The ALICE Muon Forward Tracker commisionning: first beam tests

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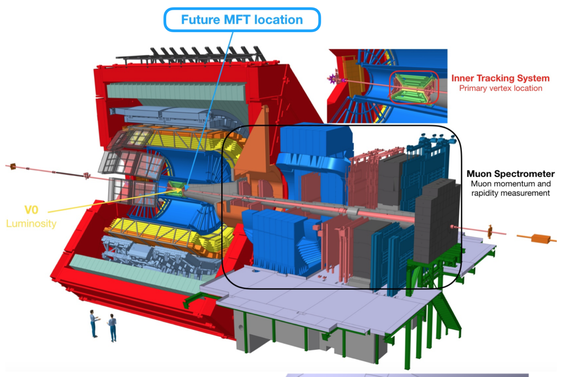
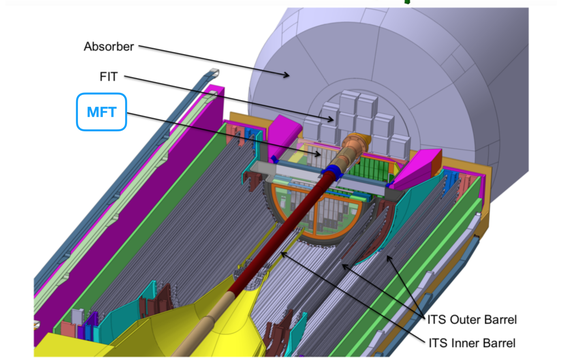
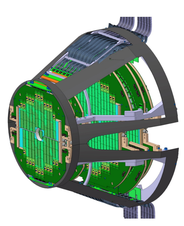
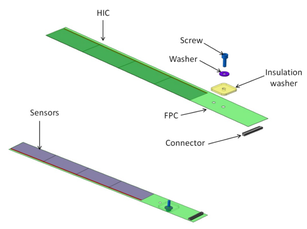
MFT upgrade overview



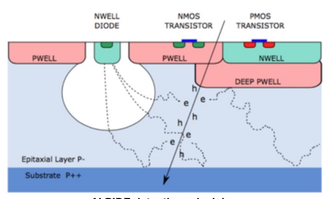


Muon Forward Tracker technology



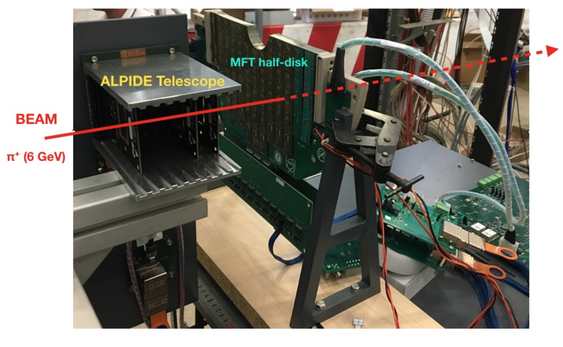


- 5 disks equipped on both sides with silicon pixel sensors (920 ALPIDE sensors). Ladder structure: FPC + sensors.
- ALPIDE technology: Monolithic Active Pixel Sensor (MAPS), CERN/CEA development.

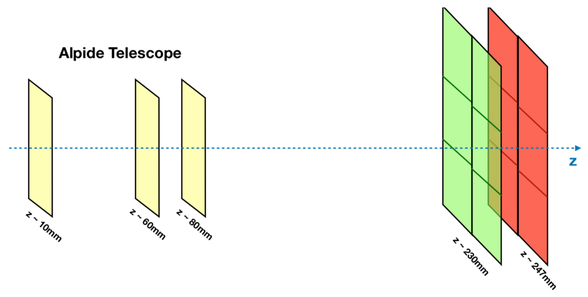


ALPIDE detection principle

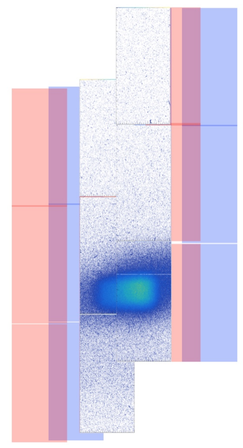
Beam test setup (June 2018 at CERN PS)



Ladders on disk



- ALPIDE Telescope: 3 chips (at 220, 160 and 140 mm from disk front plane).
- Trigger signal: plastic scintilliators upstream.



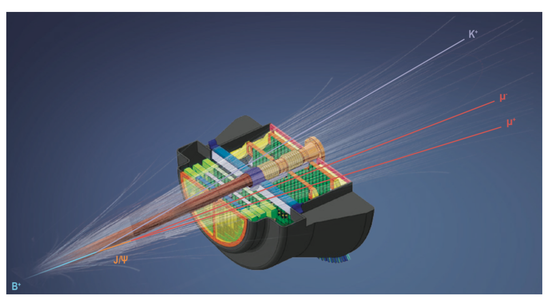
First hit maps from MFT disk protoype

Physics motivations

Main ALICE improvements with MFT

- Extend the open heavy flavour Physics program at large pseudo-rapidity, measurements down to low p_T.
- Increase S/N ratio matching tracks with MUON Spectrometer.
- Add high-precision vertexing capabilities to the MUON spectrometer (Currently limited by the front absorber). e.g. prompt/non-prompt charmonium discrimination.

New high-precision measurements accessible thanks to MFT upgrade are summarised in the Table 1.1.



Schematic view of B decay J/ψ identification

Table 1.1: New physics measurements made possible by the MFT addition.

Observable	p_T-coverage (GeV/c)
Charm	
Prompt J/ψ – R_{AA} & v_2	$p_T(J/\psi) > 0$
$\psi(2S)$ – R_{AA}	$p_T(\psi') > 0$
μ from c-hadron decays – R_{AA} & v_2	$p_T(\mu) > 1$
Beauty	
Non-prompt J/ψ – R_{AA} & v_2	$p_T(J/\psi) > 0$
μ from b-hadron decays – R_{AA} & v_2	$p_T(\mu) > 3$
Chiral symmetry and QGP temperature	
Light vector mesons spectral functions and QGP thermal radiation	$p_T(\mu\mu) > 1$

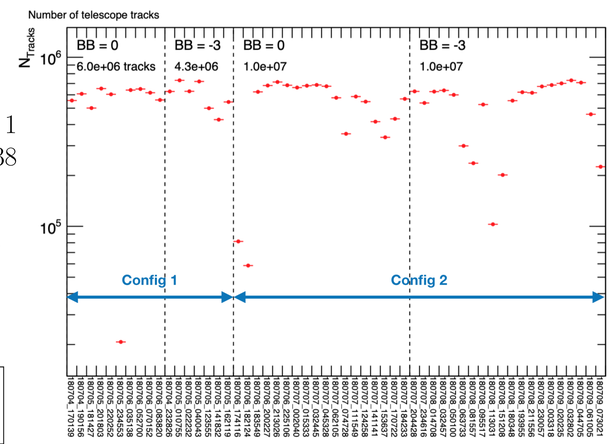
Main beam test motivations

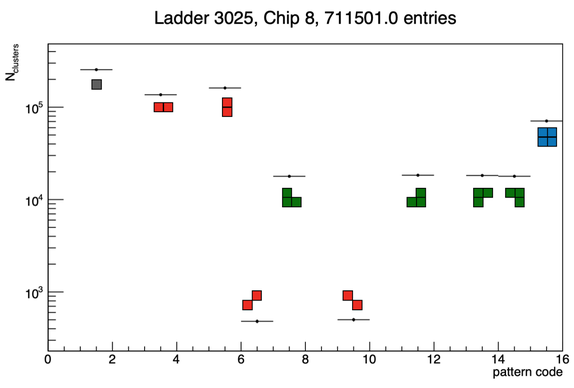
- Test readout and tracking capabilities from a half disk prototype using MOSAIC readout boards (1 board/ladder).
- Estimate resolution on track reconstruction (Expected sensor intrinsic spatial resolution: $\sim 5\mu m$).
- Estimate detection efficiency (Expected detection efficiency $> 99.5\%$).

Beam test data and methods

Collected data specifications

- Total Number of reconstructed tracks: $\sim 3.10^7$.
- 2 acquisition configurations: 1 front ladder + 1 back ladder (17 runs) and 1 front + 2 back (38 runs).
- 2 back-bias voltage configurations: 0V and -3V.





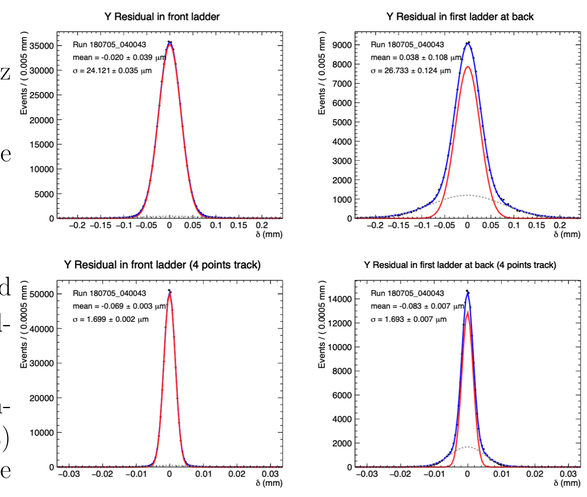
Cluster pattern study

- Cluster pattern distribution for one chip on a ladder. Distributions consistent for all chips.

Resolution and efficiency calculations

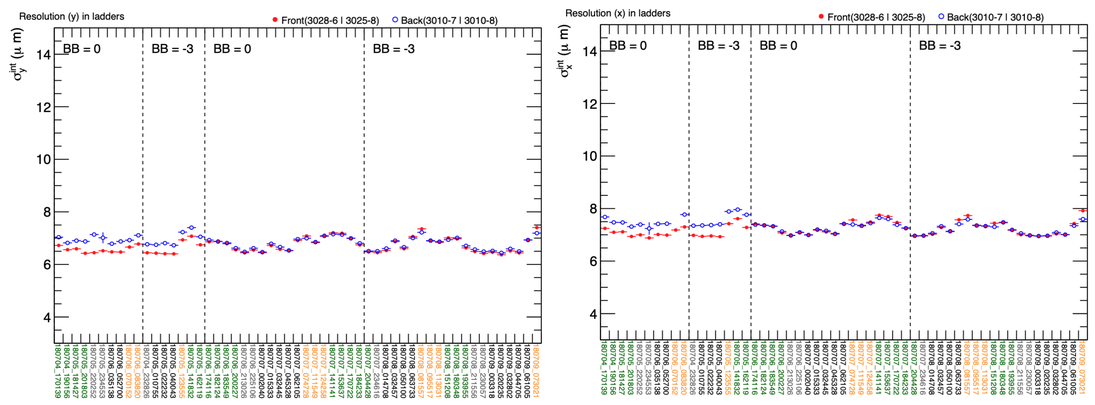
- Alignment performed using Millepede with x, y, z and θ_z coordinates as free parameters.
- **Resolution** $\sigma^{int}_{x,y}$ calculated in the transverse plan in each direction (x or y).
- Horizontal direction (y):

  $\sigma^{int}_{y} = \sqrt{\sigma^{with}_{y} * \sigma^{without}_{y}}$, where "with" and "without" mean taking into account or not the ladder point to do the tracking.
- **Efficiency** defined as the ratio between the number of tracks found in 2 ladders (1 back + 1 front) and the number of tracks found in the reference ladder (e.g back = ref to estimate front eff).



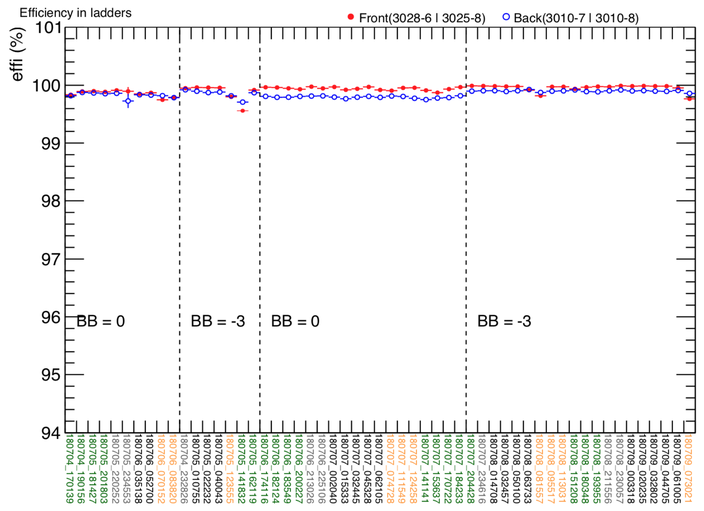
Results of beam test data analysis

Resolution



- Estimated Resolution for beam test data $\sim 7\mu m$ for y direction ($\sim 7.5\mu m$ for x direction).
- Consistent with expected resolution $\sim 5\mu m$ considering multiple-scattering effects.

Efficiency



- Estimated detection efficiency consistent with expected efficiency ($> 99.5\%$).

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