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The Fast Interaction Trigger Upgrade for ALICE

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The **ALICE Fast Interaction Trigger (FIT)** is a set of **forward** detectors which will be used in LHC **Run-3 and Run-4** for **triggering**, **beam monitoring** and determination of **centrality** and **event plane**.

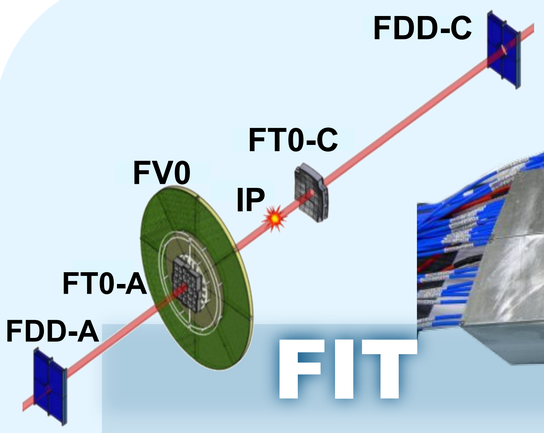
Motivation

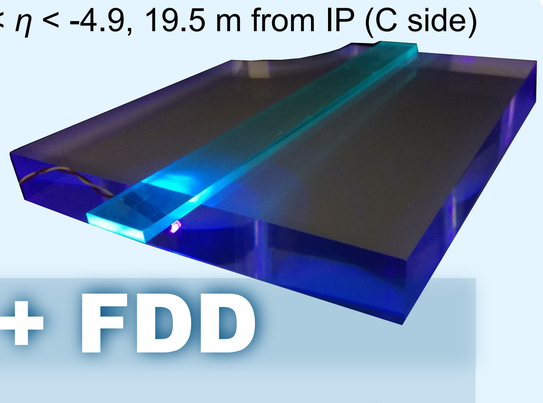
The ALICE experiment is dedicated to study properties of hot and dense nuclear matter produced in high energy nuclear collisions. The detector is undergoing a major upgrade during the LHC second long shutdown (LS2). ALICE is being prepared to collect data at increased collision interaction rates of 50 kHz in Pb–Pb and 1 MHz in pp. To make this possible, most of the ALICE detectors will operate in continuous read-out mode, which requires online event selection with fast and efficient forward detectors.

Tasks

- luminosity and beam-induced background monitoring
- triggering:
  - minimum bias trigger
  - centrality/multiplicity selection
  - online vertex determination
  - beam-induced background rejection
  - veto flag for ultraperipherial collisions
- centrality and event plane determination
- collision time measurement

What is FIT?





FIT = FT0 + FV0 + FDD

- FIT consists of three detectors with different designs and technologies
- they will provide complementary information to fulfil data acquisition requirements

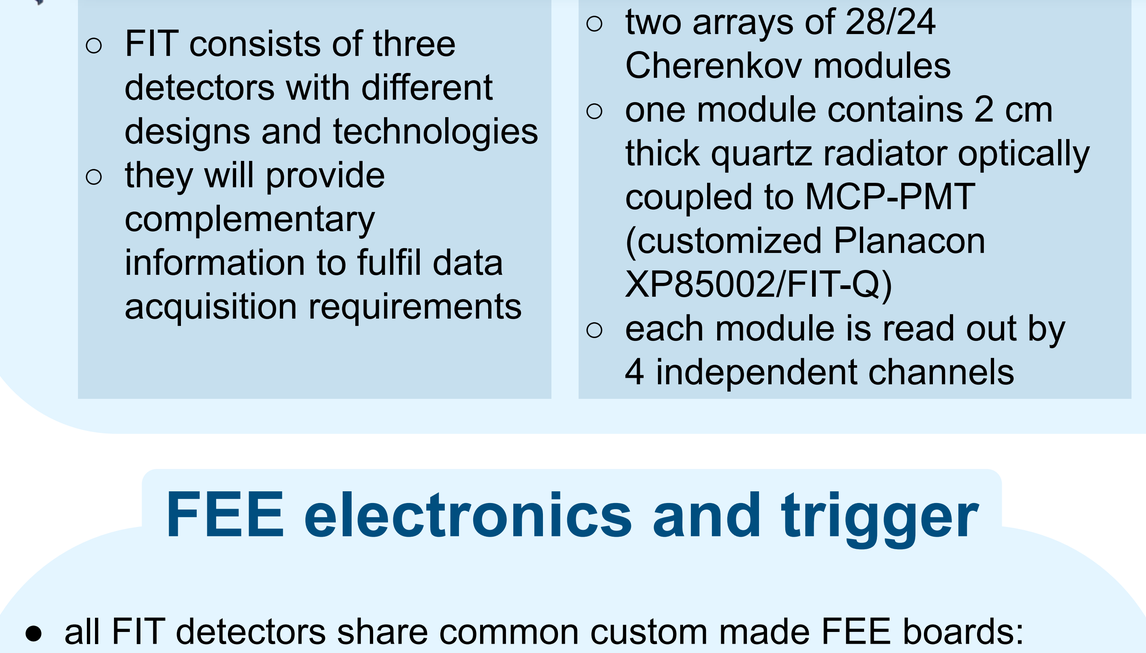
FT0
- two arrays of 28/24 Cherenkov modules
- one module contains 2 cm thick quartz radiator optically coupled to MCP-PMT (customized Planacon XP85002/FIT-Q)
- each module is read out by 4 independent channels

FV0
- plastic scintillator connected with clear fibers to 48 fine-mesh PMTs (Hamamatsu R5924-70)
- thanks to its light collection system it does not require wavelength shifters
- split into 5 rings with similar η coverage and 8 azimuthal sectors
- large diameter of 144 cm
- located only on the A side

FDD
- two arrays consisting of 4 sectors and 8 modules each
- plastic scintillators connected to fine-mesh PMTs (Hamamatsu H8409-70) through wavelength-shifting bars and clear fibers

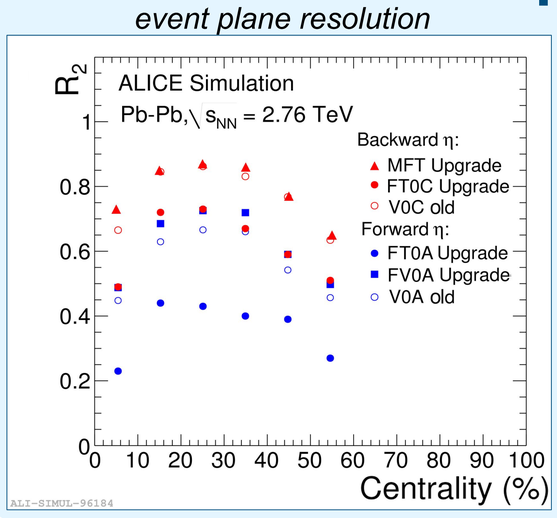
FEE electronics and trigger

- all FIT detectors share common custom made FEE boards: Processing Module (PM) and Trigger and Clock Module (TCM)
- fast data processing on these boards is based on FPGA circuits
- overall trigger latency must be kept below 425 ns including transmission channels
- 5 simultaneous trigger outputs can be configured per detector

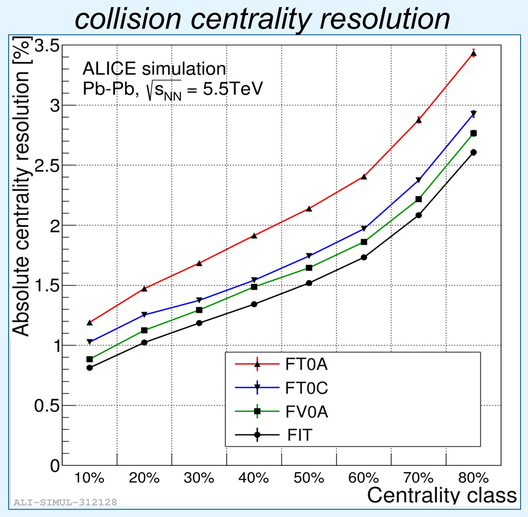


Simulation performance

event plane resolution

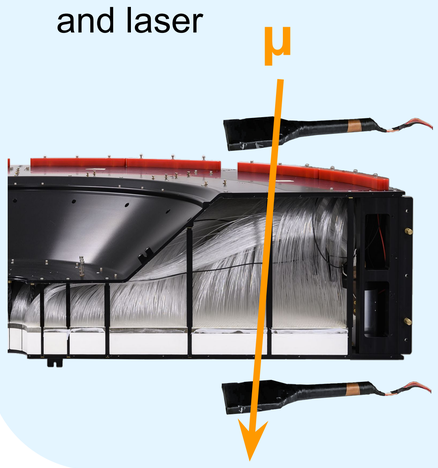


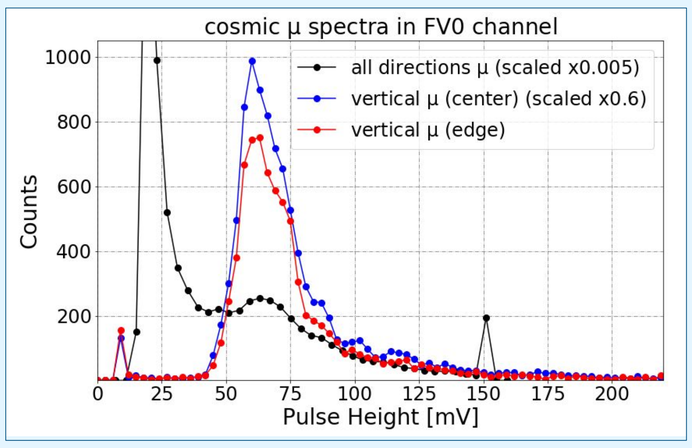
collision centrality resolution



FIT commissioning

- FDD construction is ongoing
- electronics is being produced and tested
- FV0 and FT0-C are fully assembled and tested with cosmic muons and laser





References:
about **FIT**: W.H. Trzaska, Nucl. Instrum. Methods Phys.Res. A 845 (2017) 463–466, https://doi.org/10.1016/j.nima.2016.06.029
about **electronics**: D.A. Finogeev, Nucl. Instrum. Methods Phys.Res. A 952 (2020) 161920, https://doi.org/10.1016/j.nima.2019.02.047