Nuclear Modification Factor and Centrality Determination in p-Pb Collisions at ALICE *

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In the ALICE detector at the LHC the physics of the Quark-Gluon-Plasma is investigated, in collisions of lead nuclei. In those collisions not only the created medium but also cold nuclear matter could play a role. The influence of this is investigated by using proton-lead (p–Pb) collisions and calculating the nuclear modification factor R_{pPb}, which is defined as:

$$R_{\mathrm{pPb}}(p_{\mathrm{T}}) = \frac{1}{\langle T_{\mathrm{pPb}} \rangle} \frac{d^2 N_{ch}^{pPb}/d\eta dp_{\mathrm{T}}}{d^2 \sigma_{ch}^{pp}/d\eta dp_{\mathrm{T}}} \qquad (1)$$

In this formula N_{ch}^{pPb} represents the multiplicity of charged particles in pPb collisions while σ_{ch}^{pp} describes the cross section in proton-proton (pp) collisions. T_{pPb} is the nuclear overlap function calculated with Glauber Monte Carlo. In case of minimum bias (MB) collisions, the nuclear overlap function is $T_{\mathrm{pPb}} = 0.0983 \pm 0.0035\,\mathrm{mb}^{-1}$.
In Fig. 1 the measurement of R_{pPb} at $|\eta_{\mathrm{cms}}| < 0.3$ is compared to shadowing calculations [2] and to predictions in a framework combining leading order (LO) pQCD and cold nuclear matter effects [3]. The predictions for shadowing, performed at NLO with the EPS09s Parton Distribution Functions and DSS fragmentation functions, describe the data very well (the calculations are for π^0), while the LO pQCD model exhibits a trend of decreasing R_{pPb}, which is not supported by the data.

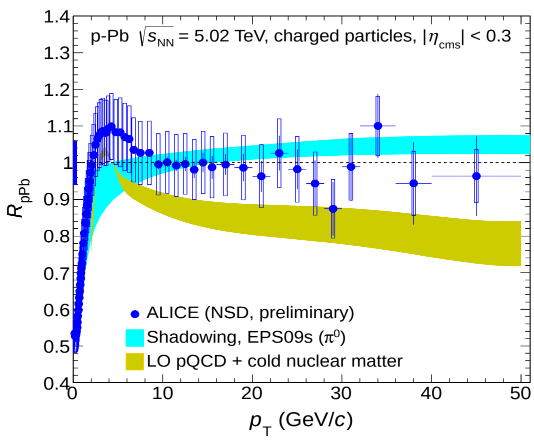

Figure 1: The measured R_{pPb} compared to model calculations.

While in Pb–Pb collisions centrality determination is straightforward, it remains more difficult in p–Pb collisions. Centrality is determined by measuring the multiplicity of particles with different detector systems within the ALICE apparatus [4]. Figure 2 shows the biased nuclear modification factor Q_{pPb} for two different estimators. ZNA relies on the forward neutron calorimeter located 114 m away from the interaction point, while V0A relies on a forward detector much closer to the interaction point.

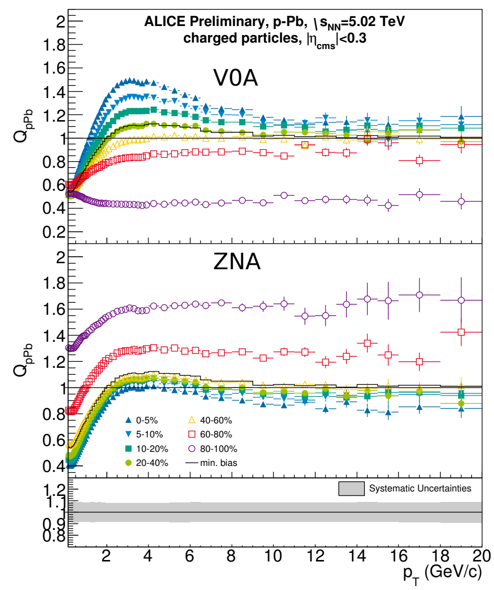

Figure 2: The transverse momentum dependence and the dependence on centrality of the biased nuclear modification factor Q_{pPb} for two different centrality estimators ZNA (upper panel) and V0A (middle panel).

The large difference between the estimators shows, that different events are selected in the different centrality classes. This shows that the geometrical correspondence of experimental centrality selection remains a challenge.

References

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