

ALICE

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LS2 DAYS

29-30 SEPTEMBER 2015

<http://indico.cern.ch/event/436424/>

Outline

- ALICE LS2 upgrade scope
- Work between now and LS2 (including YETS/EYETS)
- Work during LS2

ALICE LS2 upgrade scope

Motivation: Focus on high-precision measurements of rare probes at low p_T

- Cannot be selected by hardware trigger
- Need to record large sample of events

Goal: Pb-Pb recorded luminosity $\geq 10 \text{ nb}^{-1}$ (plus pp and p-Pb data)

- 8×10^{10} events to gain a factor 100 in statistics over the Run1+Run2 programme

Strategy:

- Read out all Pb-Pb interactions at a maximum rate of 50kHz (i.e. $L = 6 \times 10^{27} \text{ cm}^{-1}\text{s}^{-1}$) upon a minimum bias trigger
- Perform online data reduction based on reconstruction of clusters and tracks
- Improve vertexing and tracking at low p_T
→ New Inner Tracking System (ITS)



ALICE LS2 detector

New Inner Tracking System (ITS)

- improved pointing precision
- less material → thinnest tracker at the LHC

Muon Forward Tracker (MFT)

- new Si tracker
- Improved MUON pointing precision

MUON Arm

- continuous readout electronics

Time Projection Chamber (TPC)

- new GEM technology for readout chambers
- continuous readout
- faster readout electronics

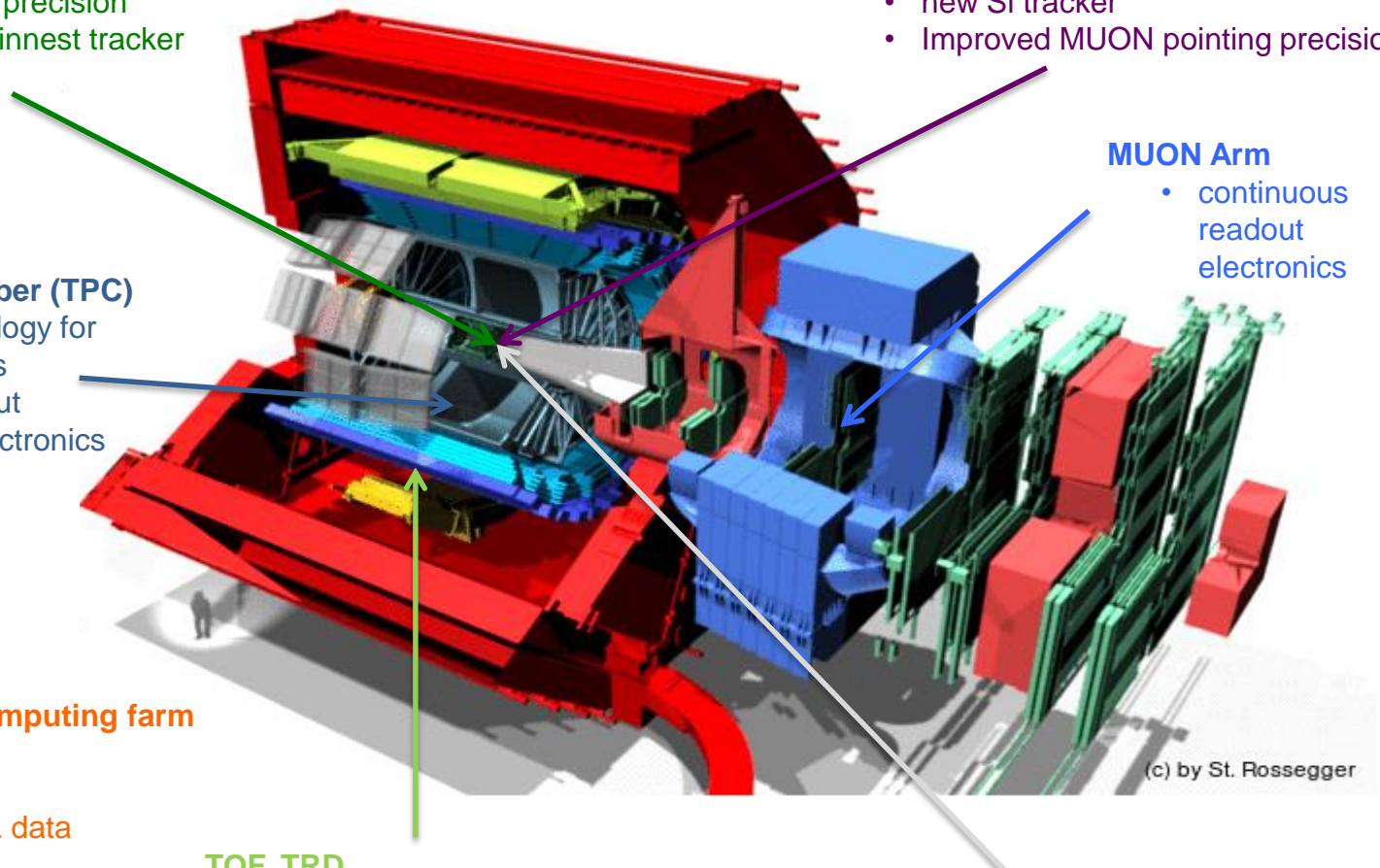
New Online/Offline computing farm (O2)

- new architecture
- on line tracking & data compression
- 50kHz PbPb event rate

TOF, TRD

- Faster readout

New Trigger Detectors (FIT)

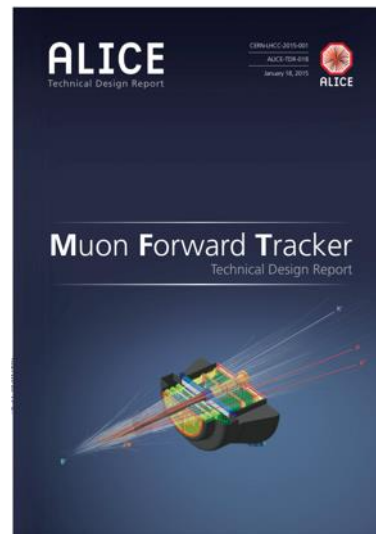
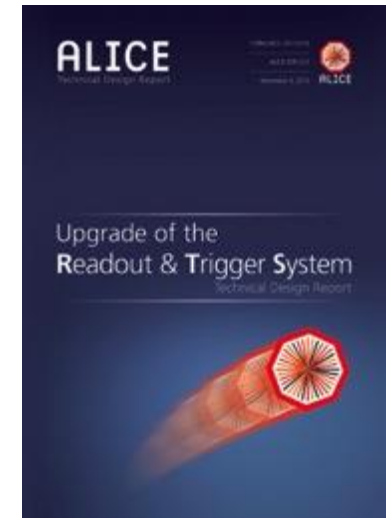


(c) by St. Rossegger

ALICE TDRs

LS2 upgrade is detailed in 5
Technical Design Reports:

- Inner Tracking System (ITS)
- Readout and Trigger System
- Time Projection Chamber (TPC)
- Muon Forward Tracker (MFT)
- Online Offline Computing System (O²)



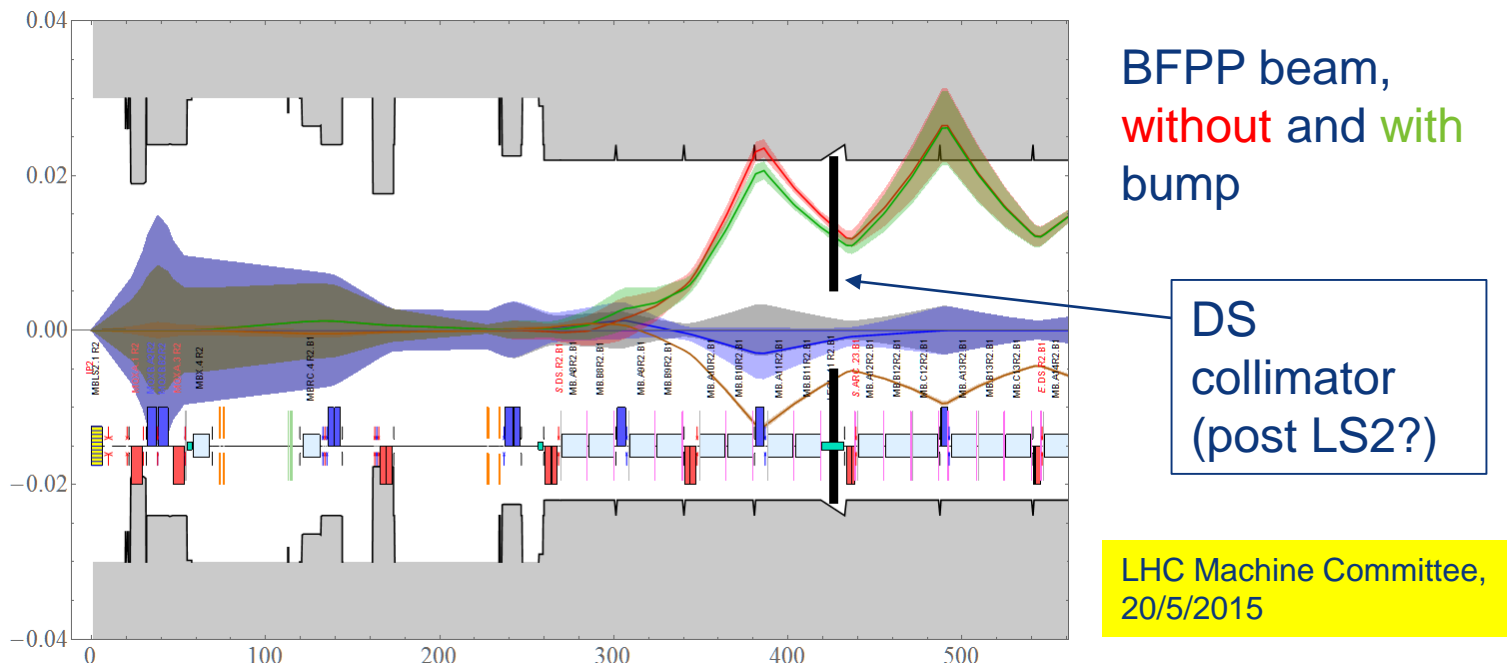
Post LS2 radiation load

- Vacuum pressure in LSS around ALICE of 2.3×10^{-8} mbar during Run1 pp resulted in excessive radiation load on the detector through beam-gas collisions
- In order to ensure that the radiation load due to beam gas collisions does not exceed the radiation load from genuine IP collisions during Run3+Run4, the vacuum pressure in the LSS must be $<10^{-9}$ mbar⁽¹⁾
- **The following machine modifications are foreseen (LS2) in order to reduce the background in ALICE:**
 - **LSS vacuum consolidation to minimize vacuum pressure (TE-VSC)**
 - **New TDI to limit high vacuum pressure from outgassing (EN-STI)**
 - **Modified layout RB24 beampipe (TE-VSC)**

1) Radiation Dose and Fluence in ALICE after LS2. ALICE int. note (PUB-2443). Auth.: W.Riegler, A.Tauro, A.Di Mauro, A.Alici

New collimator in IR2 region

- Bound Free Pair Production (BFPP) losses would limit the PbPb max luminosity for ALICE
- **Solution: put a new collimator and short 11T dipoles or a collimator in the cryostat connection region. The implementation of this collimator is scheduled for LS2**
- Decision after the quench test with Ions at the end of this year's PbPb run



Items between now and LS2 with direct involvement of Technical Sector

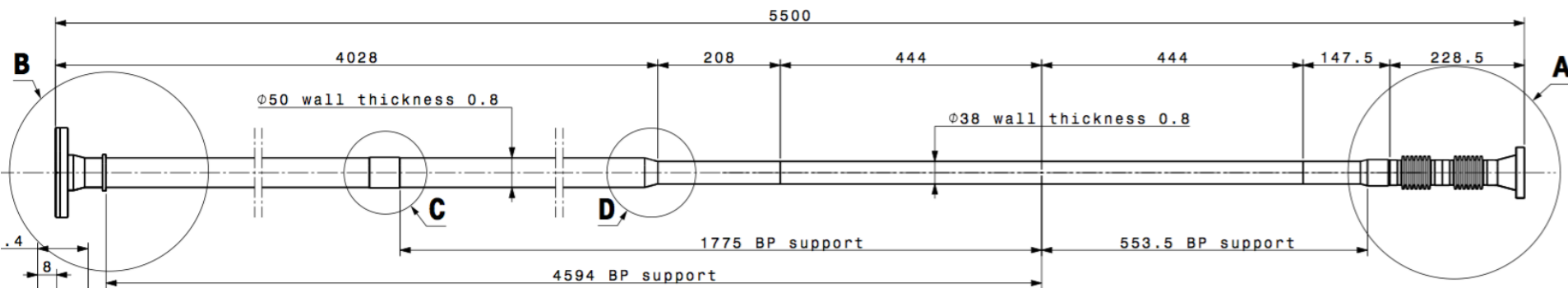
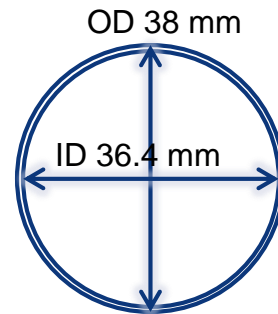
- Design and procurement new central beampipe
 - New Online/Offline computing farm (O²)
 - New cleanroom
 - New ALICE visitor centre at P2
 - New dry air plant for present ITS (upcoming YETS)
 - New ITS, MFT water cooling plants (construction only)
- Equipment
- Infrastructure
- Services

New central beampipe (TE-VSC)

Design & procurement schedule:

- New beampipe approved at LMC in September 2014
- Central beampipe section: OD38mm, ID36.4mm i.e. 0.8mm wall
- Engineering design completed
- Order placement: Q3 2015
- Delivery to ALICE: Q2 2017

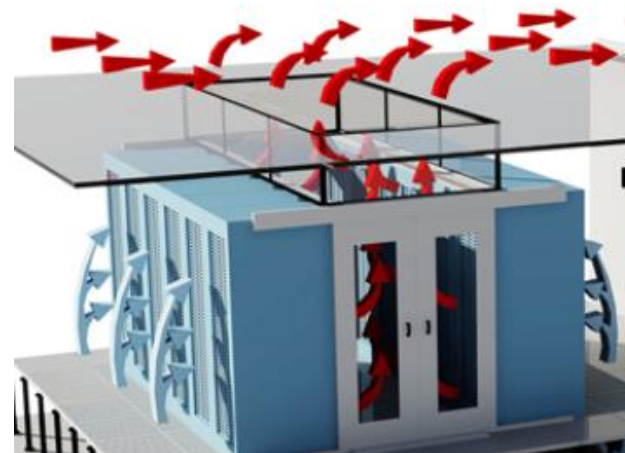
	Present beampipe	LS2 beampipe
Outer diameter	60mm	38mm (only central part)
Wall thickness	800um	800um
Length	482cm	550cm
Beryllium length	395cm	88.8cm
Bellows/flanges	SS	Al
Nb. of supports	3	3



New Online/Offline computing farm (O²)



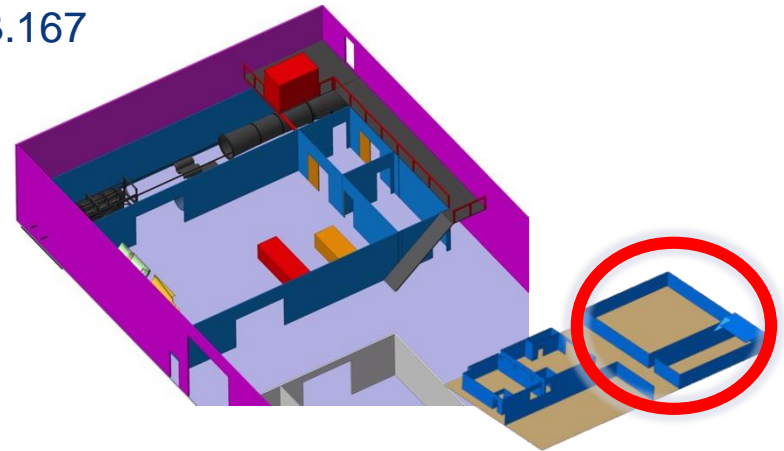
- O² is a new computing farm of 1750 nodes (2.4 MW)
- **Cooling: different options being evaluated:**
 - **Custom building & mixed or primary water cooled racks**
 - **Built-in container & outside air cooling (“Fresh Air Cooling”)**
- The infrastructure costs are included in the O² project. Collaboration with EL, CV and GS
- Plan: decision by end 2016, infrastructure installation before end 2018



Cleanrooms

- **ITS cleanroom (b.167): new 200m² cleanroom for the assembly of the ITS components**
- **TPC cleanroom (SXL2, P2): will be used for TPC upgrade. A refurbishment of the ventilation system is needed, such to improve the air quality (and possibly reach an ISO7)**
- Resources: CV, (EL, GS)
- Schedule:
 - ITS cleanroom in 2016
 - TPC cleanroom in 2017-18 (design end 2015)

B.167

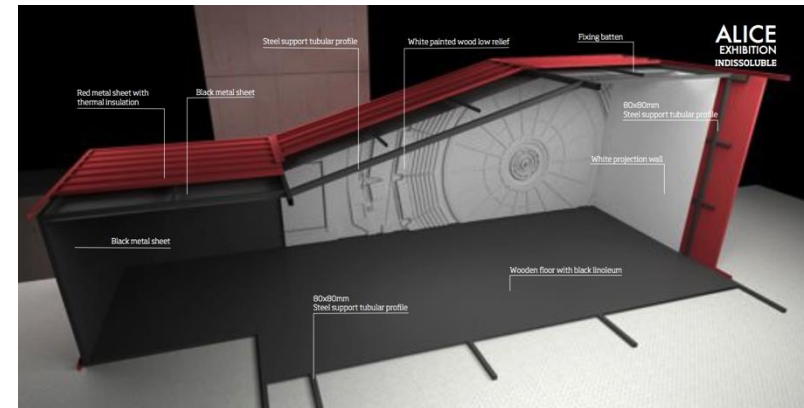


P2 (SXL2)



New ALICE visitor centre

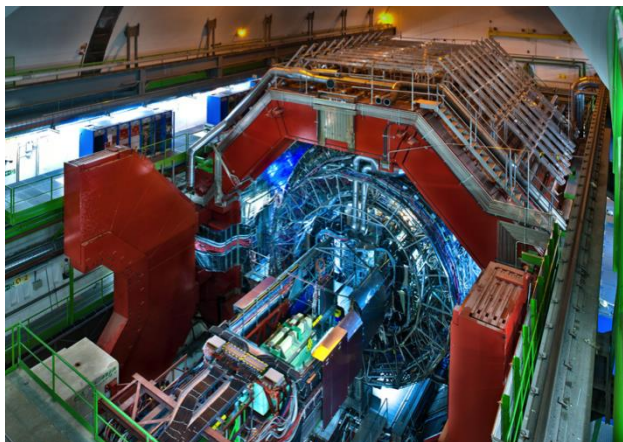
- ALICE will be part of CERN official tours
- **Redo entirely existing exhibition at P2**
- Resources: GS, EL and CV
- Plan: design complete Dec 2015, implementation in 2016



Work during LS2

- Three sequential phases:
 - ① 2 months: opening Experiment + TPC/ITS/beampipe de-installation
 - ② 10 months: TPC upgrade + services modifications
 - ③ 8 months: reinstall TPC/ITS/MFT/FIT/beampipe + close Experiment
- This plan foresees 5 months contingency over the LS2 duration
- **We greatly rely on the availability of the CERN support groups, and in particular:**
 - **Transport coordination (many operations in two shifts)**
 - **Survey (mostly during re-installation)**
 - **CV & EL, VSC, ...**
 - **Safety coordination**

① Opening Experiment + TPC/ITS/beampipe de-installation



Phase I	Duration
Open cavern, L3 doors, comp.magnet/miniframe	3.5
Remove ITS & beampipe	4.5
Bring TPC to cleanroom	1
Total: 9 weeks	



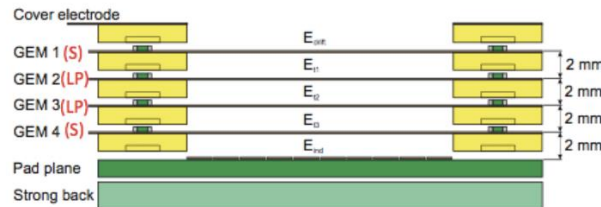
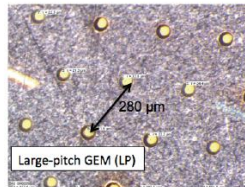
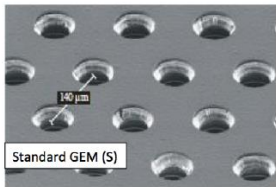
Transport organized in 2

② TPC upgrade



Phase II	Duration
Remove electronics	4
Swap chambers	10
Survey and align chambers and end plates	2
Sealing and He leak test	4
Reinstall electronics	8
Readout test	7
Contingency	5
	Total: 40 weeks

Replace all wire chambers with 4-GEM
 New FE electronics
 Work executed in P2 cleanroom – **40 weeks**

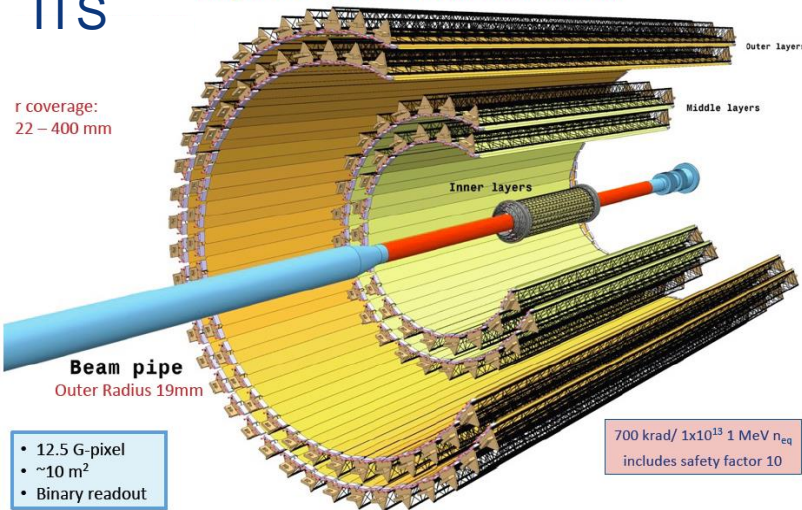


**Cavern services
 modification in parallel
 (EL & MEF)**

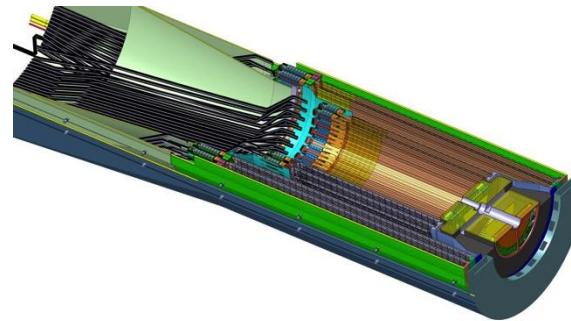
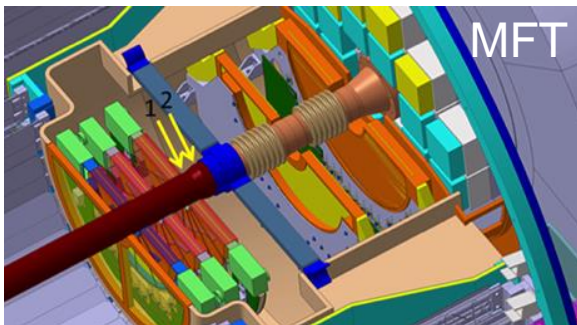
③ Reinstall TPC/ITS/MFT/FIT/beampipe + close Experiment

ITS

7 layers of Monolithic Active Pixel Sensors



Phase III	Duration
Reinstall TPC/miniframe/MCTS	4
Install ITS cage and new beampipe (incl.bakeout)	5
Install & commissioning MFT/FIT/ITS	26
Close L3 doors and cavern	1.5
	Total: 36.5 weeks



Survey & transport deeply involved in all these operations

Services: cabling & fibers

- **Copper cabling campaigns:**
 - LV & signal cables for ITS/MFT/FIT (EN-MEF)
 - Remove all cables from C-side (absorber area) (ALICE + FSU/PJAS)
 - Miniframe modification (patch panels, cables,...) (ALICE + FSU/PJAS)
- **Optical fibers for Detector to O² data transfer – 10'000 links (EL-CF):**
 - Two types of fibers being evaluated: blowing (+splicing) or pre-connectorized. It seems the pre-connectorized option is more advantageous as one do not need to do the splicing in the pit
 - Choice by end of this year
 - Possible synergies with LHCb

Services: cooling & ventilation

- **New ITS cooling plant**
 - Most probably water based
- **New MFT cooling plant**
 - Very similar or identical to ITS cooling plant, but separate machine
- **ITS/MFT dry air plant**
 - Whether needed has yet to be decided

Production before LS2, installation at the beginning of LS2, commissioning jointly with ALICE during LS2

All these plants will require control (EN-ICE) and power (EN-EL)



Cooling pipes to detectors installed by ALICE

Conclusion

- ALICE will be upgraded in LS2 to read all PbPb events at 50kHz ($L=6 \times 10^{27} \text{cm}^{-1} \text{s}^{-1}$) into the online system. Increase data sample of MB physics by a factor 100!
- In order to reduce the radiation load in ALICE after LS2 due to beam-gas, the vacuum in the LSS around P2 must be consolidated. New collimator is foreseen in the IR2 region to limit the BFPP losses
- Several activities scheduled from now until LS2, service groups are already at work!
- ALICE has a very dense planning for the upgrade implementation, partially organized in shifts
- Availability of transport, survey personnel and safety coordination is very important
- Services: ALICE will supervise its own FSUs/PJAS to carry some of the cabling activities, however we greatly rely on the EL and MEF cabling contracts and on the CF section for the fibers installation



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THANK YOU