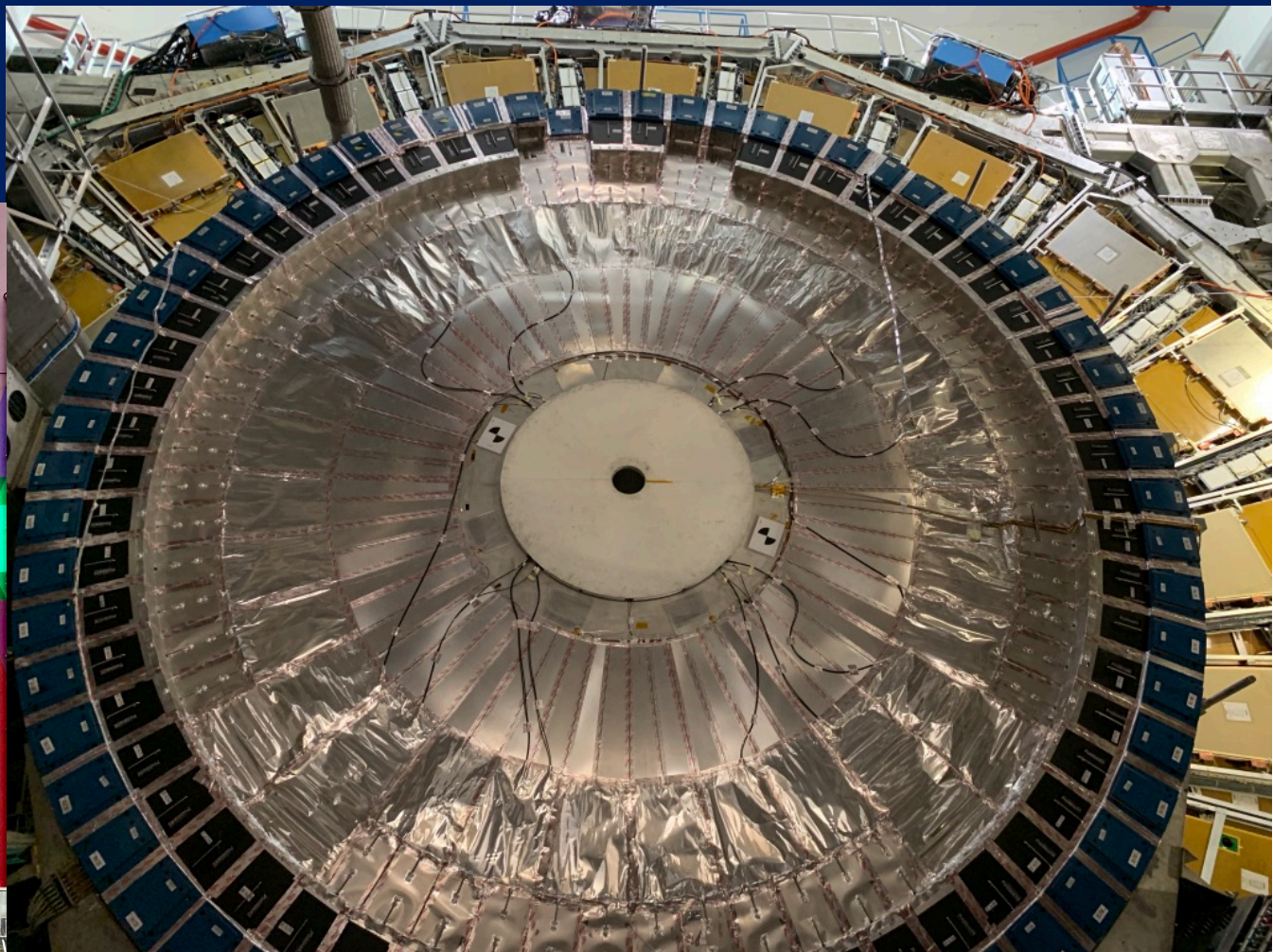


ATLAS Status Report: LS2 activities and Phase I Upgrade

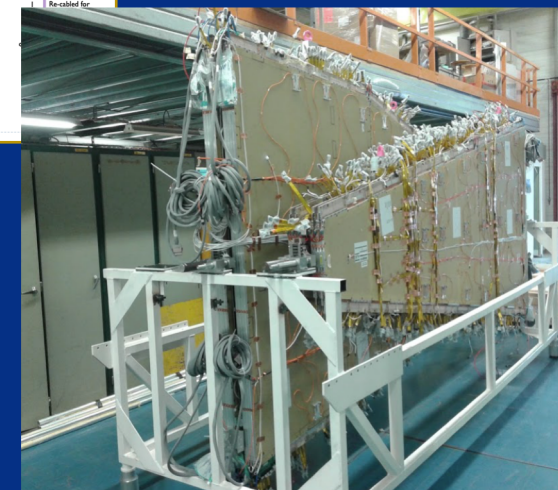
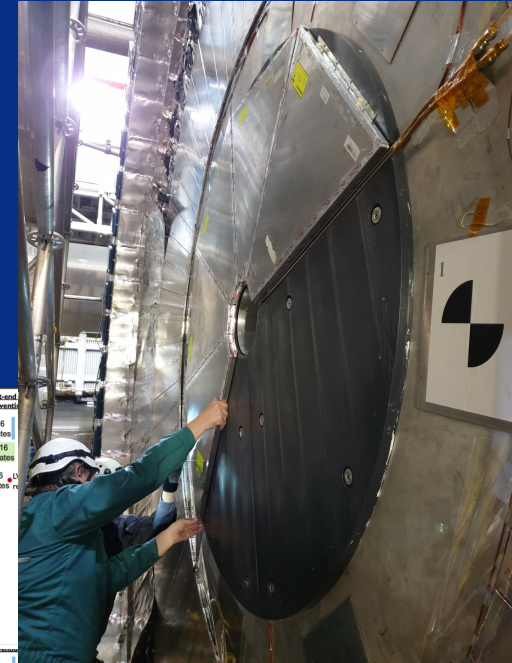
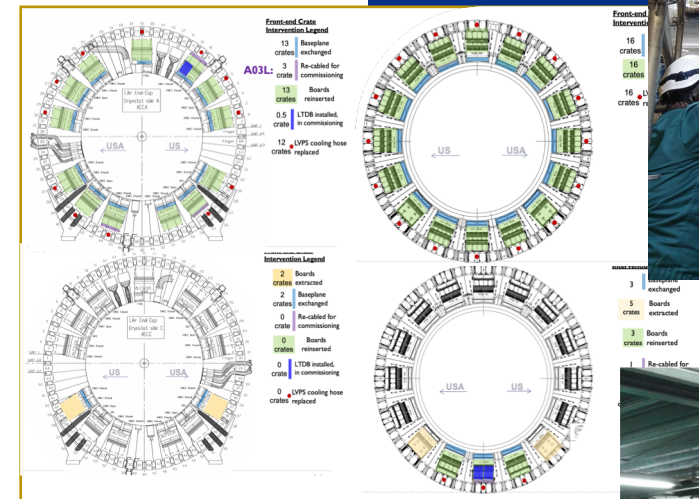


RRB 28/10/2019

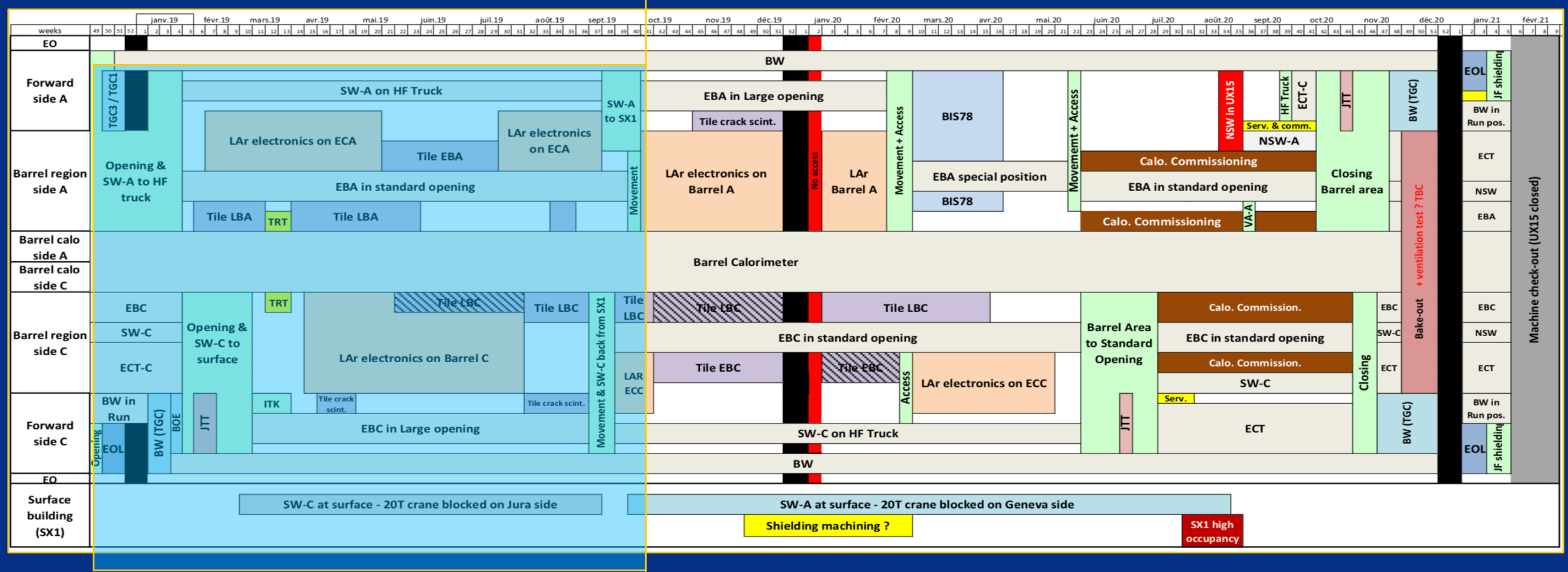
L. Pontecorvo CERN

Outline

- LS2 current status and main upcoming activities
- Consolidation activities on detectors
- Infrastructure upgrades
- Phase I upgrade projects



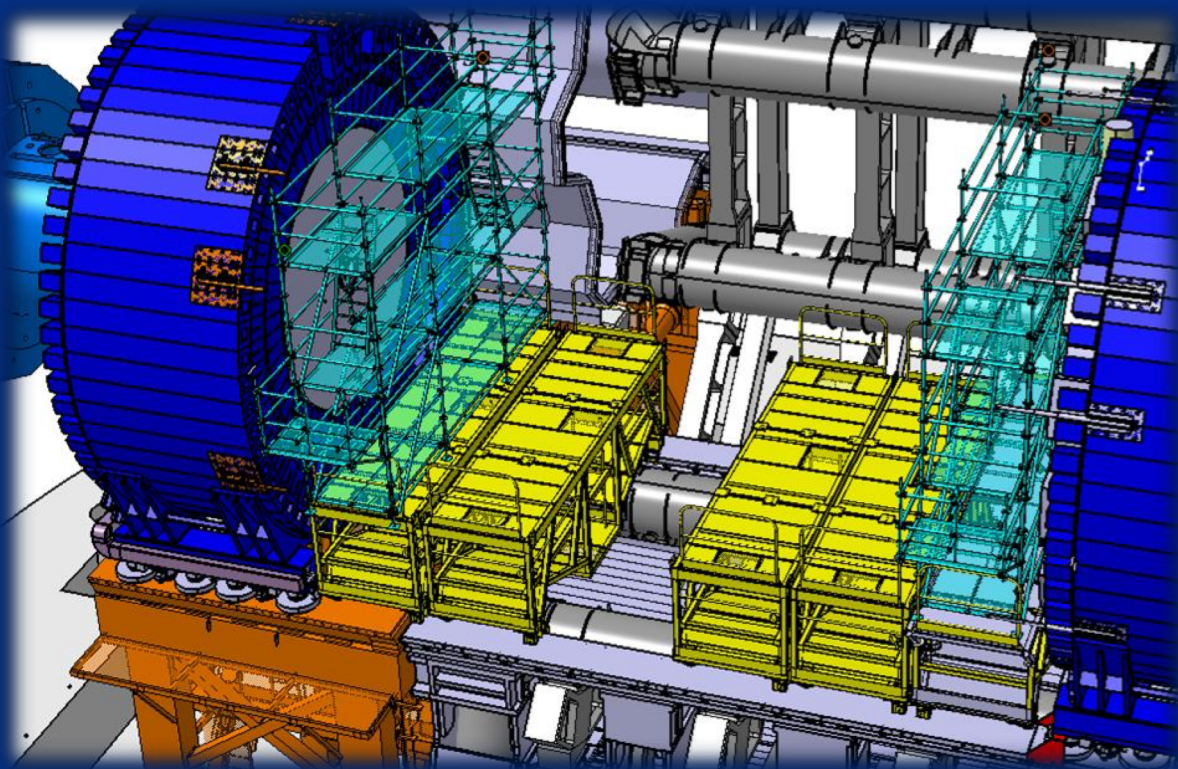
ATLAS LS2 Schedule



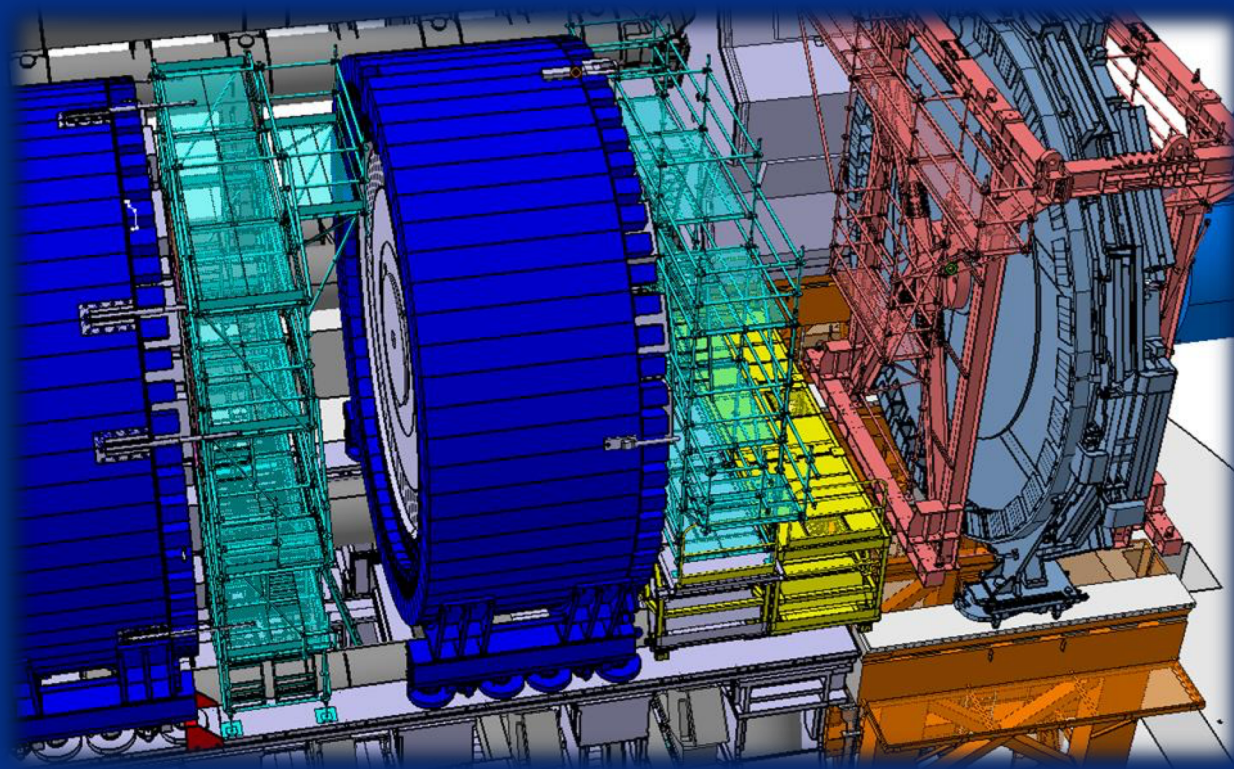
- Detector opening and all planned detector **consolidation / maintenance work went smoothly so far, on track!**
- Planning adapted to allow for (late) installation of NSW-A

Cavern Configuration up to next spring

Side A



Side C



In **September cavern was reconfigured** to give **good access to Calorimeters** to complete their upgrade and maintenance program

Cavern **configuration stable** up to March then **special access for BIS7/8 installation**

Summary of main upcoming activities

- Liquid Argon:
 - installation of **backplanes** on front end crates, refurbishment of **Front-End boards** and installation of **LiquidArTimeDigitiserBoards (LTDB)**
- Tile:
 - Finalization of **cooling-connectors replacement** and finalization of **electronics maintenance**
 - Installation of **crack scintillators** and **Minimum Bias Trigger Scintillators (MBTS)** on side A
- Muons:
 - Installation of **BIS7/8 in the muon Barrel spectrometer**
 - **RPC gas leak repairs**

Maintenance and Consolidation status

Inner Detector consolidation

TRT consolidation

- Leak in the TRT front end cooling system **consolidated** with regulation of flow and modifications of the return pipe layout
now at the level of **1.2 ℓ/day C₆F₁₄**
- Due to **gas leaks** (200 ℓ/day) the **barrel part** will be operated with **Ar** instead of Xe gas in Run 3

Pixel and SCT

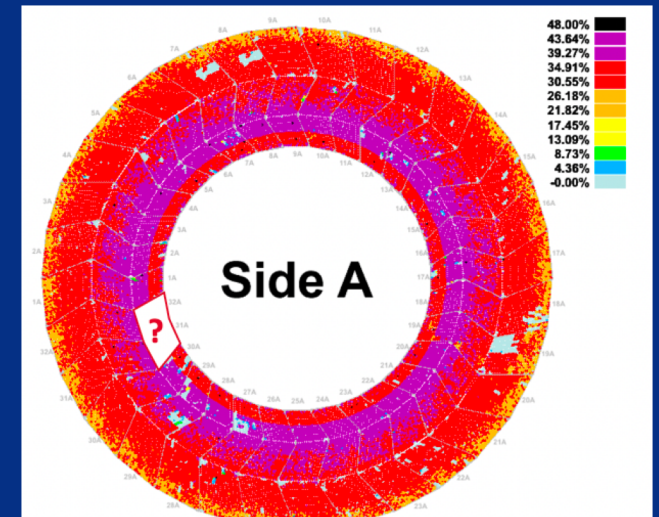
- Pixel and SCT at room temperature for only 17 days (max allowed 60):
 - Limit the time at warm to avoid reverse annealing
- Several **ID technical weeks** performed including **cosmic rays runs**
 - **Detector in very good status**

Pixel Optoboard

- **Production launched**, aim to install new optoboards before summer 2020
- Optical spectrum measured on all optoboards to identify weak boards

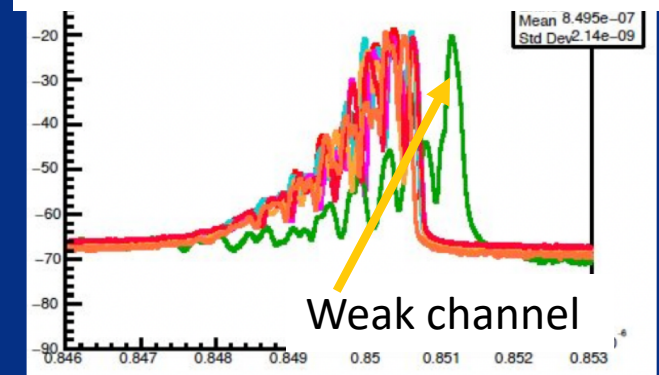
SCT Power supplies

- **Test of New Power Supplies** under dummy load
- Readiness Review in early 2020 before mass production
- Aim to **install** in US15 in **Summer 2020**



TRT occupancy map, two sectors in inner layer switched off

Optical spectrum of optoboards

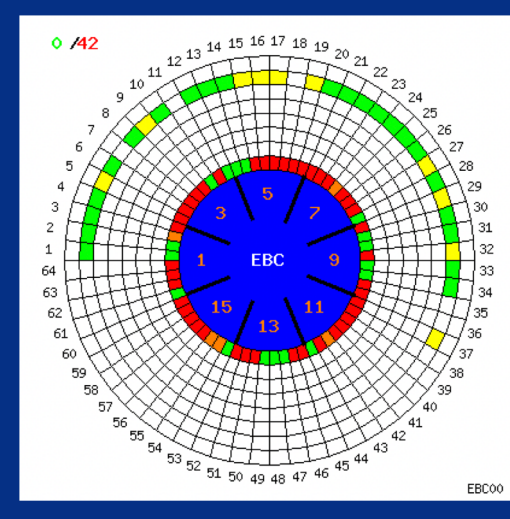
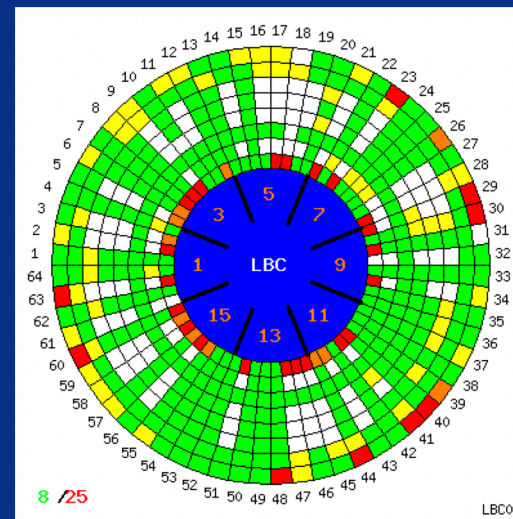
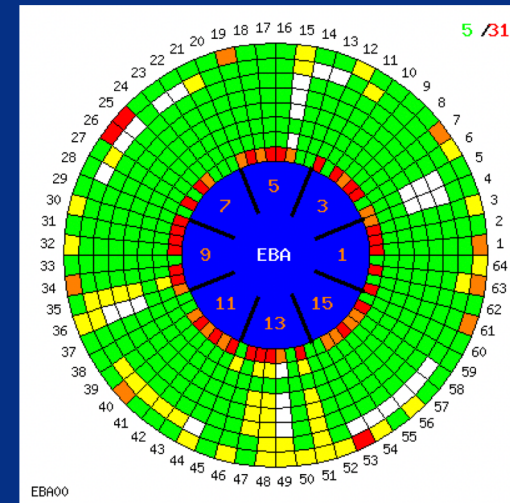
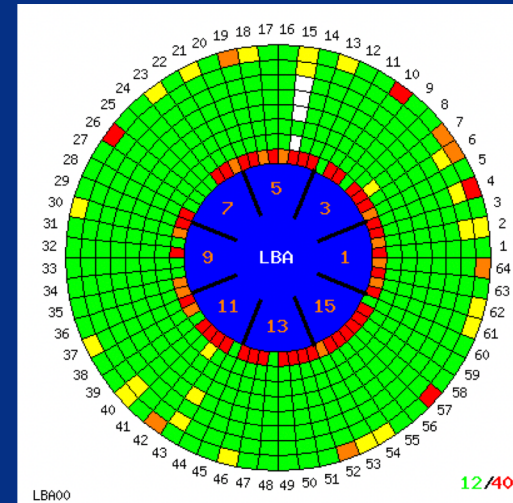


Long term test of new power supplies

Tile calorimeter consolidation

- **Standard maintenance**
 - 120+/256 modules to be maintained, 70 high-priority
 - Maintained 90+ modules
 - EBA, LBA and LBC almost done, EBC is underway
- **Cooling circuit consolidation**
 - Work finished on LBA, EBA LBC, almost finished on EBC. In total 253/256 connectors already replaced
 - In-situ tests with isolation valves are being prepared
- **Cs system maintenance**
 - EBA ready for commissioning
 - EBC and LB(A+C) work ongoing
 - Intercalibration of 5 Cs sources done

All activities very well advanced



Old: acetal



New: stabilised polypropylene

Tile calorimeter consolidation

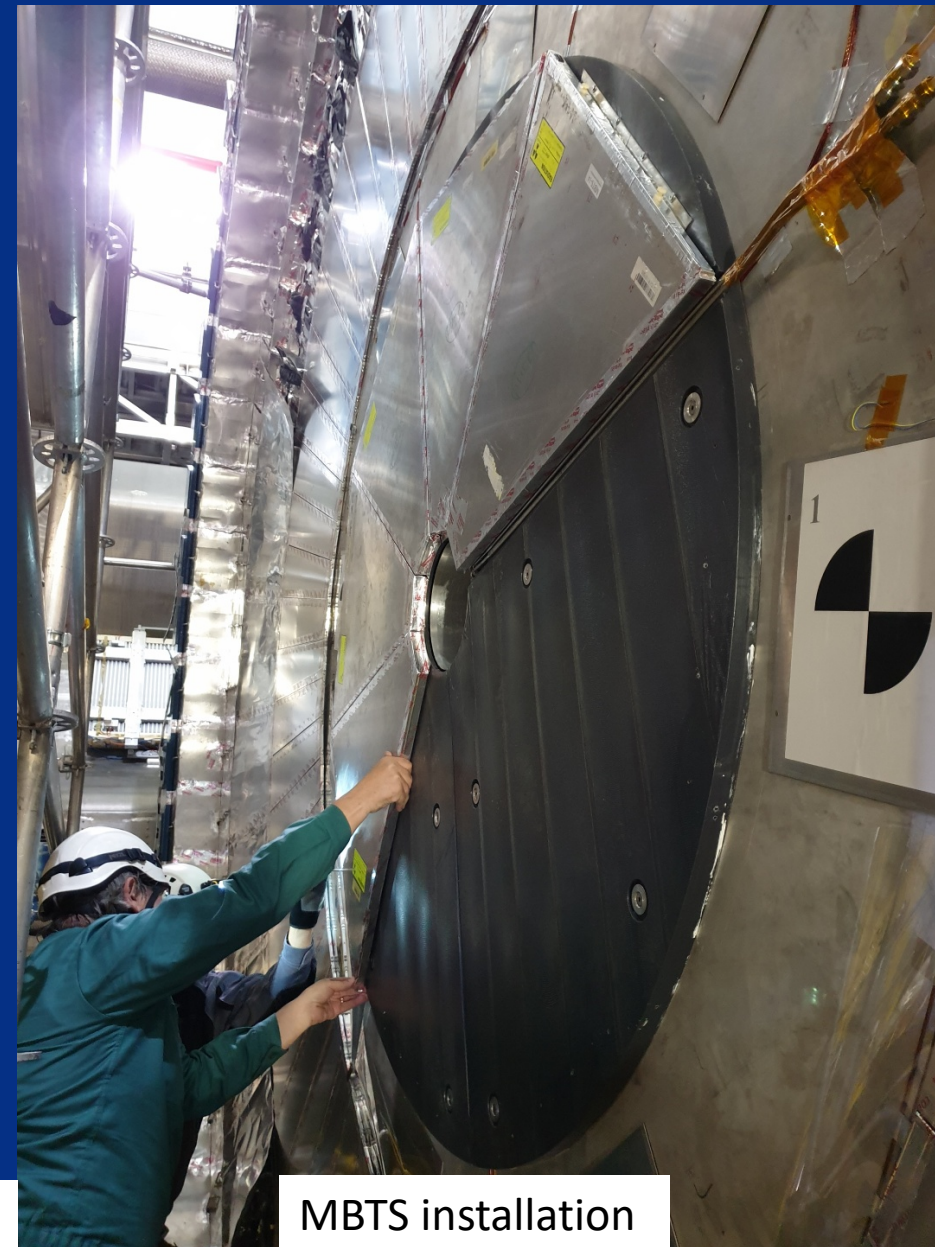
- **Phase-II demonstrator installed**, under commissioning
- **Crack Scintillators and MBTS**
 - Scintillators successfully **installed on C-side in Sept.**
 - work on A-side started with present MBTS and Crack scintillator dismantling , **aiming at installation in Nov.**



Tile Demonstrator installation in ATLAS



Crack Scintillator installation



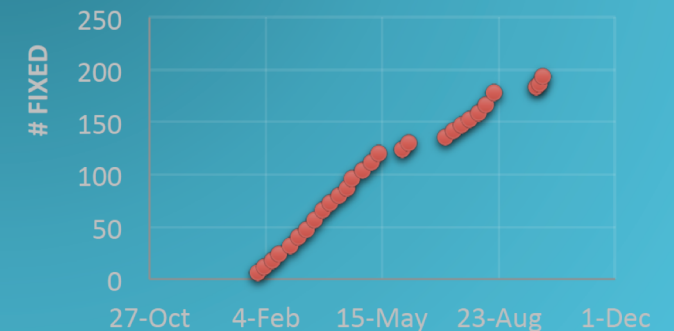
MBTS installation

Muon maintenance

- **TGC**
 - 9 chambers replaced at the beginning of LS2, ~8 chambers available to be installed at the end of LS2 (subject to time constraints)
 - **Installation of new Sector Logic boards completed**
- **RPC**
 - Main activity: fixing of gas leaks (**226 leaks repaired, ~47% of known leaks, work to continue throughout LS2**)
 - Upgrade of gas system to mitigate risks of producing new leaks: **racks under production** (available by end of November)
 - Production and installation of no-return valves to mitigate impact of leaks
- **MDT**
 - Standard maintenance on electronics, gas system and alignment system
 - Feasibility studies for **replacement of on-chamber electronics for Phase-II: very much improved wrt to TDR**
- **CSC**
 - **Diagnosis and repair of front-end electronics cooling problems (C side) done**
- **Installation of BIS7/8 chambers in Q1/2020: preparation of the chambers in BB5 well advanced**



Gas leak repair VS time



Forward detectors

- **LUCID:**

- Loss of Photomultipliers at the end of run 2 due to bad contacts between bases and PMs
- Plan to use new PM bases with connectors
- **Work finished on LUCID C**, back to storage, **about ready for installation**

- **AFP:** Installation of new ToF system not achieved in 2018;

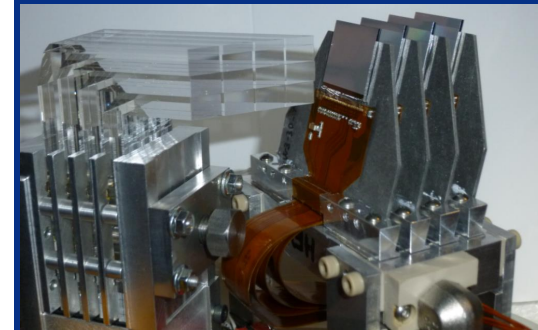
- **Solution with PM in vacuum not demonstrated to work**
- **Promising backup solution, with PMs “out-of-vacuum”**, tested in DESY test-beam, **review outcome to be delivered soon**
- new **sensors for silicon system in production**

- **ALFA:** Expected to measure total and elastic cross-sections at 14 TeV early in Run 3 (radiation hardness of electronics)

- **Production of spare DAQ motherboards ongoing**

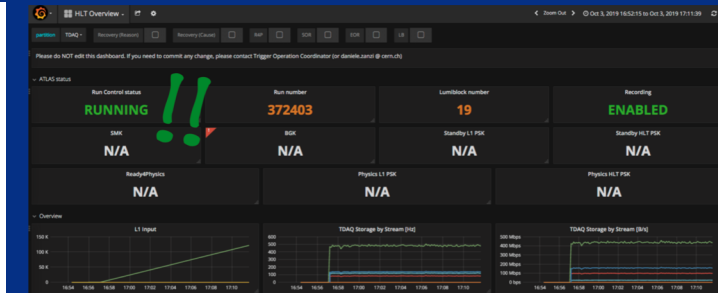
- **ZDC:** Refurbishing of existing ATLAS ZDC hardware;

- **replacement of trigger and signal cables, trigger and readout system (higher sampling rate), ZDC fibres (fused silica)**



Trigger and DAQ

- Refurbishment of **TDAQ network finished and recommissioned**
- **Technical Run 5 successfully completed** two weeks ago
 - (2018 pre-loaded data, HLT-only and HLT-CTP partitions)
- Important work ongoing on **Readout system**
 - (Installation and commissioning of **FELIX in Jan 2020**)
- **L1Calo**: LAr legacy path has started to be validated using the Run-2 L1Calo components
- **L1Muon**: installation of the New Sector logic Boards and optical fibres (endcap) and optical interfaces (barrel → MUCTPI)
- **L1Calo: TDAQ Surface Test Facility operational** (already used for many tests for Phase-I L1Calo components)
 - Full slice test of L1Calo planned for Q4/2019 using final production boards



HLT running on pre-loaded data

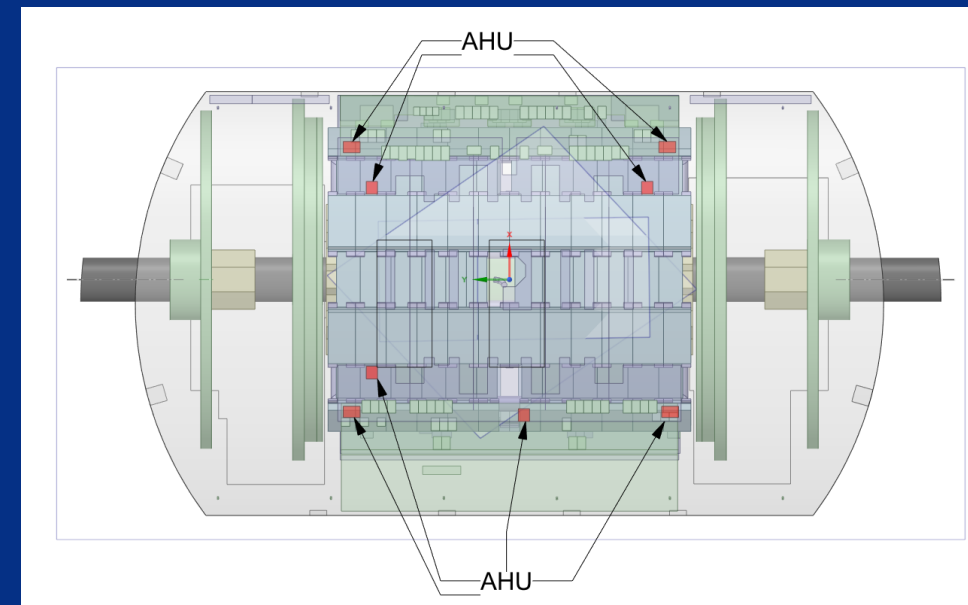
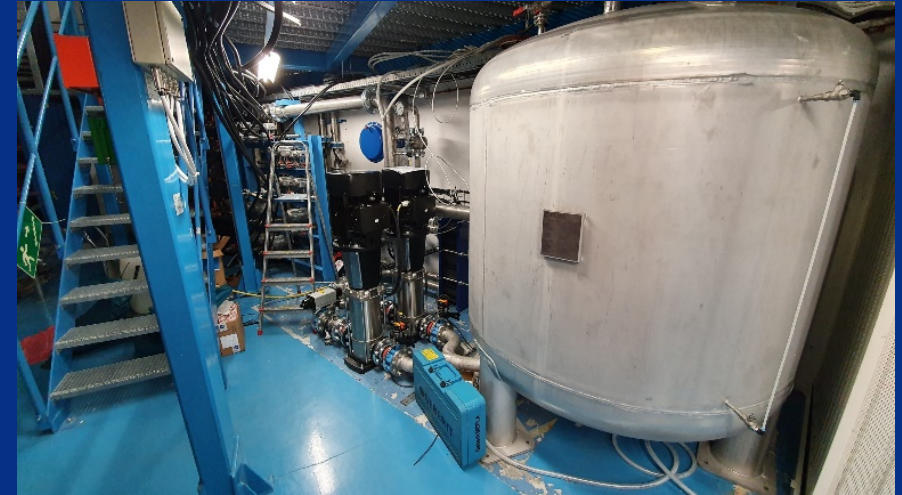


TDAQ surface test facility

Infrastructure

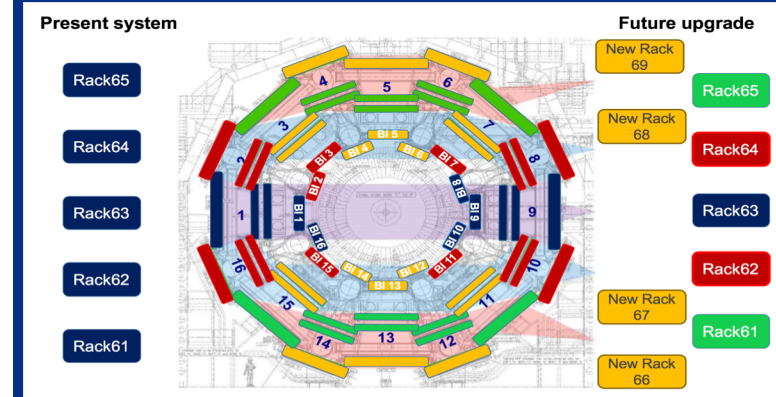
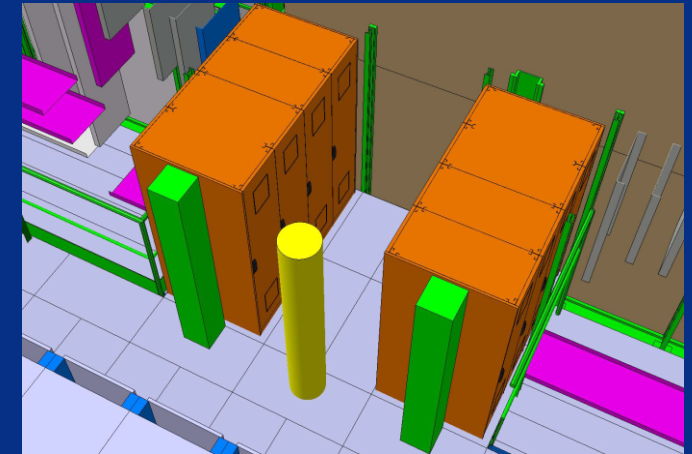
Infrastructures: Cooling and Ventilation

- Upgrade of Ventilation control, **completed**
- Maintenance of **detector cooling** **completed including Thermosiphone**
- **New muon Cooling stations:** installation is ongoing
 - **C side: installation and commissioning completed**
 - On side A completion foreseen for mid November 2019
- **Upgrade of air distribution in UX15**
 - Installation of 8 Air Handling Units (AHU) to increase the cooling power in UX15 by ~ 100 KW (for RPC)
 - Integration studies advanced, purchase process started, **foreseen completion by summer 2020**



Infrastructures: Electrical Power, Network, Lifts

- **Expansion of UPS from 300kVA to 600kVA in US15**
 - To provide Broad Coverage UPS to the New Small Wheel and eventually to Phase II detectors
 - Project fully validated, procurement of UPS and switchboards ongoing, **project completion in May 2020**
- **Consolidation of central UPS distribution (USA15)**
 - Will be done if resources will be available at the end of LS2
- **RPC gas system upgrade:** Installation of 4 new gas racks for the RPC and their connection to the gas supply and to the chambers
 - Racks **production** (EP/DT) will be **completed by end of November 2019**
- **ATCN (ATLAS Control Network) refurbishment:** mostly done. New routers installed in spring, switches replacement ongoing , **completed by November 2019**
- **PX15 lift replacement:** Ongoing forseen **completion 20 Dec 2019**
- **NO VISIT during lift replacement**



Phase I Upgrades

Phase-I Detector Upgrade Projects

(i) Liquid Argon Trigger Electronics upgrade

Aim to improve the Level-1 calorimeter decision for Run 3 and beyond by enhancing granularity at trigger level

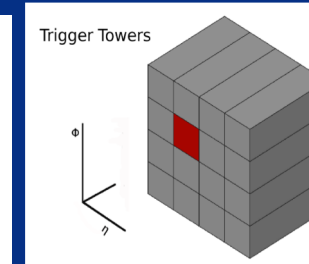
(ii) Trigger / DAQ

Take full advantage of the LAr trigger electronics upgrade to enhance e/gamma selectivity and Jet rejection, improved end cap muon trigger information (NSW)

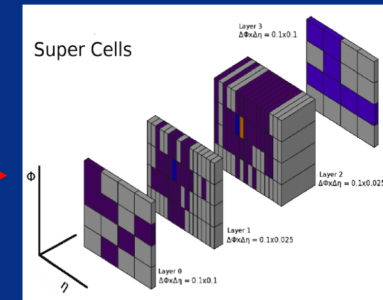
(iii) Muon System: New Small Wheel

Replacement of the inner muon station in the endcap regions of the detector;

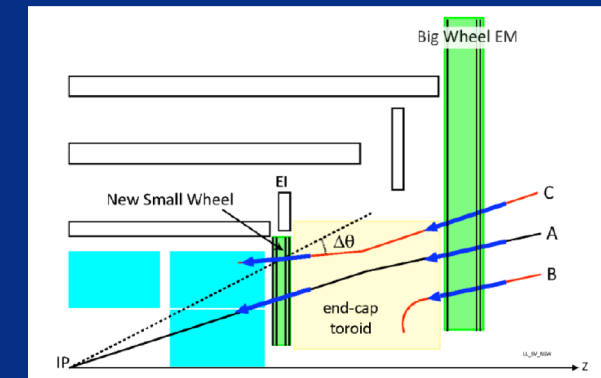
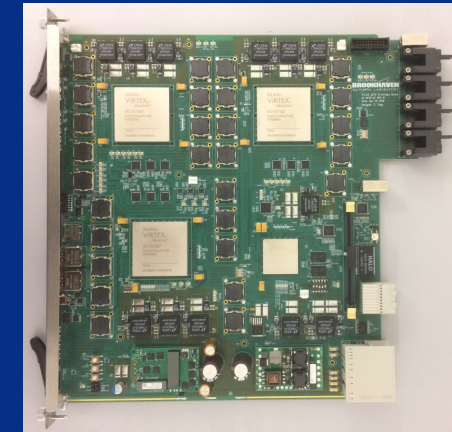
→ reduced muon fake trigger rate, preserve position resolution and efficiency at HL-LHC



Present



Phase-I



ATLAS nomenclature:

PDR: Preliminary Design Review

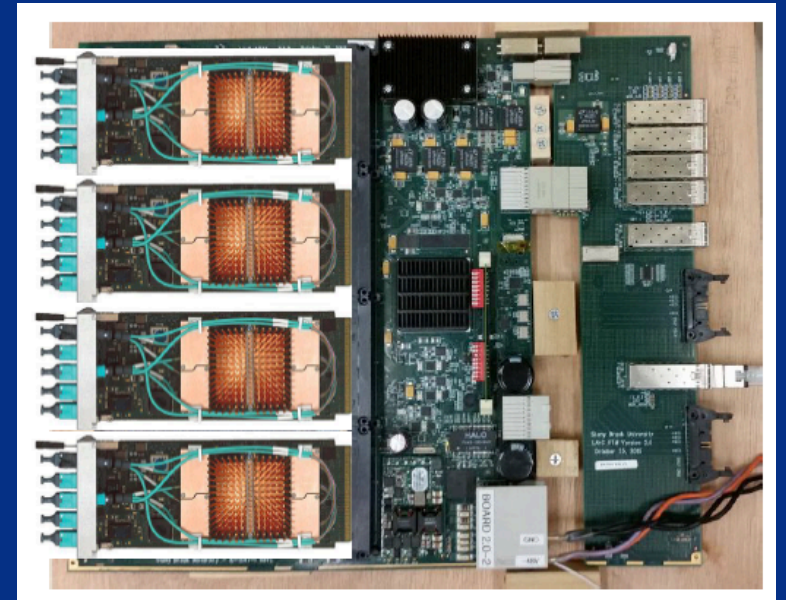
FDR: Final Design Review

PRR: Production Readiness Review

EMB LDTBs production



4 LATOMEs + 1 LArC -> LDPB

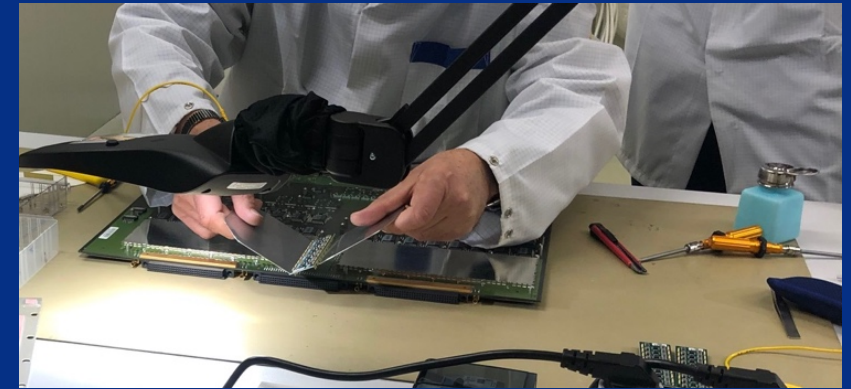


- **ASICs: Production Completed for all ASICs**
 - NEVIS ADC, LOCx2, LOCId, MTx and MTRx
- **Baseplanes**
 - Standard baseplanes **56/64 ready**, 22 under production, **32 installed**
 - **EMEC Special baseplane ready.**
- **Layer Sum Board exchange and Front End Boards refurbishment**
 - In full swing in SR1, **Target of 50 Boards/Week achieved**
- **New trigger digitizer board (LTDB) (on-detector)**
 - All 150 PCBs fabricated
 - **70 LTDBs for Barrel completed**
 - **2 EMEC-standard completed**, 3 under assembly now and then **series production of remaining LTDBs**
- **Power Distribution Board (PDB):** Production boards revealed **mechanical non conformities**, decided to **reproduce 150 boards**
 - **Installation of LTDBs with PDBs** in ATLAS delayed by **3 months but not on critical path**
 - 10 LTDBs with modified PDBs are being installed in ATLAS for commissioning purposes
- **Backend: LDPB production (LATOME and LAr Carrier Boards assembly)**
 - 150 **LATOME** boards delivered, 143 passed QC tests
 - 34 **LAr Carrier** qualified

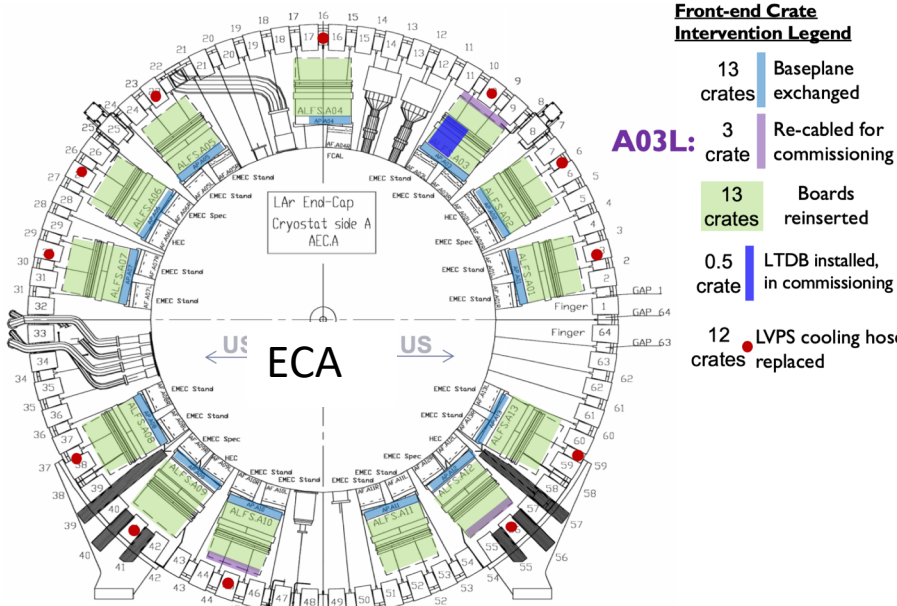
On track, risks reducing

LAr Phase-I Installation work on a very good track

- Removal then re-installation of all front-end boards and LTDB;
- SR1-radiation lab for Layer Sum Boards (LSB) & FEB cooling hoses and cooling plates replacement
- Required speed achieved in routine operations



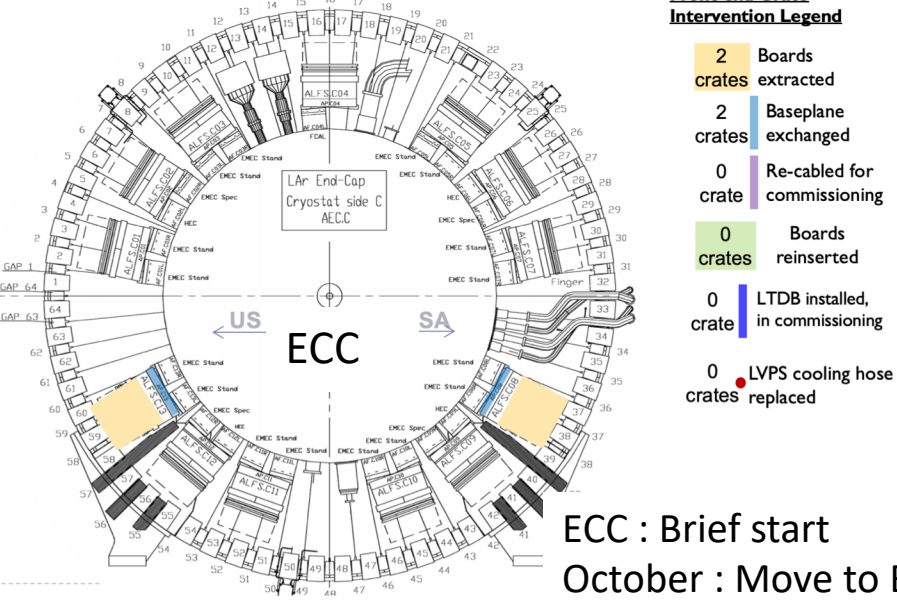
LAr overall Installation status



Front-end Crate Intervention Legend

- 13 Baseplane crates exchanged
- 3 Re-cabled for commissioning
- 13 Boards crates reinserted
- 0.5 LTDB installed, in commissioning
- 12 LVPS cooling hose crates replaced

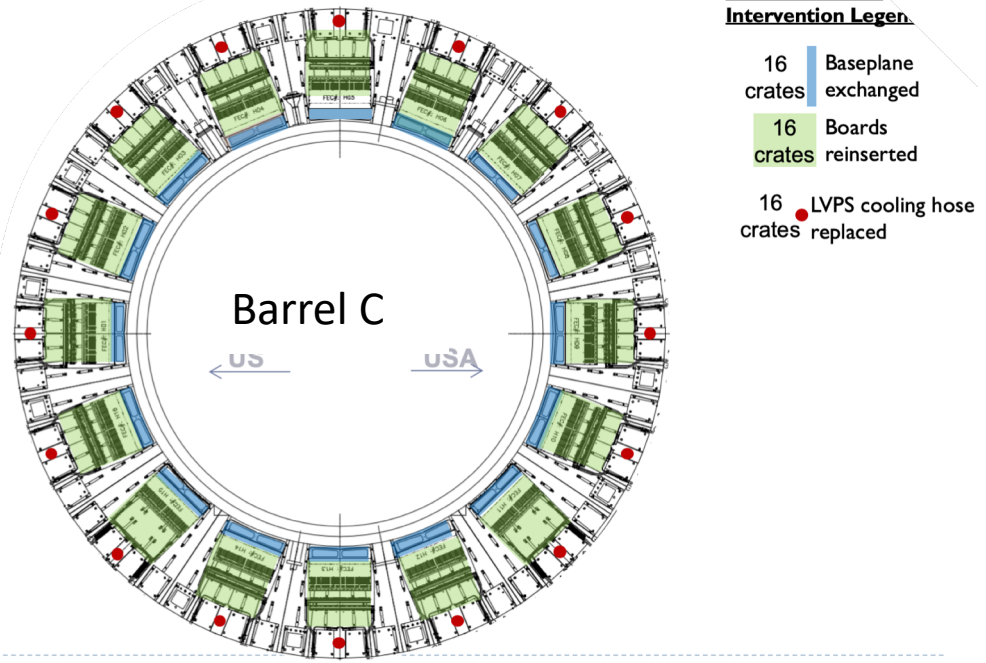
A03L:



Intervention Legend

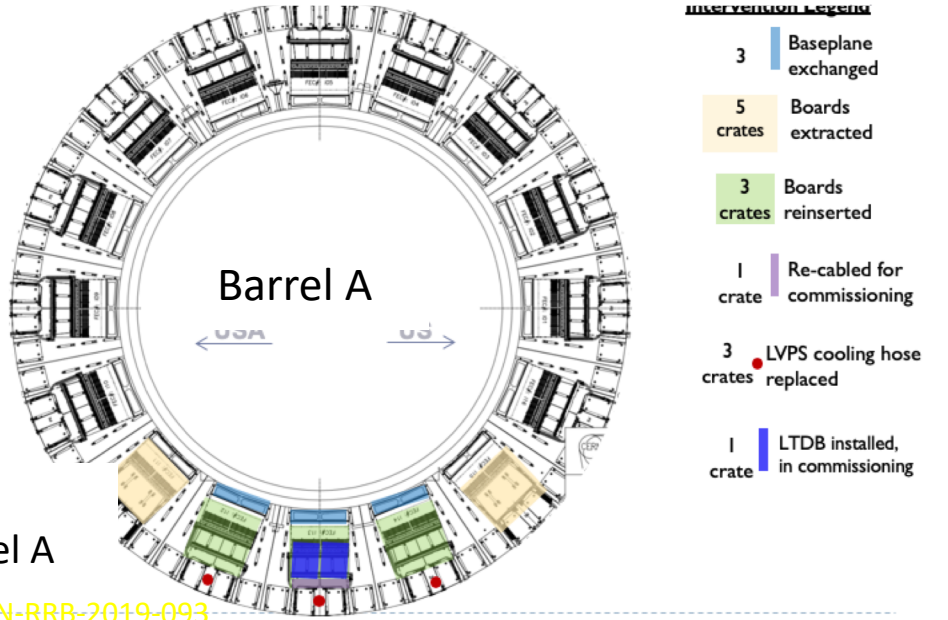
- 2 Boards crates extracted
- 2 Baseplane crates exchanged
- 0 Re-cabled for commissioning
- 0 Boards crates reinserted
- 0 LTDB installed, in commissioning
- 0 LVPS cooling hose crates replaced

ECC : Brief start
 October : Move to Barrel A



Front-end Crate Intervention Legend

- 16 Baseplane crates exchanged
- 16 Boards crates reinserted
- 16 LVPS cooling hose crates replaced



Intervention Legend

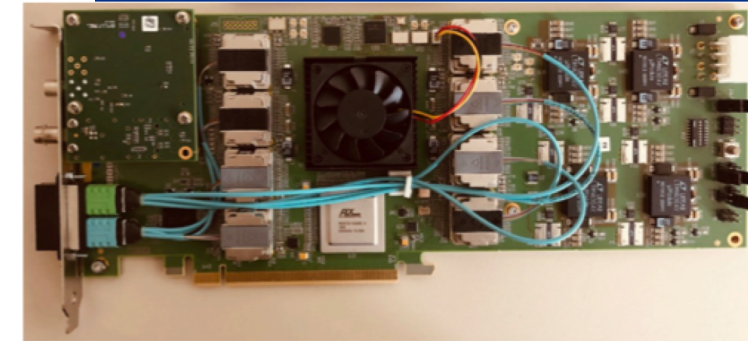
- 3 Baseplane crates exchanged
- 5 Boards crates extracted
- 3 Boards crates reinserted
- 1 Re-cabled for commissioning
- 3 LVPS cooling hose crates replaced
- 1 LTDB installed, in commissioning

Biggest challenge are the Feature EXtractor (FEX) processors

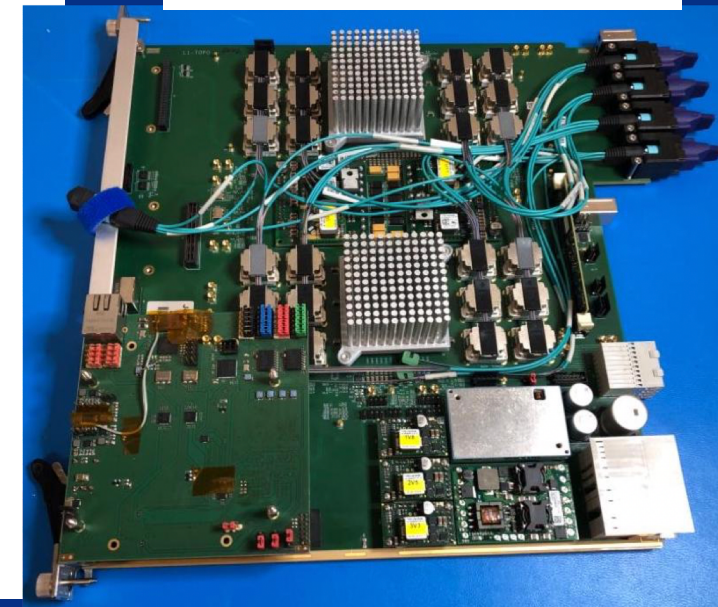
- eFEX: (Delays)
 - **Pre-production prototypes** expected by the **end of the month** , **main parts of firmware well tested**
- jFEX:
 - **Infrastructure & baseline algorithm firmware completed and integrated, readout is under test**
 - PRR held in Sep'19
 - **production of all PCBs and 1st production module expected in Dec'19**
- gFEX:
 - **Production completed since June 2018** (already real pp data recorded via FELIX in LAr demonstrator)
 - Baseline algorithm firmware completed
- FELIX:
 - **PRR approved production of 120 cards** (Aug'19)
 - The **installation in USA15** expected to start **in Jan'20**
- Other parts of the system progressing well
 - (FOX, ROD, HUB, muon SL, MuCTPI,..); All PRRs passed

Overall: despite some delays (eFEX) , updated schedule remains consistent with LS2 installation and commissioning plans

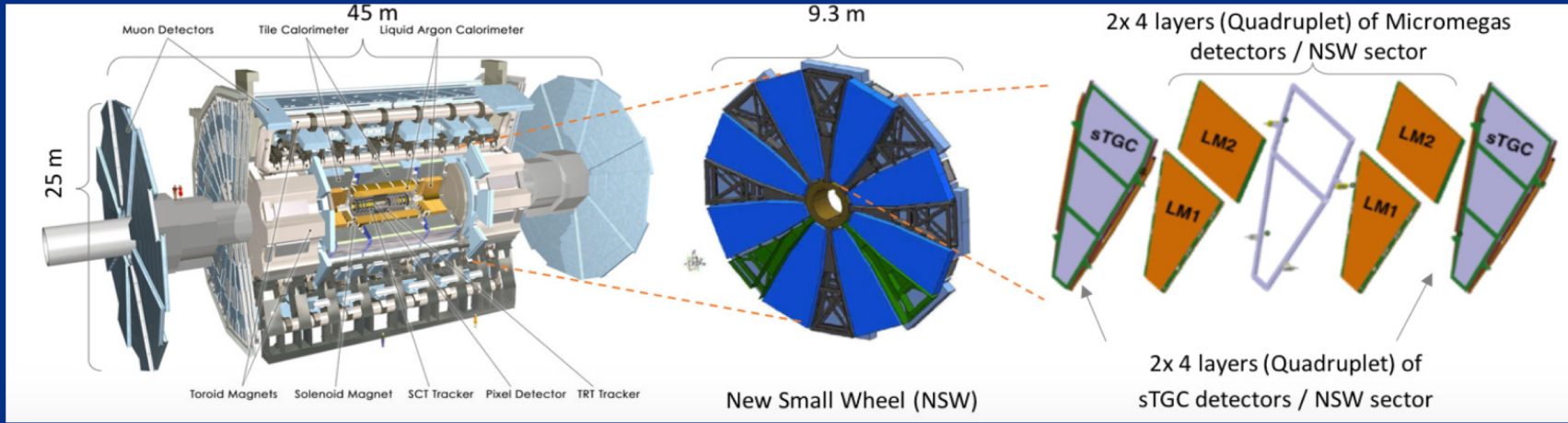
FELIX



First production L1TOPO



Status of New Small Wheel Project



Mounting of services, small sector spokes (+ alignment bars) on support disk finished

Micromegas (MM) and small-strip Thin Gap Chambers (sTGC), each to provide both tracking (up to $|\eta|=2.7$) and triggering (up to $|\eta|=2.4$) capabilities (in total 16 layers)

Large progress in many areas:

- **Mechanics: NSW structure ready** and awaiting the detector sectors since several months, **transport and installation tooling produced**
- **Electronics:**
 - * Series **production wafers for all four ASICs (ART, TDS, ROC and VMM) received;**
 - * **ART and TDS completed, incl. packaging and testing;**
 - * **Packaging and testing of bulk order for VMM on critical path**
 - * Significant progress with **production of front-end boards**
(all PRR passed, **production is ongoing**, completed for first sectors)



NSW: Small-Strip Thin Gap Chambers (sTGC)

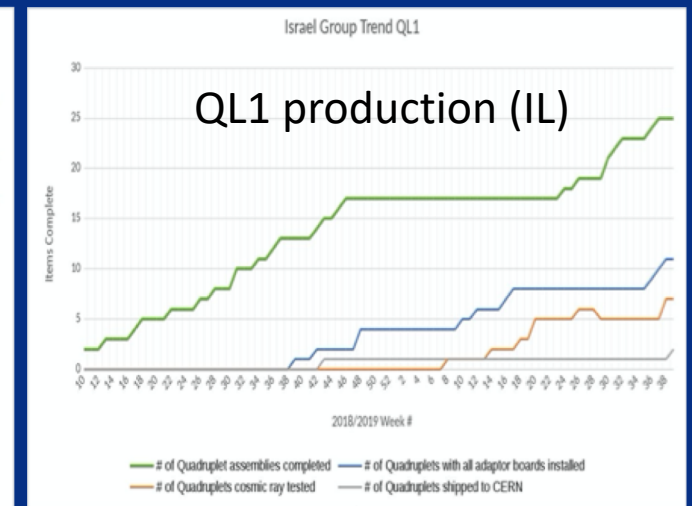
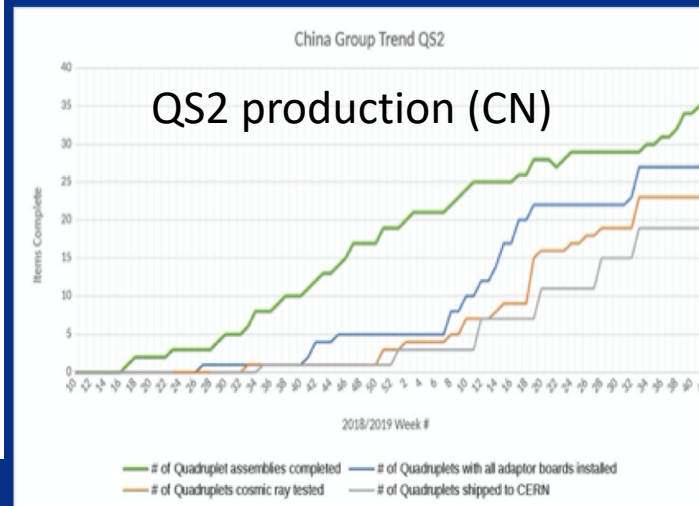
Thin Gap Chambers (sTGC)

- **Chamber construction (quadruplets):**
steady progress at all five production sites
- **Wedge assembly:**
 - proceeding well at CERN for small sectors (10/16 done);
 - Large sector assembly is less advanced, efforts are being made to recover (two QL1 chambers just received)

Chamber type	Chambers at CERN for NSW-A
QS1	11/16
QS2	19/16
QS3	14/16
QL1	2/16
QL2	3/16
QL3	4/16



First sTGC production wedge at CERN (Dec. 2018)



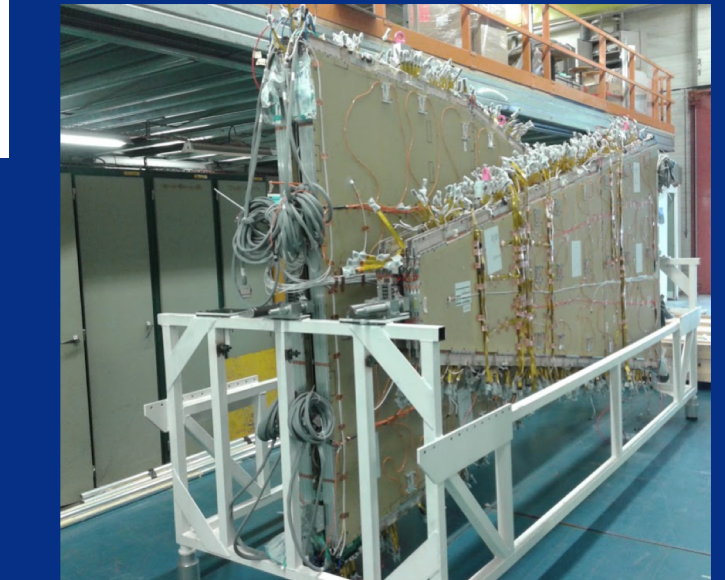
Micromegas (MM)

- Chamber construction continued to suffer from HV instability problems (due to local spots of low resistivity)
- Method of “**edge passivation**” developed (Frascati) and **deployed at other production sites**
- **Production rates for small sectors now reaching required speed ;** “Edge passivation” method being deployed for large sectors, **speed-up expected for large chambers**
- **Wedge assembly at CERN progressing: 4/8 small (half small sector wheel) and 1/8 large double wedge(s) completed**

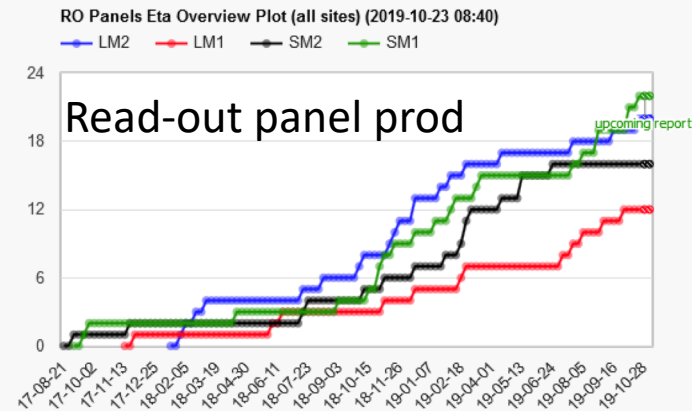
Need to speed up the construction and the assembly of Large Sectors



Small Double wedge under test in BB5



First large double wedge and small double wedge



Chamber type	Chambers at CERN for NSW-A
SM1	14/16
SM2	16/16
LM1	6/16
LM2	5/16

NSW Project: Slice Test

Slice Test:

- Preparation and setting up for commissioning the first full sector
 - Including a **MICROMEGAS double wedge** and **two sTGG wedges** integrated with **trigger and read-out electronics**
 - Micromegas double wedge and sTGC wedges **presently readout** and studied separately in BB5/B180 --> input for the Readiness Review
- **Important milestone** towards the decision whether NSW-A will /can be installed in August 2020
- **Readiness Review** has been scheduled for
 - 4th / 5th November 2019



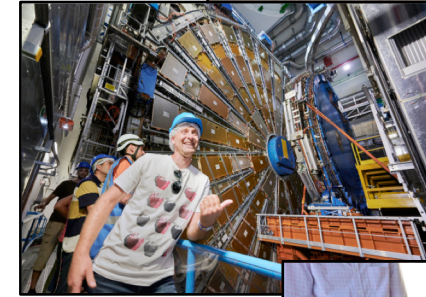
- Overall: Large and coherent effort needed to complete chamber construction at all sites (for NSW-A and NSW-C)
- Wedge assembly / integration / testing requires more effort (technicians) based at CERN;
- **Requires maintaining the full commitment of all NSW institutes and increasing the involvement of the whole Muon system for the next two years**



The Open Days in numbers



- CERN Open days have been from Friday September 13th to Sunday September 15th
- CERN registered 75000 visitors in total 🍪
- 279 ATLAS volunteers
- ~**3800** visitors underground (Sat: 1890, Sun: 1911) 😲
- ~1500 visitors for ACR and AVC
- ~15 ATLAS walking tours from P1 to B191
- ~267 registered LEGO models
- ~1800 proton cookies served
- ~3000 science café cookies were eaten
- ~2900 ATLAS cups were given out
- ~2000 coffees were served (with ~1000 sugar bags)



GREAT SUCCESS!!!



Summary

- LS2 activities in full swing
 - Maintenance and consolidation work progressing well both for detectors and infrastructure
- Phase I activities advancing well
 - Liquid Argon Calorimeter and TDAQ completing production and started installation phase
 - New Small Wheel showing very good progress but it is on the critical path and only one wheel can be installed in LS2, for the second we aim at the Extended Year End Technical Stop (2021-22)

Thanks for your Support