Momentum spectra of identified particles in pp collisions with the ALICE detector

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Recontres de Moriond
La Thuile 13-20 March
• Description of the ALICE detectors devoted at the PID in the central barrel
• Current Particle Identification (PID) performance of ALICE
• Strategy and status of the identified spectra measurement in ALICE (pp $\sqrt{s} = 900$ GeV)
• Resonances with the ALICE detector in the first pp collisions ($\sqrt{s} = 900$ GeV)
ALICE detector

Solenoid magnet 0.5 T

HMPID, PMD, ITS

TOF, TRD, TPC

Muon Arm

PHOS

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The Inner Tracking System

- **Six layers of silicon detectors**
  - Coverage: $|\eta| < 0.9$

- **Three technologies**
  - Pixels (SPD)
  - Drift (SDD)
  - Double-sided Strips (SSD)

- **Design goals**
  - Optimal resolution for primary vertex and track impact parameter
  - dE/dx information in the 4 outermost layers for particle ID in $1/\beta^2$ region
The Time Projection Chamber

- **Characteristics:**
  - 85 m³ - NeC₂O₂N₂ gas mixture
  - 557,568 readout channels
  - Maximum drift time = 92 μs
  - Many (>90) 3D points (+dE/dx) per track

- **Calibration:**
  - >750 million events (cosmics, krypton, and laser) recorded, with and without B
  - First round of calibrations (dE/dx, momentum, alignment, gain) completed before pp collisions
The Time Of Flight

**Characteristics:**
- 18 sectors covering the whole azimuthal angle, $|\eta|<0.9$;
- Granularity: $2.5 \times 3.5 \text{ cm}^2$ at $\sim 3.7 \text{ m}$ from the primary vertex;
- Resolution at present $\sim 130 \text{ ps}$ (calibration only from cosmic rays);
- $\sim 153k$ readout channels ($\sim 97\%$ active at the moment);
- Pion/kaon/proton separation immediately after the first $pp$ collisions.
Combined measurement

**ITS**

- **\( \pi \):** 0.2 – 1
- **K:** 0.2 – 0.4
- **p:** 0.3 – 1

**TOF**

- **\( \pi \):** 0.5 – 2
- **K:** 0.5 - 2
- **p:** 0.5 – 2.5

**TPC**

- **\( \pi \):** 0.2 – 0.7
- **K:** 0.3 – 0.6
- **p:** 0.5 – 1
Yields extracted from ITS dE/dx distributions

ALICE Performance
work in progress
minimum bias p+p (2009)
$\sqrt{s} = 900$ GeV

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Yields extracted from TPC dE/dx distributions

ALICE Performance
work in progress
minimum bias p+p (2009)
$\sqrt{s} = 900$ GeV

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Yields extracted from TOF time distributions

1.00 < p_T < 1.10 GeV/c -- positive

1.20 < p_T < 1.30 GeV/c -- positive

1.60 < p_T < 1.70 GeV/c -- positive

\( t_{\text{TOF}} = \text{TOF time} - t_0 \)

\( t_0 = \text{measured with a combinatorial algorithm using the TOF tracks (if } N_{\text{TOF tracks}} > 3) - \text{resolution} \sim 80 \text{ ps} \)

otherwise

\( t_0 = \text{average event time (run by run) - resolution due to beam size} \sim 130 \text{ ps} \)

\( \sqrt{s} = 900 \text{ GeV} \)
Invariant mass distributions – $K^0_s$

- $K^0_s$ using the secondary vertex reconstructed by SPD

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Invariant mass distributions - $\Lambda_s$

$\Lambda$ in $p \pi$ channel using the secondary vertex of the SPD

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Invariant mass distributions - $\Xi$s

2009 data
$p+p$ at $\sqrt{s} = 900$ GeV

$\Xi^- + \Xi^+$ candidates
$(M_{\Xi^0} = 1.3217$ GeV/$c^2$)

Gaussian Fit:
$\chi^2/\text{ndf} = 23.4/12$
$M_\Xi = 1.3218 \pm 0.0002$ GeV/$c^2$
$\sigma_M = 2$ MeV/$c^2$

$\Xi^+/-$ in $\Lambda\pi^+/-$ channel using the secondary vertex of the SPD

ALICE Performance
Work in Progress

ALICE Performance
work in progress

$\Xi \rightarrow \Lambda^0 + \pi^-$
Mass: 1.322 GeV/$c^2$
$p^-_\Xi$: 1.459 GeV/c
Decay length: 6.95 cm

Run 104892, raw data chunk 09000104892020 130, event in chunk 1840
Invariant mass distributions – $\phi$ and $K^{*0}$

- $\phi$ using the kaon TOF identification from 1.0 to 3 GeV/c
- $\phi$ using the kaon TOF+TPC identification from 0.5 to 3 GeV/c
- $K^{*0}$ using the kaon TOF identification

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The ALICE detector is in a very good shape for Particle Identification in a wide range of momenta.

First results on identified hadron spectra with a combined measurement of ITS, TPC, TOF are about to come.

We are investigating many channels for the study of resonances thanks to our capability to reconstruct secondary vertexes (for weak decays) and the K/π separation power.