

Search for collective phenomena in high-multiplicity pp and p-Pb collisions with the ALICE experiment

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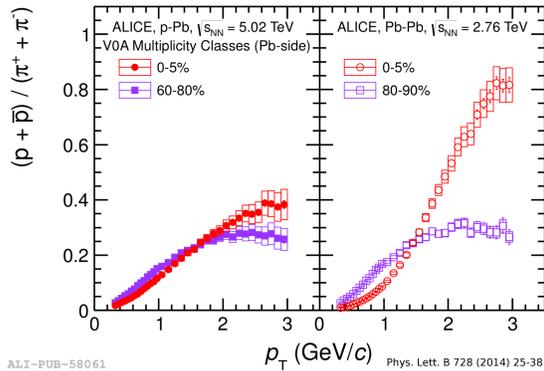
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ALICE

Introduction

Recent particle production measurements in high-multiplicity proton-lead (p-Pb) collisions have shown features that are reminiscent of lead-lead (Pb-Pb) phenomenology. These observations warrant a detailed study of identified particle production also in high-multiplicity proton-proton (pp) collisions, as differences or similarities of such measurements in the three systems may shed light on the particle production mechanisms at play.



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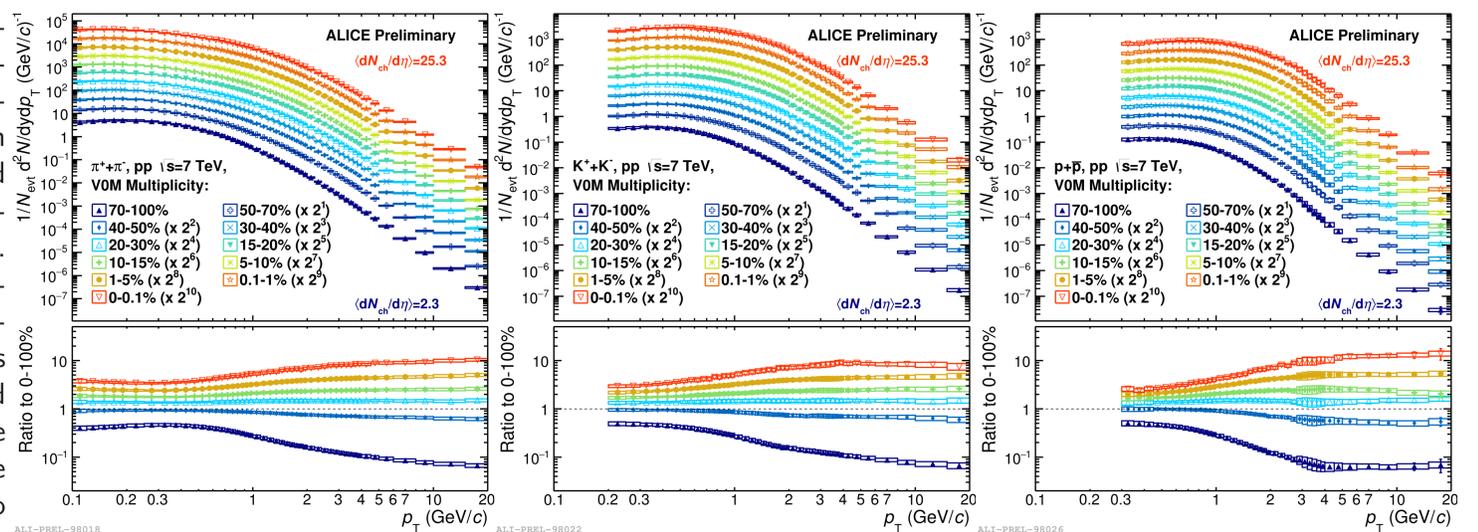
Detector and analyses

The ALICE detector employs a large variety of particle identification techniques in order to cover the widest transverse momentum (p_T) range possible. In this work, a number of different techniques and detectors were used to achieve a p_T range of 0.1 to 20 GeV/c. The presented spectra were obtained by combining data analyses that employ the Inner Tracking System (ITS), the Time-Projection Chamber (TPC) and the Time-of-Flight (TOF). Events were classified according to their total charged particle multiplicities as measured in the forward regions by the VOA and V0C scintillators, located at $2.8 < \eta < 5.1$ and $-3.7 < \eta < -1.7$, respectively. The multiplicity percentiles used in analyses and the corresponding $\langle dN_{ch}/d\eta \rangle$ are given in the table below.

VOM	$\langle dN_{ch}/d\eta \rangle$	VOM	$\langle dN_{ch}/d\eta \rangle$
0-0.1%	25.3 ± 0.8	0.1-1%	20.8 ± 0.6
1-5%	16.5 ± 0.5	5-10%	13.5 ± 0.4
10-15%	11.5 ± 0.3	15-20%	10.1 ± 0.3
20-30%	8.4 ± 0.3	30-40%	6.7 ± 0.2
40-50%	5.4 ± 0.2	50-70%	3.9 ± 0.1
70-100%	2.3 ± 0.1	0-100%	6.0 ± 0.2

Results

Identified particle spectra were measured in the central region ($|y| < 0.5$) in order to avoid autocorrelations of measurements and the event multiplicity estimator, which is taken to be the sum of VOA and V0C signals and is denoted as VOM. The p_T -differential spectra become harder with increasing multiplicity. This effect is more pronounced for protons than for pions, indicating the flow-like mass ordering and showing patterns reminiscent of those observed in p-Pb and Pb-Pb collisions. The spectral shapes are seen to be unaltered at high p_T , where the ratios to the inclusive spectra are seen to be independent of momentum.

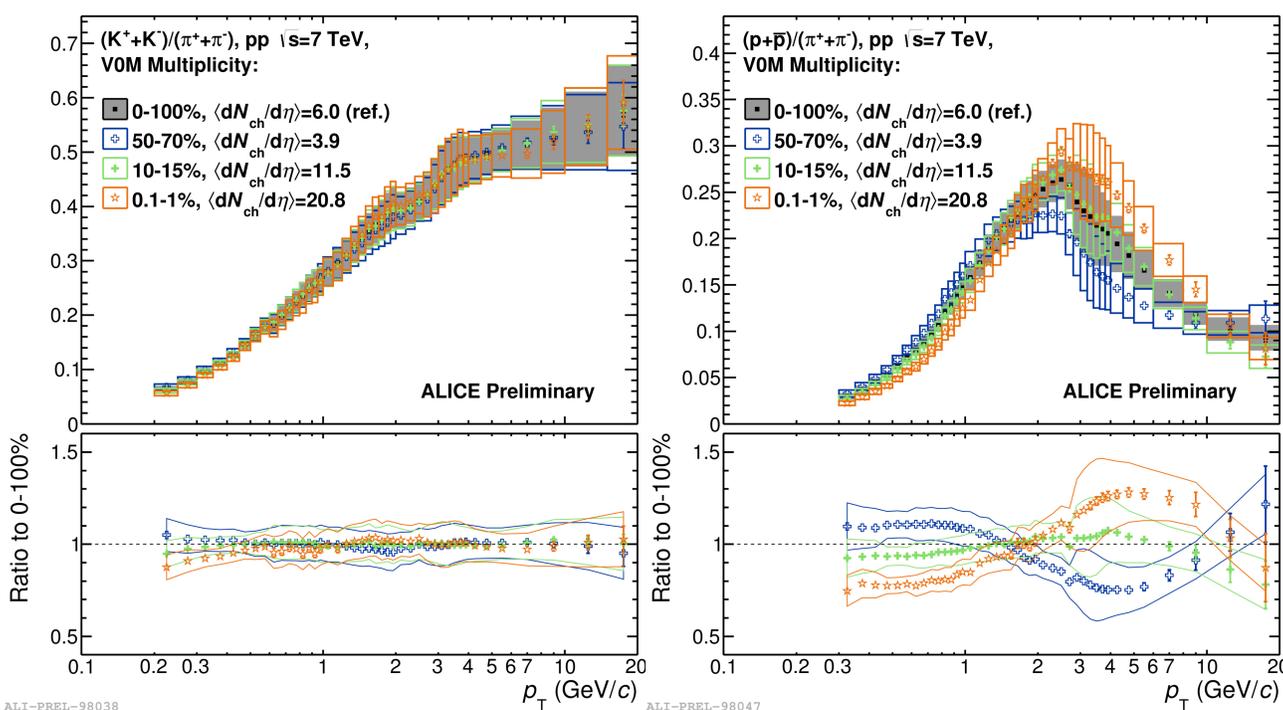


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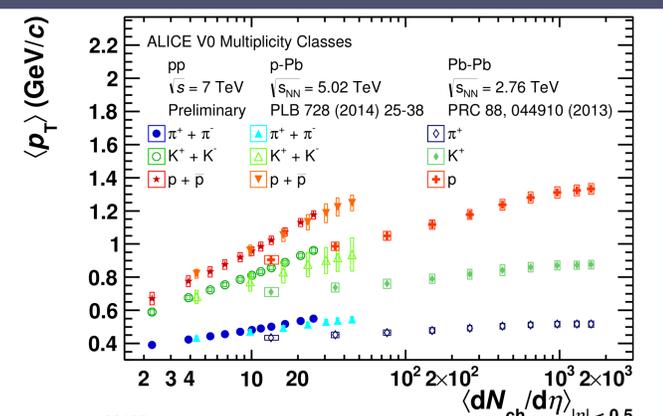
Discussion



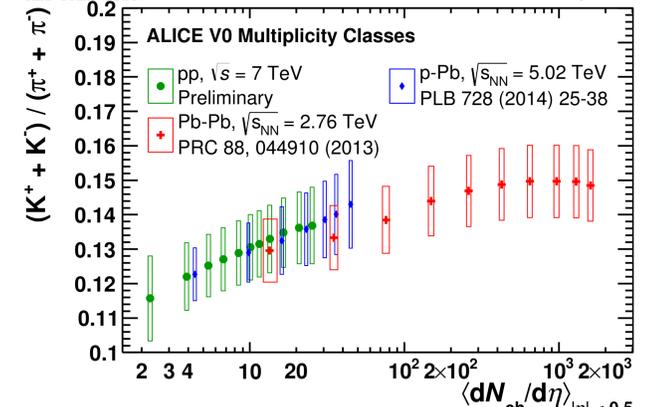
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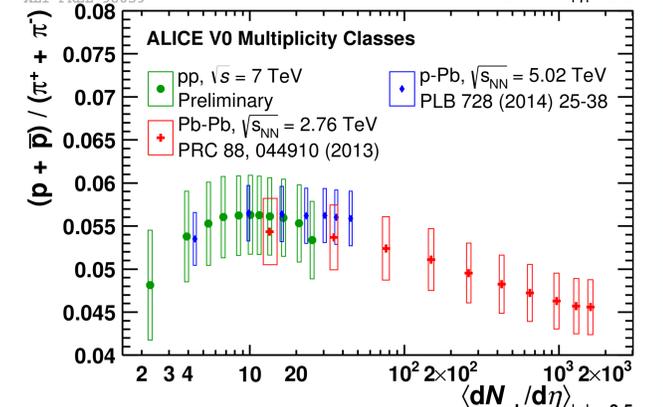
- ▶ In contrast to the K/π ratio, the p/π ratio shows a significant evolution from low to high multiplicity with a common crossing point around $p_T \approx 1.5$ GeV/c. The same qualitative behaviour is observed in p-Pb and Pb-Pb collisions.
- ▶ The $\langle p_T \rangle$ is seen to increase with multiplicity in a more pronounced way for heavier hadrons.
- ▶ The ratios of yields K/π and p/π in pp collisions are in good agreement with those of p-Pb and Pb-Pb.
- ▶ In summary, the identified particle production is observed to depend on multiplicity in pp, p-Pb and Pb-Pb collisions in qualitatively similar ways. These studies will help to constrain models that describe particle production in the three collision systems, especially those employing a unified approach.



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