HK 56: Heavy-Ion Collisions and QCD Phases XIV

Time: Wednesday 17:30–19:15 Location: HBR 62: EG 05

HK 56.1 Wed 17:30 HBR 62: EG 05

Photon reconstruction in the Transition Radiation Detector of ALICE — •Peter Stratmann for the ALICE Germany-Collaboration — Universität Münster

The Transition Radiation Detector (TRD) of the ALICE detector at the Large Hadron Collider has the main purpose of identifying electrons and triggering on electrons and jets. Furthermore, it improves the resolution in track reconstruction at high transverse momenta. The working principle is based on transition radiation, which is produced by charged particles transversing boundaries of material with different dielectric constants.

In a rather new approach, the TRD should be used for measuring the photon production through the detection of conversion electrons. This is facilitated by the large material budget located in front and inside of the TRD. For this purpose, stand-alone tracking independent of the Inner Tracking System and the Time Projection Chamber had already been implemented. So far, this is achieved by a Kalman filter. As a new method, the photons are reconstructed in the TRD using Graph Neural Networks. These have the advantage that they operate well on the high-dimensional and sparse nature presented by the TRD data. In this talk, we will present the principles of the TRD, the direct photon reconstruction in the stand-alone tracking, and first results obtained with the Graph Neural Network.

Supported by BMBF within the ERuM framework, and the DFG as part of the GRK 2149.

HK 56.2 Wed 17:45 HBR 62: EG 05

Measurement of direct photons in Pb-Pb collisions in ALICE at $\sqrt{s_{NN}}$ = 5TeV — •Stephan Stiefelmaier — Physikalisches Institut Heidelberg

Direct photons are interesting since they allow to track the evolution of the Quark Gluon Plasma (QGP), the medium which is formed in heavy ion collisions at the LHC. I present the current state of their measurement with photon conversions in the 2018 Pb-Pb data sample using the latest reconstruction and calibration methods. Since eta mesons and neutral pions are responsible for a large part of the experimental background their measurement is also presented.

HK 56.3 Wed 18:00 HBR 62: EG 05

Reconstruction of neutral mesons via photon conversion method in Ag-Ag collisions at 1.58A GeV with HADES* — •Tetiana Povar for the HADES-Collaboration — Bergische Universität Wuppertal,Wuppertal,Germany

Virtual photons and their decays into electron pairs $\left(e^- + e^+\right)$ represent one of the best sources for investigating the properties of nuclear matter under extreme conditions of temperature and density. One of the experiments which focuses on measurements of the dilepton spectrum is the HADES (High Acceptance DiElectron Spectrometer) at GSI in Darmstadt. The precise determination of all contributing sources in the dilepton spectrum is critical to obtaining accurate information about the dense nuclear medium in the early stages of collisions. The major background in the $\left(e^- + e^+\right)$ spectrum at the low invariant mass region is Dalitz-decays of light neutral mesons (π^0, η), so that precise knowledge about neutral meson production is mandatory for the dilepton analyses.
In HADES, these mesons can be reconstructed via their dominant $\gamma\gamma$ decays (BR $\sim$ 99%) using the electromagnetic calorimeter (ECAL) or via double external pair conversion in target or detector material.
In this contribution, main emphasis will be put on determining the efficiency and acceptance corrected π^0 yield applying the conversion method in Ag+Ag collisions at 1.58A GeV, including a detailed discussion of systematic and statistical uncertainties.
* Work supported by BMBF (05P21PXFC1) and GSI.

HK 56.4 Wed 18:15 HBR 62: EG 05

Development of a ML algorithm for neutral meson and photon reconstruction using PCM in ALICE — •Abhishek Nath for the ALICE Germany-Collaboration — Ruprecht Karl University of Heidelberg, Germany

Direct photons are unique probes to study and characterize the quark-gluon plasma (QGP) as they leave the medium unscattered. They are produced throughout all stages of the collision. Thus, they carry information about the space-time evolution and the temperature of the medium. However, they are present amidst a large background of mostly decay photons. So a precise estimate of decay photons is necessary. The Photon Conversion Method (PCM) is a great tool to identify photons, especially at low transverse momentum as they result in oppositely charged track pairs when they interact with detector materials.

Armed with the current machine learning algorithms, we try to reconstruct photons and their source mesons in heavy ion collision using PCM. The aim is to have an efficient estimate of the mesons along with photon samples with high purity and compare both with the current standardized cuts-based method implemented in the PCM analysis workflow. Our analysis is based on 2018 Pb-Pb data where we aim to explore various algorithms (XGBoost and others) to classify photons on-fly. Based on the analysis, a roadmap for analyzing high luminosity run 3 data is stated at the end.

HK 56.5 Wed 18:30 HBR 62: EG 05

Measurement of neutral meson and photon production in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV with the ALICE EMCal — •Marvin Hemmer for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

Direct photon production in Pb–Pb collisions can be utilised to study the properties of the QGP and the different stages of the collision. The transverse momenta (p_{T}) of the direct photons carry information on their production time and mechanism; while low p_{T} direct photons are produced in the QPG phase of the collision, photons at high p_{T} are predominately produced during the initial scattering and hence are an ideal probe to study initial conditions of the colliding nuclei.

To disentangle direct photons and photons from hadronic decays, most notably the π^0 and η mesons, a precise measurement of the π^0 and η spectra is needed. In ALICE neutral mesons can be measured using different reconstruction methods. For π^0 and η mesons at high transverse momentum these methods are based on the detection of decay photons with the EMCal calorimeter.

In this talk, the measurement of π^0 and η mesons with the ALICE EMCal in Pb–Pb collisions at $\sqrt{s_{\mathrm{NN}}}$ = 5.02 TeV is presented. Additionally,the status of the direct photon analysis at high p_{T} will be discussed.

HK 56.6 Wed 18:45 HBR 62: EG 05

Measurement of neutral meson production in small collision systems with ALICE — •Joshua König for the ALICE Germany-Collaboration — Institut für Kernphysik, Goethe-Universität Frankfurt

The precise measurement of the neutral meson production in pp collisions can be used to constrain fragmentation functions and parton density functions needed by pQCD calculations. The dependence of the measured neutral meson yield on the event charged-particle multiplicity can give further insight into possible final-state effects in high-multiplicity pp collisions, where other measurements show surprising similarities with results in heavy-ion collisions. Additionally, the measurement of neutral mesons serves as a baseline for direct photon analyses.

The measured neutral meson spectra cover a wide range in p_{T} due to three independent photon reconstruction techniques available in ALICE, including two calorimeters as well as measured e^+e^- pairs from photon conversions in the detector material.

In this talk, the production cross sections of π^0, η and ω mesons as a function of p_{T} in pp and p–Pb collisions measured with ALICE will be presented. For pp collisions at $\sqrt{s}$ = 13 TeV, the dependence of the π^0 and η meson production on the charged-particle multiplicity is shown. Additionally, the production of these mesons inside reconstructed jets are used to provide a direct estimate of the fragmentation function.

Supported by BMBF and the Helmholtz Association

HK 56.7 Wed 19:00 HBR 62: EG 05

Performance of photon measurements using PCM with ALICE in Run 3 — •Alica Marie Enderich — Physikalisches Institut, Universität Heidelberg

With the beginning of Run 3 at CERN-LHC and the related upgrades of the detectors used in the ALICE experiment, also the material bud-

get associated with the experimental setup changed. Therefore, a renewal of the knowledge of the material budget is necessary as this is required for the reconstruction of charged particles produced in collisions. This can be achieved by using pions as they make up the biggest fraction of particles created at collisions.
As neutral pions π^0 decay into photons, the latter need to be measured in order to reconstruct them. Photons can be measured in ALICE with electromagnetic calorimeters (EMCal and PHOS) as well as with the photon conversion method (PCM). PCM uses the fact that photons can convert into e^+e^- pairs when traversing material which can then be reconstructed. The reconstructed photons can subsequently be used to probe the detector material. This allows the improvement of Monte Carlo simulations used for charged particle reconstruction. Furthermore, the experimental π^0 mass resolution can be used to examine the momentum resolution and thus the quality of the reconstructed photons.
This talk will present analyses on the PCM performance with ALICE in Run 3 for pp collisions at $\sqrt{s_{\mathrm{NN}}} = 13.6$ TeV. The talk will focus on studies of the material budget as well as the quality of the reconstructed photons. The current status of the analyses will be presented.