Measurement of the Nuclear Modification Factor of Charged Particles in p–Pb Collisions at $\sqrt{s_{NN}} = 5.02$ TeV with ALICE at the LHC*

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In September 2012 the LHC at CERN provided p–Pb collisions for the first time at the center-of-mass energy of $\sqrt{s_{NN}} = 5.02\,\text{TeV}$ in a short run test run for the main p–Pb run in 2013. During a few hours of collisions the ALICE detector [1] collected data using a minimum bias trigger. For this analysis non-single-diffractive collisions have been selected with a trigger efficiency of 99.2%, leading to a 1.7×10^6 events, with negligible contributions from beam-gas background, single-diffractive and electromagnetic interactions. For tracking and determination of the transverse momentum the information from the large Time Projection Chamber (TPC) is combined with the hits in the Inner Tracking System (ITS).

The p_T spectra are measured for primary charged particles in the p_T range 0.5 GeV/c $< p_\mathrm{T} <$ 20 GeV/c and pseudorapidity $|\eta_\mathrm{cms}| < 0.3$. Primary charged particles are defined as all prompt particles produced in the collision, including decay products, except those from weak decays of strange hadrons. Details of the analysis can be found in [2].

The measured p_T distribution can be compared to that measured in proton-proton collisions in terms of the nuclear modification factor R_pPb which is defined as

$$R_\mathrm{pPb}(p_\mathrm{T}) = \frac{\mathrm{d}^2N/\mathrm{d}\eta\,\mathrm{d}p_\mathrm{T}}{\langle T_\mathrm{pPb}\rangle\,\mathrm{d}^2\sigma^\mathrm{pp}_\mathrm{ch}/\mathrm{d}\eta\,\mathrm{d}p_\mathrm{T}}$$

$\langle T_\mathrm{pPb}\rangle$ is the average nuclear overlap function calculated using Glauber MC, $\langle T_\mathrm{pPb}\rangle = 0.0983 \pm 0.035\,\mathrm{mb}^{-1}$.

As there is no measurement of $\sigma^\mathrm{pp}_\mathrm{ch}$ at $\sqrt{s} = 5.02\,\text{TeV}$, the pp reference spectrum has been derived from the ALICE measurements at $\sqrt{s} = 2.76$ and 7 TeV. For the high-p_T part above 5 GeV/c, where pQCD is reliable, the measured differential cross section at 7 TeV was scaled with a factor obtained from NLO calculations. At lower and intermediate $p_\mathrm{T} <$ 5 GeV/c, the measured cross sections at $\sqrt{s} = 2.76$ and 7 TeV have been interpolated in every p_T bin assuming a power law behaviour in $\sqrt{s}$.

In absence of any nuclear effects R_pPb equals unity under the assumption of binary collision scaling expected for high-p_T processes. In Figure 1, the measured R_pPb is compared to nuclear modification factors measured in Pb–Pb [3].

In our measurement of R_pPb there is almost no enhancement at intermediate p_T, known as Cronin effect, which was observed at RHIC. For $p_\mathrm{T} >$ 2 GeV/c the nuclear modification factor is consistent with unity, indicating only small contributions from cold nuclear matter effects in this p_T range. At low p_T $<$ 2 GeV/c production of charged particles is supressed in p–Pb compared to pp. Predictions from several models have been compared to the data, calculations based on the Color Glass Condensate (CGC) model are consistent with the measurement, see [2] for details including other models.

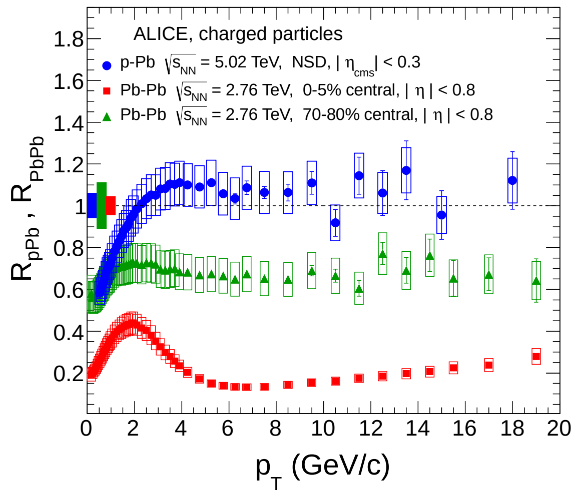

Figure 1: The nuclear modification factor of charged particles as a function of transverse momentum in NSD p–Pb collisions as $\sqrt{s_{NN}} = 5.02\,\text{TeV}$ compared to measurements in central (0-5%) and peripheral (70-80%) Pb–Pb collisions at $\sqrt{s_{NN}} = 2.76\,\text{TeV}$. Systematic uncertainties are represented as boxes, the statistic uncertainties by lines around the data points. Normalization uncertainties are shown as filled boxes around unity.

In central Pb–Pb collisions a strong suppression of particle production at high p_T was observed, which remains substantial also for peripheral collisions. The measurement of p–Pb clearly shows that the suppression observed in Pb–Pb is not an initial state effect but due to the hot QCD medium.

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References

[1] ALICE Collaboration, K. Aamodt *et al.*, JINST **3**, S08002 (2008), `doi:10.1088/1748-0221/3/08/S08002`.

[2] ALICE Collaboration, B. Abelev *et al.*, Phys.Rev.Lett, in press (2013), `arXiv:1210.4520`.

[3] ALICE Collaboration, B. Abelev *et al.*, Phys.Lett.B, in press (2013), `arXiv:1208.2711`.