Transverse-momentum distributions and the nuclear modification factors of charged particles in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV

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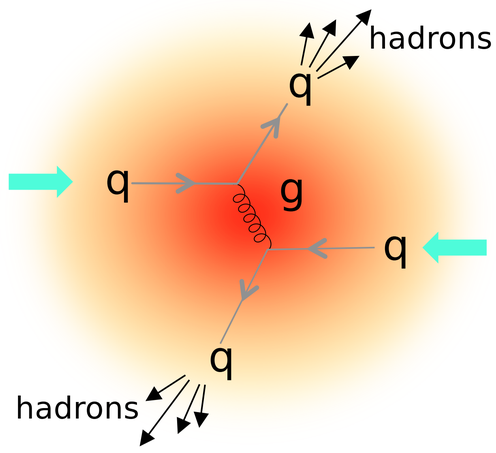
Motivation

Heavy-ion collisions at high energies allow to study the properties of deconfined matter. Partons originating from initial hard scattering processes lose energy in the medium, leading to a suppression of high-p_{T} jets. Typically the suppression of particle yields is expressed by the nuclear modification factor (R_{AA}) which is defined as:

$$R_{\mathrm{AA}}(p_{\mathrm{T}}) = \frac{1}{T_{\mathrm{AA}}} \frac{\mathrm{d}N_{\mathrm{AA}}/\mathrm{d}p_{\mathrm{T}}}{\mathrm{d}\sigma_{\mathrm{pp}}/\mathrm{d}p_{\mathrm{T}}},$$

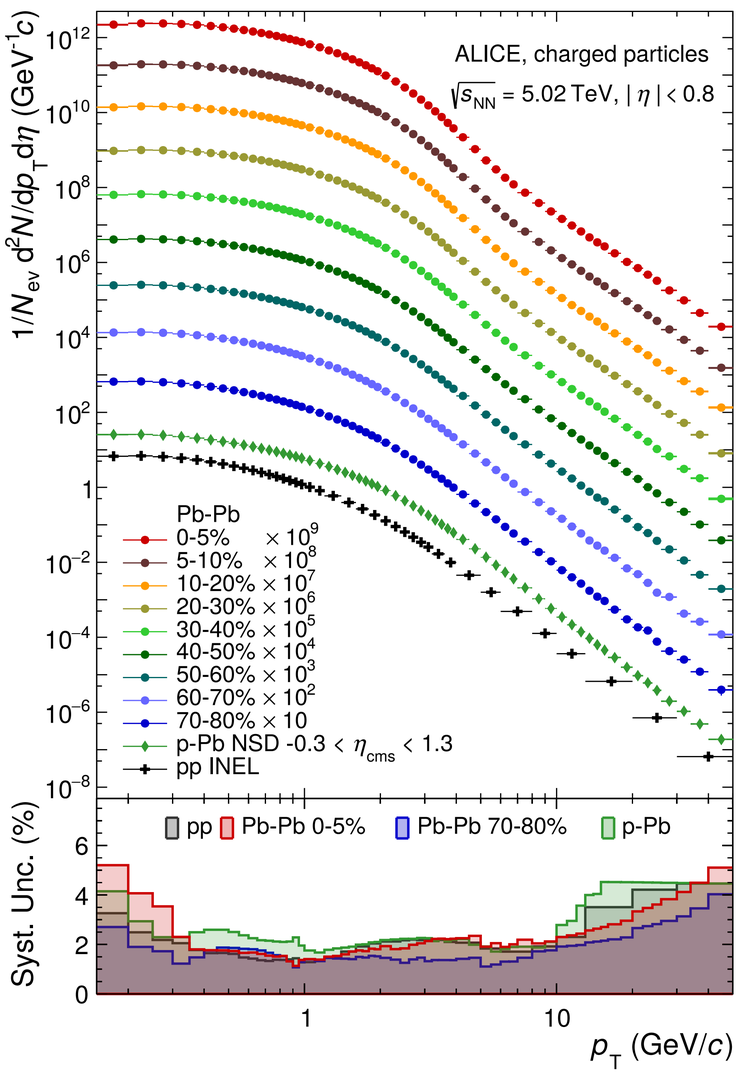
where T_{AA} is the nuclear-overlap function. R_{AA} smaller than 1 indicates suppression in AA collisions.

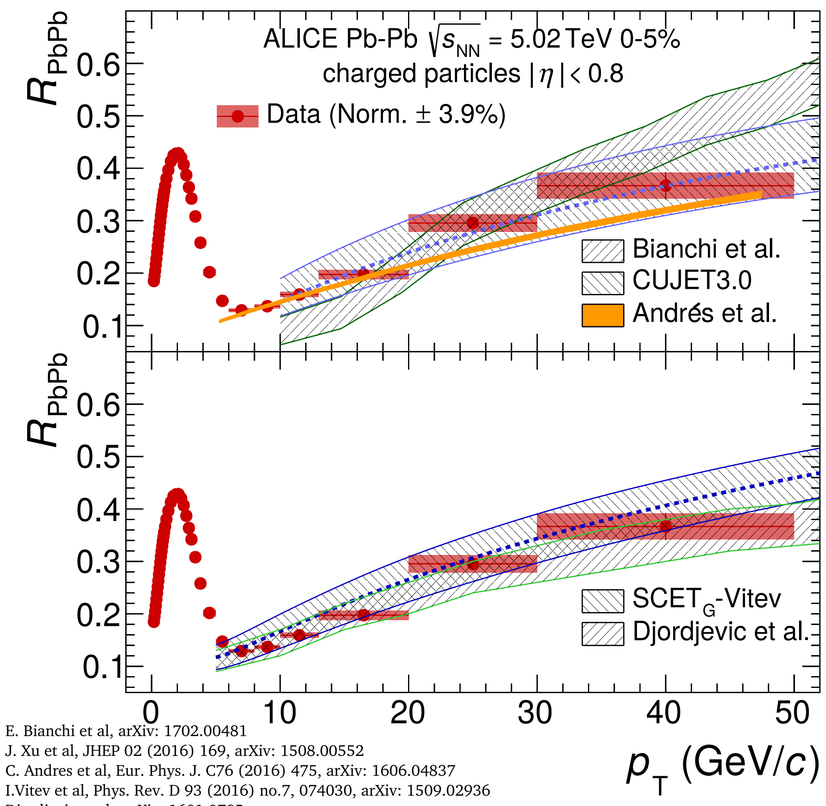


Partons originating from an initial hard collision lose energy in the created medium before forming hadrons.

Particle yields are strongly dependent on the centrality of the heavy-ion collision, as the number of binary collisions (nucleon-nucleon) changes. This is addressed by the T_{AA} which is determined by Glauber Monte-Carlo calculations. Previous measurements at RHIC in Au-Au collisions at $\sqrt{s_{\mathrm{NN}}} = 200$ GeV show that the high-p_{T} yield in central collisions is only ~20% of the expected one. Following measurements at the LHC in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV have shown that this suppression is even stronger at higher collision energies, indicating a hotter and denser medium. The suppression remains substantial up to very high p_{T} and is also observed in jet measurements.

Results





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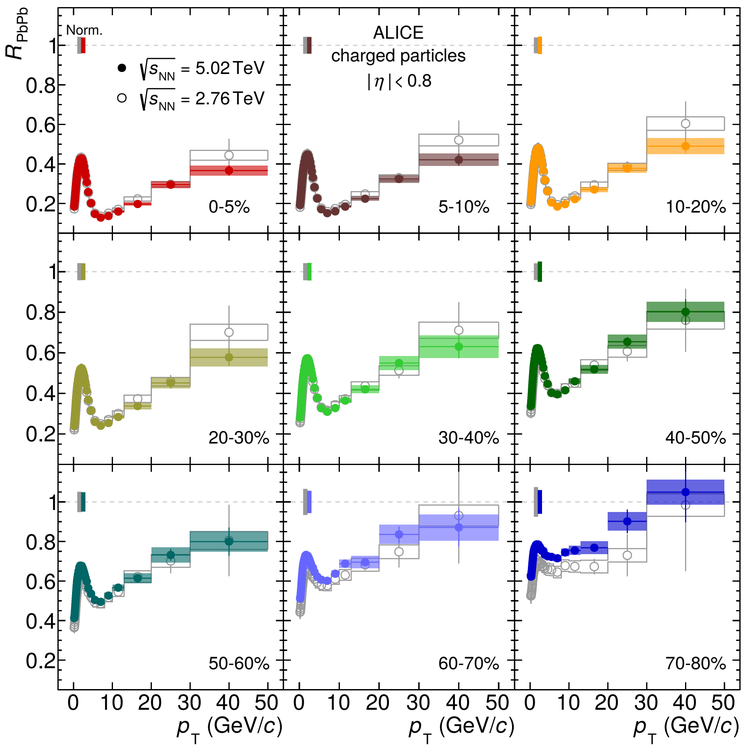
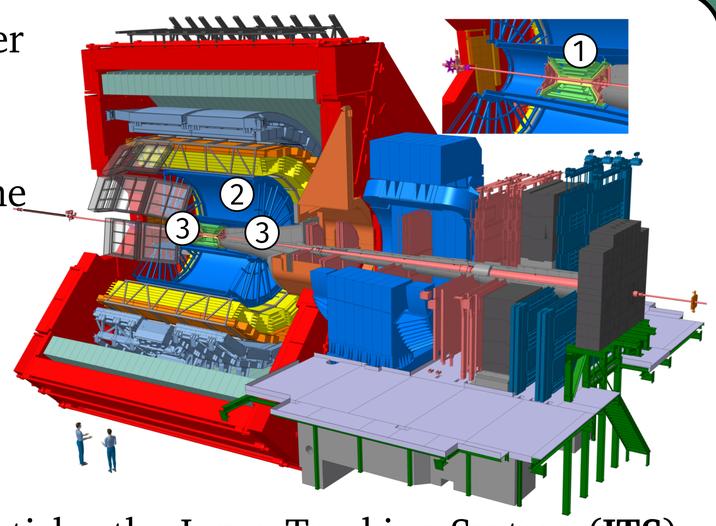


Conclusions

The R_{AA} measured in Pb-Pb collisions at $\sqrt{s_{\mathrm{NN}}} = 5.02$ TeV is similar to the measurement at $\sqrt{s_{\mathrm{NN}}} = 2.76$ TeV. Given that the spectra are harder for higher center-of-mass energies this result hints towards a denser and hotter medium.
Theoretical calculations describe successfully the R_{AA} rise towards high p_{T}.

ALICE (A Large Ion Collider Experiment) is a general-purpose detector primarily designed for the study of the Quark Gluon Plasma in heavy-ion collisions. ALICE offers excellent particle identification and tracking capabilities.



For tracking of charged particles the Inner Tracking System (**ITS**) and the Time Projection Chamber (**TPC**) are used.
The **ITS** (1) is a six layer silicon detector employed in tracking, with a significant contribution in the precise determination of the distance of closest approach (DCA) of the track to the vertex.
The **TPC** (2) is the main Particle IDentification (**PID**) and tracking detector of the central barrel.
The **V0** detectors (3) are mainly used as a trigger detector. They also provide information used for beam-gas event rejection as well as event multiplicity and centrality classification.

Event Selection

About 20 million minimum-bias (V0A && V0C) events were analysed.
Events are required to have a valid reconstructed vertex within a range of $|z| < 10$ cm with respect to the beam crossing.

Track Selection

Tracks are reconstructed using the combined information from the TPC and ITS detectors.
A track is required to reach a minimum length in the active volume of the TPC.
High-purity selection of primary charged particles is achieved with a p_{T}-dependent cut on the distance of closest approach in the transverse plane between the track and the primary vertex.

Corrections

The particle spectra are corrected for detector inefficiencies, acceptance and contamination using Monte-Carlo generators. In addition data driven approaches based on identified particle measurements and DCA distributions are used to tune the Monte-Carlo sample.

Work supported by the Helmholtz Graduate School for Heavy Ion Resarch

Venezia 2018 Quark Matter

ALICE Collaboration arXiv:1802.09145