

Centrality dependence of particle production in p-Pb collisions at ALICE *

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With the ALICE detector at the LHC the physics of the Quark-Gluon Plasma is investigated in collisions of lead nuclei. In those collisions the number of participating nucleons - thus the collision centrality - is an important parameter. While in Pb-Pb collisions the connection of geometrical centrality to physical observables as particle multiplicity is direct, in p-Pb collisions this connection is difficult. In Pb-Pb collisions the number of participating nucleons grows with increasing overlap of the nuclei and as a result the produced particle multiplicity increases. To determine the collision centrality, a Glauber-Monte-Carlo simulation is compared to measured multiplicity distributions. This method is used with various detectors eg. the forward VOA, the midrapidity inner tracking system (ITS) or the zero-degree neutron calorimeter ZNA, located 114 m away from the interaction point. Not only the intervals of centrality are calculated, but also the number of binary nucleon-nucleon collisions N_{coll} is estimated.

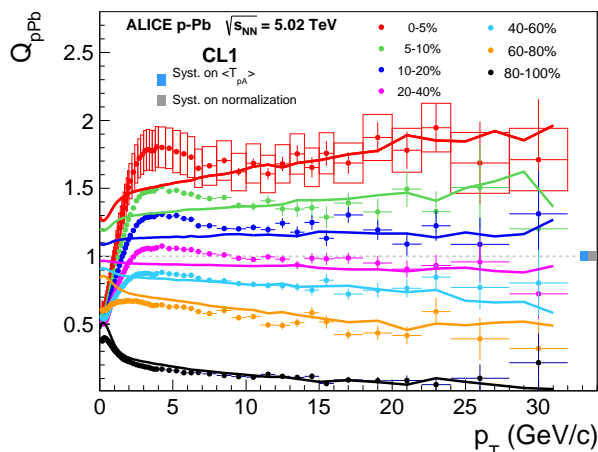


Figure 1: The measured Q_{pPb} for charged primary particles obtained with CL1 in comparison to G-PYTHIA (lines).

One observable of interest is the nuclear modification factor Q_{pPb} . It quantifies the effects of the nuclear matter in p-Pb collisions in comparison to pp collisions.

$$Q_{\text{pPb}}(p_T; \text{cent}) = \frac{1}{\langle T_{\text{pPb}}^{\text{Glauber}} \rangle} \frac{dN_{\text{ch}}^{\text{pPb}}/dp_T}{d\sigma_{\text{ch}}^{\text{pp}}/dp_T} \quad (1)$$

In this formula $N_{\text{ch}}^{\text{pPb}}$ represents the yield of charged particles in pPb collisions while $\sigma_{\text{ch}}^{\text{pp}}$ is the cross section

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in pp collisions. $T_{\text{pPb}}^{\text{Glauber}}$ is the nuclear overlap function calculated with Glauber-Monte Carlo ($T_{\text{pPb}}^{\text{Glauber}} = N_{\text{coll}} / \sigma_{\text{NN}}^{\text{inel}}$). In this notation Q_{pPb} is distinguished from R_{pPb} , as the centrality selection can introduce a bias not related to nuclear effects. Hence, Q_{pPb} can be different from unity even in the absence of nuclear effects.

Figure 1 shows the biased Q_{pPb} for centrality intervals obtained using the second layer of the ITS. Additionally calculations with a PYTHIA event generator coupled to p-Pb Glauber-Monte Carlo (G-PYTHIA) are shown, which reproduce well the bias at high p_T . In order to minimize

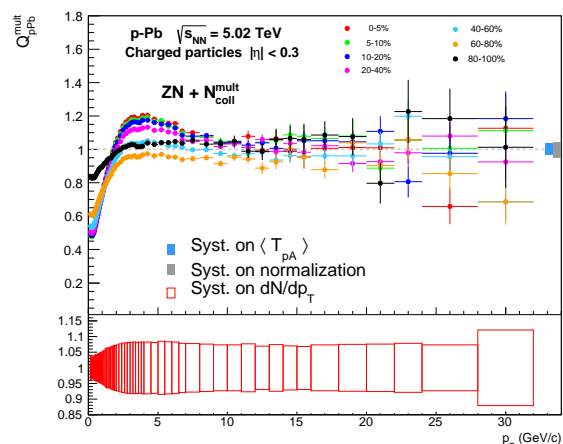


Figure 2: The Q_{pPb} in classes of centrality determined with the hybrid method.

the biases from the centrality selection and guarantee a robust determination of $\langle N_{\text{coll}} \rangle$ the so called hybrid method was introduced. Hereby the centrality selection relies on the energy deposited in ZNA, while $\langle N_{\text{coll}} \rangle$ is calculated using the assumption that the charged particle multiplicity at mid-rapidity is proportional to N_{part} . Other assumptions use the proportionality of N_{coll} to the yield of high- p_T particles, or to the total charged multiplicity measured with VOA in the Pb-side at forward rapidity. The variations on N_{coll} obtained with the three methods is below 10% and accounts as an uncorrelated systematic uncertainty. Figure 2 shows the Q_{pPb} , consistent with unity at high p_T for all centrality classes, with some Cronin-enhancement at $p_T \sim 3 \text{ GeV}/c$ stronger in central collisions.

References

- [1] ALICE Collaboration, Eur.Phys.J. C74 (2014) 3054, arXiv:1405.2737 [nucl-ex].
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