

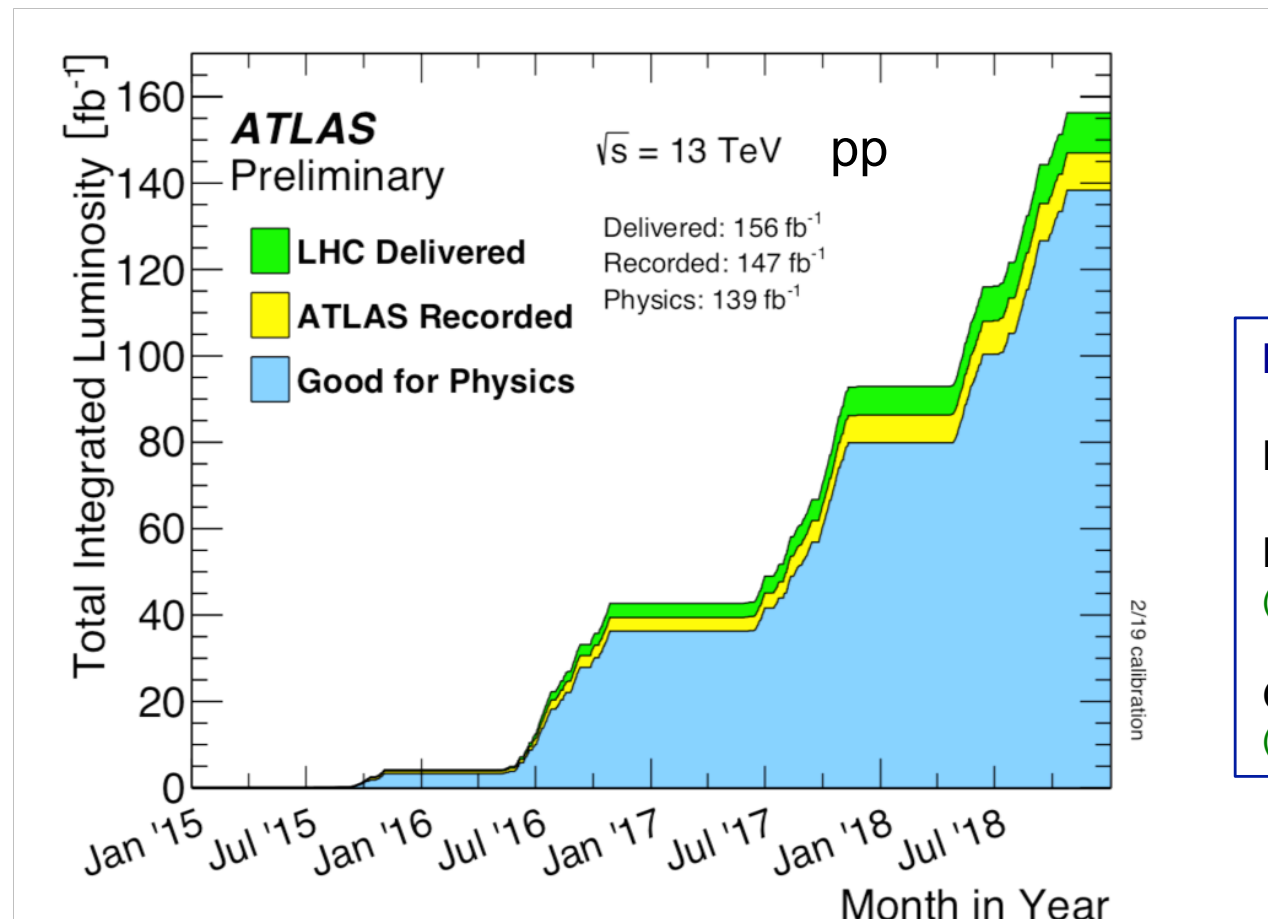
ATLAS

~ Focus on Japanese Activities ~

Kazunori Hanagaki (KEK)

Slide from Karl Jakobs

Excellent progress in analysis of Run-2 data



In Run 2 (2015 – 2018):

Delivered: 156 fb⁻¹

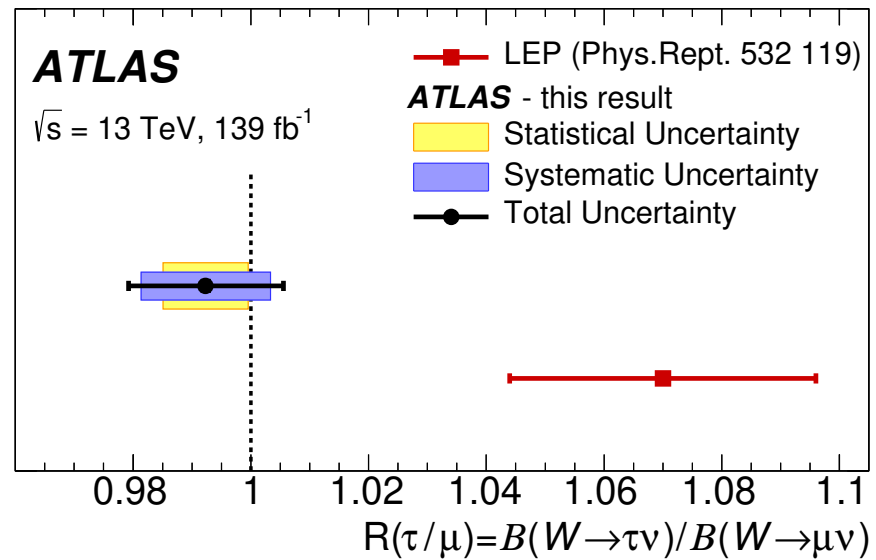
Recorded: 147 fb⁻¹
(Data taking efficiency 94.2%)

Good for Physics: 139 fb⁻¹
(Efficiency 94.6%, → high data quality)

- **100 public results (60 papers)** with complete Run-2 pp dataset, 139 fb⁻¹
<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/ResultswithData2018>
- **11 public results (4 papers)** incl. the 2018 Heavy Ion data, 1.7 nb⁻¹
<https://twiki.cern.ch/twiki/bin/view/AtlasPublic/HeavyIonsPublicResults>
- **37 ICHEP 2020 Conference contributions**
<https://atlas.cern/updates/atlas-news/summary-ichep-2020>

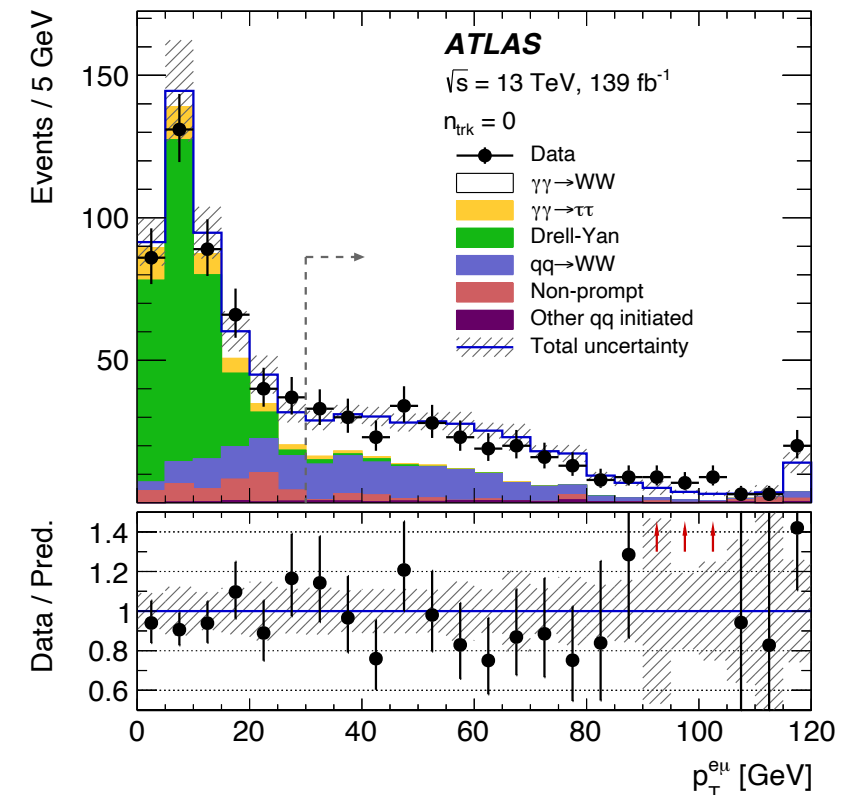
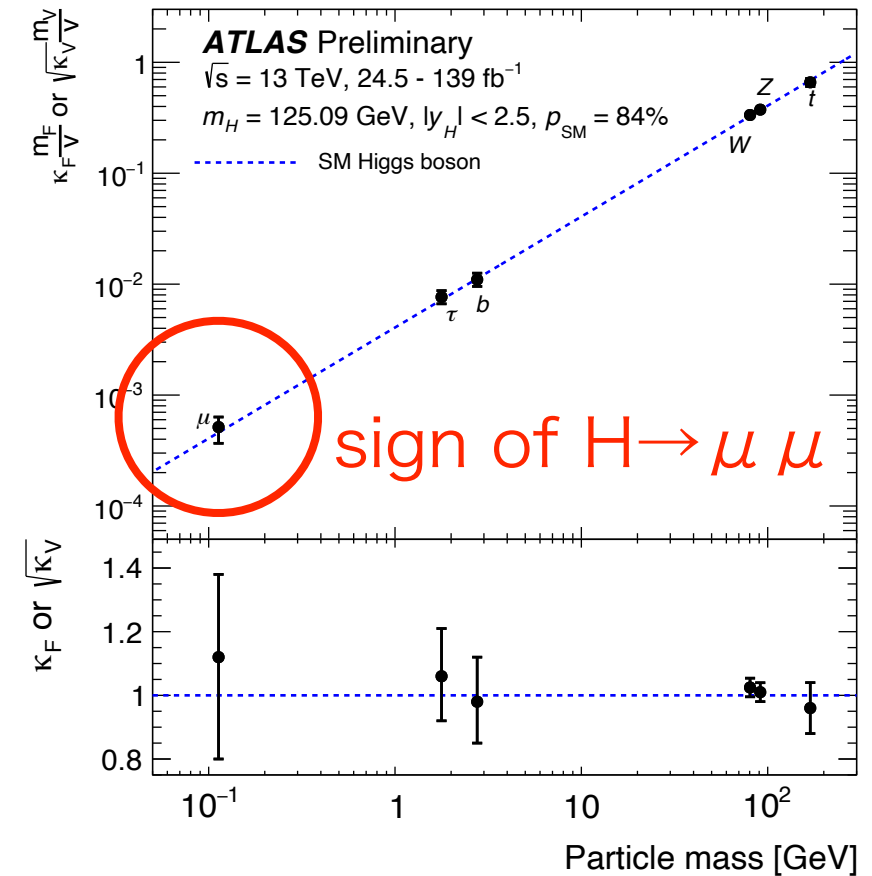
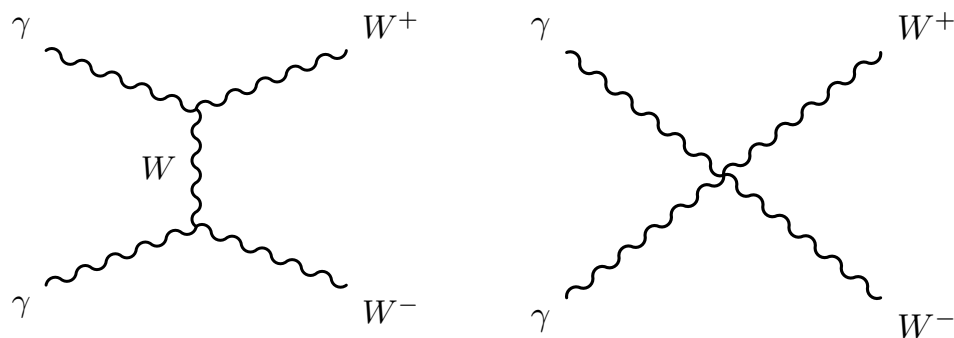
Highlights of Physics Result

Precision improves everywhere



test of lepton universality
 ← long standing issue solved

Observation of $\gamma\gamma \rightarrow WW$



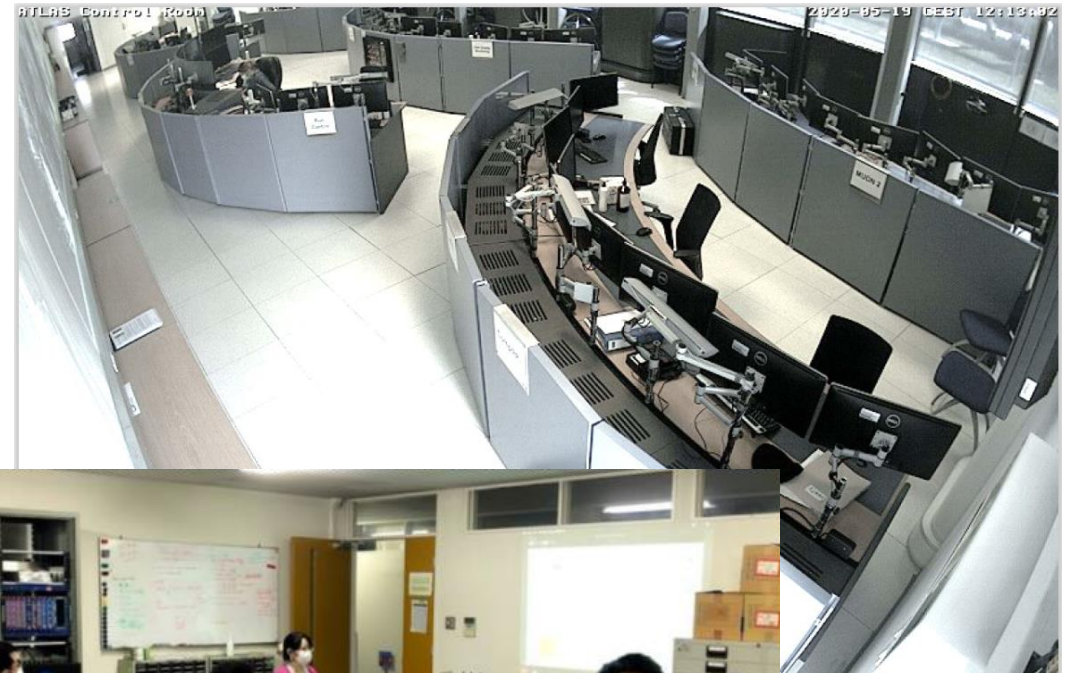
Research with COVID-19

LS1



View at the global DAQ testing

LS2 July 2020



LS2 October 2020



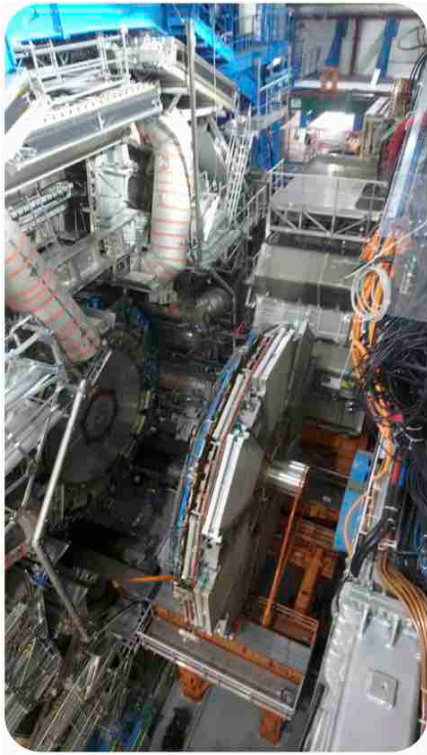
completely remote

in person participation with anti COVID19 measures

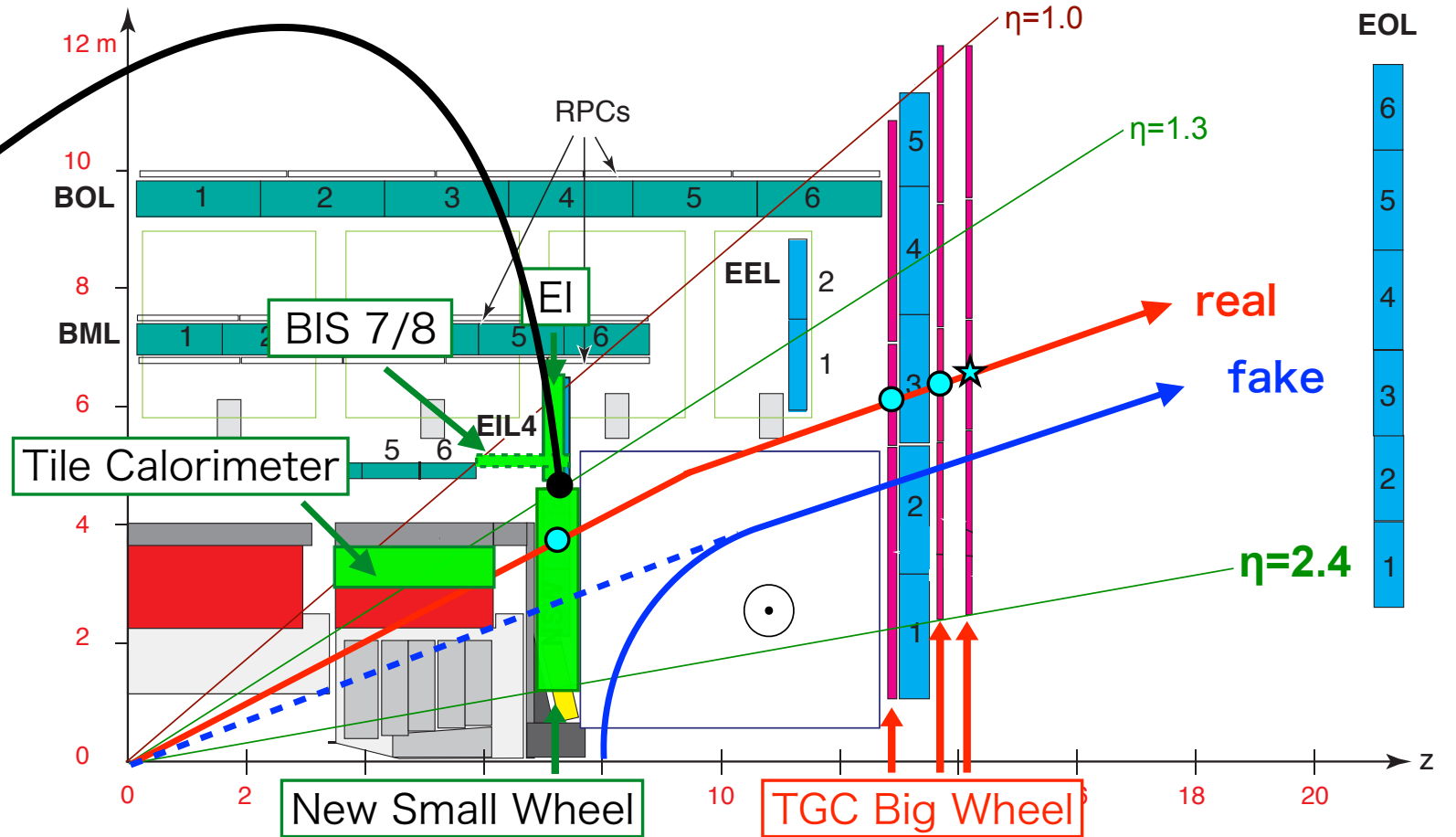
Japanese Phase-I Activities

- ❖ Consolidation of Pixel and SCT
- ❖ Phase-I upgrade
 - ▶ Muon trigger
 - ▶ LAr trigger

New Small Wheel (NSW)

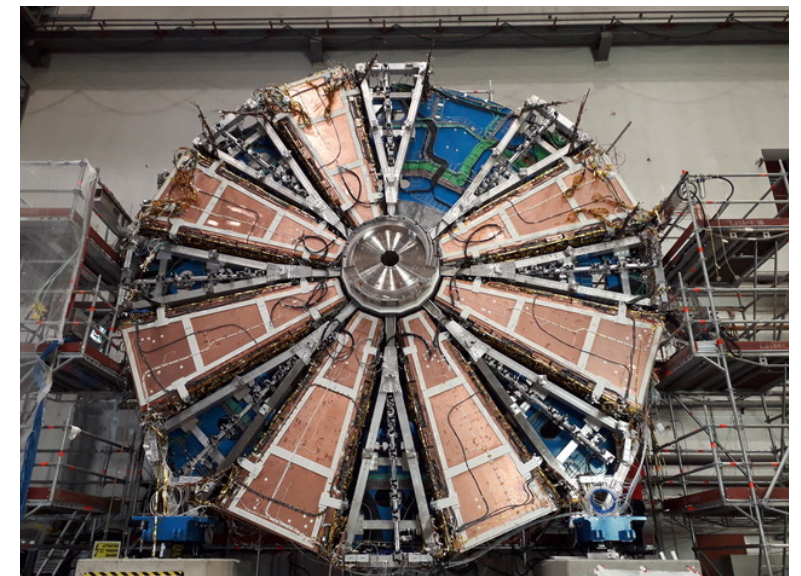


old Small Wheel to surface



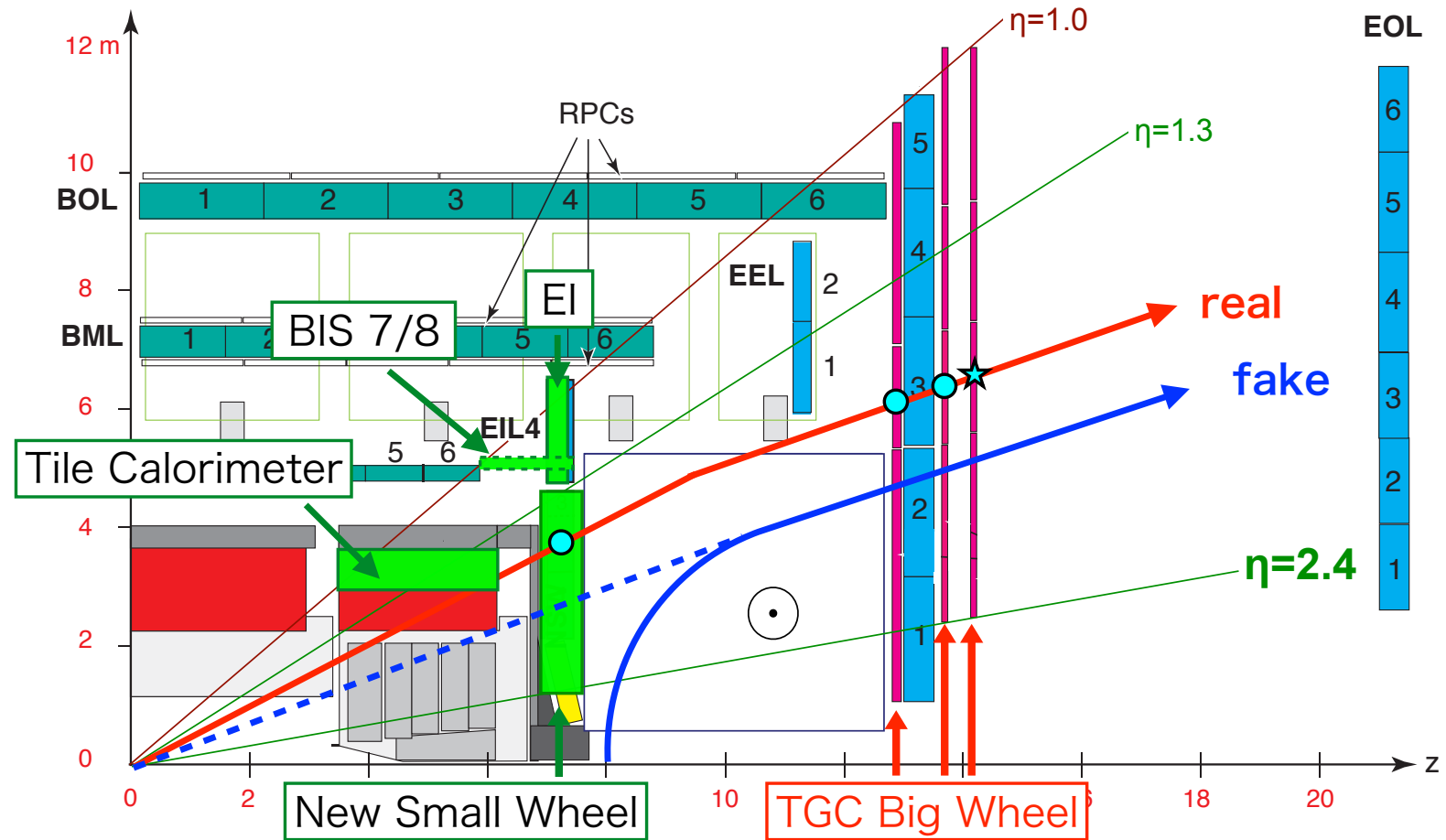
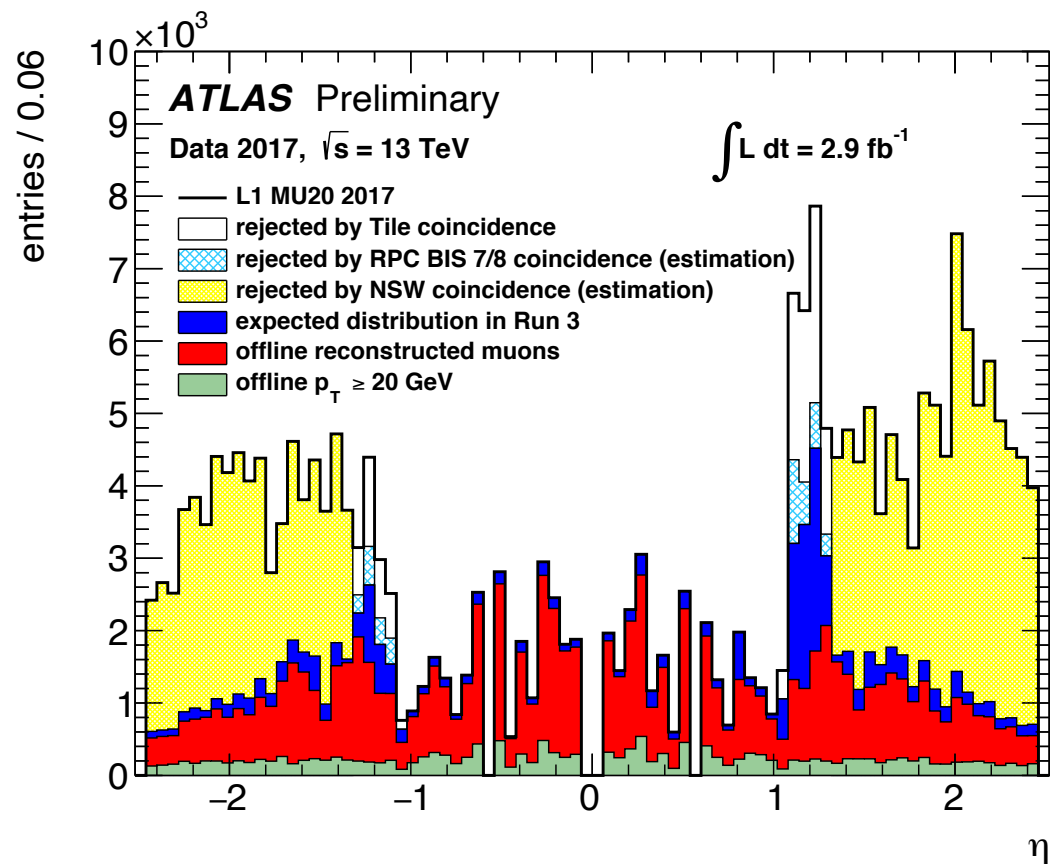
February 2020

September 2020

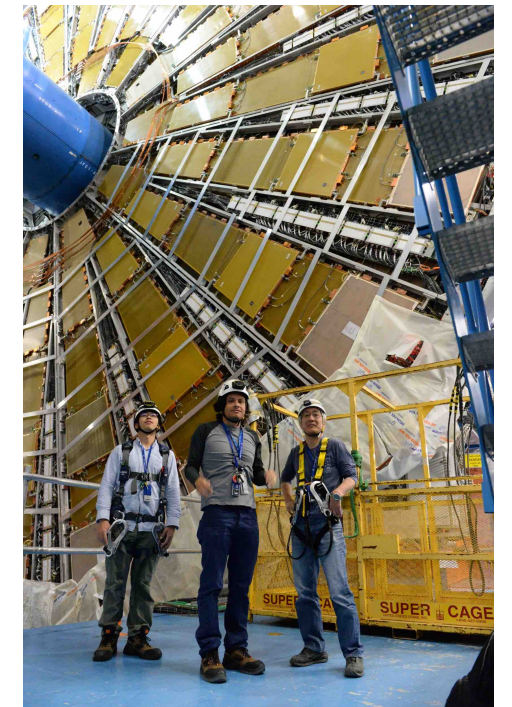
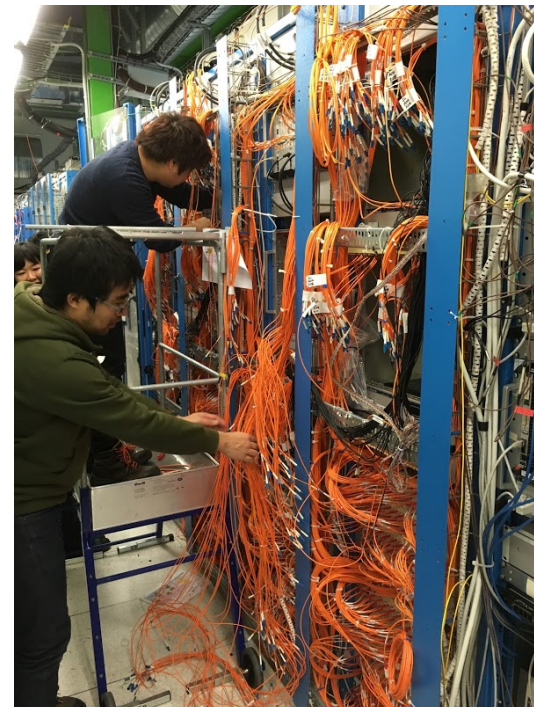
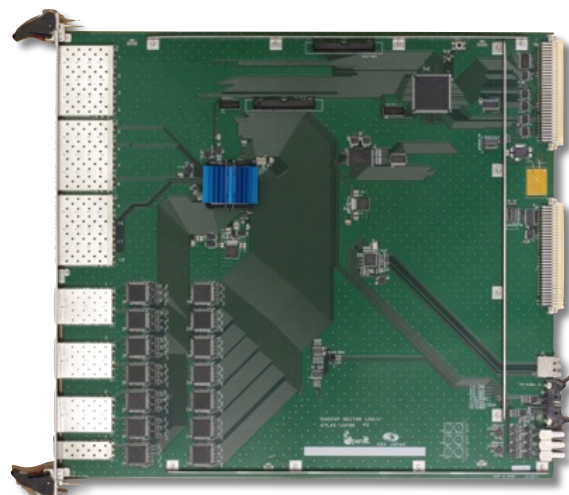


New Small Wheel being constructed

Japanese Activity for NSW



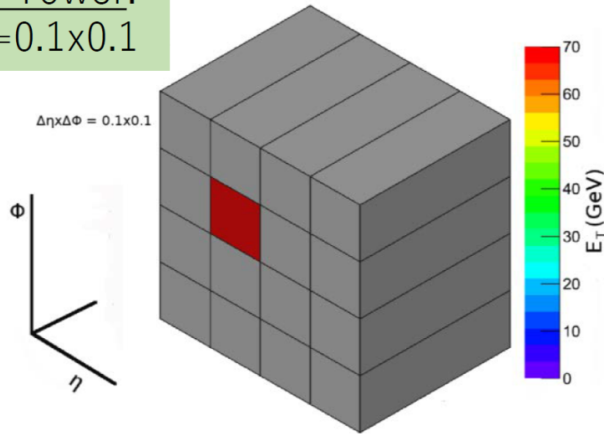
New trigger logic boards to cope with NSW were installed. Commissioning in progress.



Japanese Activity for LAr Trigger

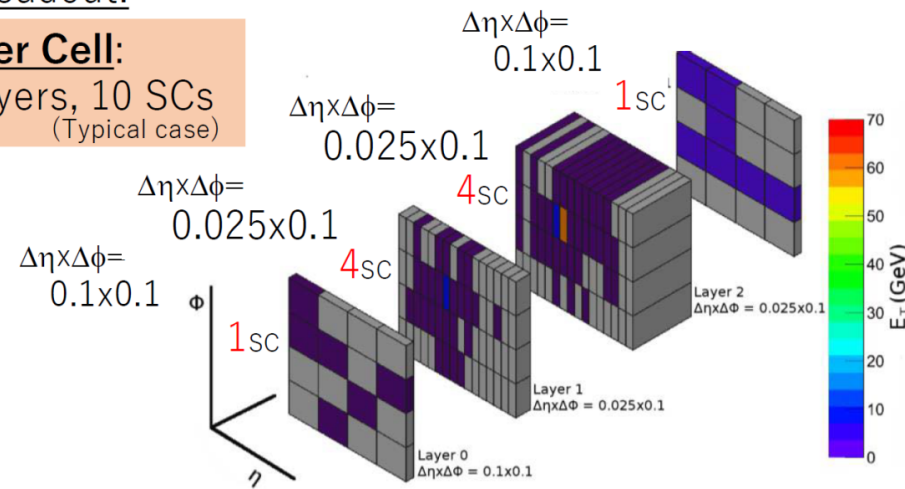
Current readout:

Trigger Tower:
 $\Delta\eta \times \Delta\phi = 0.1 \times 0.1$

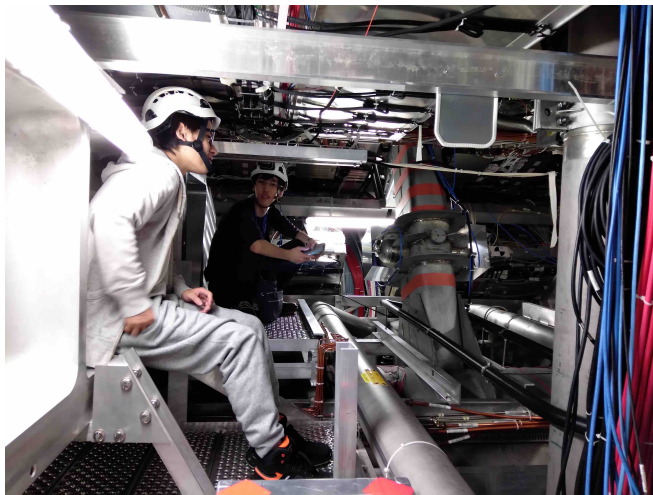


NEW readout:

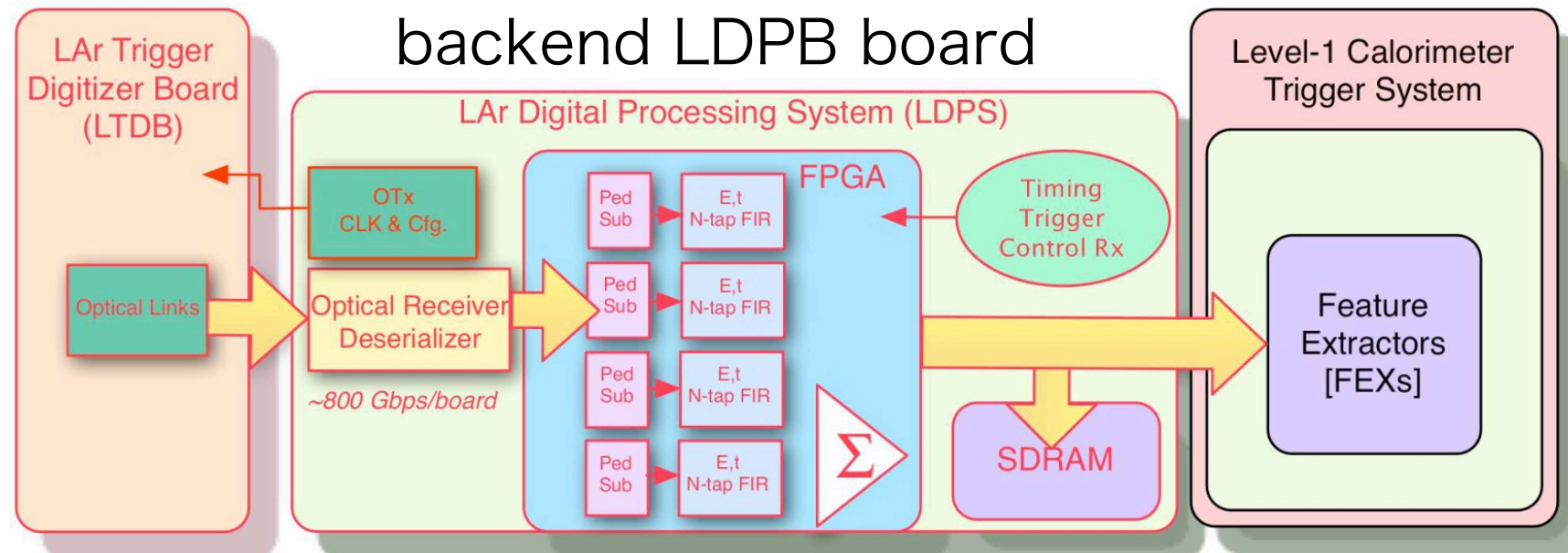
Super Cell:
 4 layers, 10 SCs
 (Typical case)



On-detector



backend LDPB board



❖ Backend LDPB board

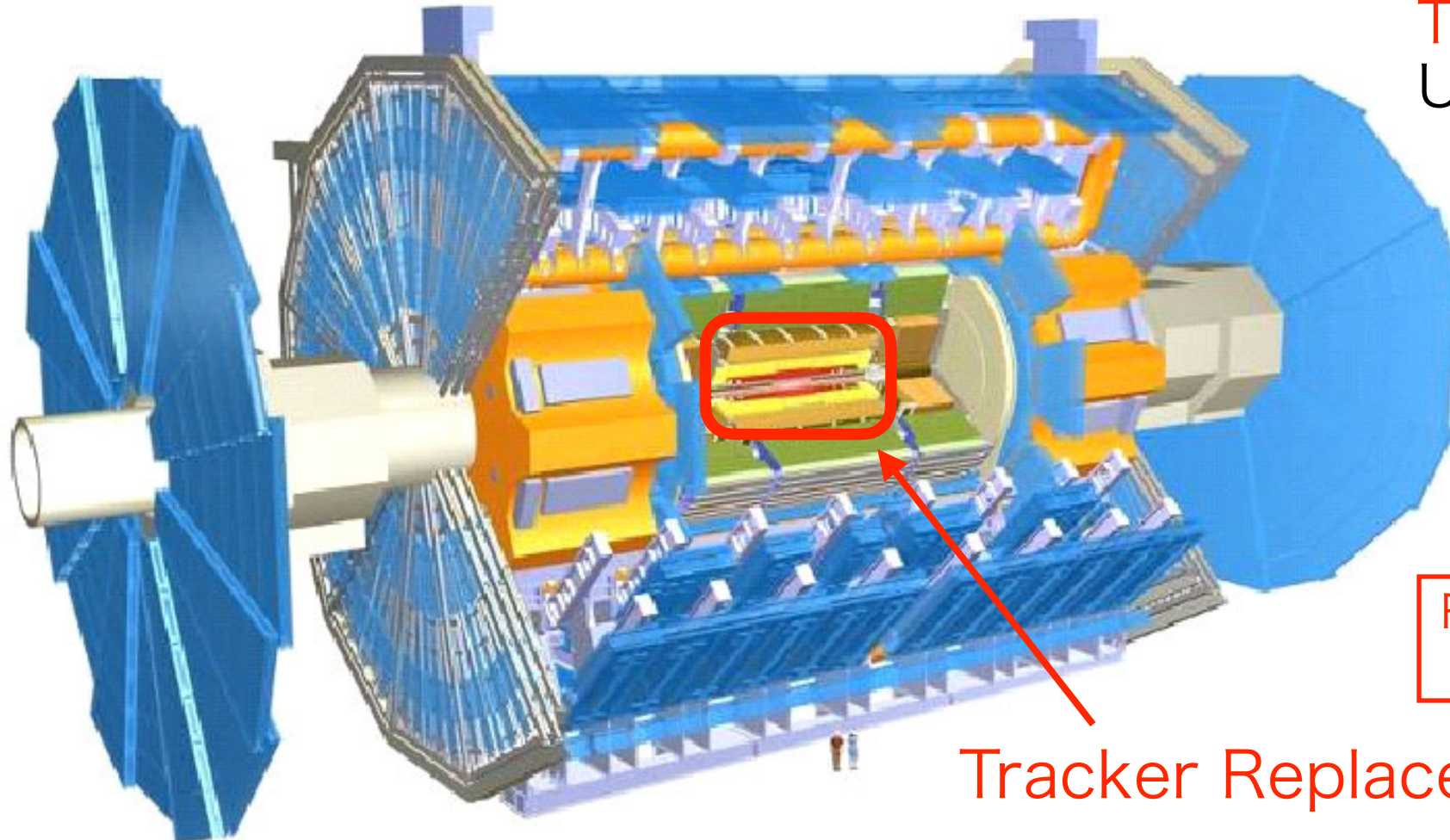
- ▶ Installation, cabling and commissioning
- ▶ Firmware development & energy calculation algorithm

Phase-II Upgrade Status

Electronics replacement

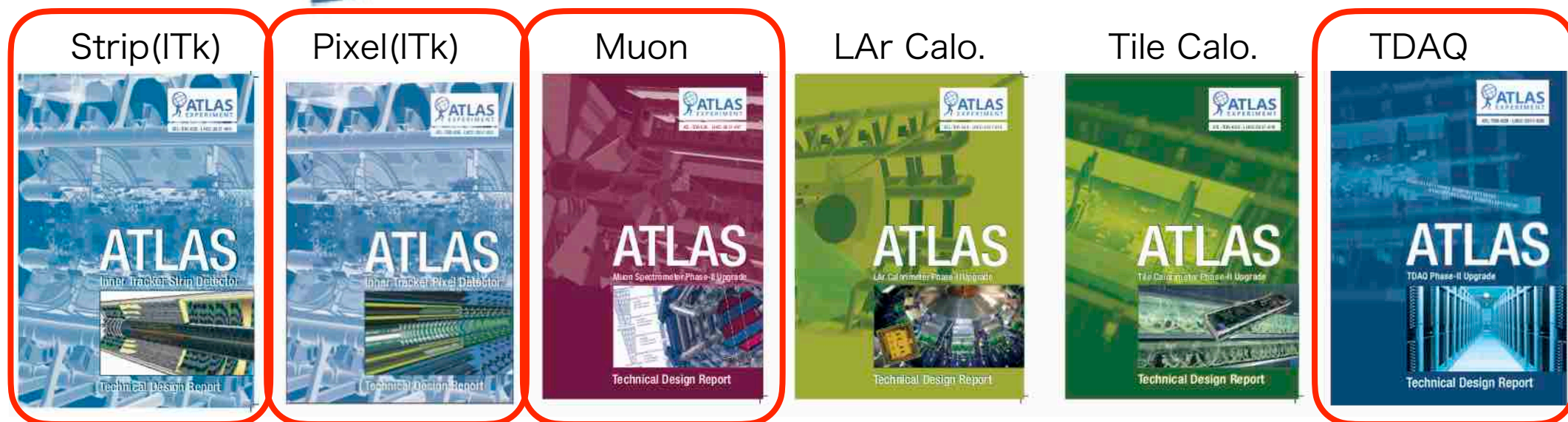
- LAr calorimeter
- Tile calorimeter
- Muon

Trigger & DAQ Upgrade

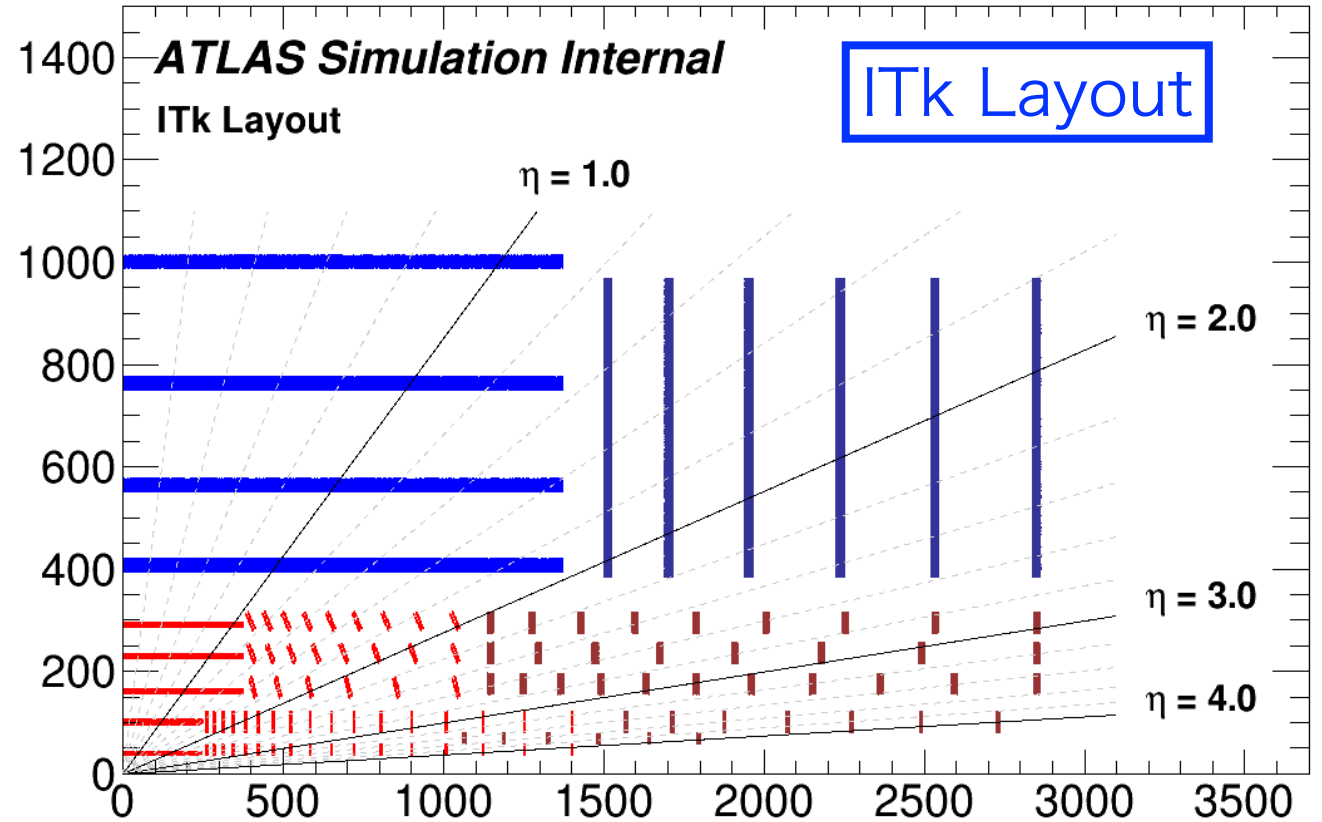
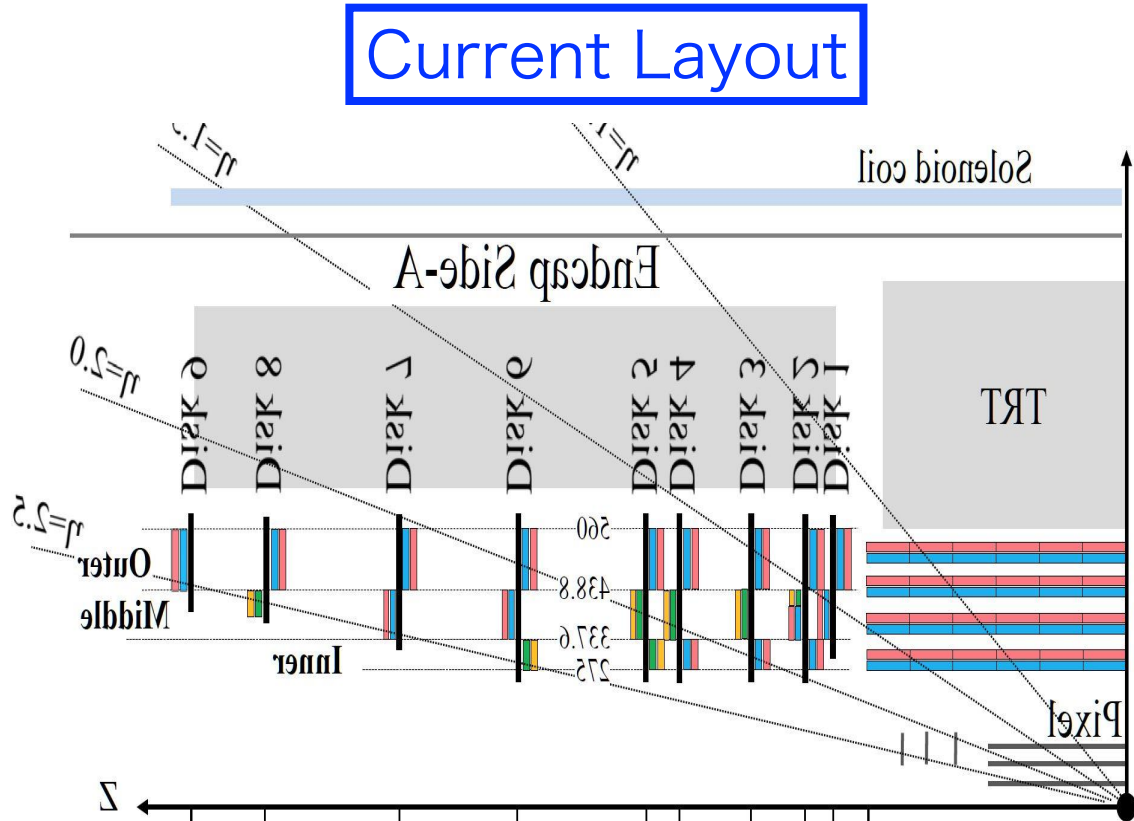


Tracker Replacement

Red : contribution by KEK/Japan



Silicon Tracker (ITk)



- ❖ Totally new detector
- ❖ Area
 - ▶ Pixel $2.7\text{m}^2 \rightarrow 13.5\text{m}^2$
 - ▶ Strip $62\text{m}^2 \rightarrow 165\text{m}^2$
- ❖ The number of channels
 - ▶ Pixel $90\text{M} \rightarrow >5\text{G}$
 - ▶ Strip $6\text{M} \rightarrow 60\text{M}$

- Finer
 - Pixel size
 $50 \times 400 \mu\text{m}^2 \rightarrow 50 \times 50 \mu\text{m}^2$
 - Strip length
 $20\text{cm} \rightarrow 2.4\text{cm}$ (shortest)
 ⇒ faster data transfer
- Radiation harder
 - Innermost $1 \times 10^{15} \text{ n}_{\text{eq}}/\text{cm}^2$
 $\rightarrow 2 \times 10^{16} \text{ n}_{\text{eq}}/\text{cm}^2$

Japanese ITk Activities

❖ Pixel

▶ Sensor

- Final Design Review (FDR) finished
→ final design work at the HPK is on going

▶ Bump bonding

- Market survey is on going
→ Japanese group assembles modules and inspects bump connectivity

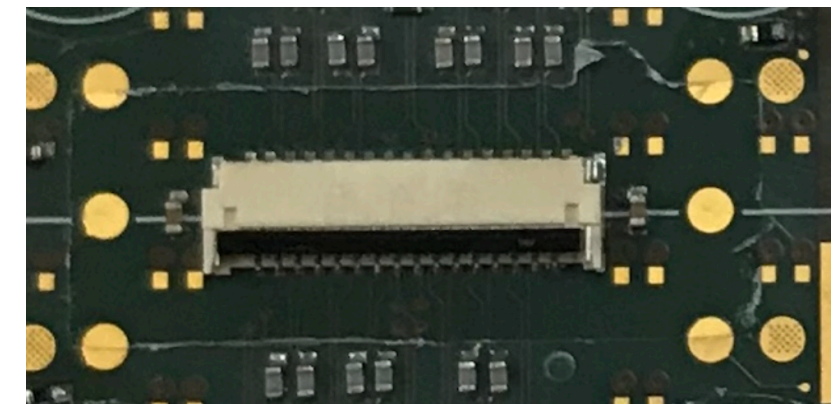
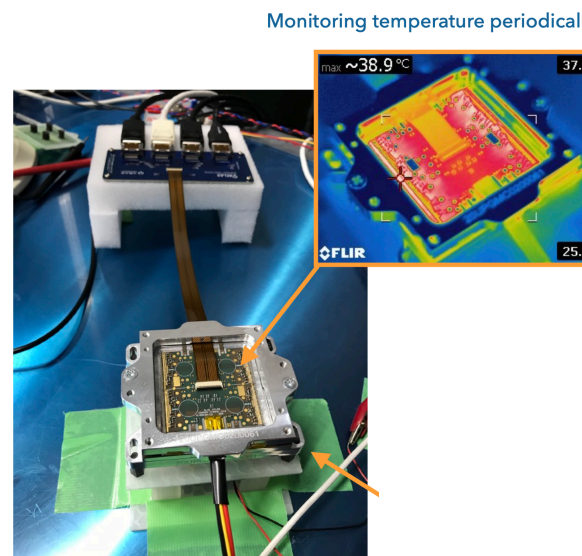
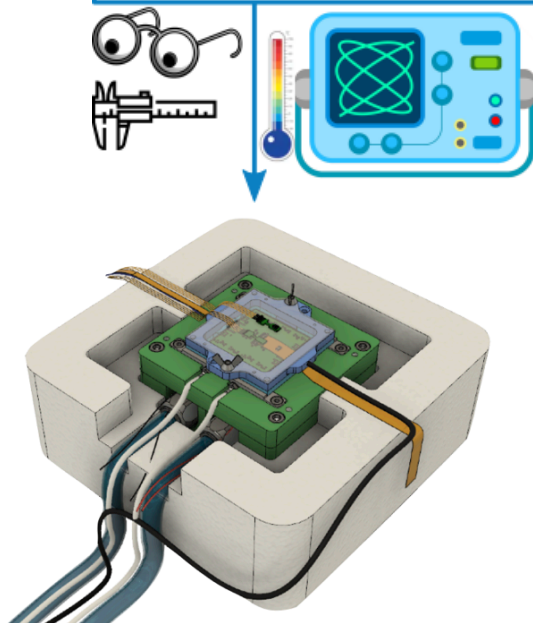
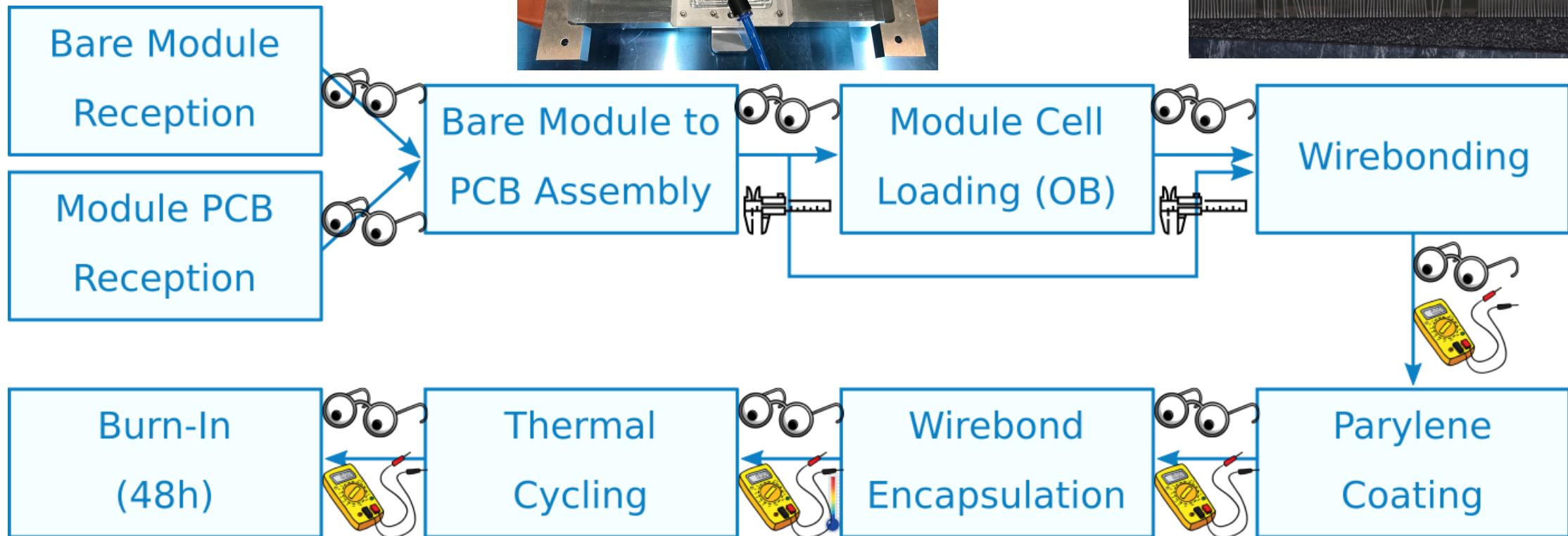
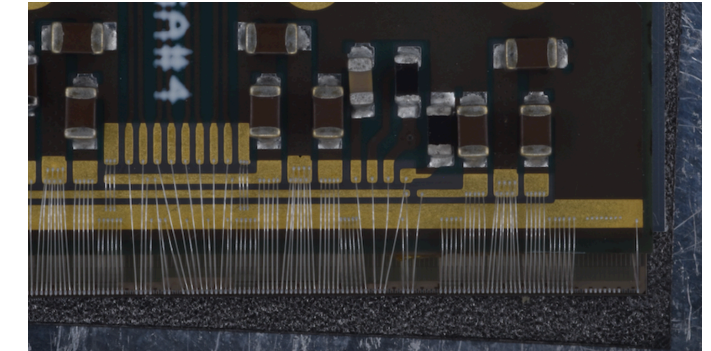
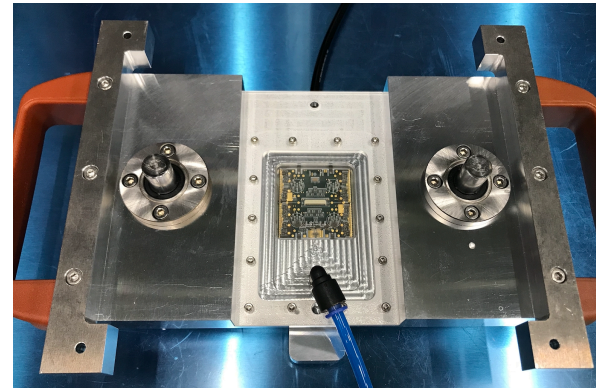
▶ Module assembly, QC/QA

- In preparation of mass-production and testing

❖ Strip

▶ Sensor production, QC/QA

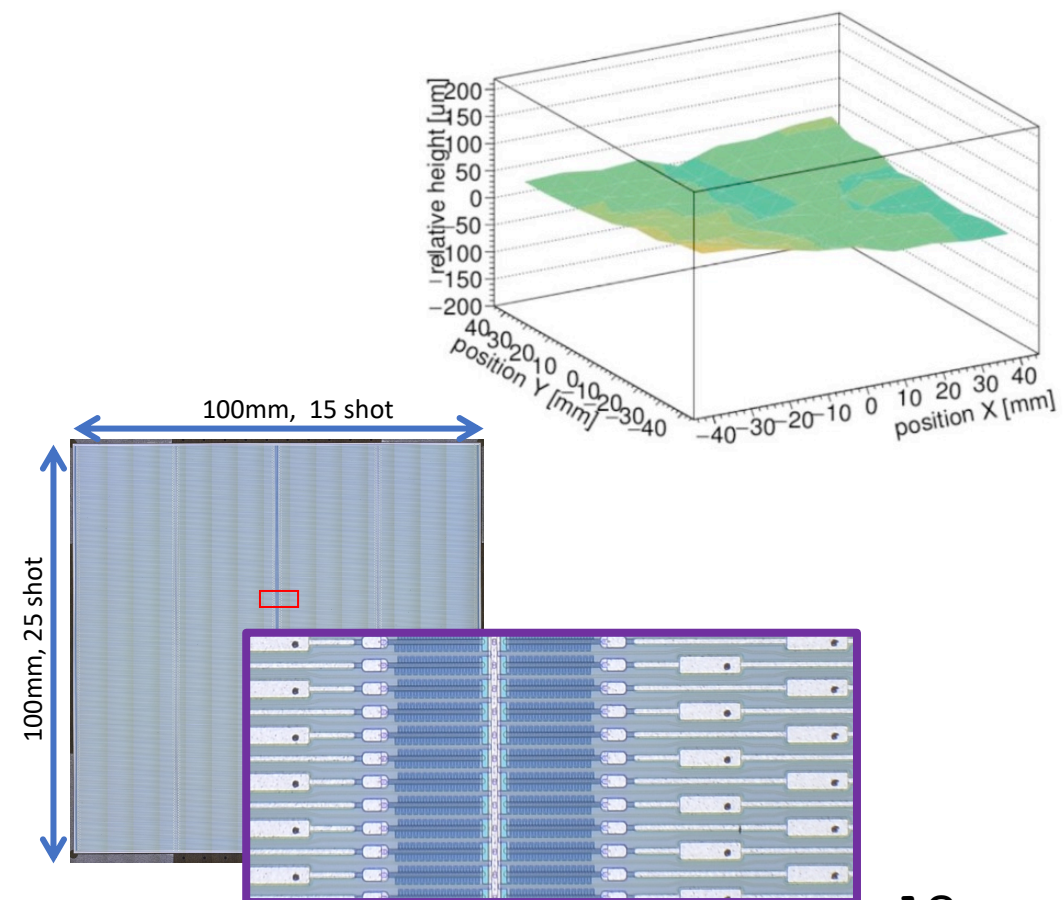
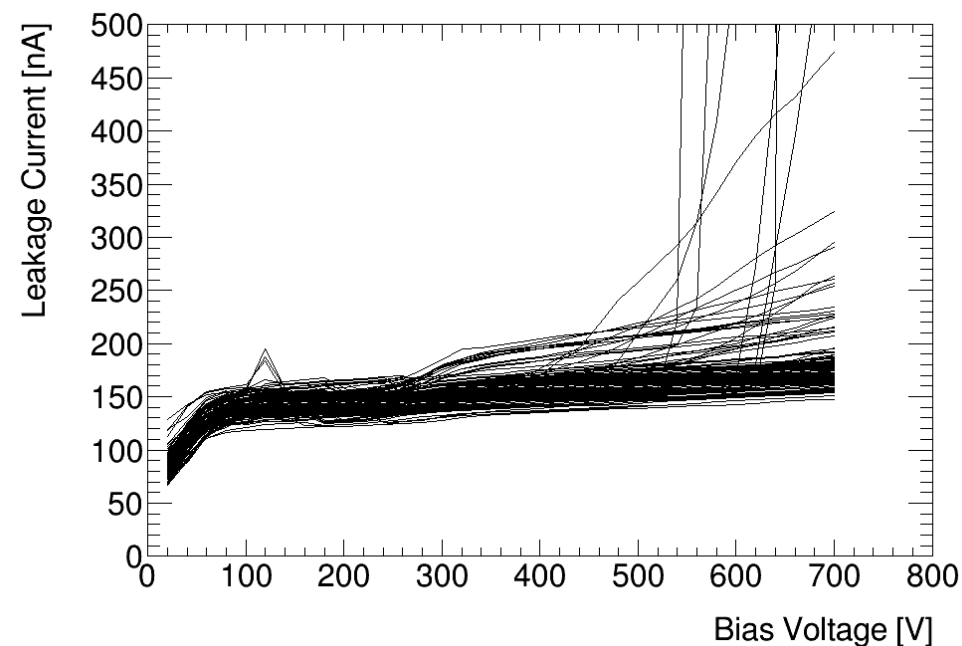
Pixel Module Assembly and Testing



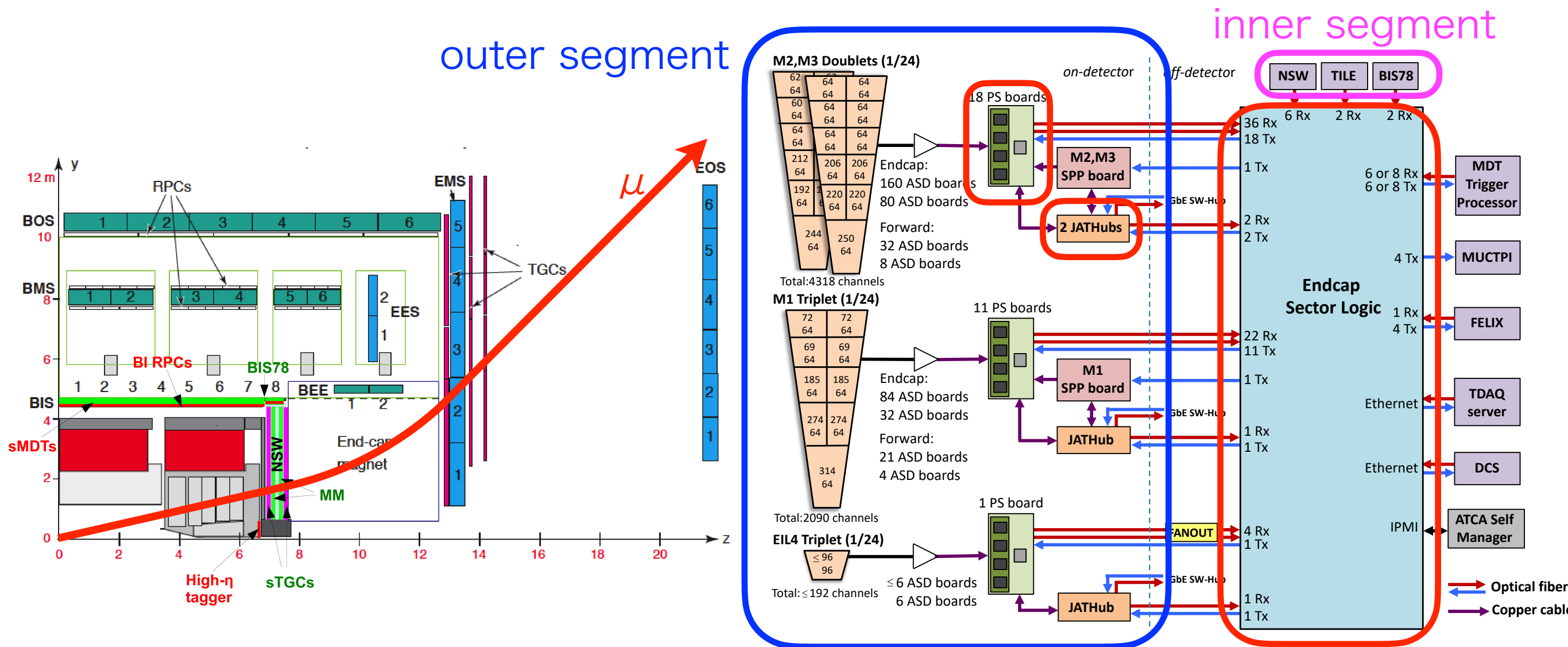
Test setup in KEK

Silicon Strip Sensor

- ❖ A half of barrel sensors will be procured and tested by Japan
- ❖ Preproduction is finished
- ❖ Testing indicates no issues
- ❖ Japan is ready for large scale (~7,000 sensors) mass-production
←waiting for the PRR



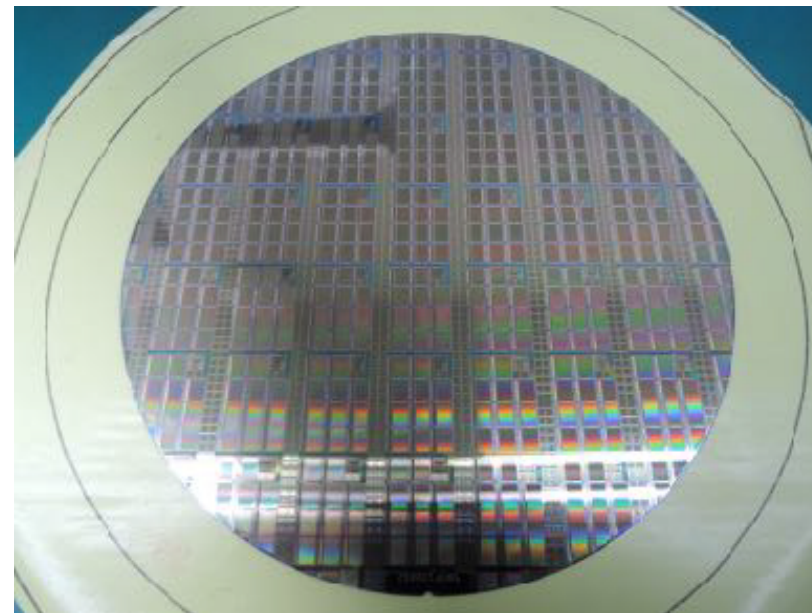
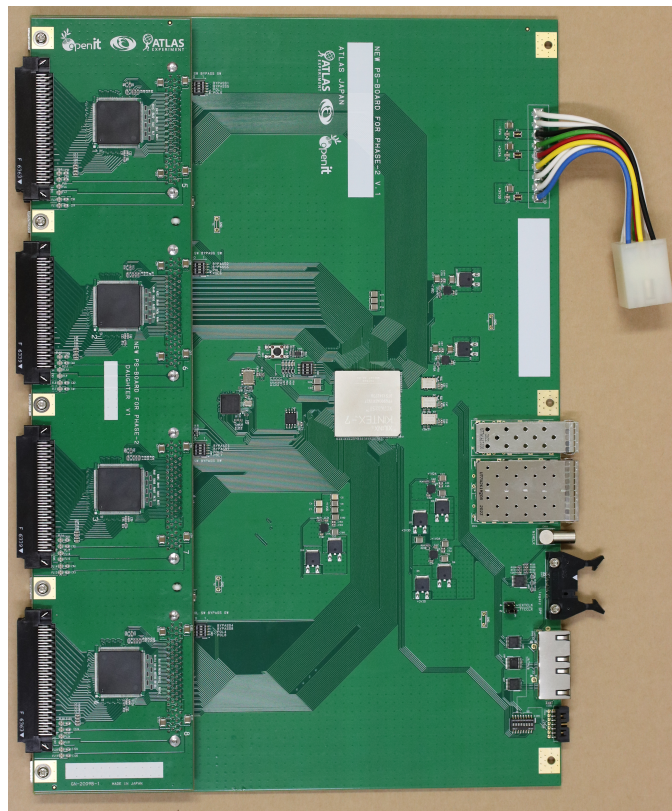
Endcap Muon Trigger Upgrade



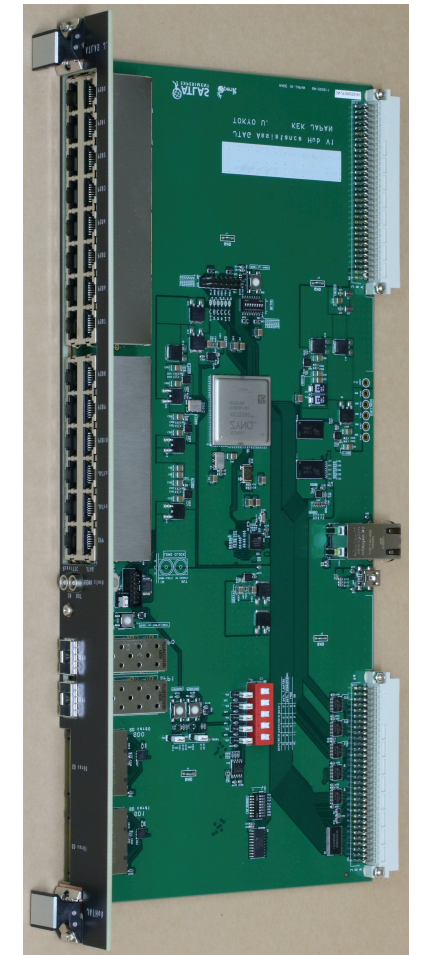
- ❖ New trigger uses informations from
 - ▶ Outer segment by TGC
 - ▶ Inner segment by NSW, BIS7&8, Tile Calorimeter
- ❖ Japanese group develops and build three types of boards; PS board, JATHub board, Sector Logic board

TGC Frontend Boards

- ❖ Both prototypes in hand, and inspection on going
 - ▶ final versions of prototype will be produced in JFY 2020
- ❖ Mass-production of Patch Panel ASIC finished



Patch Panel ACIS
for PS board



JATHub board

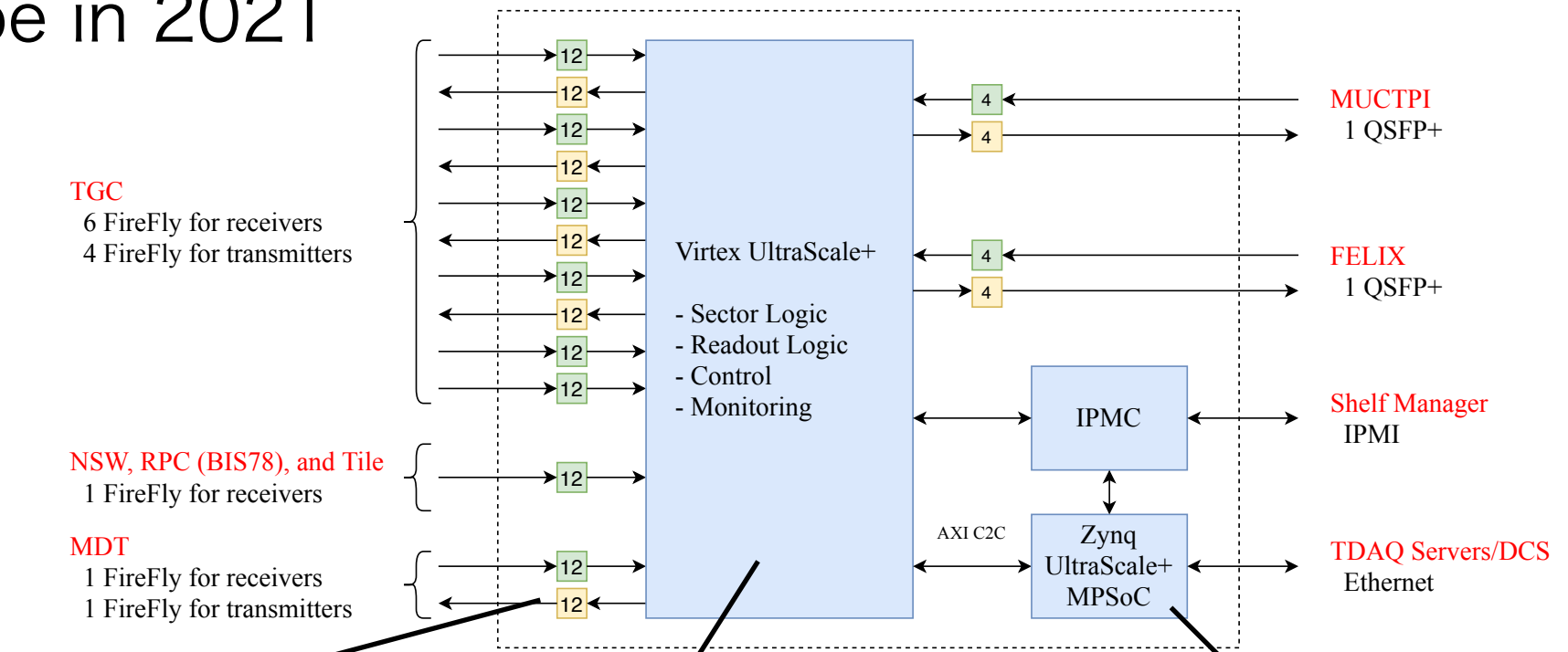
PS board

- identify BCID and
- send all TGC hit information to the backend module

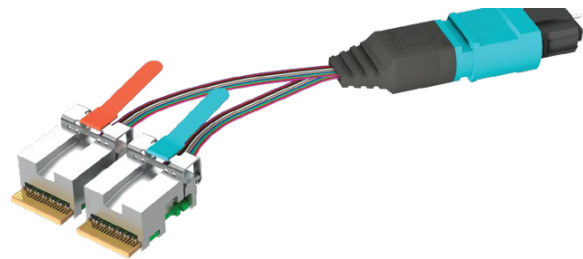
- monitor and control FPGAs on PS board

Sector Logic Board

- ❖ Design and parts procurement on going
- ❖ First prototype in 2021



24 lane optical system
(12 Rx + 12 Tx)
x30 data transmit rate
(comparing with current system)



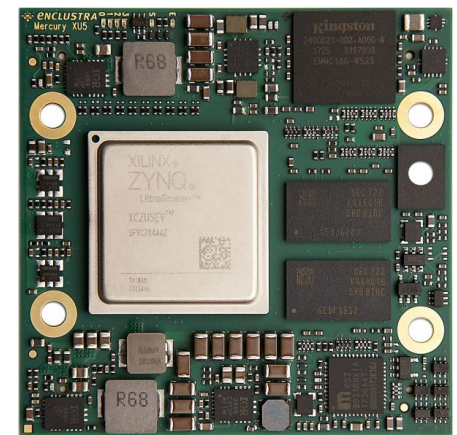
For x30 data transmit rate
than current system

High performance FPGA
(XCVU13P)
with x10 larger resources
(comparing with current FPGA)



For complex trigger algorithm

MPSoC FPGA



To control/monitor system

ATLAS Upgrade Status Report 2020 – 2021

● Phase-II Upgrade MoUs: Status of Signing

| Funding Agency | TDAQ | ITK Pixel | ITK Strip & Common Items | LAr | Tile | Muon | Common Fund |
|-----------------|----------|-----------|--------------------------|----------|----------|----------|-------------|
| Argentina | Signed | | | | | | Signed |
| Armenia | | | | | | | Signed |
| Australia | Signed | | Signed | | | | Signed |
| Austria | Unsigned | | | | | | Signed |
| Azerbaijan | | | | | | | Signed |
| Belarus | | | | | Unsigned | | Unsigned |
| Brazil | | | | | | | Unsigned |
| Canada | | | Signed | Signed | | | Signed |
| Chile | | | | | | Unsigned | Signed |
| China NSFC+MSTC | | | Unsigned | | | Unsigned | Unsigned |
| Colombia | Unsigned | | | | | | Signed |
| Czech Republic | Signed | Signed | Signed | | Signed | | Signed |
| Denmark | Unsigned | | Unsigned | | | | Signed |
| France IN2P3 | Signed | Signed | Signed | | Signed | | Signed |
| France CEA | | Signed | Signed | | | Signed | Signed |
| Georgia | | | | | Signed | | Signed |
| Germany BMBF | Signed | Signed | Signed | | | | Signed |
| Germany DESY | | | Signed | | | | Signed |
| Germany MPI | Signed | Signed | Signed | | | Signed | Signed |
| Greece | Unsigned | | | | | Unsigned | Unsigned |
| Hong Kong | | Signed | Signed | | | Signed | Signed |
| Israel | Signed | | | | | | Signed |
| Italy | Unsigned | Signed | Signed | Signed | Signed | | Signed |
| Japan | Unsigned | Unsigned | Unsigned | | | Unsigned | Signed |
| Morocco | | | | | | | Unsigned |
| Netherlands | Signed | Signed | Signed | | | Signed | Signed |
| Norway | | Signed | Signed | | | | Signed |
| Poland | Unsigned | | Unsigned | | | | Unsigned |
| Portugal | Signed | | | | Signed | | Signed |
| Romania | Signed | | | | Signed | | Signed |
| Russia | | Unsigned | Unsigned | Unsigned | Unsigned | Unsigned | Unsigned |
| JINR | Signed | | | Signed | Signed | | Signed |
| Serbia | | | | | | | Signed |
| Slovak Republic | Signed | | | Signed | Signed | | Signed |
| Slovenia | | | Signed | | | | Signed |
| South Africa | | | Signed | | Signed | | Signed |
| Spain | | Unsigned | Unsigned | | Unsigned | | Signed |
| Sweden | Signed | | Signed | | Signed | | Signed |
| Switzerland | Signed | Unsigned | Signed | | | | Signed |
| Taipei | | | | | | Unsigned | Signed |
| Turkey | Unsigned | | | | | Unsigned | Unsigned |
| United Kingdom | Signed | Signed | Signed | | | | Signed |
| USA DOE | Unsigned | Unsigned | Unsigned | Unsigned | | | Unsigned |
| USA NSF | Unsigned | | | Unsigned | Unsigned | Unsigned | Unsigned |
| CERN | Signed | Signed | Signed | Signed | Signed | Signed | Signed |

o Last updated: 8-May-2020

- When informed by the office of the DRC

Signed
Unsigned

o Summary

| | TDAQ | ITK Pixel | ITK Strip & Common Items | LAr | Tile | Muon | Common Fund |
|--------------------------|--------|-----------|--------------------------|--------|-------|--------|-------------|
| Signed | 16 | 11 | 18 | 9 | 12 | 9 | 35 |
| % signed | 62% | 69% | 72% | 75% | 75% | 53% | 78% |
| CORE value signed (kCHF) | 26'187 | 30'228 | 46'468 | 18'035 | 8'274 | 15'069 | 17'443 |
| % CORE value | 59% | 63% | 62% | 64% | 71% | 52% | 71% |

- 70% of all MoUs signed
- Representing 62% of the total CORE value

o HGTD MoU in first quarter 2021

Japanese Funding Situation

- ❖ 2019 : Budget framework “Particle physics with the High-Luminosity Large Hadron Collider (HL-LHC)” is approved
 - ▶ Budget request (KEK→MEXT→MOF) for each single year
 - ▶ FY2021 request now in MEXT→MOF
 - Actual budget size determined at the end of year

- ❖ So far no problems to fulfill the MoU share (although signing is not yet...)
 - ▶ In my personal impression, expect no serious problems in coming years

Conclusions

- ❖ Good progress in ATLAS
 - ▶ Physics analyses yield many interesting results
 - ▶ Phase-I upgrade on going
- ❖ Japanese contributions to :
 - ▶ Various physics analyses
 - ▶ Phase-I trigger upgrade including NSW
 - ▶ Phase-II Japanese contributions
 - Pixel in preparation for production, finishing R&D
 - Ready for procurement and testing of Strip sensors, waiting for Production Readiness Review
 - Muon trigger development (and procurement) in good shape
 - so far almost independent work without influence of the delay due to COVID-19