HEP2021
VIRTUAL EDITION

ALICE

Status of the Fast Interaction Trigger detector for the ALICE upgrade

European Physical Society conference on high energy physics 2021

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FJFI

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LHC – Run 3

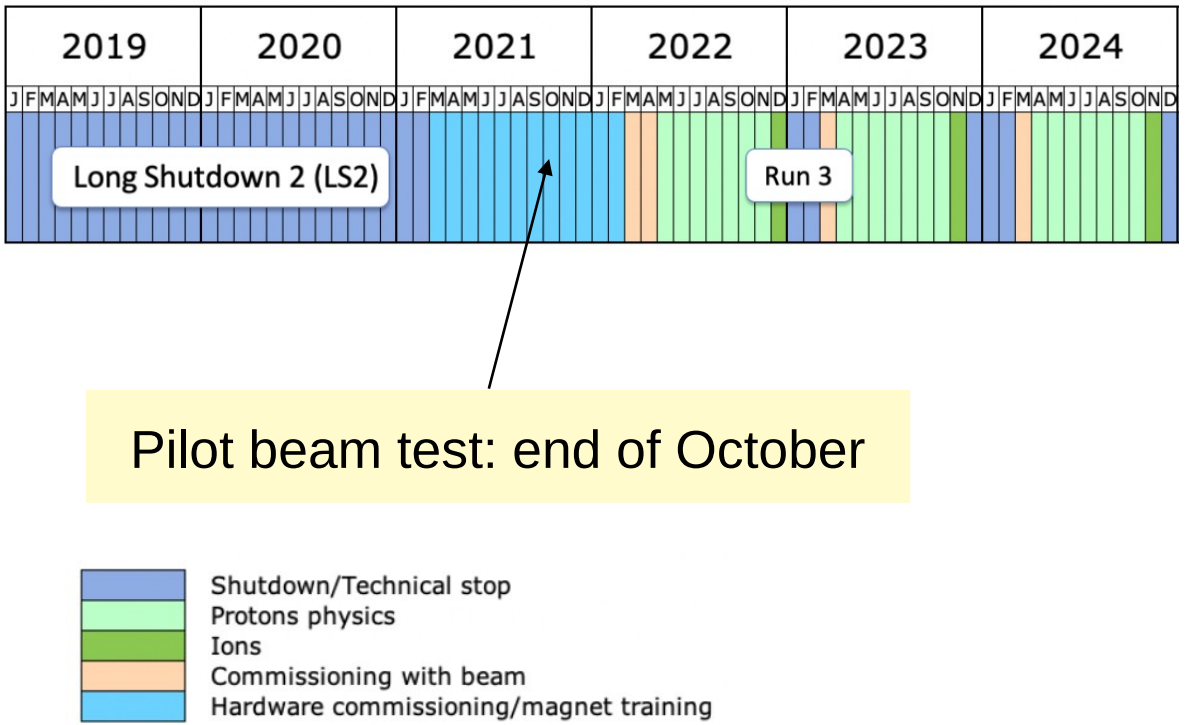
After the second **Long Shutdown** (LS2), the LHC will deliver much more luminosity to ALICE than in the past

Pb beams

- Collisions rate = 50 kHz
- Average luminosity = 6×10^{-27} cm^{-2} s^{-1}

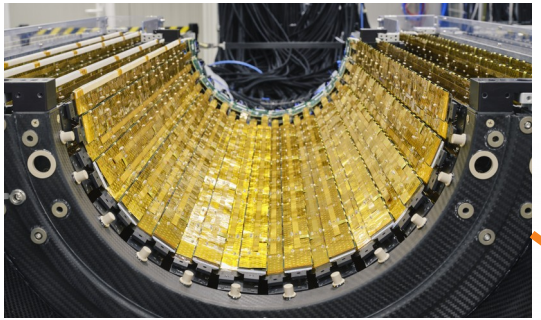
Protons beams

- Collisions rate = 1 MHz
- Average luminosity = 10^{-34} cm^{-2} s^{-1}



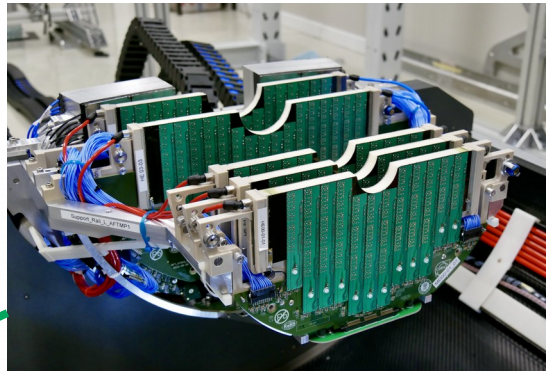
New ALICE detectors for Run 3

Inner Tracking System*

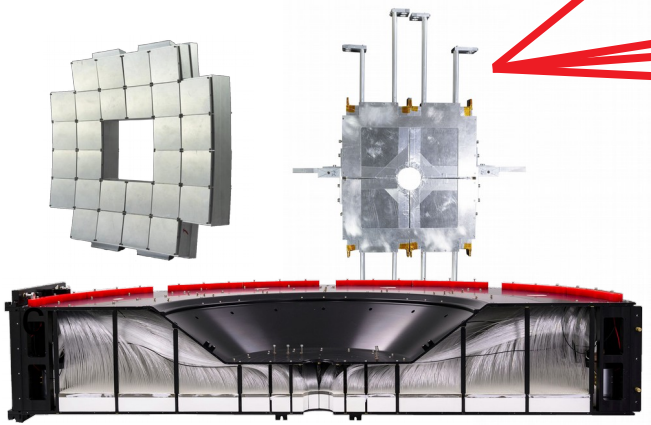


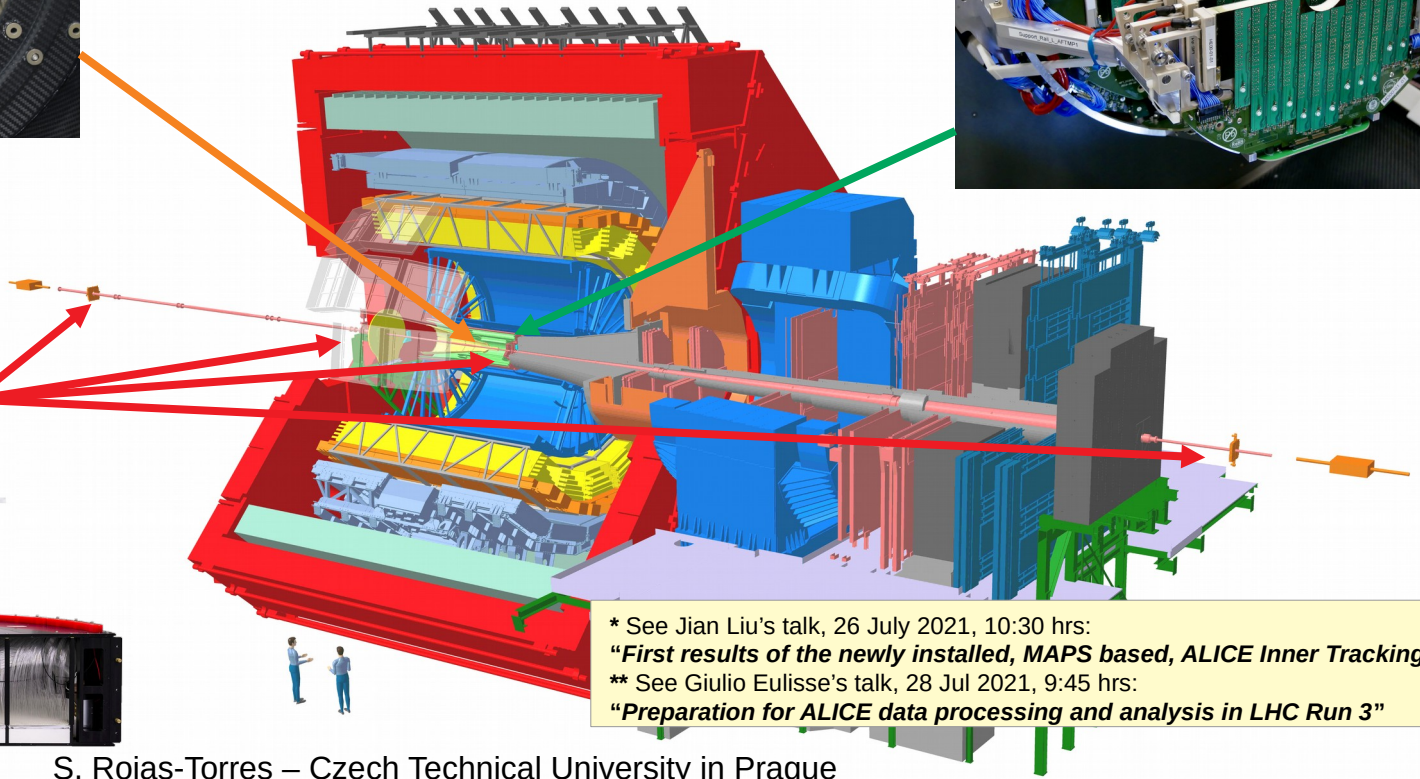
- Major upgrade of the **Time Projection Chamber (TPC)** detector.
- **New Online-Offline (O^2)** computing infrastructure.**

Muon Forward Tracker



Fast Interaction Trigger





***** See Jian Liu's talk, 26 July 2021, 10:30 hrs:
"First results of the newly installed, MAPS based, ALICE Inner Tracking System"
****** See Giulio Eulisse's talk, 28 Jul 2021, 9:45 hrs:
"Preparation for ALICE data processing and analysis in LHC Run 3"

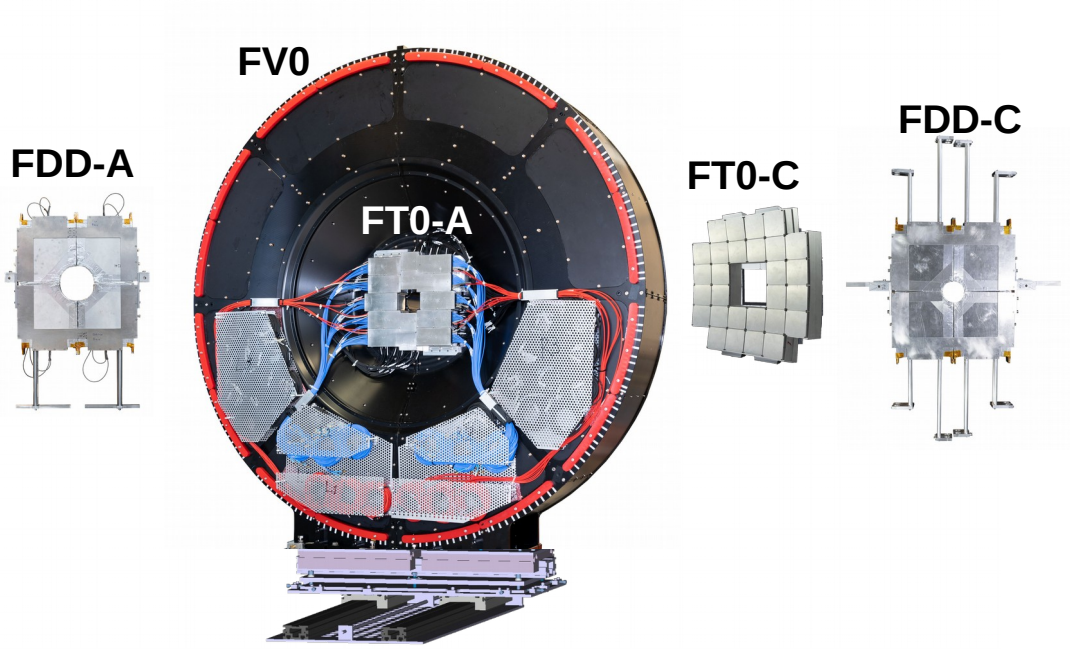
Fast Interaction Trigger

The FIT detector consists of three subsystems:

FV0, FT0 and **FDD**

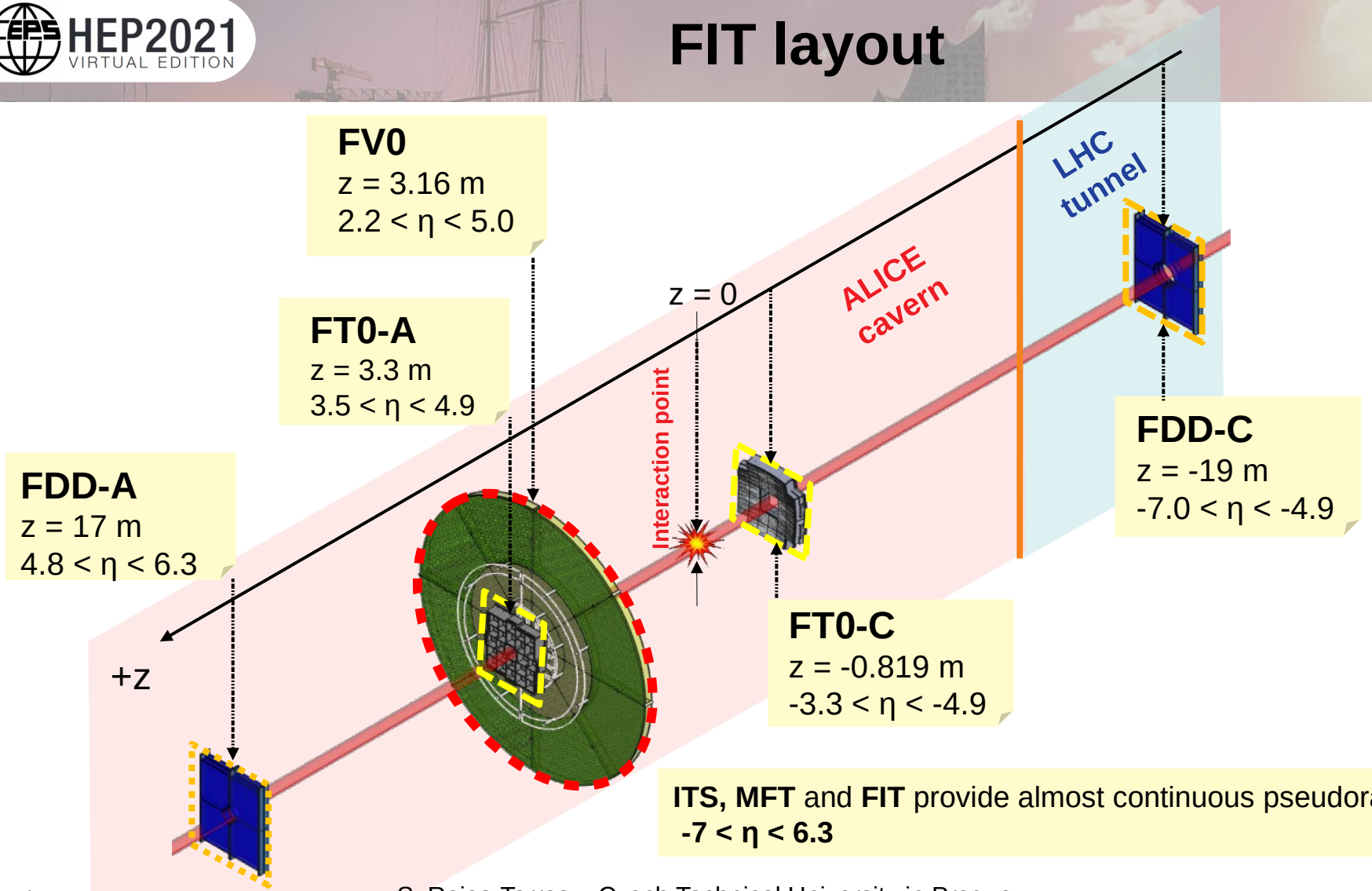
FIT will deliver:

- **Minimum latency** interaction trigger (**<425 ns**)
- **Luminosity**
- **Vertex position**
- Forward multiplicity
- Precise **collision time** for TOF-based particle ID
- **Centrality** and **interaction plane** for flow measurement
- Tags for **diffractive** and **ultra-peripheral** collisions



All sub-detectors have a **laser calibration system** and common **Front-End Electronics** and **Detector Control System**.

FIT layout

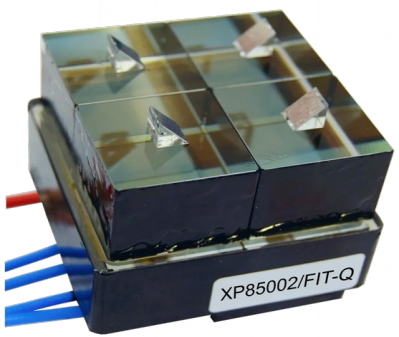


ITS, MFT and **FIT** provide almost continuous pseudorapidity coverage:
-7 < η < 6.3

FT0 sub-detector

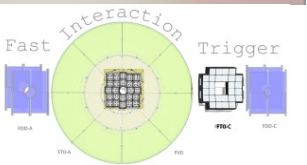
Detector technology

- Based on quartz Cherenkov radiators
- Customized Planacon® MCP-PMTs: XP85012/FIT-Q
- 4 pixels with its own quartz radiator per MCP-PMT.
- Excellent time resolution
  - <50 ps for a single channel @ 1 MIP
  - Better resolution is achieved with higher amplitudes or multichannel average.



FT0-A

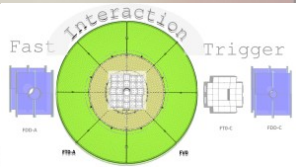
- 24 modules x 4 pixels = 96 channels
- Planar shape
- Integrated with FV0



FT0-C

- 28 modules x 4 pixels = 112 channels
- Concave shape
- Integrated with MFT

FV0 sub-detector

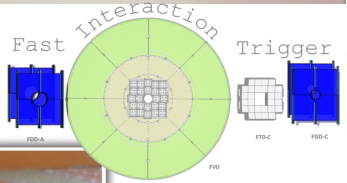


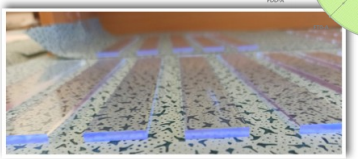
- 40 scintillator cells: EJ-204, 4 cm thick
  - Five concentric rings
  - 2 channels per cell in the 5th ring -> 48 readout channels
- Novel light-collection technique* with optical fibre:
  - Asahi optical fibres
  - Keep pulses width < 25 ns
  - No wavelength-shifting fibres
- Fine mesh PMT: H6614-70-Y001
- Time resolution: 200-250 ps @ 1 MIP

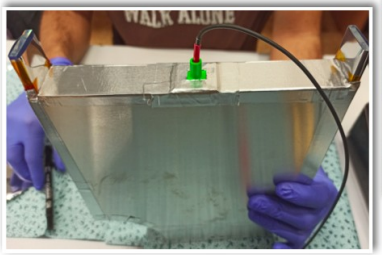
* https://arxiv.org/abs/1909.01184v1

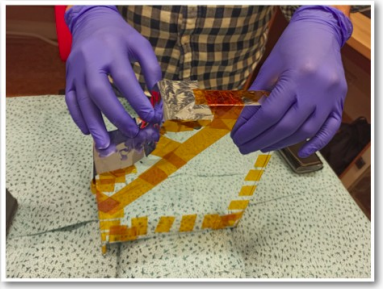
FDD sub-detector

- 16 readout channels: 2 stations with 8 channels each
- Plastic scintillator: BC-420
- Fast wavelength-shifting bar: 1 ns re-emission time, NOL-38
- Light transport by clear fibre bundles: 3, 1, 0.57 meter long, Kuraray PSM-Clear
- Fine mesh PMT: H8409-70

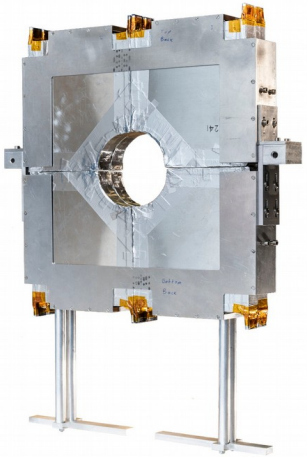




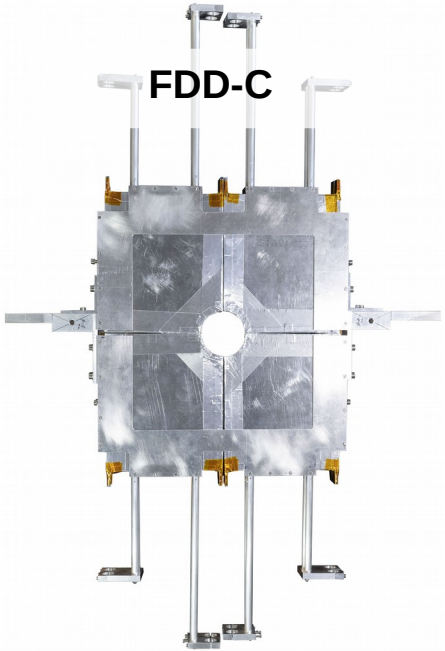


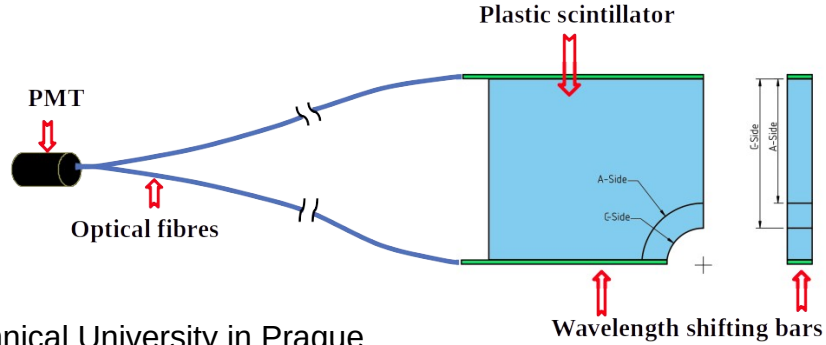


FDD-A



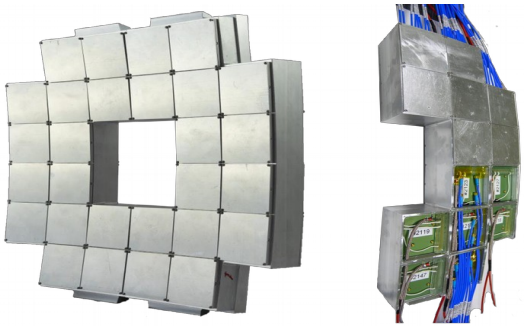
FDD-C



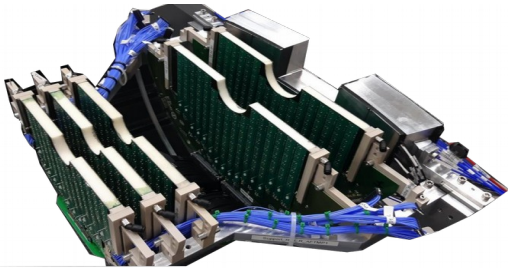


FT0 – Construction and integration

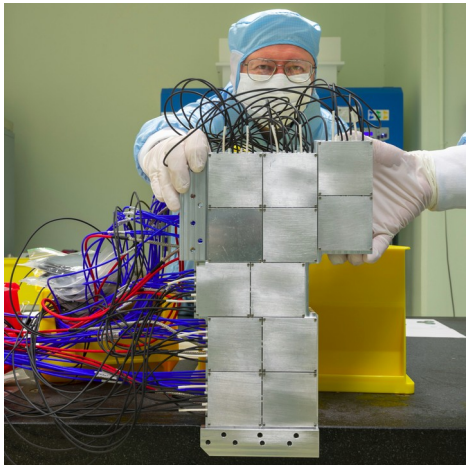
FT0-C



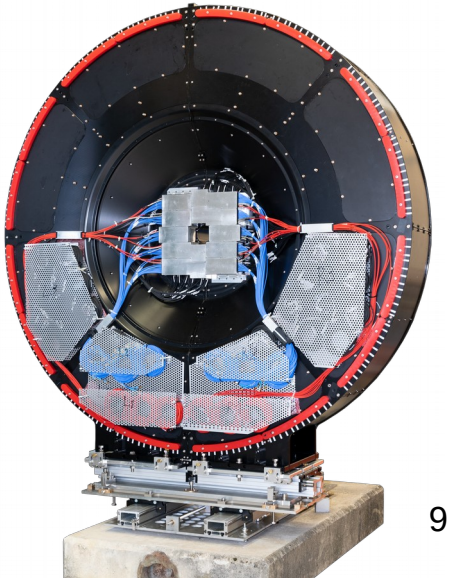
FT0-C & MFT



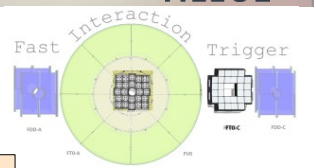
FT0-A



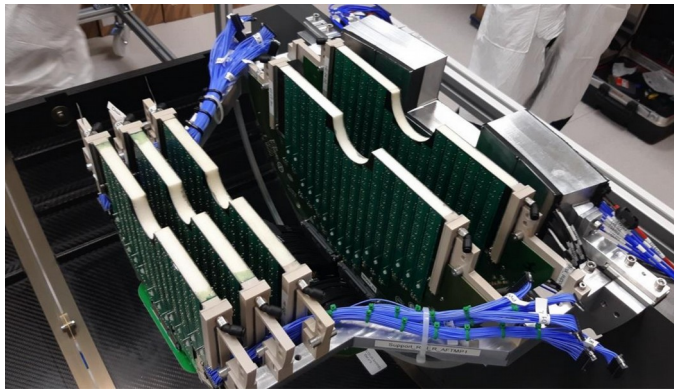
FT0-A & FV0



FT0-C & MFT installation

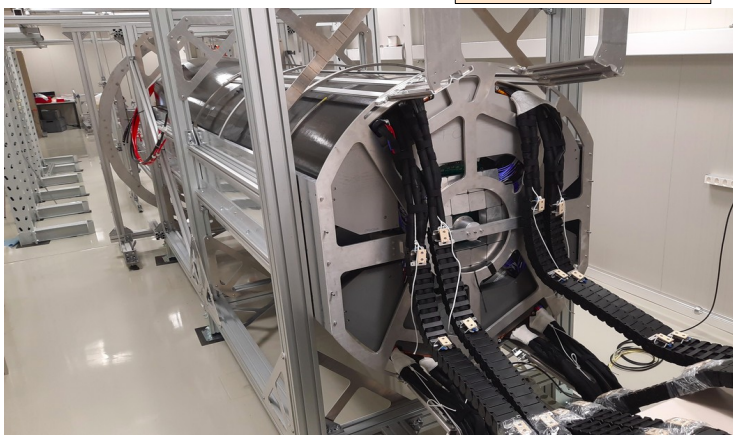


FT0-C & MFT



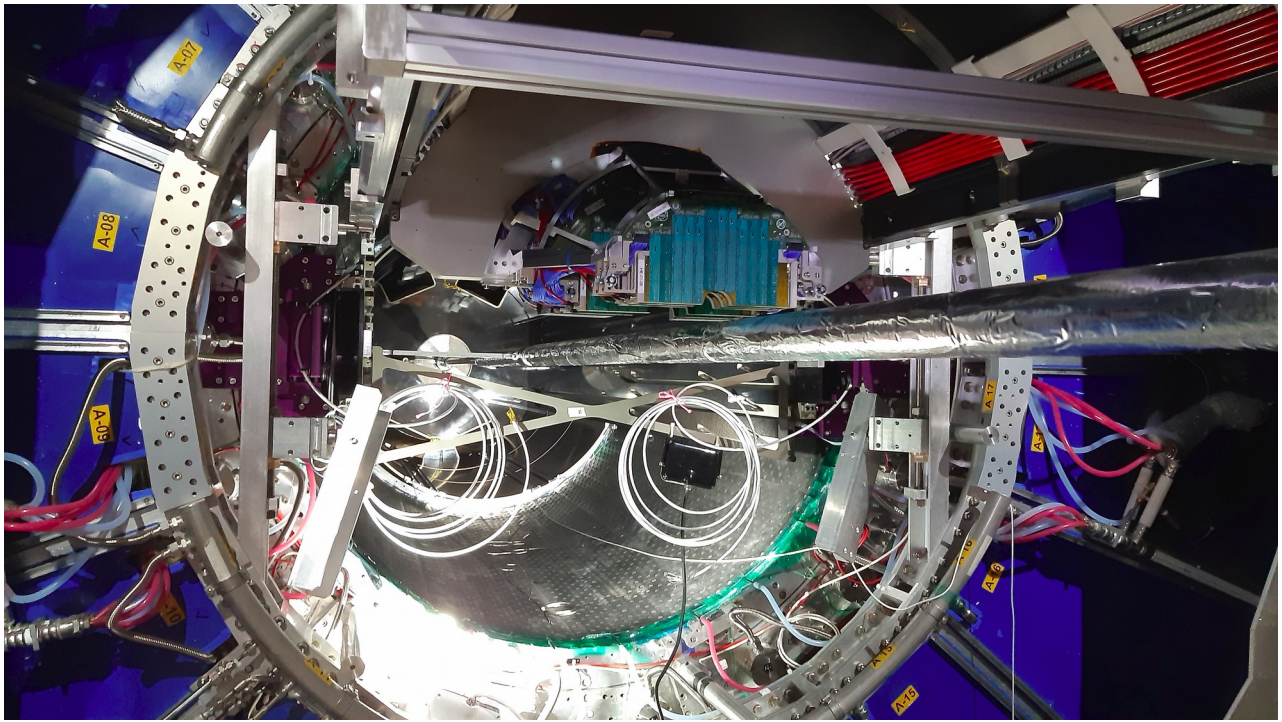
Insertion Test

25.11.2020



Insertion to inner barrel

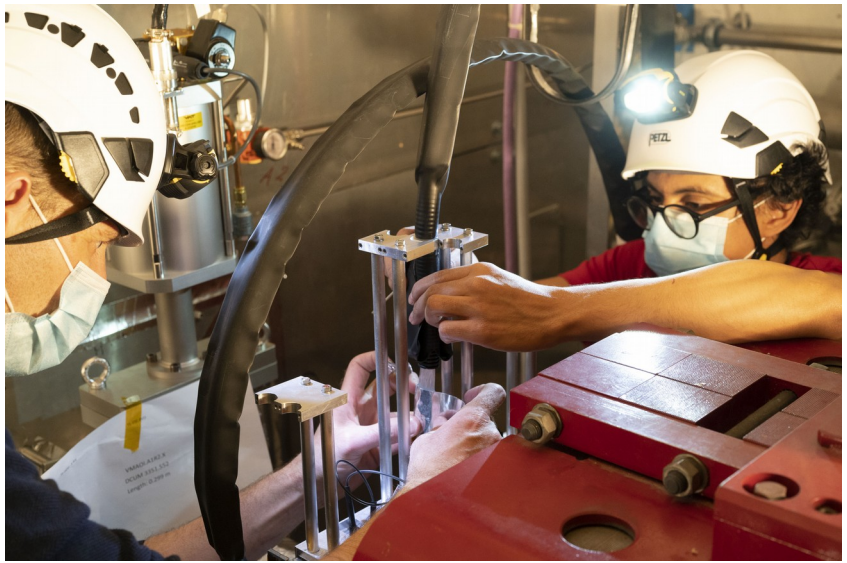
3.12.2020



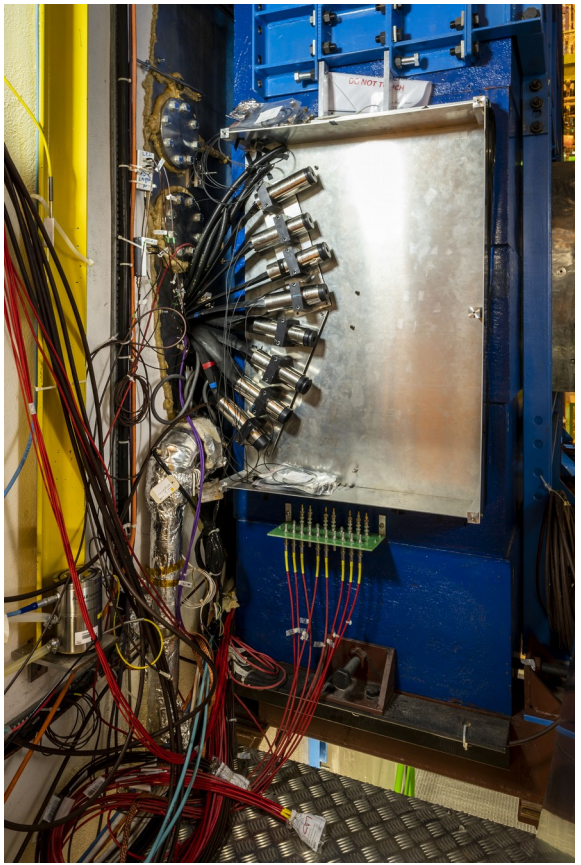
FDD-C installation

22.02.2021

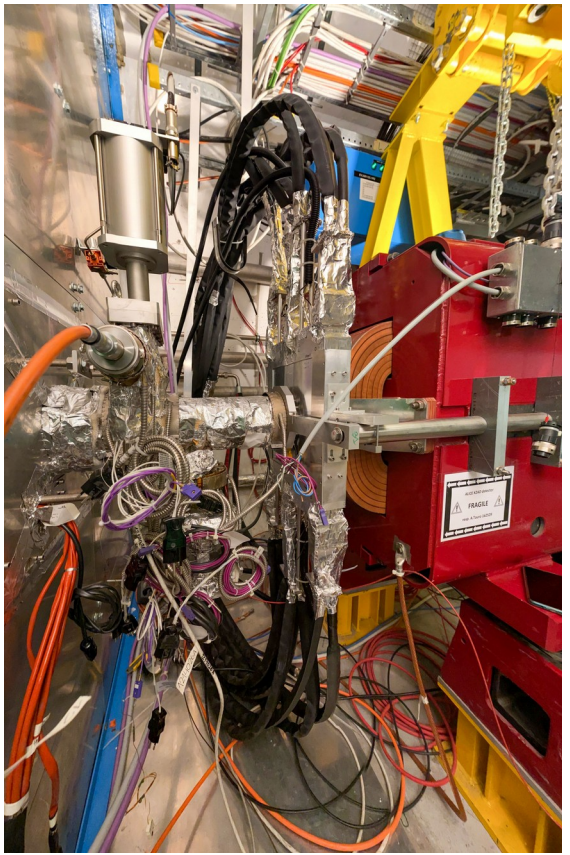
Fibre bundles installation



ALICE cavern - PMTs

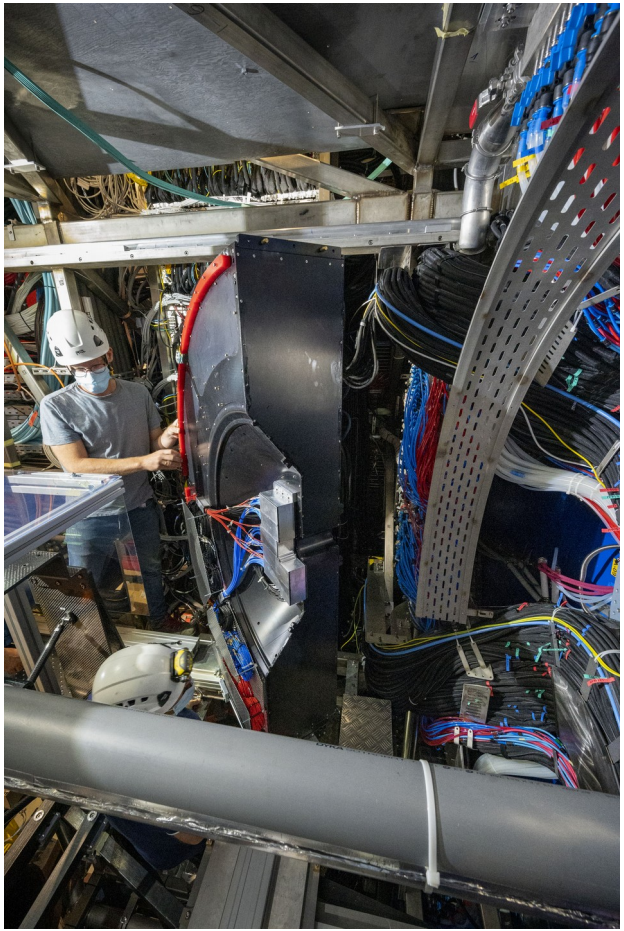


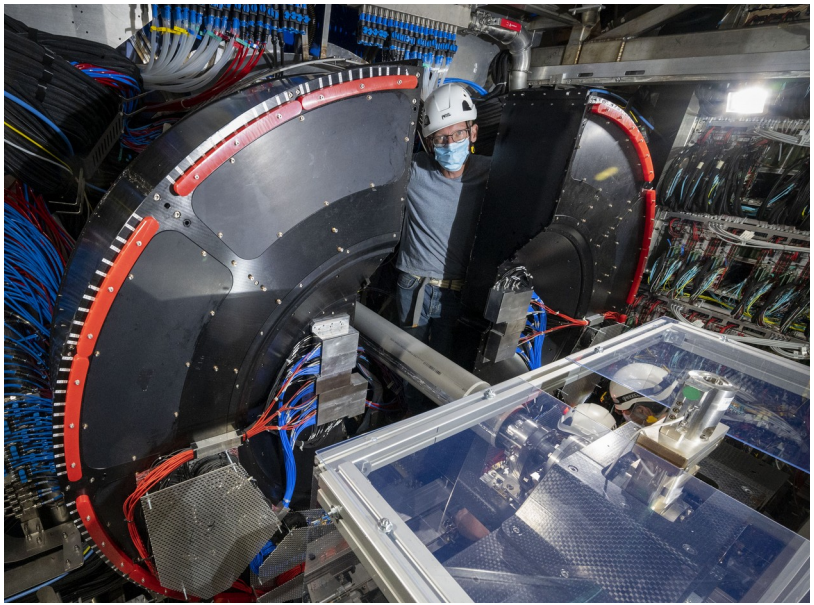
LHC tunnel – FDD-C



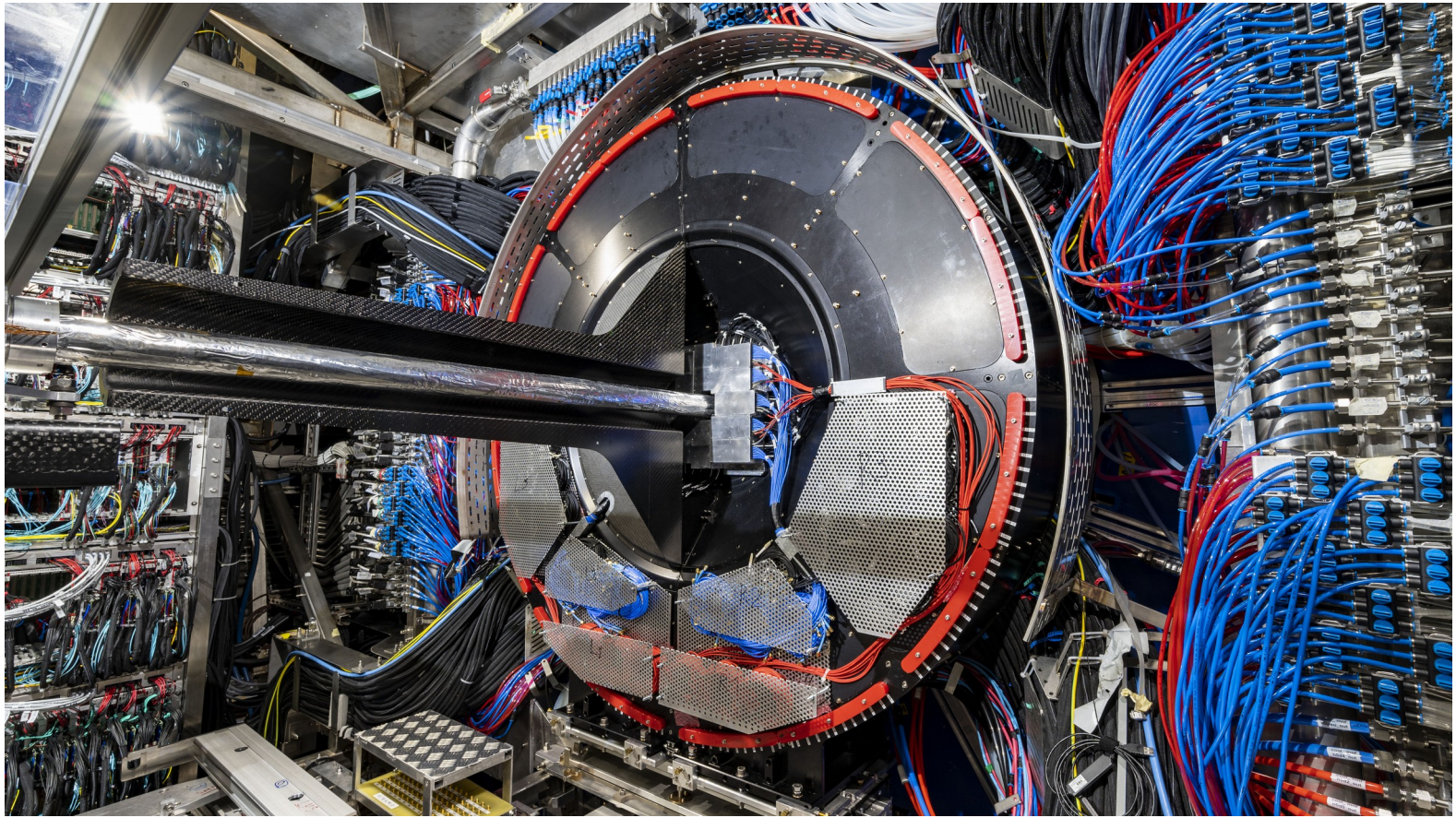
FIT FT0-A & FV0 installation

21.06.2021



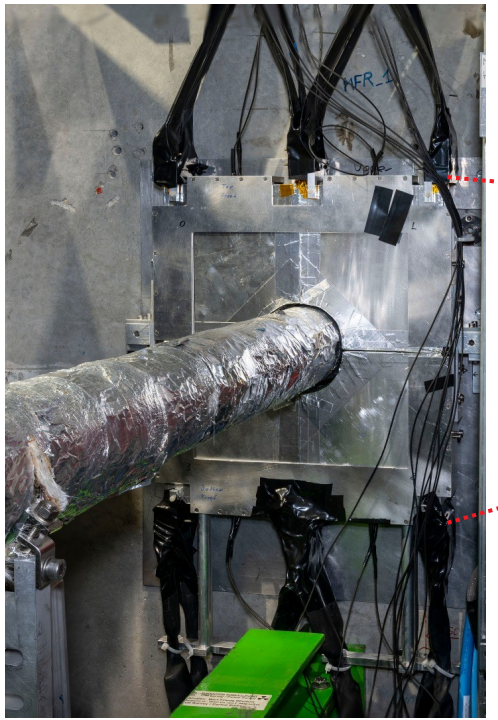


FIT FT0-A & FV0 installation



FDD-A installation

14.07.2021



Summary

- All 3 FIT sub-detectors have been constructed and installed on schedule
- FIT is ready for global commissioning and integration with the rest of ALICE
- Looking forward to the pilot-beam collisions in October 2021!

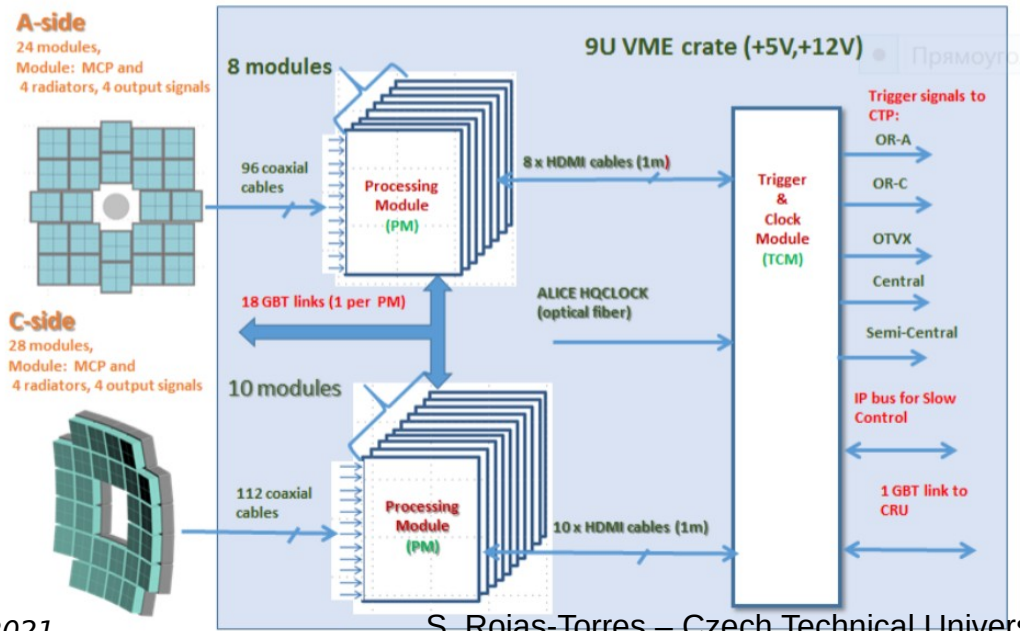
Backup slides

Front-End Electronics

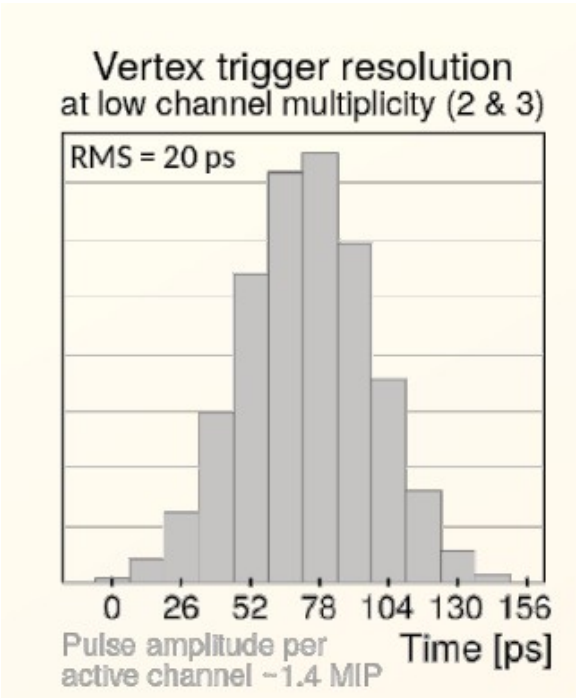
All three FIT sub-detectors use the same electronics scheme

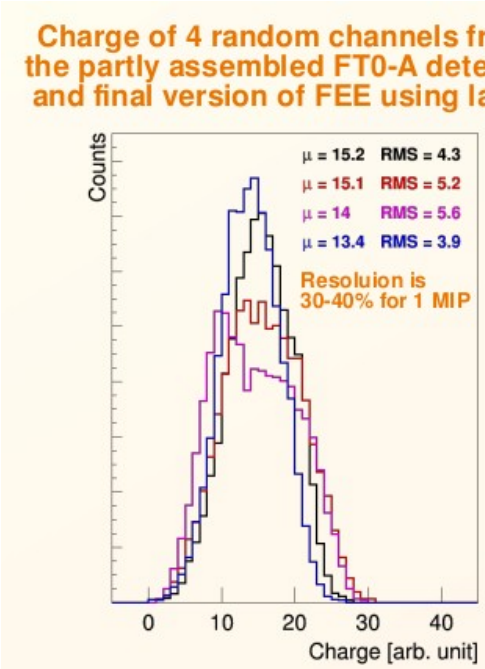
- Processing Module (PM):
  - 12 signal inputs for fast digitization of charge and time.
- Trigger and Clock Module (TCM):
  - dedicated FW for each detector, low latency trigger generation (< 425 ns for FT0).

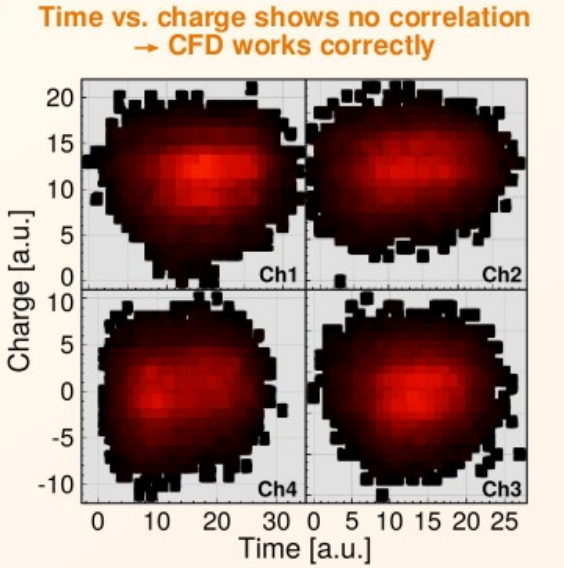
Modified LHC crate with power-only back plane



Front-End Electronics - Performance

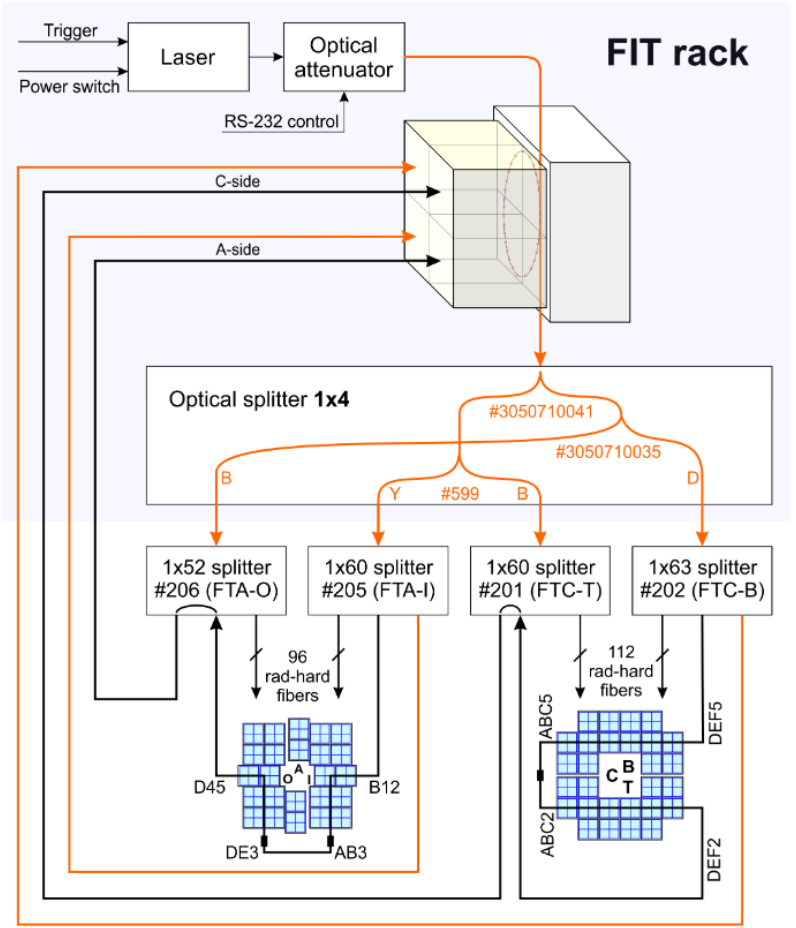






Laser Calibration System

A **Laser Calibration System** was designed and installed to **calibrate** and **monitor the performance** of the detector.



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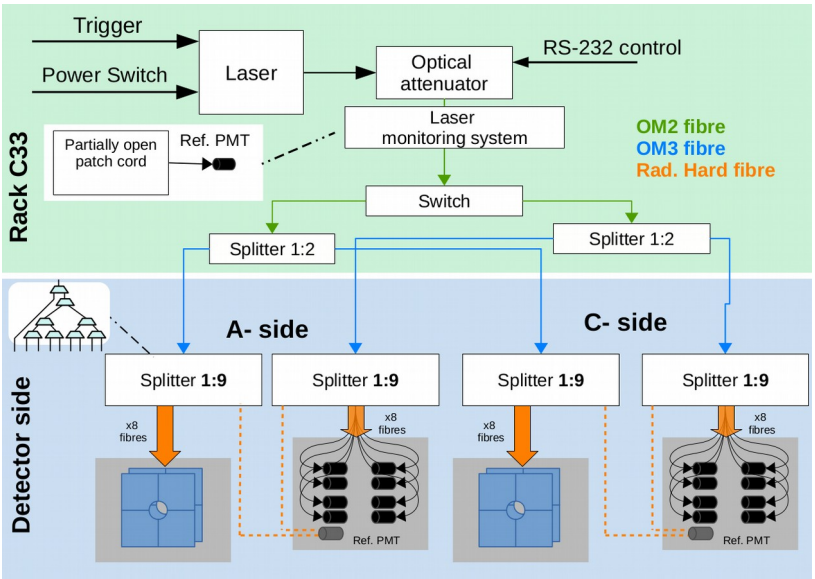
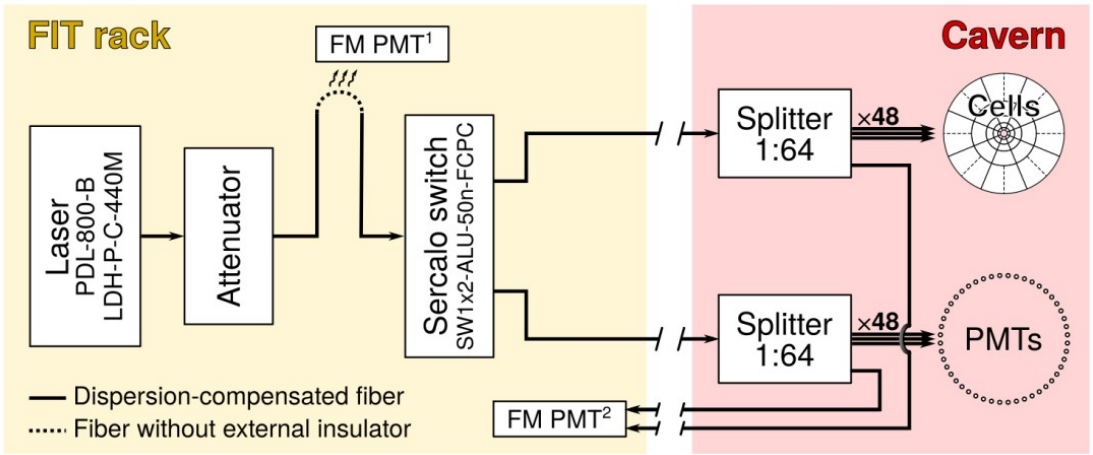
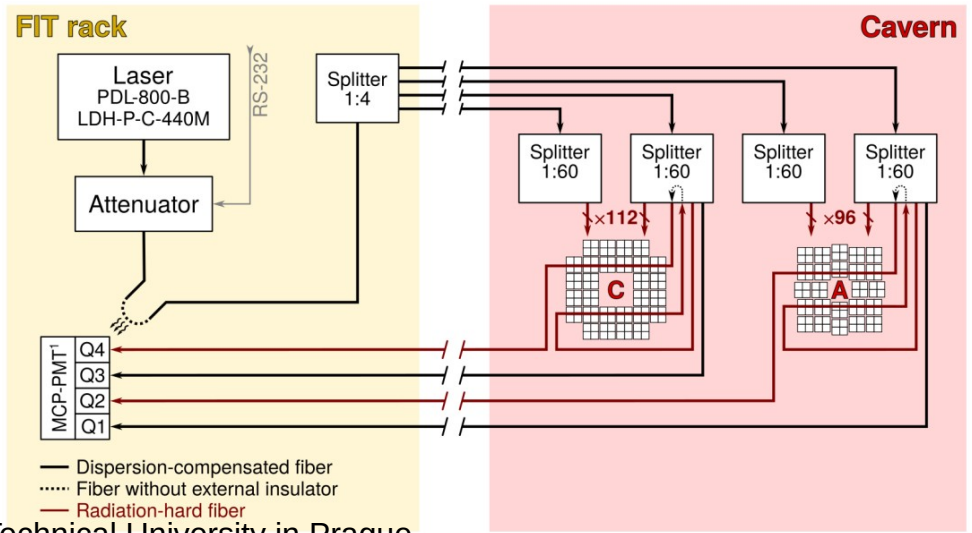
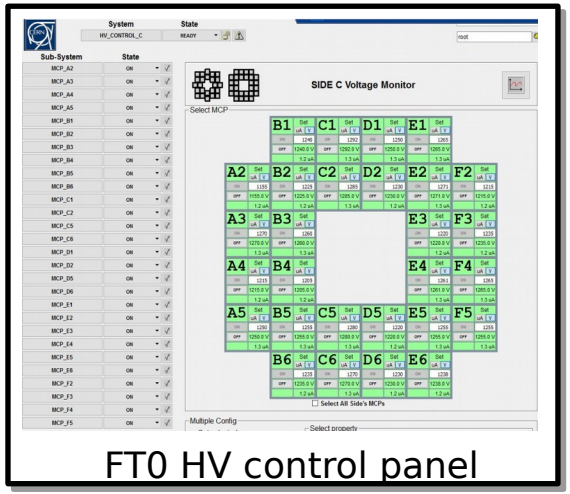




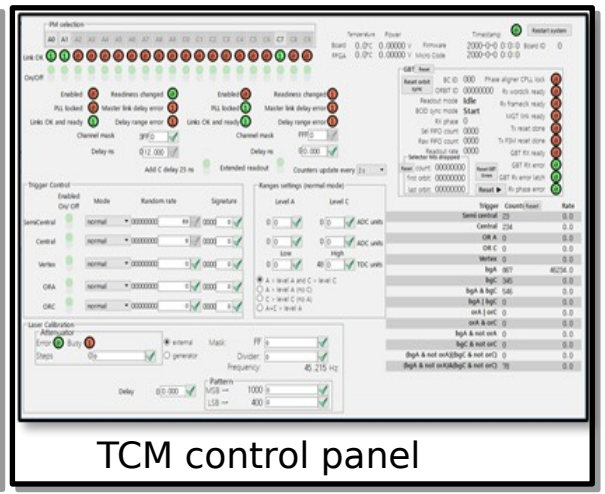


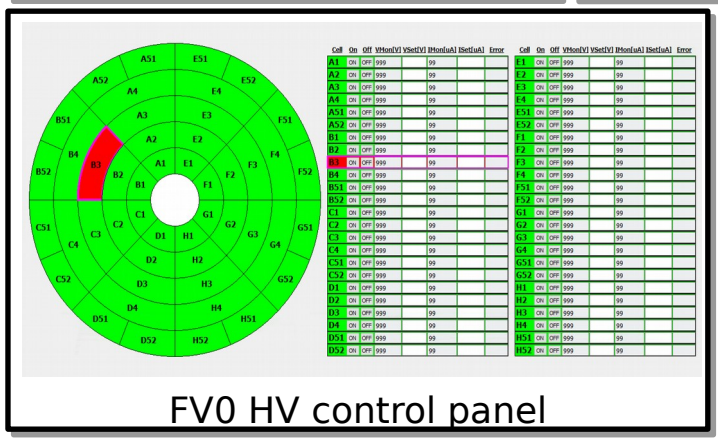
Detector Control System (DCS) status

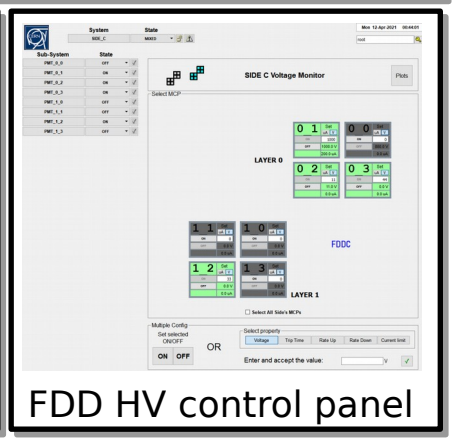
- DCS in the last phase of stand-alone commissioning
- Integration in the cavern with the rest of ALICE in August.
- Detector control system operational.
- Looking forward to the first data in the form of the pilot-beam in October this year.



FT0 HV control panel


TCM control panel


FV0 HV control panel



FDD HV control panel