Transverse momentum spectra and nuclear modification factor of identified light flavour hadrons in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE at the LHC

Nur Hussain[1] for the ALICE Collaboration*
[1] *Nuclear and Radiation Physics Research Laboratory, Department of Physics, Gauhati University, Guwahati-781014, India*

Introduction

The study of the transverse momentum (p_T) spectra of identified particles as a function of centrality particularly at low p_T is considered to be a sensitive probe to investigate collectivity in heavy ion collisions [1]. High p_T particles produced in the initial state of the collision via hard processes experience the full evolution of the system. If the system evolves through a deconfined system of color charges, the quarks and gluons are expected to suffer radiative energy loss in the medium [2]. This energy loss in the medium is traditionally quantified by the nuclear modification factor, which is the yield ratio of a given observable measured in AA collisions to pp collisions at the same colliding energy with proper normalization [2],

$$R_{AA}(p_T) = \frac{dN^{AA}(p_T)/dp_T}{\langle N_{coll}\rangle dN^{pp}(p_T)/dp_T}, \qquad (1)$$

where $\langle N_{coll}\rangle$ is the average number of binary collisions in a given centrality class in AA collisions. Any deviation of R_{AA} from unity, such as a suppression at high p_T might indicate strong nuclear medium effects. In this paper a study has been made of the centrality dependence of transverse momentum spectra and nuclear modification factor of identified pions, kaons and protons (π/K/p) with new ALICE Pb-Pb collision data at $\sqrt{s_{NN}} = 5.02$ TeV.

*Electronic address: nur.hussain@cern.ch

Analysis details

Identified particle spectra of π, K, and p were measured independently with ITS, TPC, TOF, and HMPID, and combined in the final stage of the analyses. In addition to the above techniques, the kaon spectrum has been measured in Pb-Pb data for the first time using the kink topology based on the TPC two body decay modes ($K \to \mu + \nu_\mu$). The same track selection criteria have been implemented in all the analyses except in the ITS standalone and kink topology analyses. In the so called ITS standalone analysis, only tracks constructed solely out of ITS clusters are used. In the case of kink analysis, in addition to kink topological selection the minimum number of TPC clusters was taken as 30. The specific energy loss (dE/dx) method is used for particle identification in ITS and TPC, whereas time of flight information and Cherenkov angles are used in the case of TOF and HMPID analyses. The efficiency and acceptance corrections are performed using the HIJING [3] event generator and GEANT3 [4] transport code.

Results

The final combined p_T spectra of identified π, K, and p in different centrality classes are shown in Fig. 1. It is clearly seen from Fig. 1 that there is a hardening of the p_T spectra in central collisions, in particular for protons, which could be due to the buildup of transverse flow during the evolution of the system [1]. In Fig. 2, the nuclear modification factors are shown, which demonstrate the presence of strong nuclear matter effects for all the particle species.

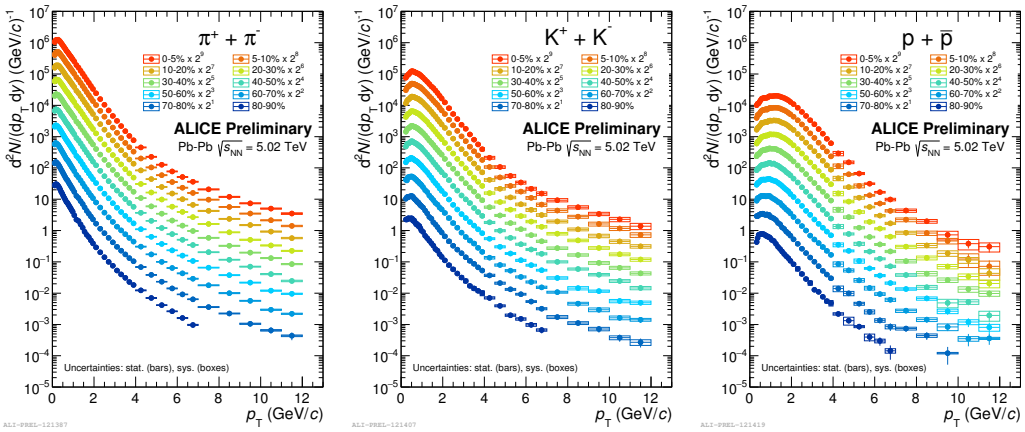

FIG. 1: Transverse momentum (p_T) spectra of identified π, K, and p for different centrality classes in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV. The different colors correspond to various centrality classes.

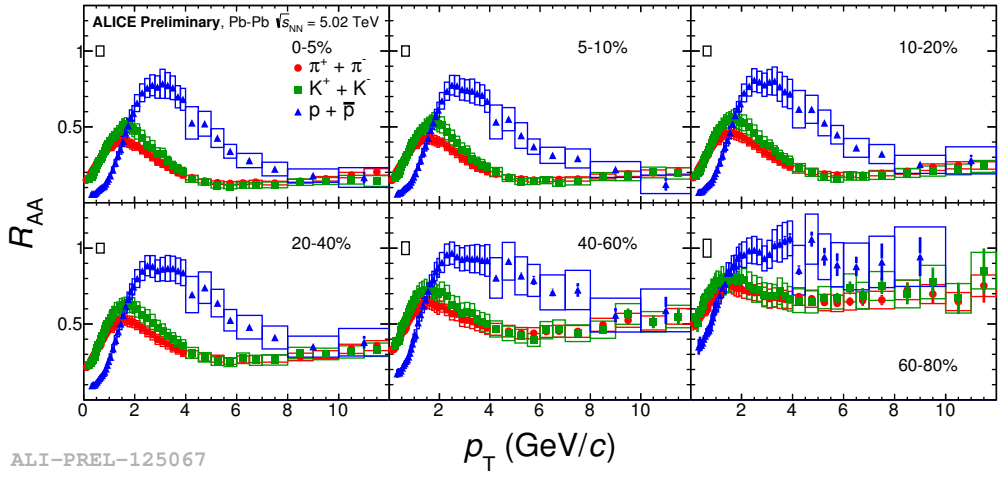

FIG. 2: Nuclear modification factor (R_{AA}) of π, K, and p as a function of transverse mpmentum (p_T) in Pb-Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV for different centrality classes. The red, green and blue markers correspond to different particles species.

References

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