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Soft and Hard probes of proton multiple scattering in p+Pb collisions with the ATLAS experiment at the LHC

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Proton-Lead (p+Pb) collisions at the Large Hadron Collider provide a unique opportunity to study the dynamics of soft and hard scattering processes in nuclear targets, at the TeV scale.

The ATLAS experiment has measured the inclusive charged particle pseudorapidity distribution, the production of Z bosons and the inclusive jet production in p+Pb collisions at $\sqrt{s_{NN}} = 5.02$ TeV.

These measurements are presented as a function of “centrality”, an experimental quantity that indirectly constrains the p+Pb collision geometry.

The p+Pb collision centrality was characterized by the total transverse energy measured over the pseudorapidity interval 3.2–4.9 in the direction of the lead beam. A Glauber Monte Carlo analysis was used to simulate the geometry of the inelastic p+Pb collision, and the mean number of nucleon-nucleon collisions was extracted in each centrality interval.

Extensions of the standard Glauber model which allow an event by event fluctuation in the nucleon-nucleon cross-section were also implemented.

Geometric scaling was studied relative to the expectation from independent nucleon-nucleon collisions. Measurements of charged particle multiplicity and Z bosons indicate that considering fluctuations of the nucleon-nucleon cross section may lead to significant changes in the geometric scaling behaviour. Measurements of inclusive jet production indicate that the factorization between hard and soft processes is violated at an unexpected level.

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