Wigner 121
Scientific Symposium

Wigner Research Centre for Physics
Institute for Particle and Nuclear Physics
Department of High Energy Physics
Hadron Physics Research Group

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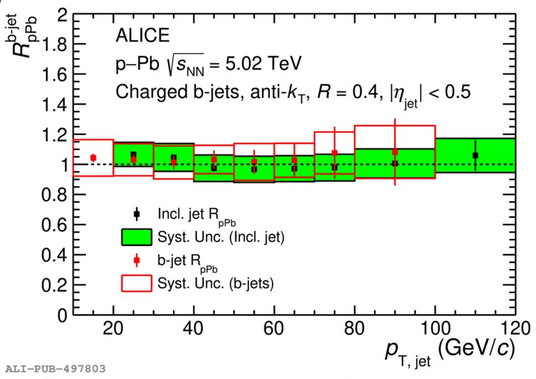
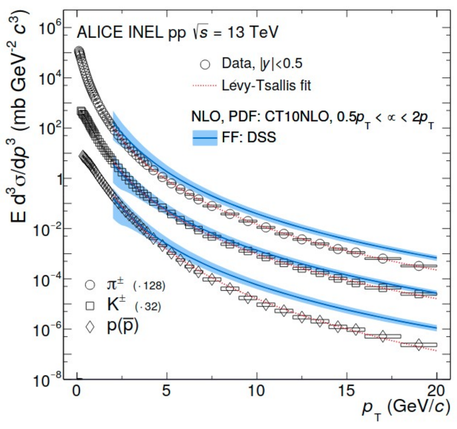
Introduction

Our research group aims to gain a better understanding of the strong interaction, one of Nature's fundamental forces, under extreme conditions. We participate in several complementary experiments (mainly CERN LHC ALICE and CMS), where we play leading roles in heavy-flavor measurements in high-energy nuclear reactions as well as in the exploration of gluon states in proton-proton collisions (glueballs). We play an active role in phenomenological investigations of the smallest droplets of the quark-gluon plasma. We lay the foundation of future measurements with detector development and methodological studies, such as the design of the ITS3 cooling system or the development of novel particle tracking and identification algorithms. We apply our expertise in the field of detectors in developing a new proton-CT method for medical diagnosis and treatment. This poster highlights some of the most important results from our group.

ALICE



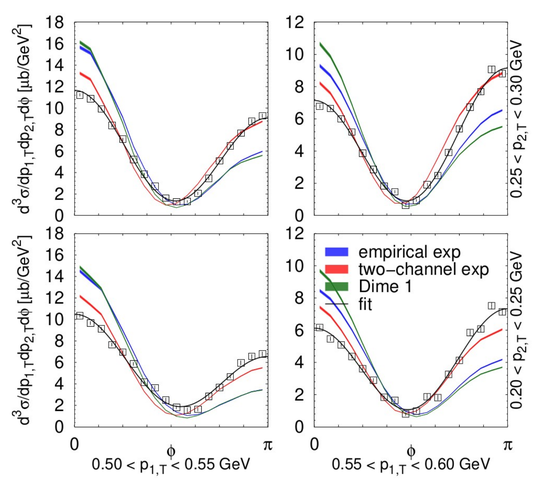
The production of heavy-flavor jets in proton-proton collisions serves as a fundamental test of perturbative QCD, while p-Pb (Pb-Pb) measurements provide information about the effects of the cold (hot) nuclear matter. Our group plays a key role in several experimental measurements within the ALICE Heavy Flavor Jets and Correlations physics analysis groups.



Light-flavor particle spectra are the benchmark test for perturbative QCD calculations beyond leading order. The production of light-flavor mesons and baryons was measured in inelastic proton-proton collisions. A hardening of the spectra at high momenta with increasing collision energy was observed. We played a leading role in these measurements.

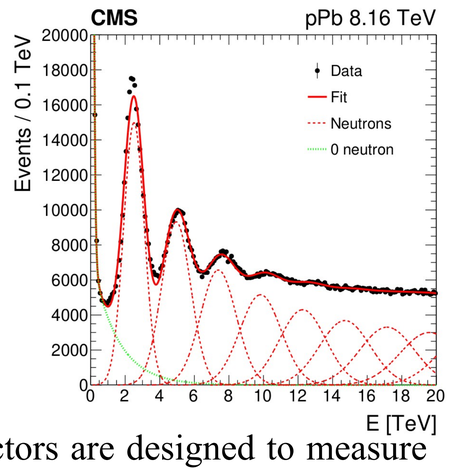
The future ALICE 3 experiment that will replace the current detector system will be fully based on semiconducting technology. We contribute to its development with performance studies and to the planned Muon ID detector with simulations and test measurements.

CMS



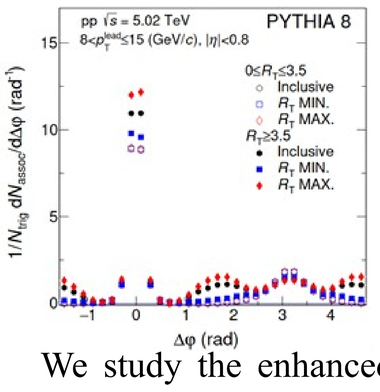
We studied the central exclusive production of charged hadron pairs in pp collisions at a center-of-mass energy of 13 TeV. The differential cross sections as functions of the polar scattering angle between the outgoing protons are measured in a wide region of proton transverse momenta. A rich structure of interactions related to double pomeron exchange emerges.

We have studied the distribution of spectator neutrons from pPb collisions at a center-of-mass energy of 8.16 TeV. The response of the detectors to ultrarelativistic neutrons was studied using in-depth Monte Carlo simulations. A method of signal extraction based on template fits was demonstrated, along with a dedicated calibration procedure.



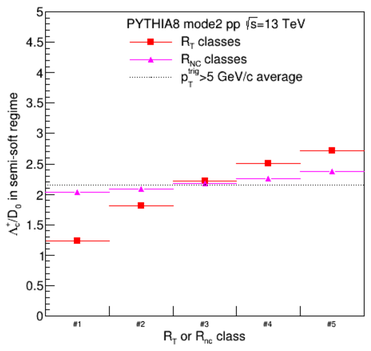
The CMS Diode ORbit and OScillation detectors are designed to measure the exact position of the proton beams, while the instantaneous luminosity is estimated by monitoring the occupancy of the Pixel Detector. We worked on improving its performance for the ongoing Run 3 data taking period.

Phenomenology

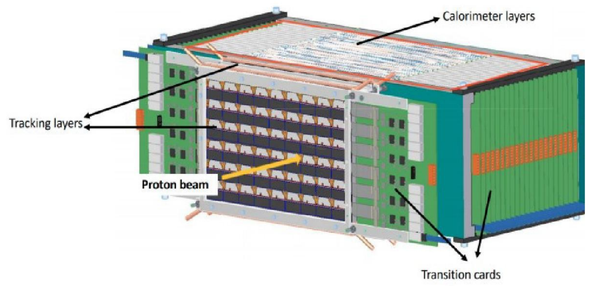


The event-activity differential investigation of particle production reveals the connection between the leading process and the underlying event. We point out a correlation between the underlying event activity and the leading particle momentum, caused by triggered samples being biased toward events with gluon-radiation, and propose a refined event classifier.

We study the enhanced production of charmed baryons relative to charmed mesons in proton-proton collisions at LHC energies. Utilizing simulations we propose methods to identify the source of the charmed-baryon enhancement. In the scenario under investigation the excess charmed-baryon production is primarily linked to the underlying event activity and not to the jets.



Proton CT



Irradiation of cancer tumors using focused hadron beams can be a very effective treatment as the patient receives less unnecessary dose, thus allowing for a deposit of high destructive dose close to the critical organs.

We participate in the Bergen pCT collaboration in the development of a sampling calorimeter to be used for imaging in cancer therapy.

Publications

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