Production of pions, kaons and protons as a function of charged particle multiplicity in pp collisions at √s = 13 TeV with ALICE at the LHC

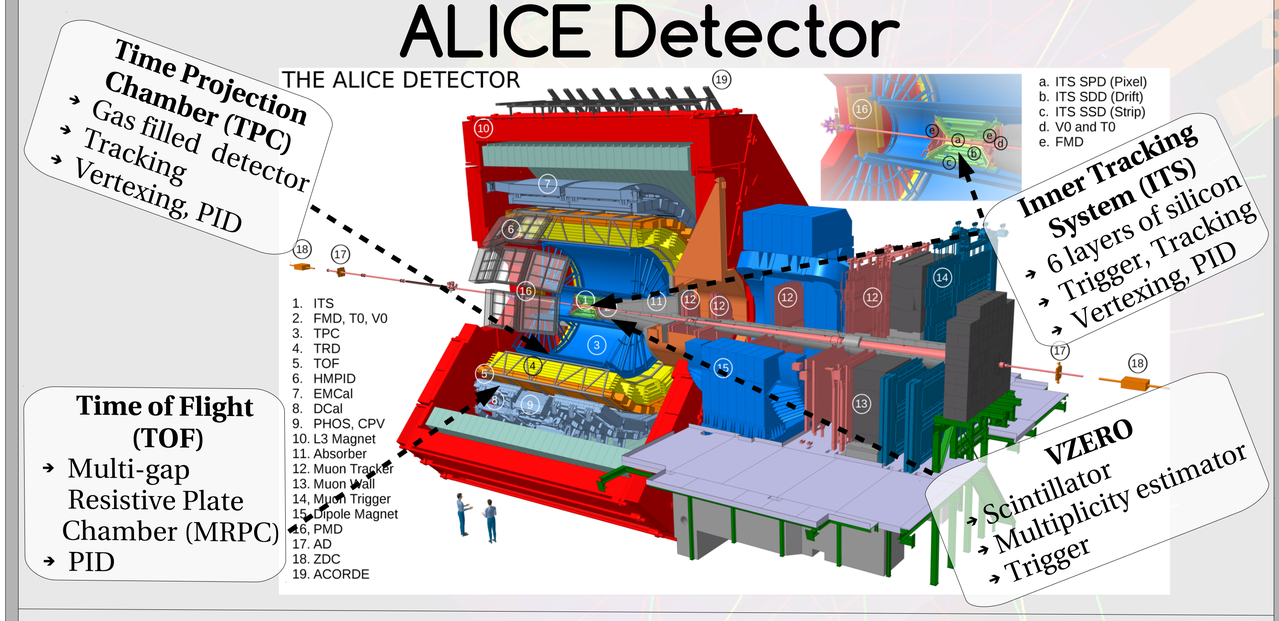
Pranjal Sarma *on behalf of the ALICE Collaboration*
Department of Physics, Gauhati University, Guwahati, India

Measurements of identified charged particle production as a function of multiplicity in pp and p-Pb collisions are important tools for understanding the similarities and differences between small and large interacting systems. The collective-like behavior observed in high multiplicity pp events is reminiscent of those observed in heavy-ion collisions. With its excellent tracking and particle identification capabilities, ALICE is an ideal instrument for the systematic study of pion, kaon and proton production from very low to high transverse momentum. In this report, the results of minimum bias as well as multiplicity-dependent transverse momentum spectra, p_T-integrated yield ratio and $\langle p_T \rangle$ of pions, kaons and protons in pp collisions at √s = 13 TeV will be presented. These results will be compared with the lower energy results of pp, p-Pb and Pb-Pb collisions as well as the predictions of various Monte-Carlo event generators and hydrodynamic models.

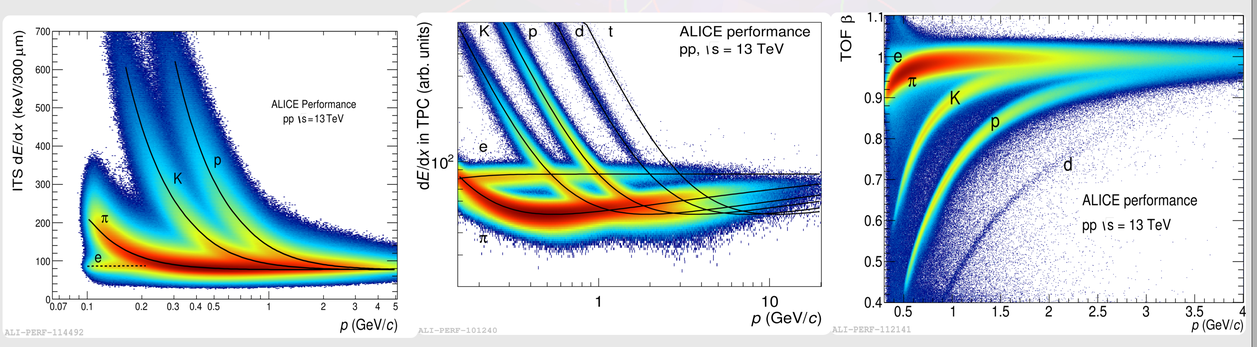
Introduction

- Identified particles spectra of relativistic heavy-ion collisions contain information about the collisions dynamics and entire space-time evolution of the system [1].
- Particle production in p-Pb collisions as a function of multiplicity shows behaviour reminiscent of those observed in Pb-Pb collisions [2-3].
- At the LHC, the multiplicities of the highest energy pp collisions are comparable to p-Pb and peripheral Pb-Pb collisions.
- A systematics study on pions, kaons and protons production as a function of charged particle multiplicity in pp collisions may provide an insight into the collective-like bahaviour observed in small systems.

ALICE Detector



Particle identification

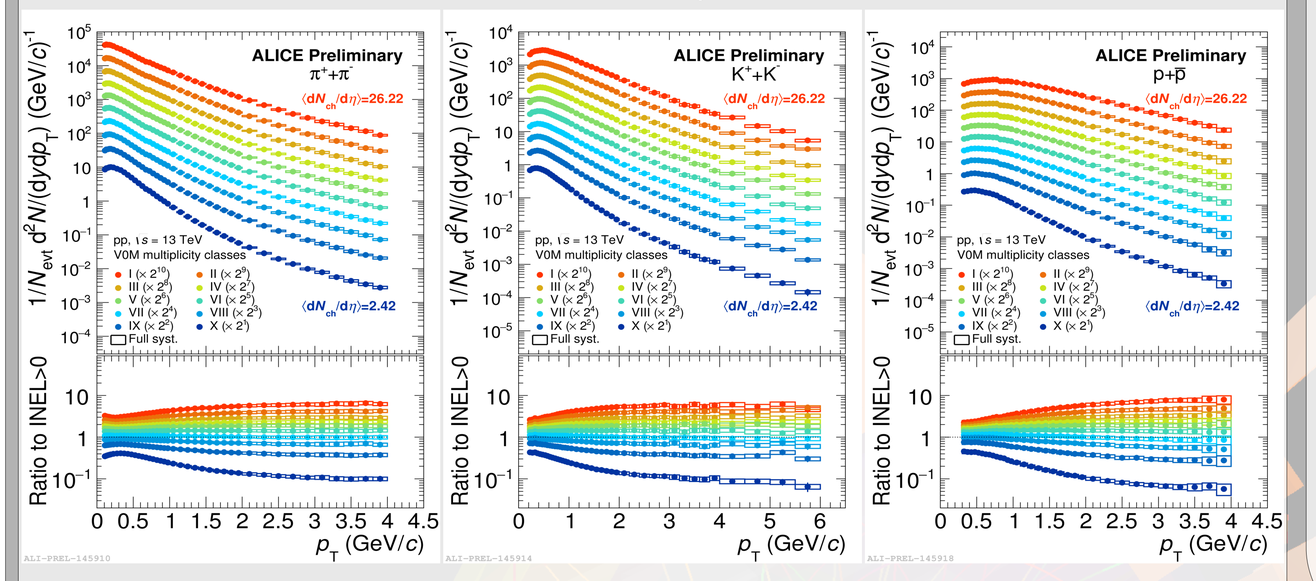


- Specific energy loss in the 4 outermost ITS layers vs. momentum.
- $\sigma_{dE/dx}$ ~ 10%

- Specific energy loss in TPC gas volume vs. momentum.
- $\sigma_{dE/dx}$ ~ 5.5%

- TOF β vs. momentum.
- σ_{TOF} ~ 80 ps

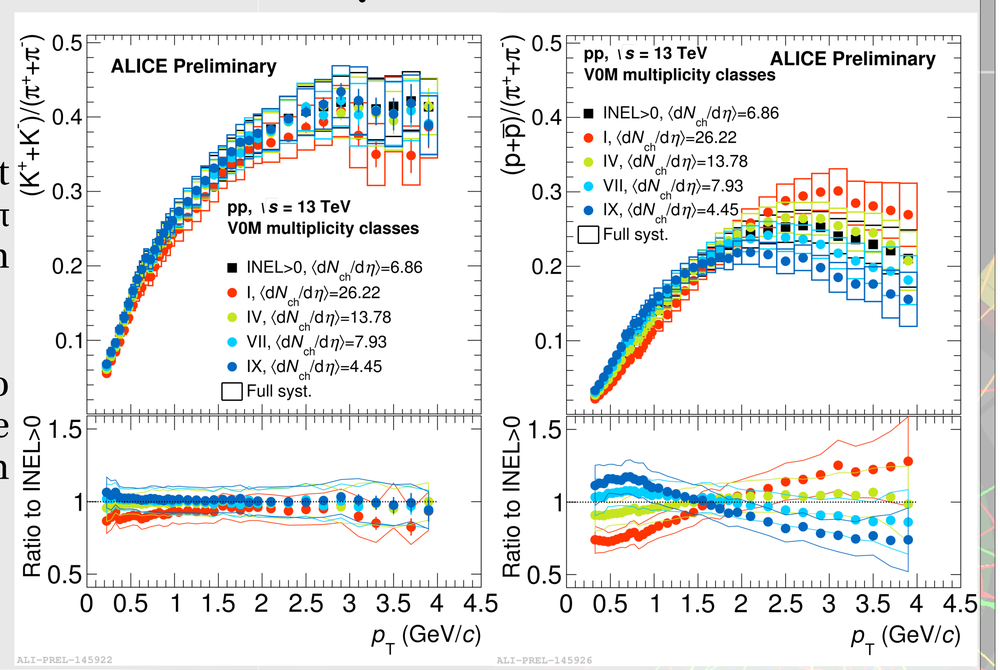
Particle spectra



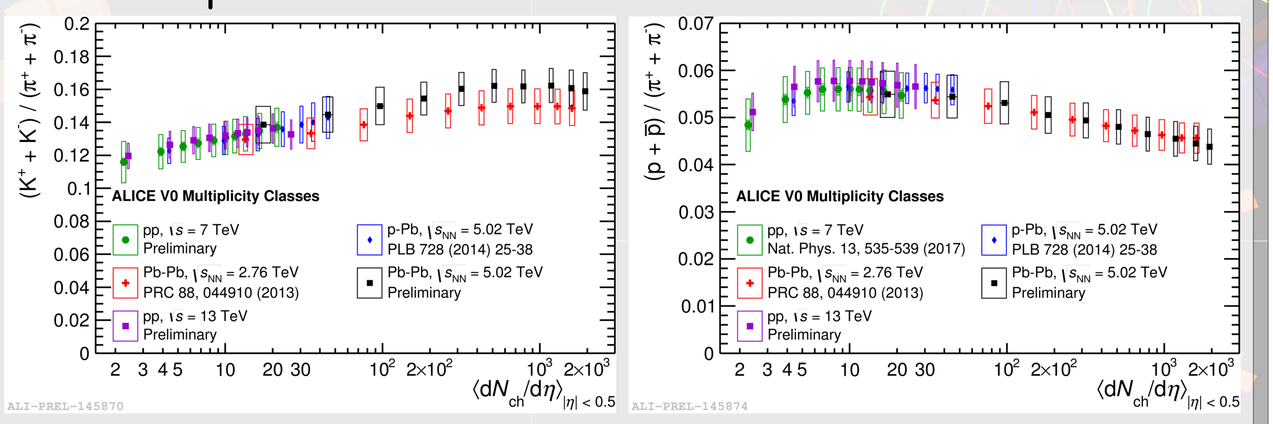
- Forward/Backward multiplicity estimator: V0M ($2.8 < \eta < 5.1$ & $-3.7 < \eta < -1.7$).
- Individual spectra of ITS, TPC and TOF PID are combined. In addition, for kaon spectra, the contribution of kink topology is also included.
- p_T spectra becomes harder as multiplicity increases.
- Hardening is more pronounced for higher mass particles.

p_T-differential particle ratios

- No significant evolution of K/π ratio with multiplicity.
- p/π ratio seems to be boosted to high multiplicity collisions.



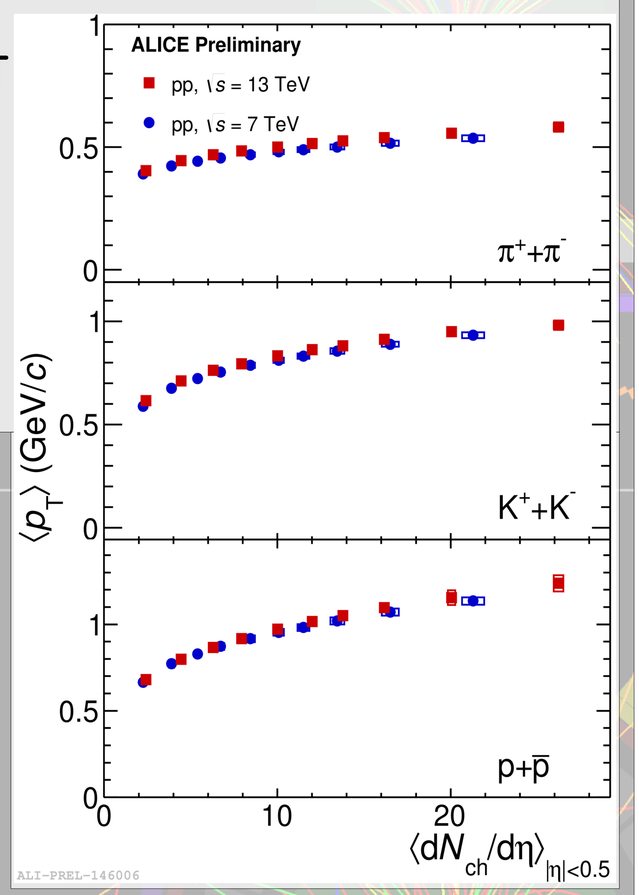
p_T-integrated particle ratios



- K/π yield ratio increases from low multiplicity pp events to central Pb-Pb collisions. An enhanced production of strangeness or a reduced canonical suppression of strangeness production in larger freeze-out volumes could explain the results [2].
- p/π yield ratio is almost constant across multiplicities.

Mean p_T

- $\langle p_T \rangle$ increases from low to high multiplicities.
- More pronounced for proton.
  - ✔ Dependence from particle mass.
- At a particular multiplicity, $\langle p_T \rangle$ of different particles are qualitatively comparable with 7 TeV results.



Summary

- p_T spectra becomes harder with the mass of the particles. p_T-differential p/π ratio boosted to high multiplicity pp collisions. Effect of radial flow or quark recombination [4-5]?
- Strangeness production is driven by final state multiplicity rather than initial beam energy and colliding systems.
- This work provides further insight into the collective behaviour in small system.

References

[1] U. W. Heinz, arXiv:hep-ph/0407360 (2004)
[2] ALICE, Phys. Lett. B 728, 25–38 (2014)
[3] ALICE, Phys. Rev. C 88, 044910 (2013)
[4] R. Fries *et. al.*, Phys. Rev. Lett. 90, 202303 (2003)
[5] P. Bozek, arXiv:nucl-th/1111.4398 (2011)

The author acknowledges the financial support of DST, India for providing scholarship and travel grant to carry out and present the work at QM.

pranjal.sarma@cern.ch

Venezia 2018 Quark Matter