar

ATLAS KEK/Japan Activities

- Operation
  - Pixel, SCT, (LAr,) TGC, High Level Trigger
    - KEK is not involved in LAr
- Phase-II upgrade
- (Physics ←coherent with High Level Trigger)

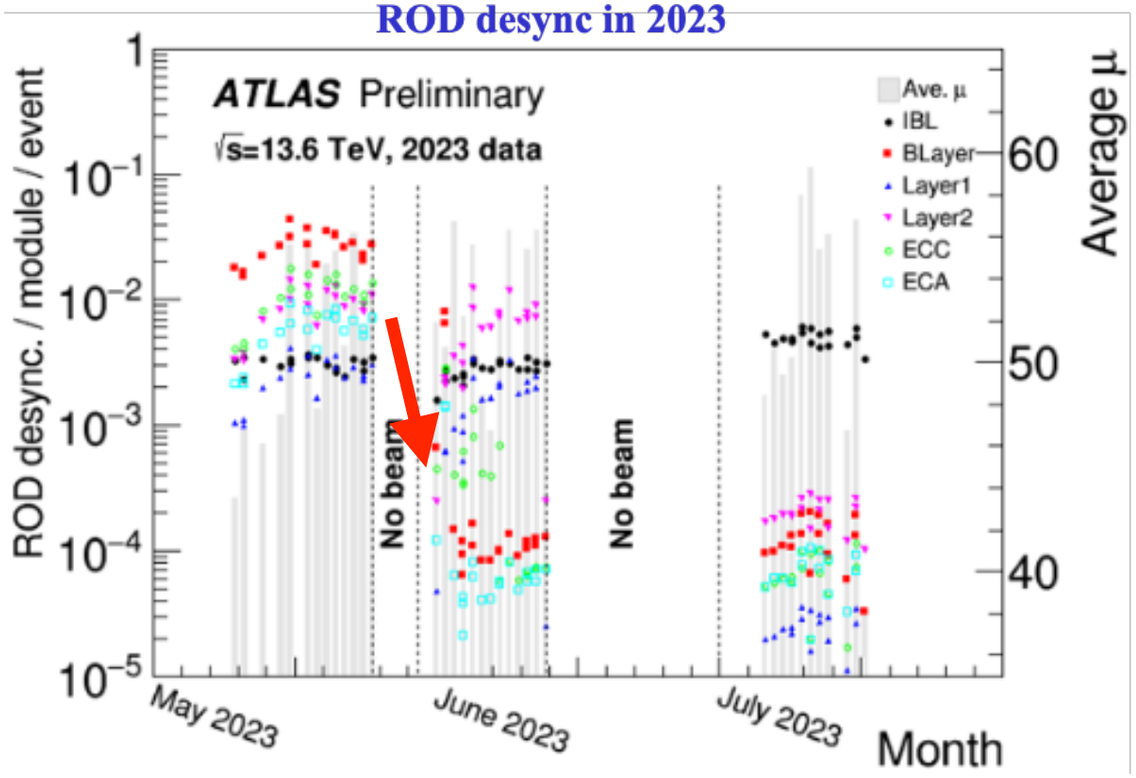
Pixel

- KEK leads DQ (Data Quality) and offline software for long time
  - Y. Takubo (Pixel DQ convener), S. Tsuno (Pixel offline convener)
- 3 class-3 tasks, and 1 qualification task
  - Development of Pixel-DQ infrastructure,
  - Study of effect of radiation damage on Lorentz angle and dE/dx
  - Pixel monitoring using information of the bytestream errors

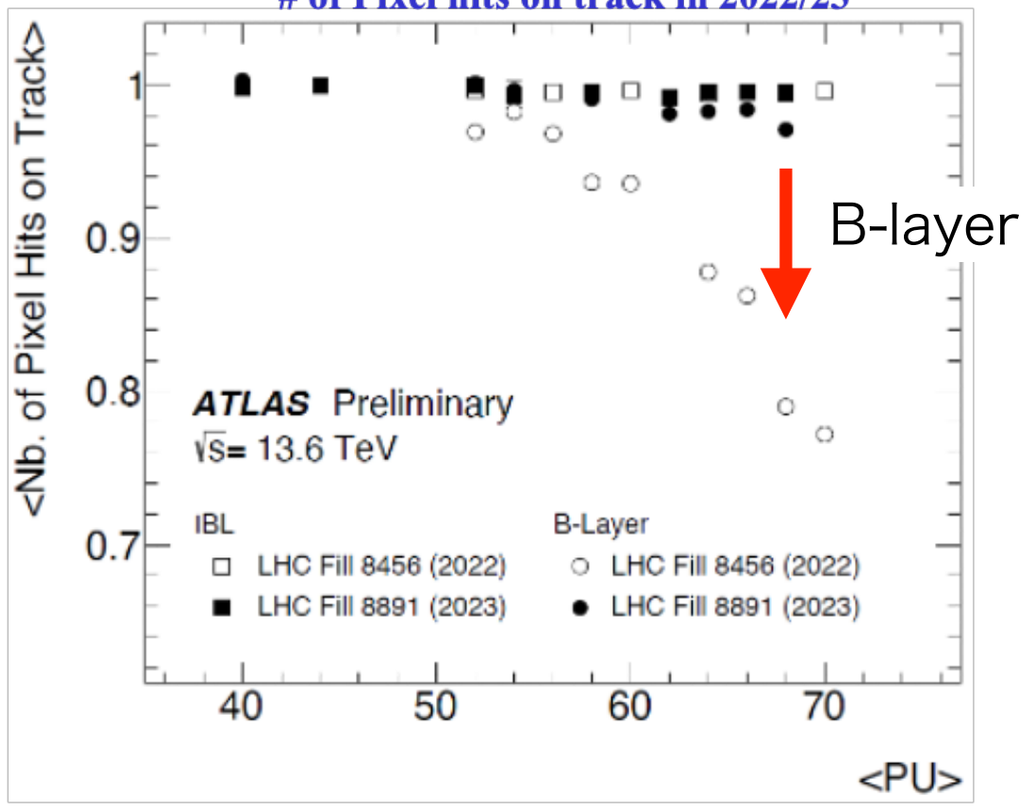
Implementation of functionality to control Level-1 trigger sending scheme

DAQ firmware/software improvement ← continuos reconfiguration

ROD desync in 2023



# of Pixel hits on track in 2022/23



SCT

- **Leading role of operation**
  - Daiya Akiyama (Waseda U.) joined SCT deputy run coordinator, successful operation achieved

Fraction took by Japanese institutes

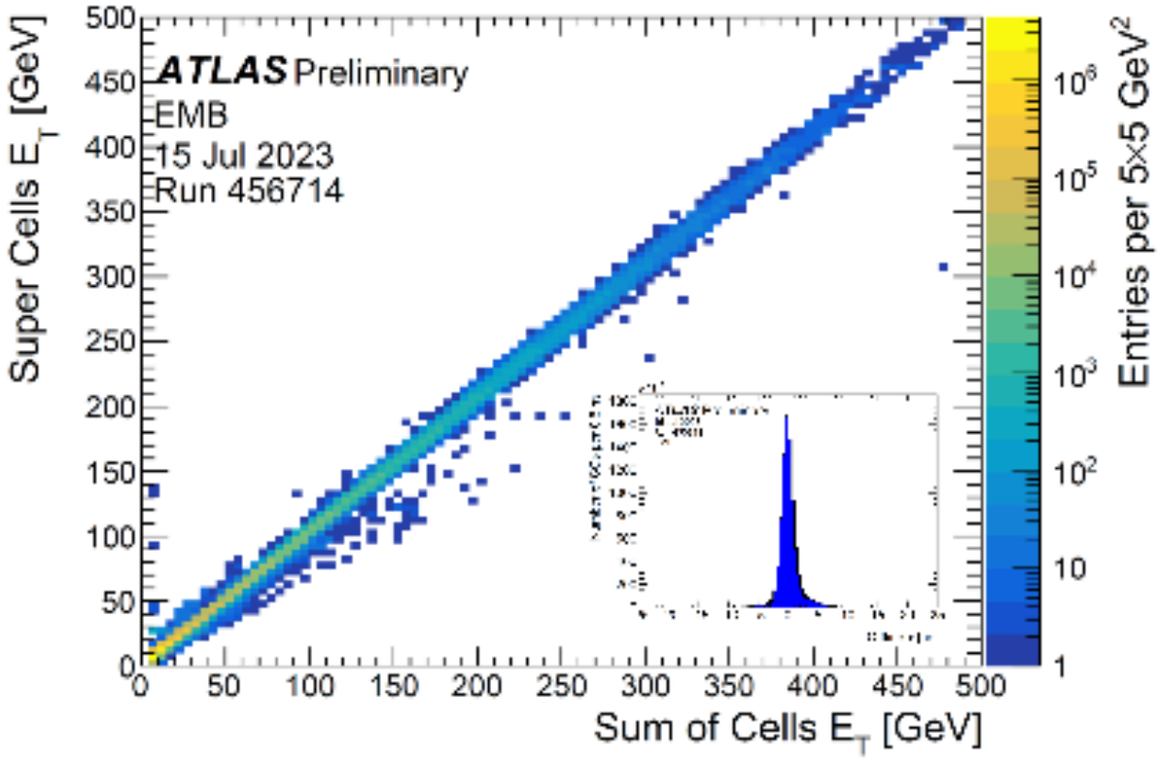
on-call shift	35%
remote shift	43%

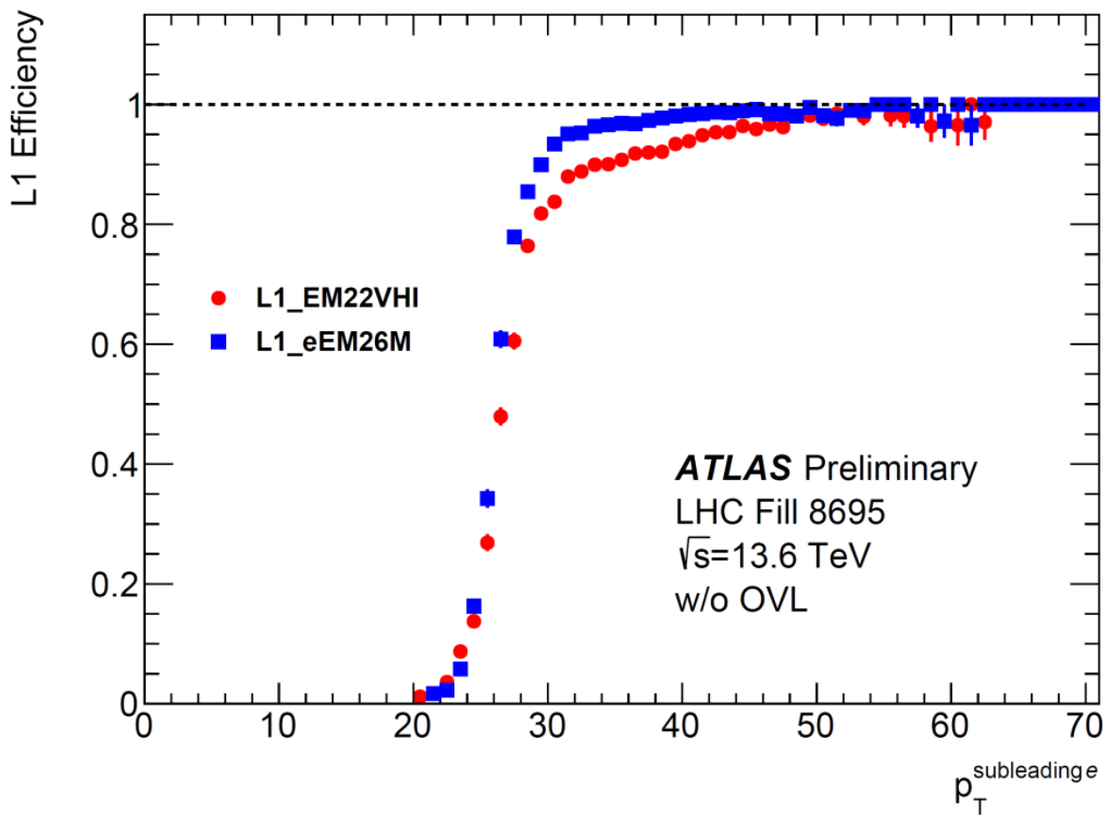
Fraction of active strip	98.4%
DAQ efficiency	99.7%
DQ efficiency	99.7%

- Complete calibration algorithm update campaign (the first major change since Run1)
- Perform and analyze HV/IV scan to evaluate radiation damage
- Develop web-based tool (called PAT) centralizing relevant information (DAQ/DCS/DQ) for daily
- Evaluate data-size limitation for possible high-pileup operation
- Participate in hardware maintenance in USA15/US15

Liquid Ar Calorimeter Digital Trigger

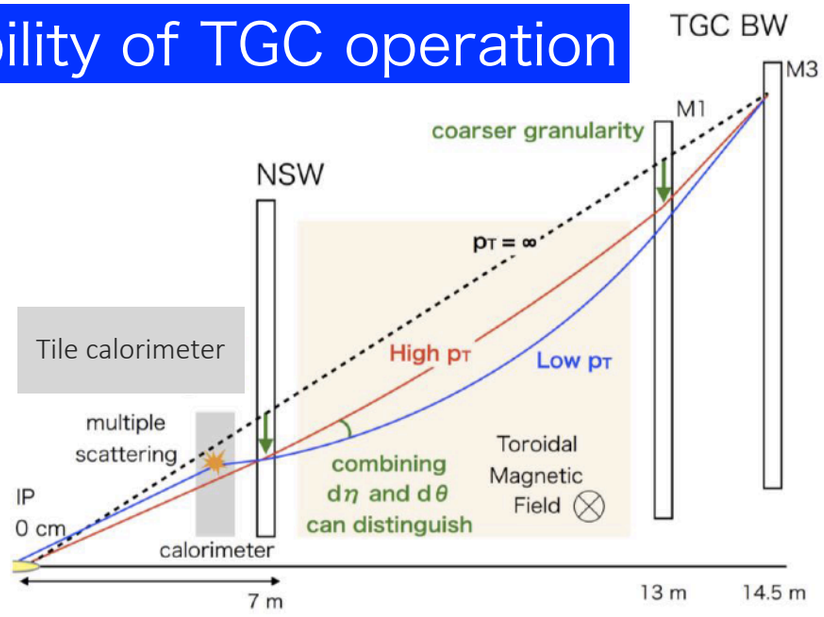
- Commissioning on the digital trigger system completed in 2022.
- Become primary trigger system from 2023.
- Good transverse energy and timing response on 99.77% of 34k Super Cells.
- Better trigger efficiency on EM objects with 25% reduction on the trigger rate.
- Also Jet and Missing ET trigger show good performance. Will be used them from 2024.

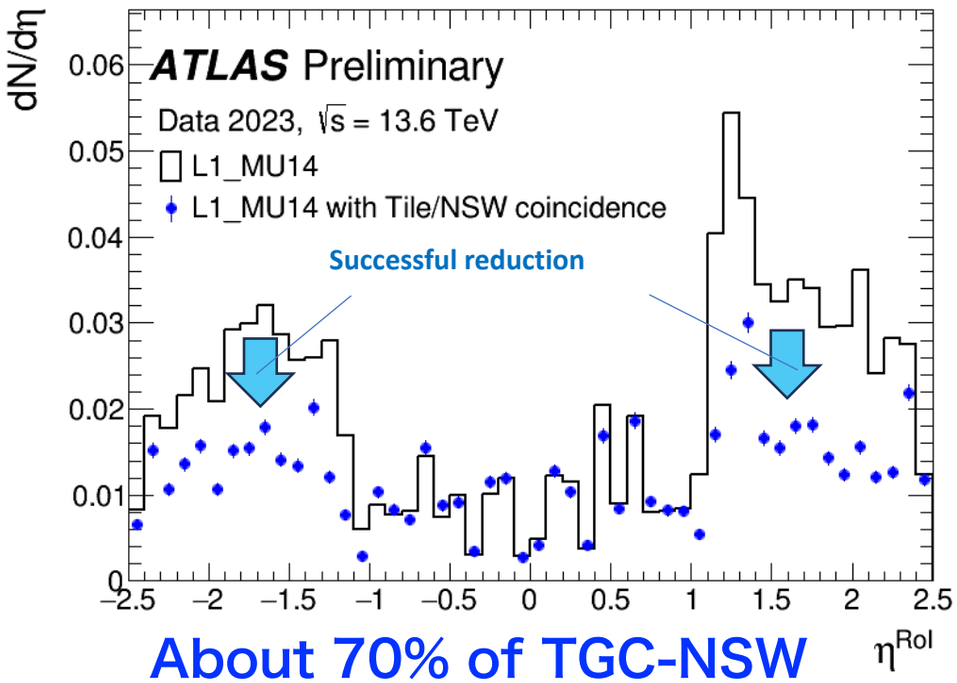




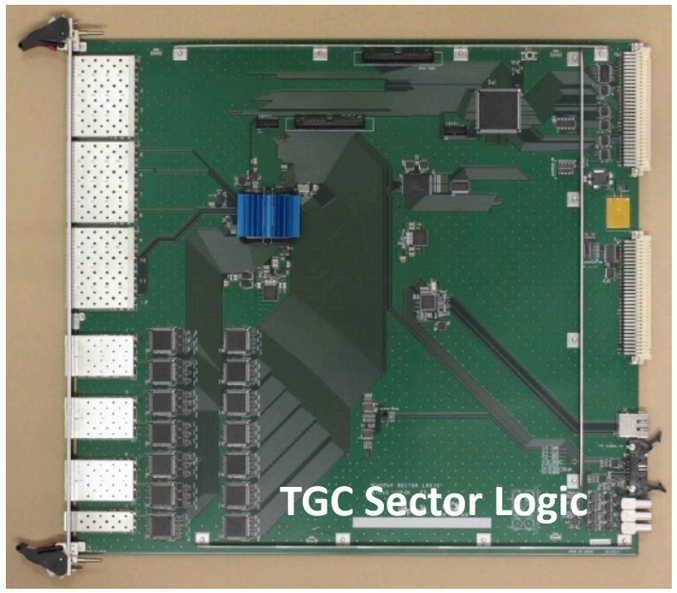
Endcap Muon Trigger

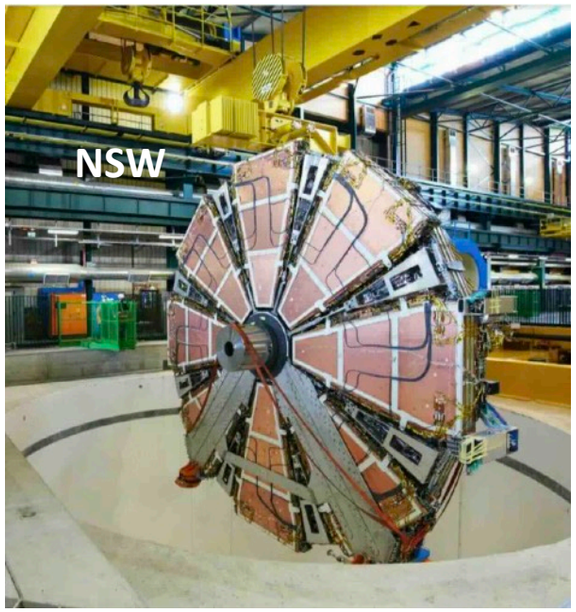
Almost full responsibility of TGC operation



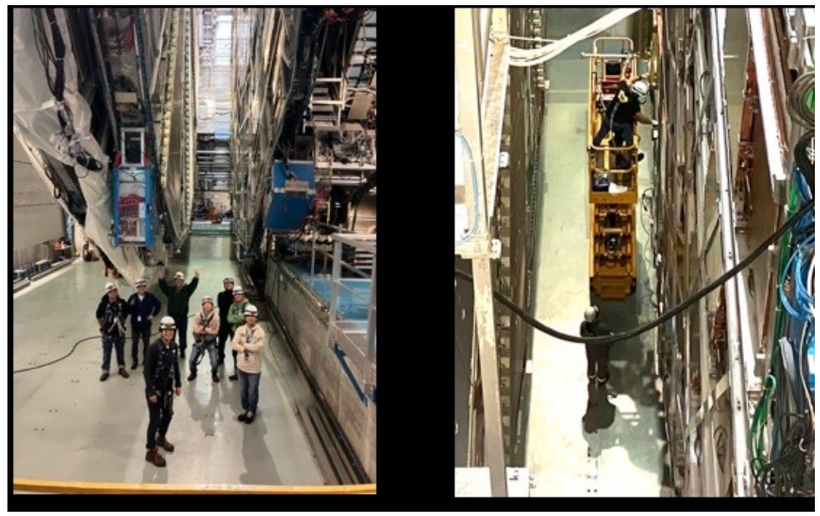


About 70% of TGC-NSW coincidence was activated





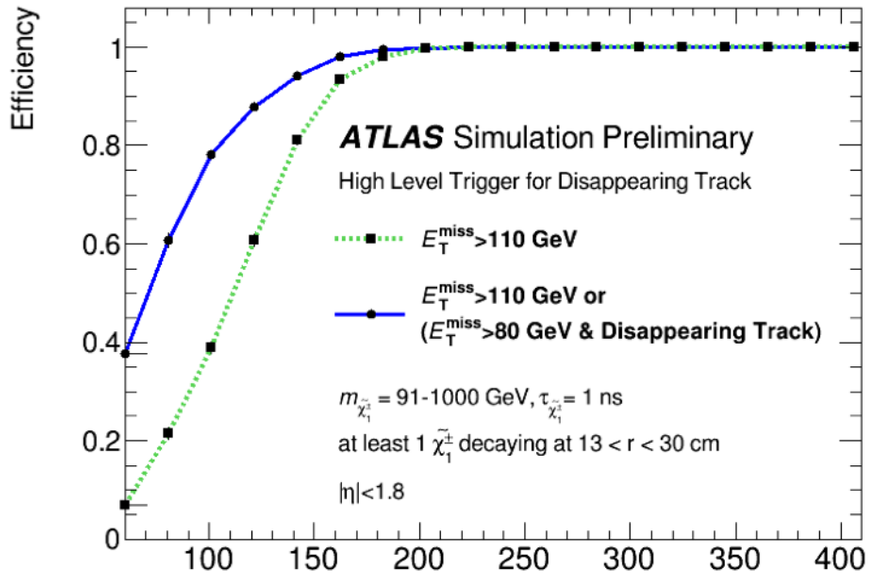
Japan built, installed and maintains TGC back-end trigger electronics for Run 3 to cope with New Small Wheel (NSW)



Extended detector maintenance is conducted during this EYETS to ensure sufficient time for system upgrade for HL-LHC during LS3

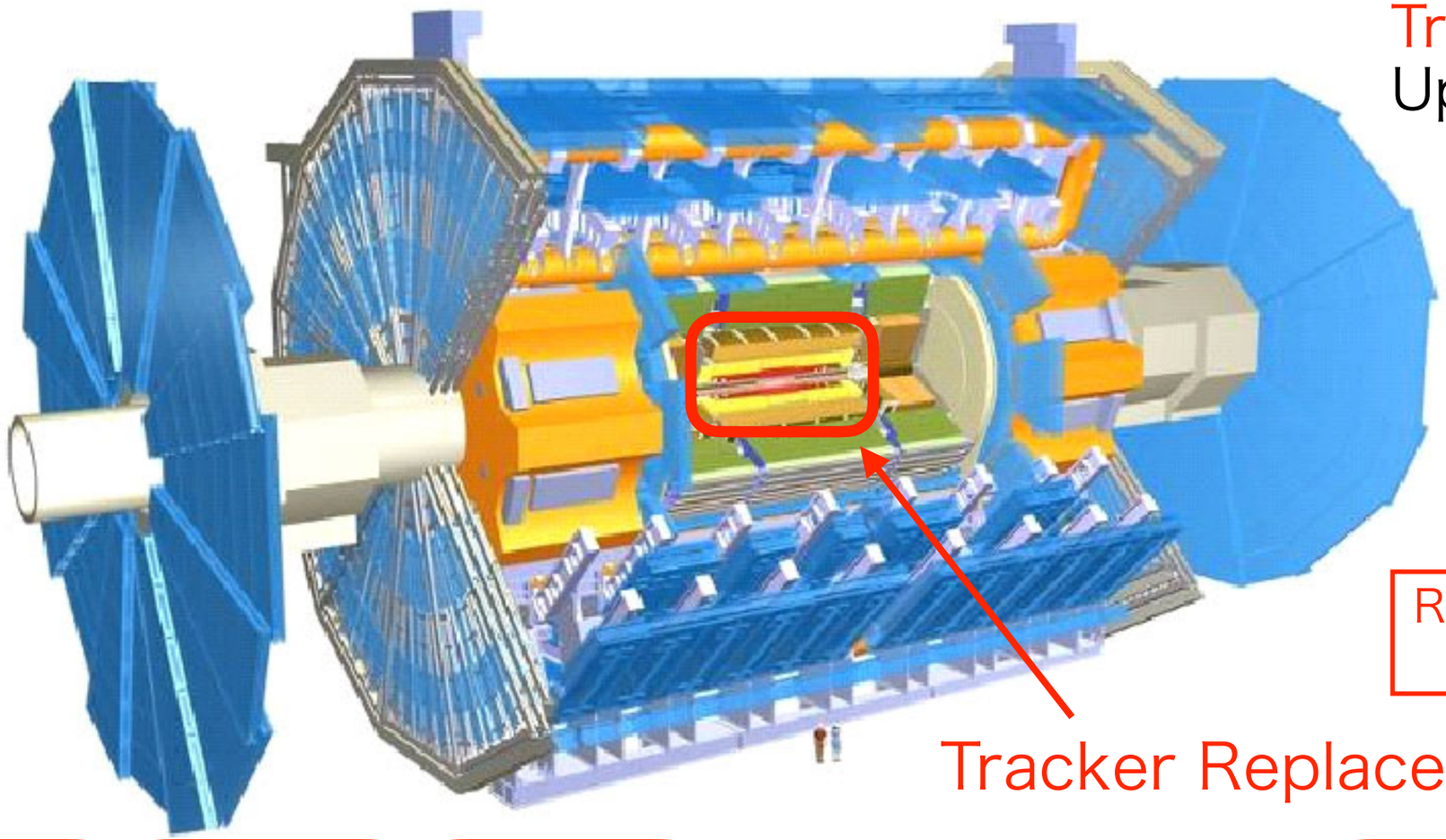
High Level Trigger

- ATLAS Japan has been significantly contributing to Trigger for long time
- Muon High-Level Trigger
  - Fast muon-standalone reconstruction algorithm improvement and operation
- Inner Detector Tracking Trigger
- Physics motivated new trigger
  - Track triggers for long-lived particles (disappearing track, large dE/dx track, displaced vertex)
  - HH→bbbb, bb$\tau\ \tau$ triggers with the delayed stream
- Coordination roles in various areas
  - Signature (Muon) and Detector Software (Inner Detector)
  - Release and Validation
  - Trigger Operation
- Hosted TDAQ Week 2023



Phase-II Upgrade

Electronics replacement
- LAr calorimeter
- Tile calorimeter
- Muon

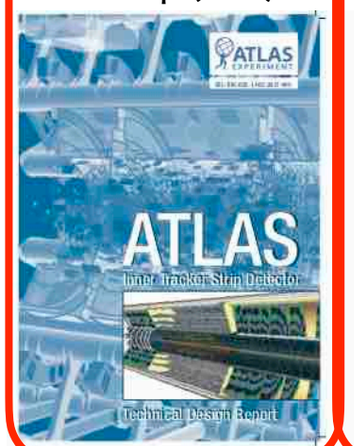


Trigger & DAQ Upgrade

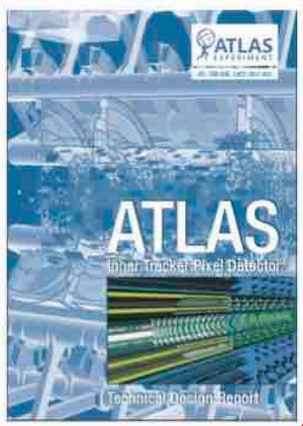
Red : contribution by KEK/Japan

Tracker Replacement

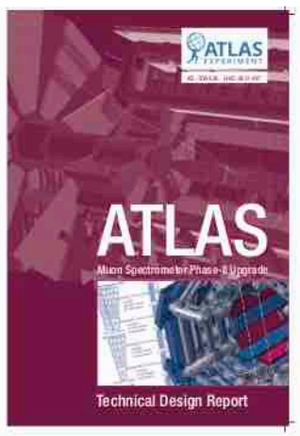
Strip(ITk)



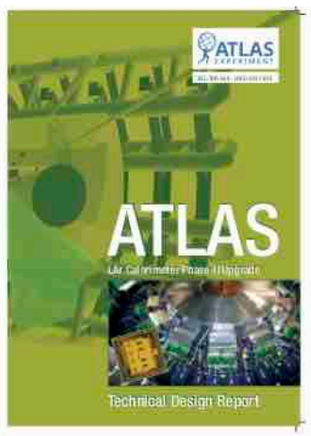
Pixel(ITk)



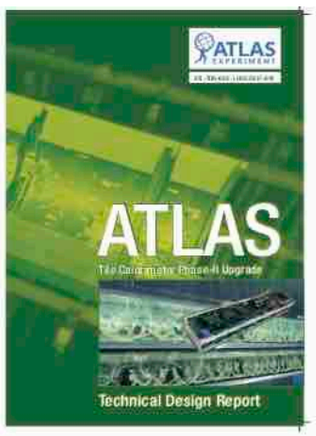
Muon



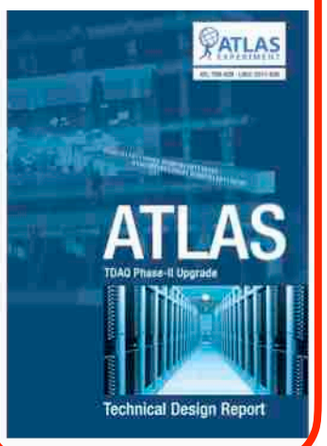
LAr Calo.



Tile Calo.



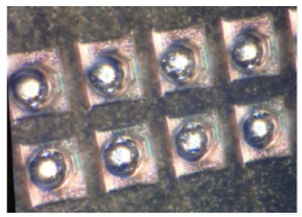
TDAQ



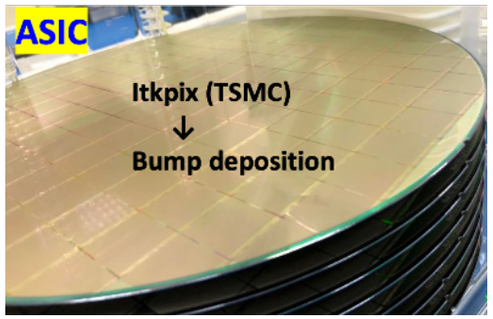
Pixel Module Production Flow

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

Bumps



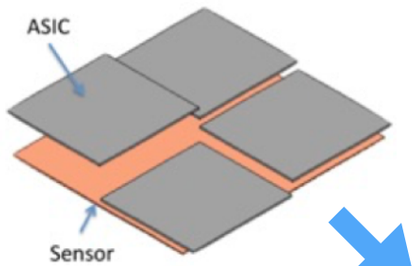
ASIC

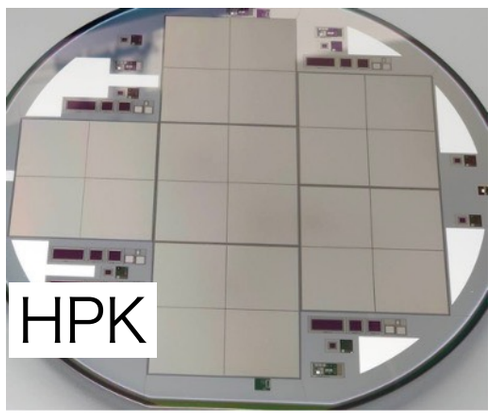


"Hybridization"

PRR in this month using pre-production modules

Bare Module

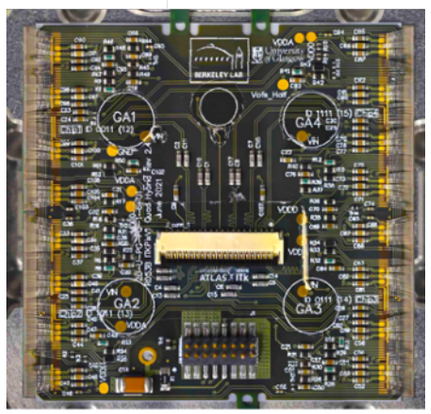




Sensor

In production
~30% finished

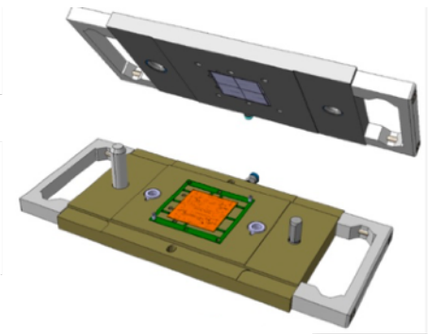
Flex PCB

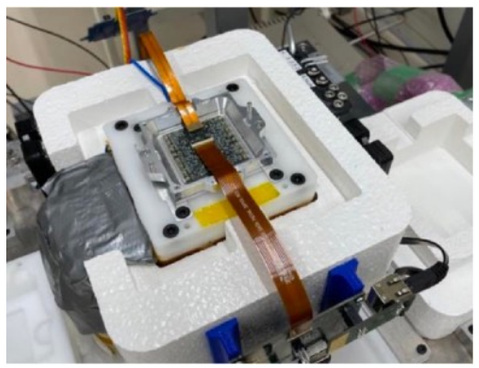


"Assembly" Module

In pre-production

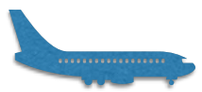
Assembly tool



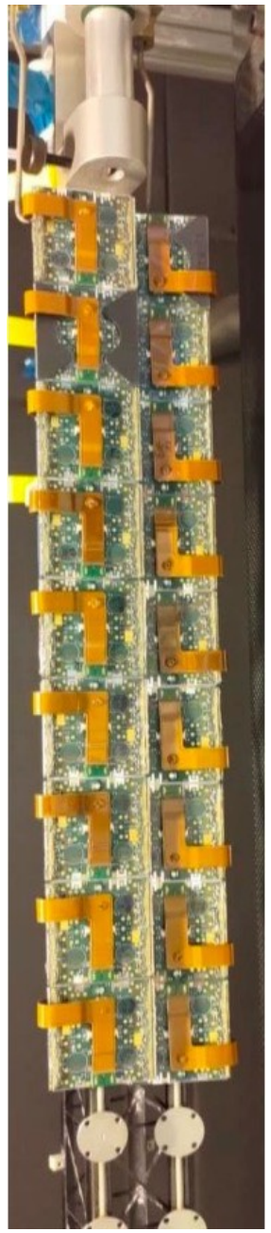


Testing

transport to CERN



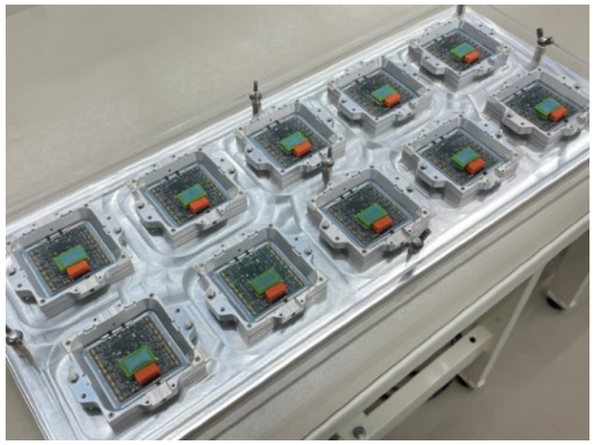
Loading to Support



Module Pre-production started

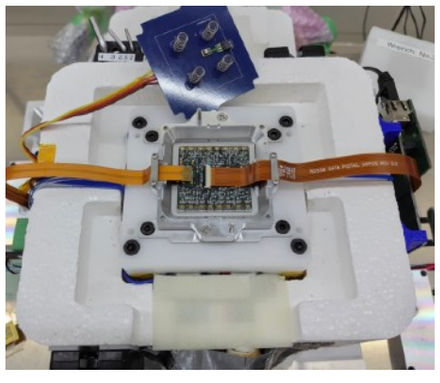
Assembly

Assembly by company
- Flex, cell attachments
- Wire bonding
- Parylene coating preparation

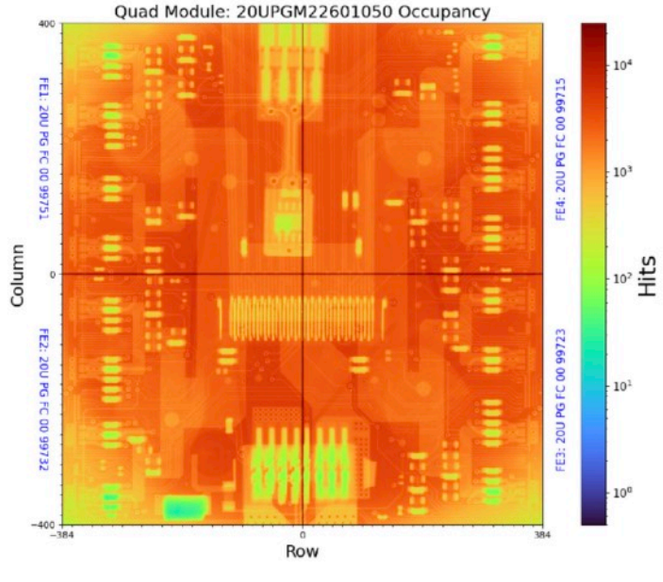


10 modules for parylene coating

Readout test (QC test)



QC testing by Scientists
- Metrology
- Electrical test
- Thermal cycles

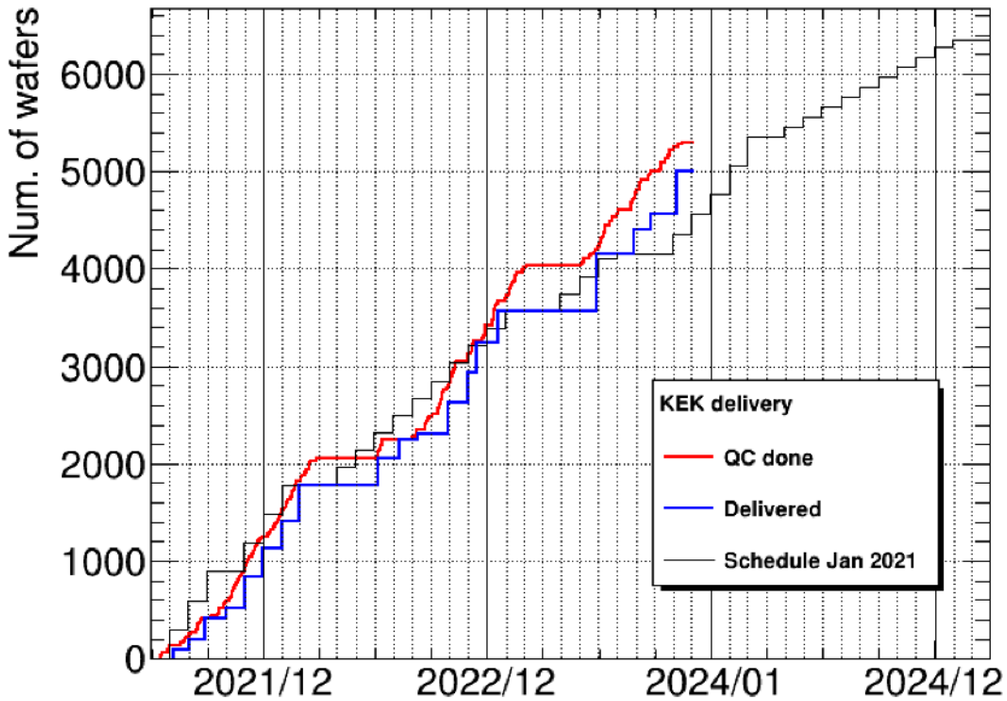


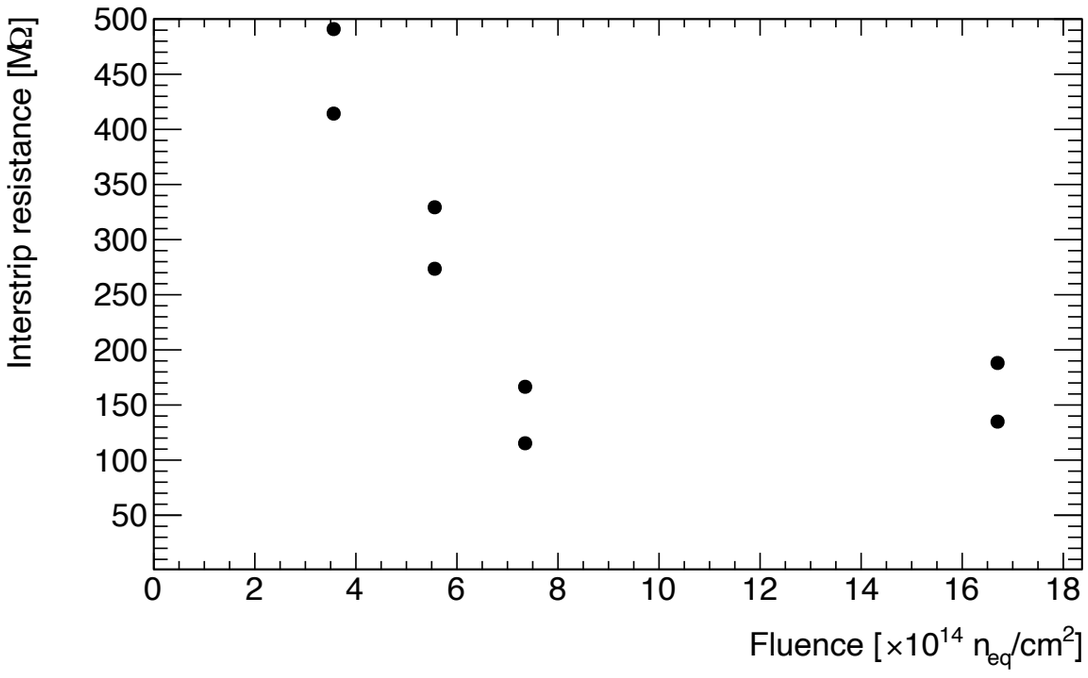
X-ray scan to check bump connectivity

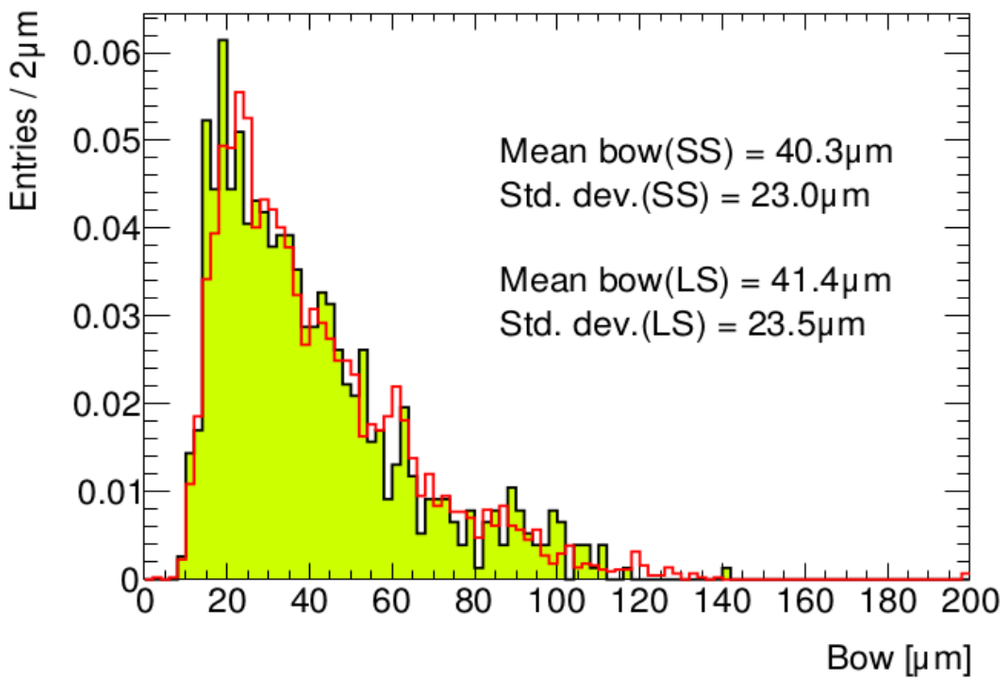
60 modules have been assembled and tested. 121 modules will be finished by January.

Silicon Strip Sensor

- Japanese responsibility is to provide a half of barrel sensors
- Production is in good progress
  - 4,996 sensors delivered as of Nov 2023
- Testing results show all sensor satisfy
  - bow < 200 μm
  - deficit strip < 0.1%
- Irradiation at CYRIC, Tohoku U for QA



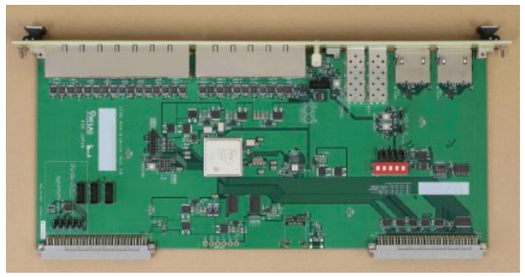




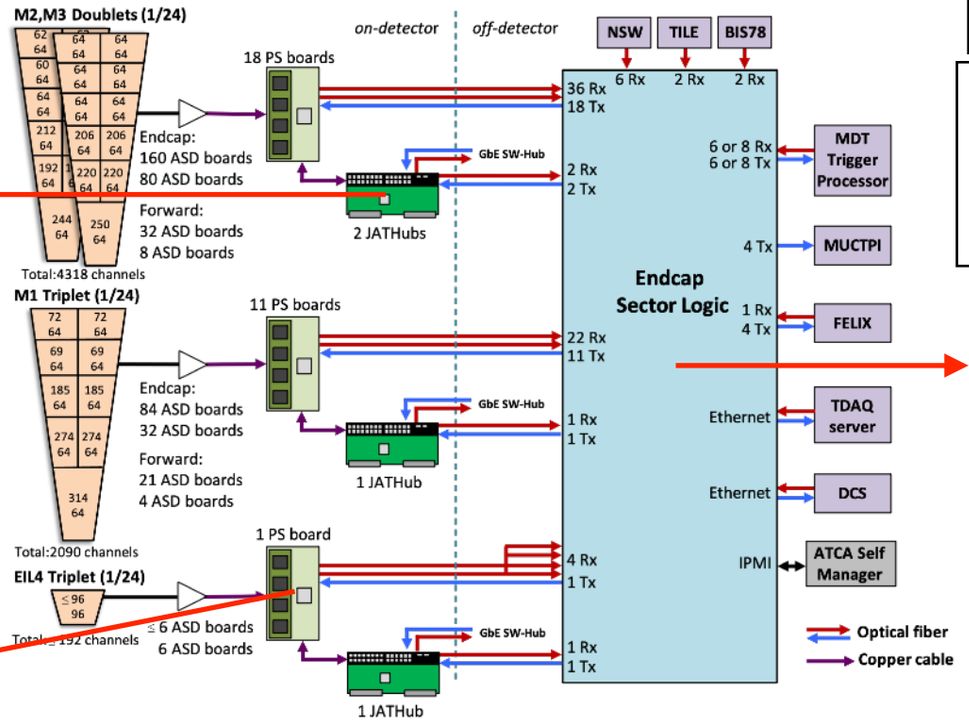
Endcap Muon Trigger for HL-LHC

JATHub board (150)

Control FPGAs in Cavern

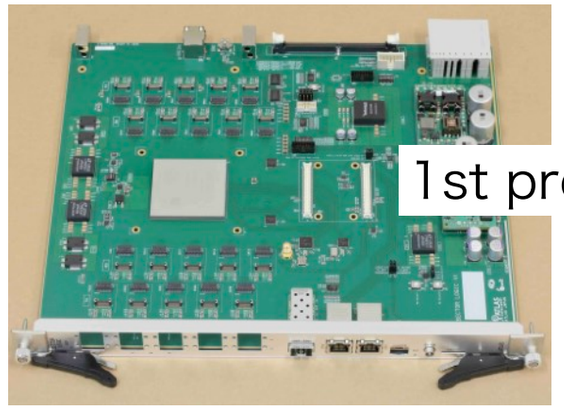


- Production finished



Trigger Processor Board (50)

- Reconstruct outer segments
- Make Inner-Outer coincidence
- Provide endcap muon trigger

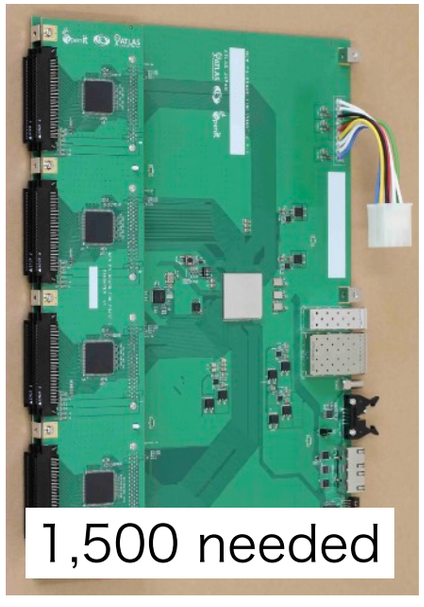


1st prototype

- 2nd prototyping starts soon
- Parts procurement on-going

PS board (1500)

Synchronizes TGC hit information and send them to the back-end board



1,500 needed

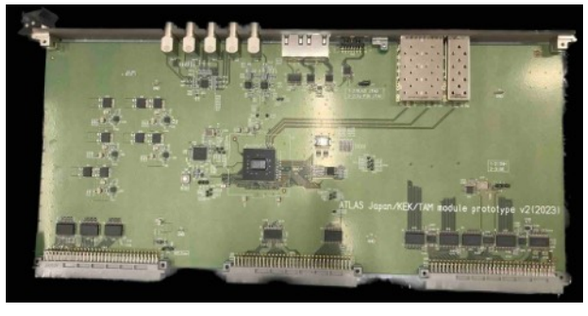
- 60 pre-production ongoing
  - 18 already produced
- QA/QC preparation ongoing

- Full-production starts next FY

Others

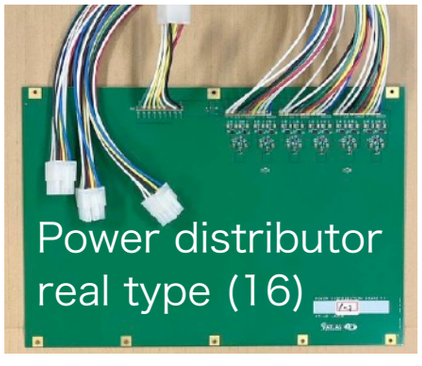
- Other boards prototyped and produced
- Purchase of ~10^4 optical fibers started

Timing Alignment Master(TAM) (30)



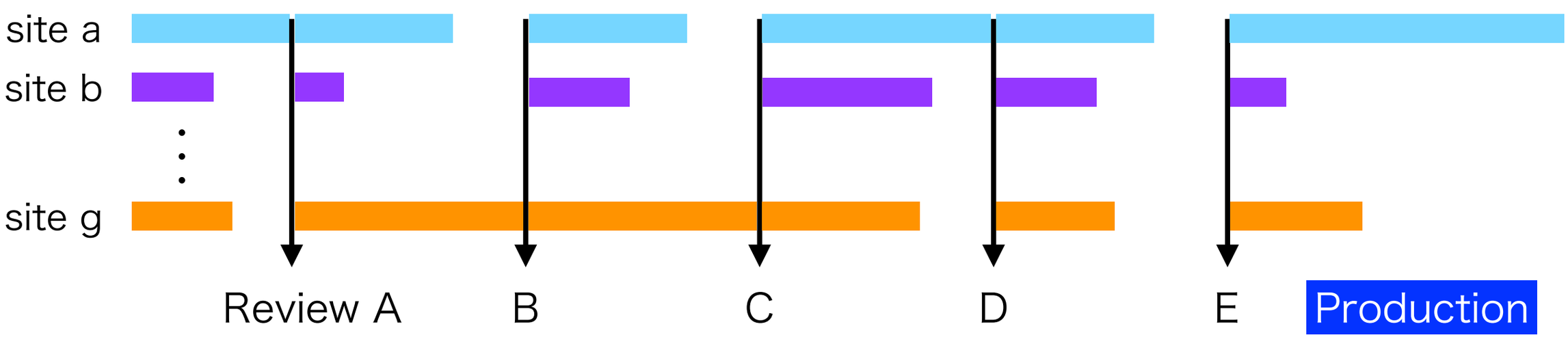
2nd prototyping

Production finished



Comments on Production Model of ATLAS Upgrade

- Delay is minimum in our muon end-cap trigger
  - Almost no dependence to other institutes/country
- Serial production is troublesome
  - Very difficult to cover/compensate failure occurred at different site
    - eg. Additional strip sensor production, where module production (and later) yield is lower than expectation
- Huge delay in Pixel
  - Complicated dependence to others, which is difficult to avoid, eg. module production needs FE ASIC
  - Production model requires advanced team to just “wait” due to parallelization. Since there are many reviews, accumulated delay is huge
    - Planning/distribution of more work for advanced team is needed

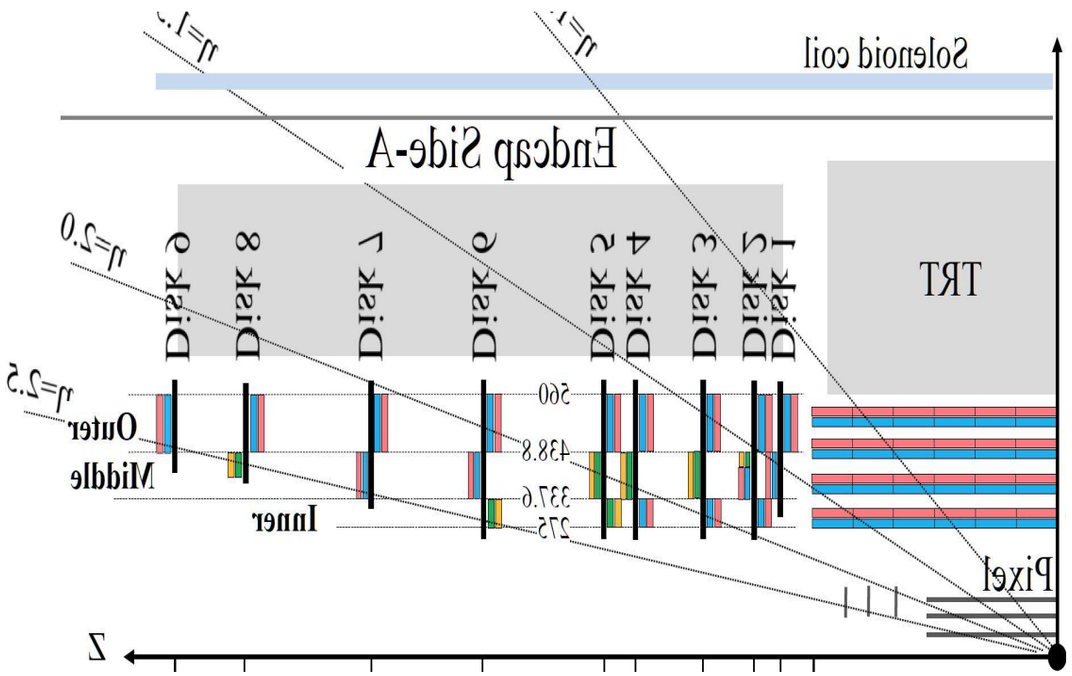


Conclusions

- Japanese contributions to :
  - Operation
    - Pixel, SCT, LAr trigger, TGC, HLT
  - Phase-II Japanse contributions
    - Pixel in preparation for production
    - Strip sensor production is on-going
    - Muon trigger development in good shape
  - Physics

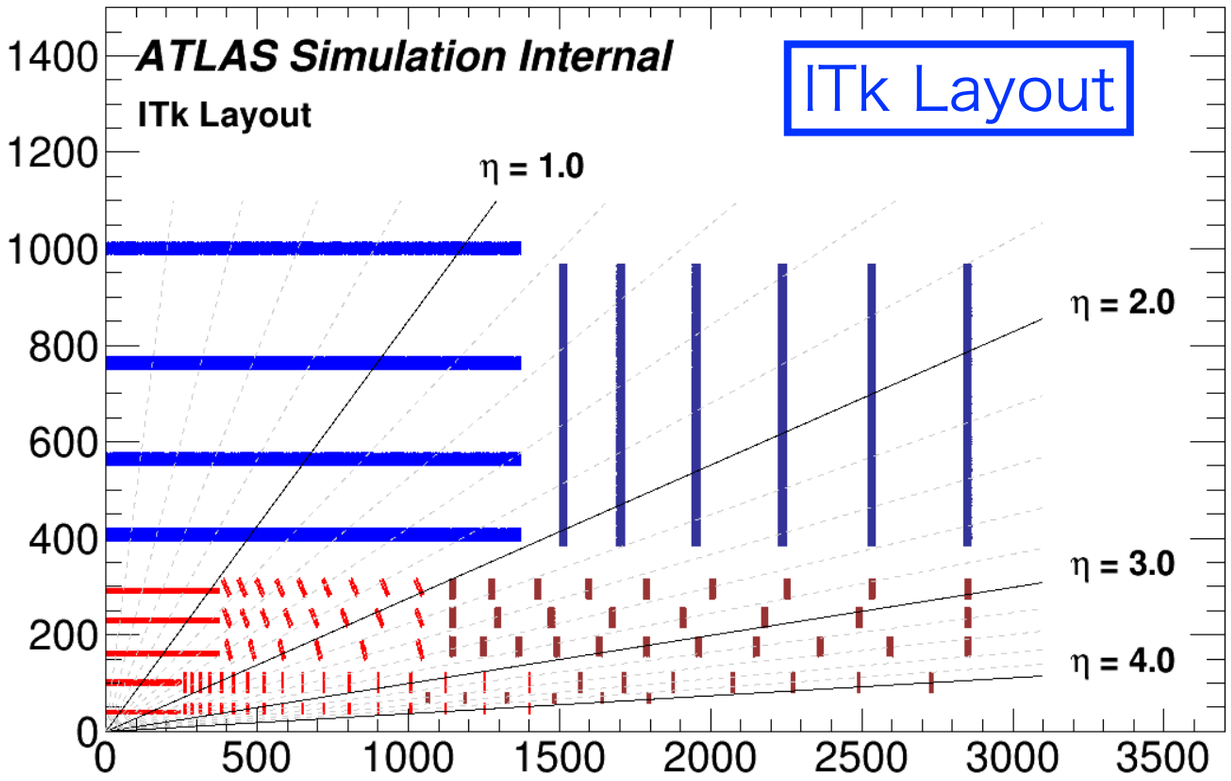
Silicon Tracker (ITk)

Current Layout



- Totally new detector
- Area
  - Pixel 2.7m^2 → 13.5m^2
  - Strip 62m^2 → 165m^2
- The number of channels
  - Pixel 90M → >5G
  - Strip 6M → 60M

ITk Layout



- Finer
  - Pixel size
    50×400 μm^2→50×50 μm^2
  - Strip length
    20cm → 2.4cm (shortest)

⇒ faster data transfer

- Radiation harder
  - Innermost 1×10^{15} n_{eq}/cm^2
    → 2×10^{16} n_{eq}/cm^2