The ALICE Muon Forward Tracker commissionning: first beam tests
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To cite this version:
Manuel Guittiere. The ALICE Muon Forward Tracker commissionning: first beam tests. 137th LHCC Meeting, Feb 2019, Genève, Switzerland. hal-02283834

HAL Id: hal-02283834
https://hal.archives-ouvertes.fr/hal-02283834
Submitted on 11 Sep 2019

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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.

Beam test setup (June 2018 at CERN PS)

- ALPIDE Telescope: 3 chips (at 220, 160 and 140 mm from disk front plane).
- Trigger signal: plastic scintillators upstream.
- First hit maps from MFT disk prototype

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 $J/\psi$ identification

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 $\theta$ coordinates as free parameters.
- Resolution $\sigma_{x,y}$ and $\sigma_{x,y}$ calculated in the transverse plane in each direction (x or y).
- Horizontal direction (y): $\sigma_{y_{\text{ref}}} = \sqrt{\sigma_{y_{\text{with}}}^2 + \sigma_{y_{\text{without}}}^2}$, 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$4 $\mu$m considering multiple-scattering effects.

Efficiency

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

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

<table>
<thead>
<tr>
<th>Observable</th>
<th>pT coverage (GeV/c)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charge</td>
<td>$p_T &gt; 3$</td>
</tr>
<tr>
<td>Energy</td>
<td>$E_{\text{in}}$</td>
</tr>
<tr>
<td>recoiling angles</td>
<td>$\Delta \phi &gt; 1$</td>
</tr>
<tr>
<td>Reconstructed tracks</td>
<td>$p_T &gt; 3$</td>
</tr>
<tr>
<td>Charged hadrons</td>
<td>$p_T &gt; 3$</td>
</tr>
<tr>
<td>Degree of freedom</td>
<td>$p_T &gt; 3$</td>
</tr>
<tr>
<td>Visible fraction</td>
<td>$p_T &gt; 3$</td>
</tr>
</tbody>
</table>

Schematic view of B decay $J/\psi$ identification

Cluster pattern study

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