



# Charged pion identification at high p<sub>T</sub> in ALICE using the TPC dE/dx

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# Outline



#### The ALICE TPC

- Description
- Performance

#### **a** PID at High $p_{T}$

- Motivation
- Performance
- Conclusion



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# **ALICE design**



#### Original design:

#### TPC Tasks

- track finding with dN/dy up to 8000 => 20 000 tracks in the TPC
- momentum measurement
- particle identification

 $0.1 \; \text{GeV/c} < p_{\text{T}} < 50 \; \text{GeV/c} \ |\eta| < 0.9$ 

#### Requirements

- tracking efficiency: > 90%
- momentum resolution: < 5 %</p>
- dE/dx resolution : < 5.5%</pre>
- two track resolution: < 5MeV/c</p>
  - rate capability: 200 Hz central Pb-Pb (1 kHz p-p)

## **ALICE TPC**





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#### **Events in ALICE** tracks reconstructed using TPC data







# **TPC Momentum Resolution**



High momentum tracks

- Cosmic muon tracks treated independently in two halves of TPC
- Comparison of p<sub>T</sub> at vertex gives resolution
- Statistics: ~ 5 x 10<sup>6</sup> events
- Low momentum tracks
  - Deduced from the width of K<sup>0</sup><sub>s</sub> mass peak

#### Status (end of 2010) :

(σ<sub>pT</sub>/p<sub>T</sub>)<sup>2</sup> = (0.01)<sup>2</sup> + (0.0045p<sub>T</sub>)<sup>2</sup> ~ 5 % @ 10 GeV/c ~ 1 % below 1 GeV/c





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## dE/dx Resolution





Measured before LHC start
 Cosmic rays: 8.3x10<sup>6</sup> tracks in 2008
 Design goal: 5.5 %
 Measured: < 5 %</li>



# TPC data @ 900GeV & 7TeV





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# PID at High P<sub>T</sub>

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# Motivation



#### Lesson from STAR:

- PID possible on the relativistic rise
   v<sub>2</sub>/nq and p/π at high pT hold interesting physics
- R<sub>AA</sub> studies for identified
   particles
- Confirming detector performanceBenchmarking QCD models
- Testing recombination models







# Particle separation in the relativistic rise



# dE/dx - <dE/dx><sub>fitted</sub>(π) for different p<sub>T</sub> Fitted with 4 Gaussians (π, K, p, e), μ & σ constrained







# **Particle ratios**



#### We can extract yield ratios from the fit



π<sup>+</sup>/π<sup>-</sup> close to 1
as expected
This confirms
the validity of
the method

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# **Particle ratios**



- Possibility to get pion fraction easily
- Stable fit results
- Still needs to be corrected for background protons
- Good start for PbPb





# pT spectra





#### **Uncorrected spectra**

Normalisation and efficiency corrections still missing for comparison with other data

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# **Comparable spectra**



#### $\blacksquare \pi^0$ from conversion



#### $\blacksquare \pi^{\circ}$ from PHOS



#### Same $p_{\tau}$ range for comparison

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# Conclusions



The ALICE TPC is showing very good performance in pp and PbPb collisions

- The performance of the TPC dE/dx to measure charged particles spectra on the relativistic rise (p<sub>T</sub>>3GeV/c) has been demonstrated up to 10GeV/c and should be possible up to 20GeV/c with full statistics
- Normalisation and corrections are still missing to use the results for physics



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# **ALICE publications**



- <u>The ALICE TPC, a large 3-dimensional tracking device with fast readout for ultra-high multiplicity events</u> arXiv:1001.1950v1 [physics.ins-det]
- Centrality dependence of the charged-particle multiplicity density at mid-rapidity in Pb-Pb collisions at sqrt(sNN) = 2.76 TeV arXiv:1012.1657v1 [nucl-ex]
- Suppression of Charged Particle Production at Large Transverse Momentum in Central Pb-Pb Collisions at √sNN = 2.76 TeV arXiv:1012.1004v1 [nucl-ex]
- Elliptic flow of charged particles in Pb-Pb collisions at 2.76 TeV arXiv:1011.3914v1 [nucl-ex]
- Charged-particle multiplicity density at mid-rapidity in central Pb-Pb collisions at sqrt(sNN) = 2.76 TeV arXiv:1011.3916v2 [nucl-ex]
- Transverse momentum spectra of charged particles in proton–proton collisions at √s=900 GeV with ALICE at the LHC Physics Letters B 693 (2010) 53–68
- Two-pion Bose-Einstein correlations in pp collisions at √s=900 GeV Phys. Rev. D 82, 052001 (2010)
- Midrapidity Antiproton-to-Proton Ratio in pp Collisons at √s=0.9 and 7 TeV Measured by the ALICE Experiment Phys Rev Lett Vol.105, No.7, (2010)
- Charged-particle multiplicity measurement in proton–proton collisions at √s=7 TeV with ALICE at LHC Eur. Phys. J. C (2010) 68: 345–354
- Charged-particle multiplicity measurement in proton–proton collisions at √s=0.9 and 2.36 TeV with ALICE at LHC Eur. Phys. J. C (2010) 68: 89–108
- Alignment of the ALICE Inner Tracking System with cosmic-ray tracks J. Instrum. 5, P03003
- First proton–proton collisions at the LHC as observed with the ALICE detector: measurement of the charged-particle pseudorapidity density at  $\sqrt{s}$ =900 GeV Eur. Phys. J. C (2010) 65: 111-125





#### Backup

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# **PID** method



- Cuts and Calibration
- Parameter constraining
- Fitting
- Normalisation





# **Cuts & Calibration**



#### Track selection

- Standard event and track selection
- acceptance cut for dead TPC regions
- In the MIP region (dE/dx ~ constant)
  - Correct Eta dependence
  - Evaluate sigmadEdx dependency with Ncl
  - Assume MIP behaviour can be extrapolated



### Fit parameters constraints



#### Mean <dE/dx> fixed from 2D fit on data (~Bethe-Bloch x 3Gaus)



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