MUON FORWARD TRACKER IN ALICE AT THE LHC

AUTHOR

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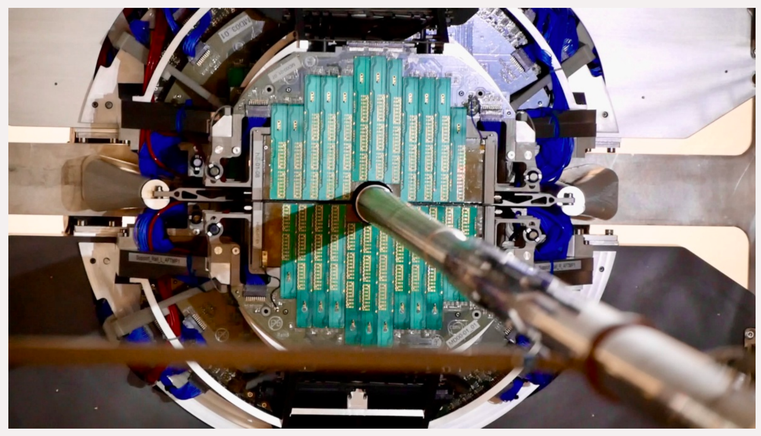
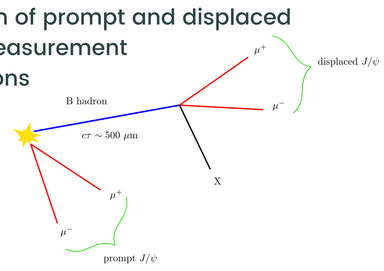


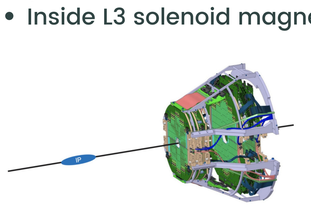
MOTIVATION

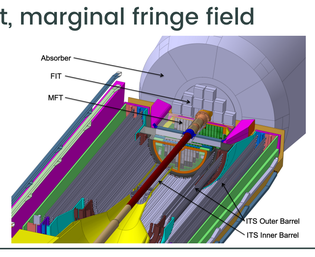
- MFT [1] was added to ALICE [2] to improve the tracking and vertexing performance of the muon spectrometer at forward rapidity for the LHC Runs 3 and 4
- MFT opens path to new measurements: new physics observables accessible down to very low p_t
- MFT allows for the separation of prompt and displaced charmonia as well as the measurement of Ψ' in central Pb-Pb colisions



PLACEMENT

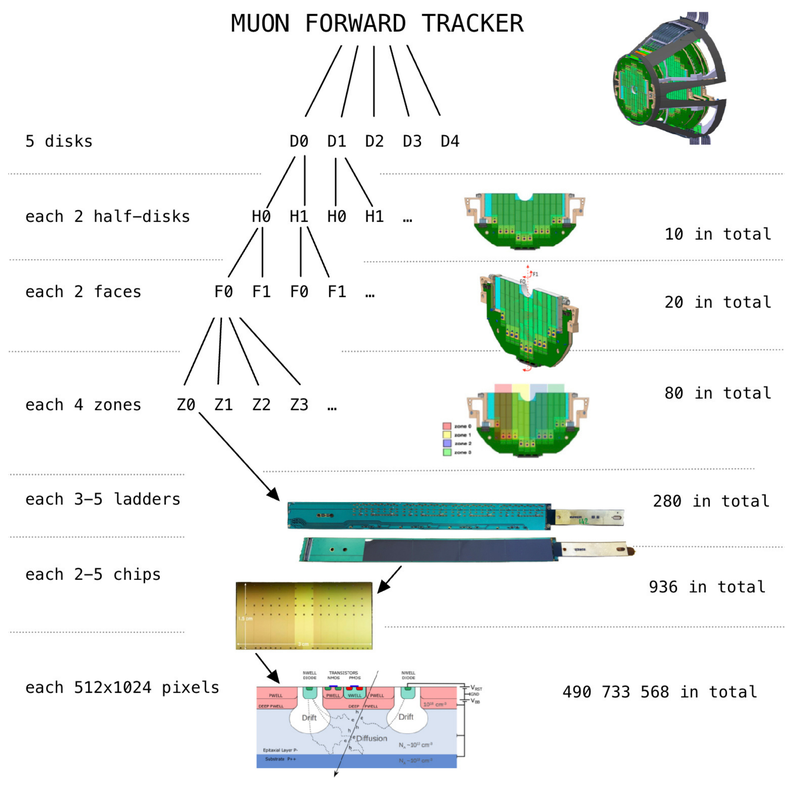
- MFT surrounds the beam pipe and is located in the ALICE central barrel, 46 cm to 77 cm from the nominal interaction point
- Pseudorapidity coverage $-3.6 < \eta < -2.45$
- Surrounded by Inner Tracking System (ITS) [3], placed in front of FT0-C [4] and the hadron absorber
- Inside L3 solenoid magnet, marginal fringe field





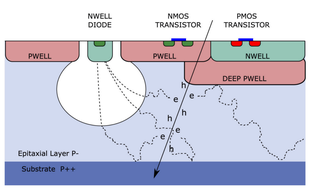
DESIGN

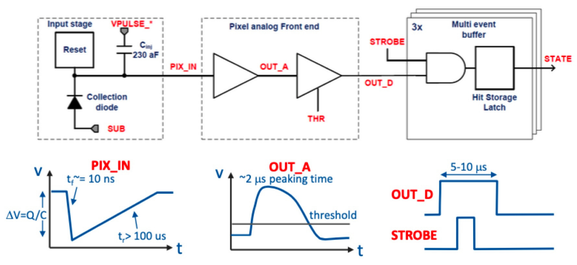
- 10 detection planes (5 double-sided disks)
- 280 ladders with 2 to 5 sensors each
- Assembled into 2 half-cones
- Power and readout segmented into 80 zones (4 per half-plane)



ALPIDE PIXEL SENSOR

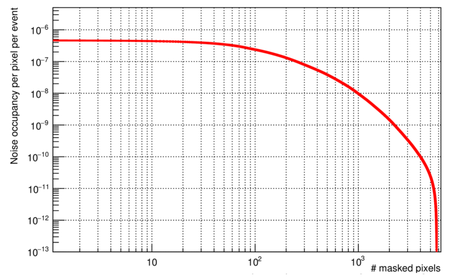
- CMOS Monolithic Active Pixel Sensor (MAPS), TowerJazz 0.18 µm
- Developed for ITS and MFT
- 512x1024 pixels, sensor size 15x30 mm
- Thickness 50 µm
- Detection efficiency >99%
- Space resolution 5 µm
- Integration time <4 µs





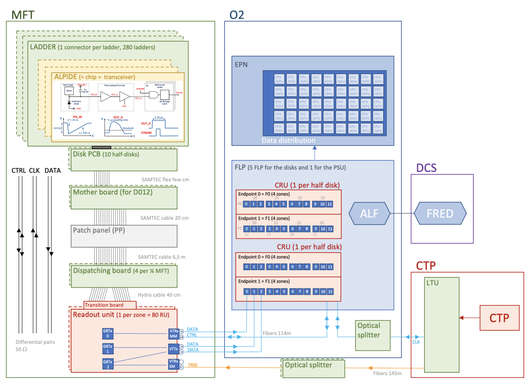
QUALIFICATION TESTS

- Sensors qualified before the ladder assembly
- Ladders qualified after assembly, before and after gluing on the disk
- Uniform threshold over all pixels
- A detailed study of fake-hit rate: by masking only 138 out of a total 490 million pixels, the noise occupancy is below 10^{-7} hits/pixel/event
- Quality of signal transmission qualified in eye diagram measurement



READOUT DATAFLOW

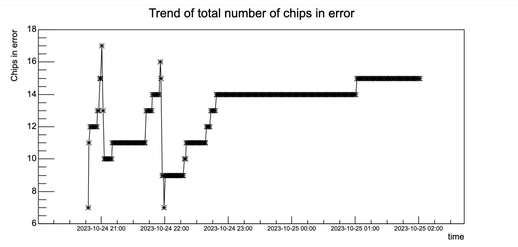
- 80 Readout Units (RU) in total, each corresponding to one MFT zone
- Optical signal from RUs processed by 10 Common Readout Units (CRUs) controlling the clock synchronization
- Clock provided for all detectors by the Central Trigger Processor (CTP)



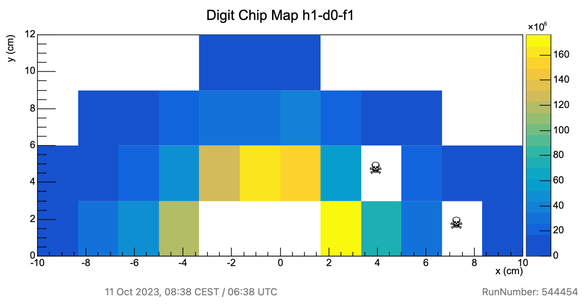
- Data collected from RUs sent via CRU to the First Level Processors (FLPs) and to Event Processing Nodes (EPNs)
- 5 FLPs used in MFT readout
- Detector Control System (DCS) communicates with FLPs via the Front End Device (FRED) framework: providing automatic sensor configuration
- Synchronous and asynchronous reconstruction on EPNs [5]

QUALITY CONTROL (QC) SYSTEM

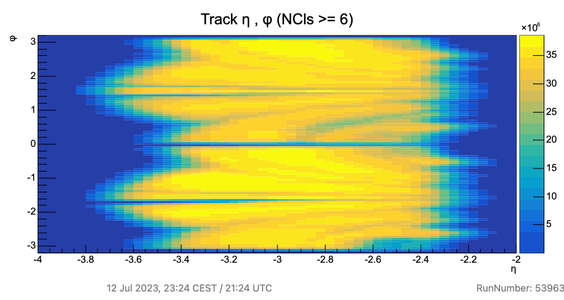
- QC system developed to monitor data quality both synchronously and asynchronously
- Dedicated tasks running on FLPs and EPNs
- 4 QC tasks in MFT monitoring readout, digits, clusters and tracks
- Accompanied with trending plots to observe time evolution of selected quantities during a run



25 Oct 2023, 02:00 CEST / 00:00 UTC — RunNumber: 545171



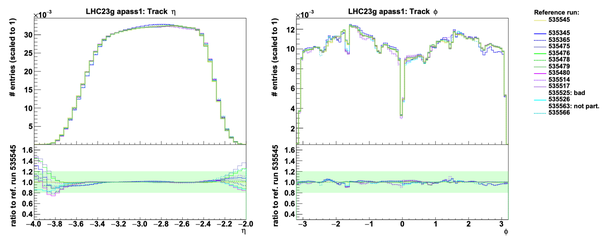
11 Oct 2023, 08:38 CEST / 06:38 UTC — RunNumber: 544454



12 Jul 2023, 23:24 CEST / 21:24 UTC — RunNumber: 539638

PERFORMANCE IN RUN 3

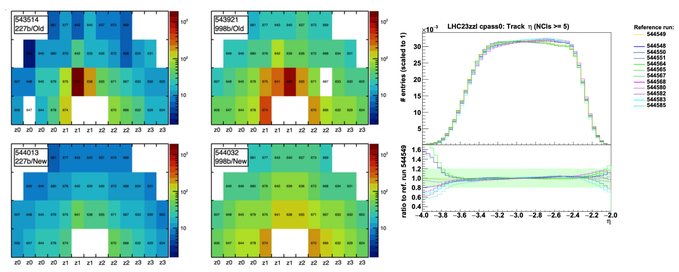
- First pp collisions recorded in October 2021
- Official start of Run 3 in July 2022: first pp collisions at $\sqrt{s}$ = 13.6 TeV
- Only 3% of MFT sensors not active: 14 dead and 14 disabled, marginal effect on reconstruction due to chip redundancy
- Noise scan performed regularly: noise level very stable
- For pp collisions at 500 kHz, MFT FLP data rate ~ 5.36 Gb/s



- Cluster and track properties consistent for all runs

PERFORMANCE IN Pb-Pb COLLISIONS

- First Pb-Pb collisions at 5.36 TeV in November 2022
- 5 weeks of Pb-Pb collisions with interaction rates up to 50 kHz in 2023: 2.16 nb^{-1} luminosity delivered to ALICE
- Beam background from LHC observed by MFT and some other detectors initially: source removed after several background study fills
- 1.96 nb^{-1} recorded after solution of the background issue



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