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Latest measurements of fully reconstructed jets in pp and p–Pb collisions with ALICE at the LHC

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Introduction

In order to study behaviour of quantum chromodynamics (QCD) at extremely high temperatures, protons and heavy-ions are collided at ultrarelativistic energies at the Large Hadron Collider (LHC) [1]. The produced matter is investigated by utilizing collimated sprays of hadrons, so-called jets, as a probe. Jets are produced by highly virtual quarks and gluons that emerge from initial hard scattering processes. Jets are thus an important probe for understanding the early stages of the collision.

ALICE has been used to study high-Q^2 processes in collisions of Pb–Pb as well as in smaller collision systems. Measurements in small systems such as pp and p–Pb are important in order to provide constraints on nuclear PDFs and the strong coupling constant α_s [2]. Moreover, jet production in pp collisions can be used as a reference for more complex systems, such as p–Pb and Pb–Pb collisions, where cold nuclear matter effects and a strongly-interacting medium play a role [3]. The full-jet invariant cross sections and their ratios for different jet resolution parameters R are presented here using the ALICE detector at the CERN LHC in pp collisions at $\sqrt{s} = 8$ TeV and p–Pb collisions at $\sqrt{s_{\rm NN}} = 8.16$ TeV.

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Analysis Details

In the measurements reported here, full jets are reconstructed using charged-particle tracks from the Time Projection Chamber and the Inner Tracking System [4], and neutral constituents from clusters in the Electromagnetic Calorimeter (EMCal). Jets are reconstructed with the FastJet package [5] using the anti-$k_{\rm T}$ algorithm with the E-scheme. Both the minimum bias and EMCal triggers are used in this analysis. Jet constituents are required to have a minimum track transverse momentum $p_{\rm T}$ of 150 MeV/c and a minimum cluster energy of 300 MeV. The reconstructed jets are required to be fully contained within the EMCal.

Results and Discussions

Figures 1 and 2 show corrected full jet $p_{\rm T}$ spectra as measured in pp and p–Pb collisions at $\sqrt{s_{\rm NN}} = 8$ TeV and 8.16 TeV, respectively, for different R with arbitrary scaling for visibility. The use of EMCal triggers makes it possible to reach high-$p_{\rm T}$ values in this measurement. Figures 3 and 4 show the measured full-jet cross section ratios for different jet R in pp and p–Pb collisions. The p–Pb cross section is seen to be consistent with the pp data within uncertainties. PYTHIA 8 also shows good agreement with the cross section ratios. The cross section ratios are particularly sensitive to the radial profile of energy within a jet cone which is an important observable to study jet fragmentation and hadronisation.

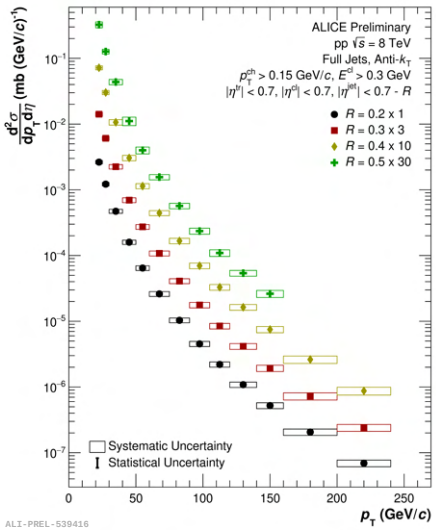

FIG. 1: Invariant cross sections for full jet production in pp collisions at $\sqrt{s} = 8$ TeV for $R = 0.2$–0.5.

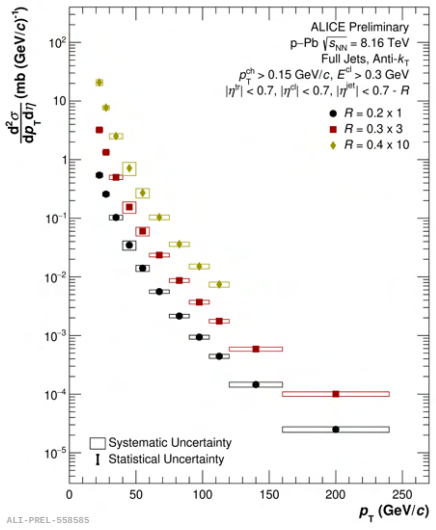

FIG. 2: Invariant cross sections for full jet production in p–Pb collisions at $\sqrt{s_{NN}} = 8.16$ TeV for $R = 0.2$–0.4.

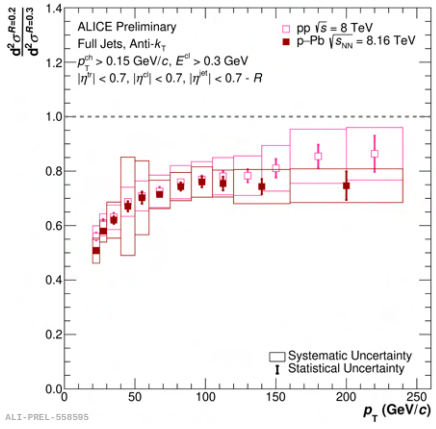

FIG. 3: Invariant cross section ratio for $R = 0.2/0.3$ full jet production in pp and p–Pb collisions at $\sqrt{s_{NN}} = 8$ and 8.16 TeV.

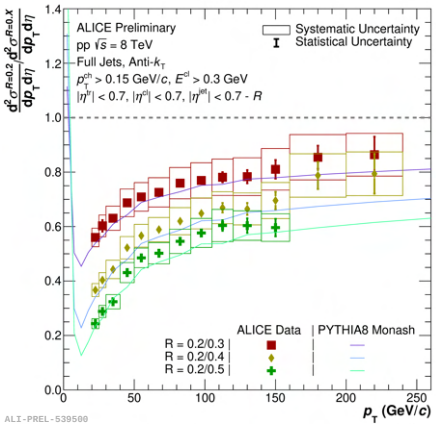

FIG. 4: Invariant cross section ratios for full jet production in pp collisions at $\sqrt{s} = 8$ TeV compared with calculations by PYTHIA 8 Monash. The numerator corresponds to the $R = 0.2$ jet spectrum and the denominator to the spectra for jet radii 0.3–0.5.

Acknowledgments

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References

[1] L. Cunqueiro, A.M. Sickles, Prog. Part. Nucl. Phys., 124, 103940 (2022).
[2] ALICE Collaboration, Phys. Rev. C 101 034911 (2020).
[3] C. Nattrass [ALICE], Acta Phys. Polon. B 47, 1543 (2016).
[4] ALICE Collaboration, JINST 5 P03003 (2010).
[5] M. Cacciari *et al.*, Eur. Phys. J. C 72, 1896 (2012).