FAIR next generation scientists - 8th Edition Workshop

Reporte der Beiträge

https://indico.gsi.de/e/fairness2024

Beitrag ID: **61** Typ: **nicht angegeben**

A SiPM-based readout system for the CBM's RICH

Donnerstag, 26. September 2024 17:10 (20 Minuten)

Comprehension of the QCD phase diagram opens a window for a better understating of matter dynamics inside massive objects like neutron stars. The Compressed Baryonic Matter experiment (CBM) at FAIR shall measure products coming out from ion collisions to study the equation-of-state of matter at high densities, to search phase transitions, chiral symmetry restoration, and exotic QCD matter. Tracking and particle identification detectors assembled along the collision axis of the CBM, record information of the particles popping up from the primary ion interaction to elucidate their predecessors and decaying channels. One of these novelty detectors is a Ring Imaging Cherenkov (RICH) counter. The CBM's RICH encloses two concave photon cameras pointing towards two spherical glass mirrors focusing Cherenkov photons produced by the interaction of charged particles with a CO2 radiator volume. The photon cameras use H12700 Multi-Anode Photomultipliers (MAPMTs). Low dark counts and radiation hardness characterize MAPMTs, but sensitivity to external magnetic fields, poor granularity, low photo-detection efficiency, and high operation voltages circumscribe their main drawbacks. Those MAPMT disadvantages have encouraged to explore new photo-detection technologies for improving timing, spatial, and amplitude resolutions. Silicon photomultipliers (SiPMs) fulfill those requirements, but the implementation of a SiPM-based RICH carries challenges due to SiPM's temperature dependency and high dark count rate. We present the design and test of a SiPM frontend electronics adapted to the CBM's RICH readout system. We implemented an 8×8 SiPM (AFBR-S4N66P024M) array, coupled to a 64-channel amplification board made of highly linear and low power-consumption amplifiers (12 mW/channel). We analyze the inter-channel signal variance, as well as, the noise levels and triggering methodologies.

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Sitzung Einordnung: Session

Beitrag ID: **62** Typ: **nicht angegeben**

Gaussian approximation within an extended linear sigma model

Freitag, 27. September 2024 11:05 (20 Minuten)

The effective models of QCD are important tools for exploring the phase diagram of strongly interacting matter. They are particularly useful in the higher chemical potential regime, where the expected critical endpoint may be found, but which is inaccessible to lattice QCD due to the famous sign problem. These models are usually calculated in a mean-field approximation, which provides a well-understood physical picture. Recently, however, there has been a growing interest in going beyond this approximation within the effective model calculations. In the same vein, we have implemented a Gaussian approximation in a 2+1 flavor, vector and axial vector meson extended Polyakov linear sigma model to study the beyond mean-field effects on the phase structure, thermodynamics, and some aspects of meson phenomenology.

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Sitzung Einordnung: Session

Beitrag ID: **63** Typ: **nicht angegeben**

Module and ladder characterization and burn-in tests of the Silicon Tracking System for the CBM experiment

Donnerstag, 26. September 2024 11:25 (20 Minuten)

The Silicon Tracking System (STS) in the upcoming heavy-ion CBM experiment is tailored for an unprecedented 10 MHz beam-target interaction rate. A unique integration strategy was employed to maintain a material budget within 2 - 8\% X_0 while ensuring ample granularity, spatial precision, and timing accuracy. The read-out electronics sit external to the sensitive volume, connected to double-sided double-metal silicon sensors through ultra-thin micro cables. Each double-sided silicon strip sensor is connected to two Front-End Boards (FEBs), featuring eight custom-designed STS-XYTER ASICs (SMX) per FEB.

Post-assembly, rigorous quality control tests, including time and amplitude calibration of all module ASICs, ensure reliable performance, operational refinement, and accurate data interpretation. Operating at room temperature to -20 ℃ (coolant) and -10 ℃ (effective), FEBs undergo mechanical stress due to temperature fluctuations. The burn-in test exposes modules to varying temperatures and power cycles, identifying weaknesses and evaluating electronics robustness and module functionality.

Post-testing, modules are affixed to carbon fiber ladders, hosting up to 10 modules each, and undergo further assessments to verify sustained functionality and performance. This study outlines the status and outcomes of tests on the first modules and ladders of the STS detector's series production, providing valuable insights into its development and performance capabilities.

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Sitzung Einordnung: Session

Beitrag ID: **64** Typ: **nicht angegeben**

Sprout - a Software Tool for Your Analysis

Mittwoch, 25. September 2024 12:05 (20 Minuten)

Data analysis from subatomic physics experiments tends to be a complex endeavour, in particular due to the many systematic checks that this entails. A large number of parameters and combinations thereof must be considered, e.g. selection criteria, fitting ranges, bin sizes, background models, etc. As an aid in this endeavour, I have developed Sprout in parallel to my own data analysis within the HADES experiment. Sprout is a general purpose C++ software library that aims to streamline data analysis using the ROOT framework. Its primary objective is to assist users in maintaining concise, manageable, and modular code by automating repetitive or cumbersome aspects of the analysis workflow. Currently, Sprout offers helper classes for handling ROOT histograms, managing analysis parameters, implementing selection cuts and extracting signal yields. Continued development of Sprout is ongoing to incorporate additional features and improvements.

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Sitzung Einordnung: Session

Beitrag ID: **65** Typ: **nicht angegeben**

Towards reconstructing dilepton flow in Au+Au collisions at low energies with HADES*

Mittwoch, 25. September 2024 09:55 (20 Minuten)

In March 2024, the High Acceptance DiElectron Spectrometer (HADES) at GSI Darmstadt, Germany collected data on dielectron production in Au+Au collisions at a beam energy of 0.8 A GeV. One of the most intriguing aspects of this physics program is to investigate the strongly interacting medium which exhibits similar conditions to those in the final stages of a neutron-star merger or the early Universe. One specific focus will be to characterize the collision system by examining the dielectron flow. The electron pairs, resulting from the virtual photon decay, will allow us to access direct and unperturbed information throughout the entire fireball evolution.

In the HADES experiment, the Ring-Imaging Cherenkov (RICH) detector operates as a high-efficiency electron identifier. The performance of the RICH is crucial for reconstructing pure electron pairs, especially in this heavy collision system where hadron multiplicities are large.

In this contribution, we will first discuss the calibration and performance of the HADES RICH. Additionally, we aim to present the first results on the extracted dilepton flow in the corresponding system.

*Work supported by "Netzwerke 2021", an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia and BMBF (05P21PXFC1).

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Sitzung Einordnung: Session

Beitrag ID: **66** Typ: **nicht angegeben**

Real-time calibrations for future detectors at FAIR

Dienstag, 24. September 2024 17:10 (20 Minuten)

The online data processing of the next generation of experiments conducted at FAIR requires a reliable reconstruction of event topologies and, therefore, will depend heavily on in-situ calibration procedures. In this study we present a neural network-based tool designed to provide real-time predictions of calibration constants, which rely on continuously available environmental data. To enhance regularization, we incorporate information about previous environmental states into the Long Short-Term Memory (LSTM) architecture. LSTM is combined with Graph Convolutions to facilitate predictions across multiple channels simultaneously and to account for correlations between the channels. A proof-of-principle of this approach has been demonstrated using data from the Drift Chambers of the HADES detector obtained during the February 2022 experiment. Our method demonstrated the ability to provide fast and stable calibration predictions with a precision comparable to that obtained using traditional offline, time-consuming approaches.

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Vortragende(r): KLADOV, Valentin (Ruhr-Universität Bochum(RUB))

Sitzung Einordnung: Session

Beitrag ID: **67** Typ: **nicht angegeben**

Performance of hit, track, and vertex reconstruction of the Silicon Tracking System of the CBM experiment

Mittwoch, 25. September 2024 16:50 (20 Minuten)

The Compressed Baryonic Matter (CBM) experiment is one of the experimental pillars at the Facility for Antiproton and Ion Research (FAIR).
The Silicon Tracking System (STS) is the central detector for track reconstruction and momentum measurement. It is designed to measure heavy ion collisions at interaction rates up to 10 MHz. It comprises approximately 900 double-sided silicon strip sensors with 1024 strips per side, arranged in 8 tracking stations in a magnetic field of 1 Tm.
In the context of the FAIR Phase-0 program, the mCBM setup at SIS18/GSI is a small-scale precursor of the full CBM experiment, consisting of pre-series productions of all major CBM detector subsystems aiming to verify CBM's concepts of free-streaming readout electronics, data transport, and online reconstruction. The mini-STS (mSTS) setup consists of 11 sensors arranged in 2 stations and no magnetic field.

Heavy ion collisions in the 1-2 GeV/c range were measured with an average collision rate of 500 kHz. The primary and secondary vertexes are reconstructed using the two layers of the mSTS detector by tracks reconstructed as straight lines. Hit reconstruction efficiency was estimated using correlations with downstream detectors. This contribution will present the performance of hit, track, and vertex reconstruction from measurements of heavy ion collisions.

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Co-Autor: CBM COLLABORATION

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Sitzung Einordnung: Session

Beitrag ID: **68** Typ: **nicht angegeben**

Inclusive analysis of Σ(1385)+/- hyperons production and decay in 4,5 GeV p+p reactions in HADES

Donnerstag, 26. September 2024 09:55 (20 Minuten)

The exact structure and inner workings of nucleons have been debated since the existence of quarks was first postulated. Since then, a large amount of experimental evidence has been gathered, indicating that nucleons and their excited states are not simple static quark states but are significantly influenced by the dynamics of baryon-meson interactions. In this context, it is interesting to extend studies from simple nucleons to particles where one light quark in a nucleon is replaced by a heavier strange quark, the so called hyperons, and their excited states such as for example Σ(1385), Λ(1520) or Λ(1405). There are many competing models which describe the internal structure of these hyperons, including those based on the dynamical state generation. In order to determine which of the models are the closest to nature, it is helpful to measure radiative decays (with emission of a photon or e+e- pairs) and hadronic decays, e.g. Λ(1520) → Σ+(1385) π-, Σ(1385)+/- → Λπ+/- or Λ(1405) → Σ π. These decay channels are largely unexplored at present, which is the motivation for the project presented in this talk.
The focus of the presented analysis is the inclusive study of the production and decay of Sigma Σ(1385)+/- hyperons produced in measurements of proton-proton reactions at beam energy of 4.5 GeV performed in the HADES experiment at FAIR in February 2022 [1]. This analysis allows for expansion on older studies based on measurements in lower energies, with much higher production cross-section, as well as incorporating new analysis methods, such as utilization of machine learning methods.

[1] J. Adamczewski-Musch et. al. (HADES Collaboration); Production and electromagnetic decay of hyperons: a feasibility study with HADES as a phase-0 experiment at FAIR; Eur. Phys. J. A (2021) 57: 138

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Sitzung Einordnung: Session

Beitrag ID: **69** Typ: **nicht angegeben**

Neutrino Transport in Binary Neutron Star Mergers

Dienstag, 24. September 2024 11:45 (20 Minuten)

Gravitational-Wave and Kilonova measurements have established Binary Neutron Star (BNS) mergers as a predominant candidate for the production of the heaviest elements in our Universe. Under hot and dense conditions such as those encountered in BNS mergers, neutrino transport effects play a crucial role in initiating mass-outflows and in shaping the composition of the ejecta and of the r-process nucleosynthesis in them. As such, in order to correctly model a BNS merger, neutrino emission, propagation and absorption also need to be taken into consideration. In this talk, we will give a brief overview of one of the methods that is used in simulating neutrino transport in the context of BNS mergers. Specifically, we will elaborate on a truncated moments scheme which evolves the first two moments of the neutrino radiation field. We will also present and discuss some of the first results of our implementation of the scheme in the 3D general relativistic moving-mesh code AREPO.

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Sitzung Einordnung: Session

Beitrag ID: **70** Typ: **nicht angegeben**

Dielectron analysis in p+p collisions at 1.58 GeV beam energy with HADES

Mittwoch, 25. September 2024 11:45 (20 Minuten)

In this contribution we present preliminary results on the dielectron production in p+p interactions at 1.58 GeV beam energy measured with the High Acceptance DiElectron Spectrometer (HADES). The HADES RICH detector has been upgraded with a new photon detection camera which strongly enhances the electron efficiency and conversion pair rejection. With this upgrade, a signal-to-background ratio above 1 is achieved over the entire dielectron spectrum. 0.5 billion collisions have been analyzed showing a contribution of π^0 and η Dalitz decays in a signal up to an invariant mass of $0.5\,\mathrm{GeV}/c^2$. Furthermore, by analyzing elastic p+p collisions, a normalization procedure for differential cross sections has been established.

The cross section spectrum shows a satisfactory agreement to previous HADES measurements as well as theoretical calculations from GiBUU. Furthermore this spectrum can serve as a baseline for the understanding and interpretation of Ag+Ag collisions which have been measured in HADES at the same energy. A precise understanding of the dielectron production in elementary reactions is needed to disentangle the various contributions to the measured dielectron yield in Ag+Ag collisions.

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Sitzung Einordnung: Session

Beitrag ID: **71** Typ: **nicht angegeben**

Systematic study of binary neutron star mergers with neutrinos

Dienstag, 24. September 2024 12:05 (20 Minuten)

We perform a systematic study of binary neutron star (BNS) mergers using relativistic hydrodynamical simulations with neutrinos by considering different total masses, mass ratios and different equations of state. By comparing asymmetric mergers to the corresponding symmetric mergers with the same total mass, we observe a systematic decrease in the dominant oscillation frequencies and an approximate plateau of maximum densities in the postmerger evolution. In the remnants of asymmetric mergers, we find higher temperatures, higher average electron fractions, and higher neutrino luminosities. Specifically, we examine the dynamical ejecta properties, including the mass ejection, the composition, and the elemental abundance production through nucleosynthesis calculations. We notice that the ejecta from asymmetric mergers exhibit an overall increase in the isotropy per unit angular bin, an increase in the ejecta mass and the mass-averaged temperatures. The electron fraction distribution of the ejecta tends toward lower values, resulting in more neutron-rich ejecta and yields a higher lanthanide fraction in asymmetric mergers compared to symmetric counterparts.

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Sitzung Einordnung: Session

Beitrag ID: **72** Typ: **nicht angegeben**

Forward Spectator Detector for CBM

Donnerstag, 26. September 2024 11:45 (20 Minuten)

The development of the Forward Spectator Detector (FSD) within
the CBM experiment represents a crucial step towards sucessful realization
of the CBM physics program - understanding of highly compressed
nuclear matter at the forthcoming FAIR facility. Specifically designed
for detection of collision participants at high collision rates at SIS-100 accelerator,
the FSD employs scintillator-based detector technology to enable
accurate reconstruction of the reaction plane and determination of collision centrality.
An overview of the technical design and performance studies
conducted for the FSD will be provided. These studies encompass
extensive prototyping and pre-series testing of the detector,
employing a combination of simulations and real data tests to
assess the efficacy of various detector configurations.

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Sitzung Einordnung: Session

Beitrag ID: **73** Typ: **nicht angegeben**

Feasibility Studies for Di-Electron Spectroscopy with CBM at FAIR

Donnerstag, 26. September 2024 12:05 (20 Minuten)

The Compressed Baryonic Matter experiment (CBM) at FAIR is designed to explore the QCD phase diagram at high net baryon densities and moderate temperatures by means of heavy ion collisions with energies from 2-11 AGeV beam energy (Au+Au collisions) and interaction rates up to 10 MHz, provided by the SIS100 accelerator. Leptons as penetrating probes not taking part in the strong interaction leave the fireball without being modified, thus carrying information from the dense baryonic matter. However, di-leptons are rare probes, therefore calling for high efficiency and high purity identification capabilities. In CBM, electron identification will be performed by a Ring Imaging Cherenkov Detector (RICH), a Transition Radiation Detector (TRD) and a Time-of-Flight detector (ToF). In this contribution, feasibility studies of di-electron spectroscopy from low mass vector meson decays will be presented. Special emphasis is put on the application of Fast Simulations to achieve higher statistics for the rare di-electrons in order to evaluate the feasibility of e.g. temperature measurements in the intermediate mass region beyond 1 GeV/^{2}.

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Sitzung Einordnung: Session

Beitrag ID: **74** Typ: **nicht angegeben**

Theoretical investigation of fluorescence and photoelectrons angular distribution in a XUV-pump XUV-probe scheme in C III ion

Dienstag, 24. September 2024 09:35 (20 Minuten)

We theoretically investigate the angular distributions of fluorescence and photoelectrons emission based on density matrix formalism [1] in a pump-probe scheme dedicated for measuring the lifetime of odd singlet excited states of C III [2]. The energy levels, bound-bound and bound-free electric dipole matrix elements belonging to C III have been computed with the Dirac-Fock-Slater model-potential method in combination with the distorted wave approximation for free states [3]. The quasi-bound states embedded in continuum are treated within time-independent perturbation theory [4]. During the pumping stage, triplet states also couple to the singlet ground state through spin-flip transitions affecting the overall yield and angular distribution of fluorescence. Similarly, during the probing stage, the ensemble of atoms excited in closely-lying states participate in the photoionization process, altering the expected C IV ion yield and the partial wave expansion of photoelectrons. The composition of the latter is investigated and highlighted by comparing the electron polarization [5] in the case of photoionization of carbon ions excited within a single state versus photoionization from a similar ensemble excited into multiple closely-lying states.

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[1] K. Blum, Density-matrix theory and applications. New York: Plenum(1981), 1-215.
[2] J. Rothhardt, M. Bilal, R. Beerwerth, A.V. Volotka, V. Hilbert, T. Stöhlker, S. Fritzsche, J. Limpert, X-ray Spectrometry 49, 165-168, 2020.
[3] M. F. Gu, Flexible Atomic Code, Can. J. Phys 86 (2008), 675-689.
[4] U. Fano, Effects of Configuration Interaction on the Intensities and Phase Shifts, Phys. Rev. A 124(1961), 1866-1878.
[5] C. Iorga and V. Stancalie, Linear polarization of the dielectronic recombination Kα satellite lines in Li-like Au76+, JQSRT 224(2019), 206-216.

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Sitzung Einordnung: Session

Beitrag ID: **75** Typ: **nicht angegeben**

Machine learning application for electron identification in CBM

Mittwoch, 25. September 2024 18:00 (20 Minuten)

The Compressed Baryonic Matter experiment is a future fixed target experiment designed to probe the QCD phase diagram at high baryonic density and moderate temperatures. Di-electrons are a penetrating probe well suited to understand the initial QCD medium since the electrons interact only electromagnetically and are hence not affected by the strong medium effects. Efficient identification of the electrons with minimum pion contamination is paramount in these kinds of studies. The CBM experiment uses a Ring Imaging Cherenkov detector (RICH) in combination with a Transition Radiation Detector (TRD) for electron-pion separation, and a Time of Flight(ToF) detector for identification of high-mass hadrons.

In the RICH reconstruction, a Single-Layer Perceptron (SLP) is used so far for the classification of $e^{\pm}$ and $\pi^{\pm}$. In it's first part, this contribution will focus on improving electron identification in CBM, particularly with the RICH detector where the classic SLP is compared to tree-based ensemble models (XGBOOST, LightGBM) and corresponding feature optimization.

Almost 80% of the electron rings in RICH stem from photon conversion in the detector material after the tracking stations. Removing such conversion electron rings from the sample can substantially reduce the false identification of pion tracks as electrons. This can be achieved by tracking conversion electrons behind the RICH (using TRD). Additionally, the information from ToF can be used as an additional electron reference (rejecting hadrons in the TRD track sample). In it's second part this contribution will discuss the efficient use of the information from TRD and ToF using ensemble models to reduce the contribution from conversion electrons.

*This work is supported by BMBF (05P21PXFC1).

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Sitzung Einordnung: Session

Beitrag ID: **76** Typ: **nicht angegeben**

Study of multinucleon knockout reactions of exotic nuclei in the region of nitrogen

Freitag, 27. September 2024 09:55 (20 Minuten)

Recently, several works which focused on light isotopes and that were based on inclusive studies [1,2,3] have shown a reduction of the measured cross sections with respect to the theoretical predictions for nucleon-removal and single-nucleon knockout reactions. These studies have reached different conclusions regarding the dependence of the reduction factor observed of the spectroscopic factor with respect to the N/Z of the projectile. The study of (p,pX) knockout reactions with the R3B setup is a golden opportunity since the inverse kinematics technique can be used and the versatile setup offers a high efficiency, acceptance, and resolution for kinematically complete measurements. The two key detectors to do this are the CALIFA calorimeter [4] made of CsI(Tl) crystals and the neutron detector NeuLAND [5], appart from the tracking detectors both from the incoming isotopes and the fragments.

Moreover, not only single-nucleon knockout reactions can be studied but also multi-nucleon knockout ones. Of particular interest is the systematic study of the probability of cluster formation. The successful experiments on stable Sn isotopes [6] indicating the pre-existence of an alpha cluster at the surface of nuclei which are compatible with theoretical predictions [7] have aroused the interest to study this phenomenon also predicted for other light nuclei such as d, t or 3He.

This presentation will be focused the particle identification method using CALIFA, specially regarding deuterons. One of the goals is to study the dependence of the cluster formation probability with respect to the mass of the projectile, since it is expected to decrease for N=Z clusters as the mass of the nuclei increases. In addition, the occurrence of deuteron clusters embodies tensor force effects in nuclei and should be relevant for p-n short-range correlations (SRC) [8].

[1] J. A. Tostevin and A. Gade, Phys. Rev. C 90, 057602 (2014)
[2] M. Gómez-Ramos and A.M. Moro, Phys. Lett. B 785,511 (2018)
[3] L. Atar et al., Phys. Rev. Lett. 120, 052501 (2018)
[4] H. Alvarez-Pol, Nucl. Instrum. Methods A 767, 453-466 (2014)
[5] K. Boretzky, Nucl. Instrum. Methods Phys. Res. A 1014, 165701 (2021)
[6] J. Tanaka, Z.H. Yang et al., Science 371, 260 (2021)
[7] S. Typel, Phys. Rev. C 89, 064321 (2014)
[8] M. Duer et al., Nature 560 620 (2018)

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Sitzung Einordnung: Session

Beitrag ID: **77** Typ: **nicht angegeben**

Strangeness fluctuations in the HADES experiment

Donnerstag, 26. September 2024 09:35 (20 Minuten)

The QCD phase diagram has been actively studied over the years in the experimental, and theoretical domains using e.g. lattice QCD. The fluctuations of conserved charges like electric charge, baryon number, and strangeness are useful probes to study the QCD phase diagram. The experimental study of higher order cumulants provides insights into potential critical behaviour, and is being analysed at different experiments. This work focuses on the analysis of strangeness fluctuations in Ag-Ag data collected at the High Acceptance DiElectron Spectrometer (HADES) in 2019 at 1.58 AGeV. HADES is a fixed target experiment at GSI that investigates the properties of dense baryonic matter at lower energy regimes around 1-2 AGeV. The lower particle multiplicity of strange particles in this dataset poses a challenge to the analysis of higher-order cumulants. This necessitates an exploratory study on the feasibility of using the strange particles in this analysis. The identification and reconstruction of strange particles like charged and neutral kaons in the Ag-Ag data is specifically looked into and will be presented.

*This work is supported by ‘’Netzwerke 2021”, an initiative of the Ministry of Culture and Science of the State of Northrhine Westphalia.

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Sitzung Einordnung: Session

Beitrag ID: **79** Typ: **nicht angegeben**

Microscopic description of β-decay rates of r process nuclei

Freitag, 27. September 2024 09:35 (20 Minuten)

β-decay rates are fundamental to understanding r-process nucleosynthesis, which is responsible for producing roughly half of the heavy elements. Existing theoretical global calculations of the rates use either Skyrme or relativistic quasiparticle random phase approximation (QRPA). These models yield very different predictions and are limited due to their treatment of nuclear many-body correlations. Many-body correlations are known to determine the low-lying beta-decay strength and consequently the decay half-lives due to their strong sensitivity to phase space. In this contribution, I address the inclusion of deformation and the coupling of quasiparticles to like-particle phonons within relativistic QRPA linear response theory. The impact on the β strength and half-lives will be discussed together with the competition of Gamow-Teller and forbidden transitions.

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Sitzung Einordnung: Session

Beitrag ID: **81** Typ: **nicht angegeben**

Hyperon-production in proton-proton collisions at 4.5 GeV with HADES

Mittwoch, 25. September 2024 10:15 (20 Minuten)

This work presents a preliminary analysis of the $+^{0}_{S}++^{+}$ final state in proton-proton scattering using data collected at T = 4.5 GeV with HADES at GSI in Darmstadt, Germany. The production of hyperons is of particular interest since it provides information about the role of N* resonances in strangeness production in NN interactions. Furthermore, this study could be relevant in describing the dynamics of high-density matter such as that located at the core of neutron stars. This talk will introduce some of the data-driven analysis procedures that have been developed to select the final-state of interest. In particular, a kinematic fitter has been used to efficiently select the signal for this exclusive state. Additionally, we present and discuss the findings from an analysis that explores the role of intermediate processes involving intermediate baryon and mesonic excitations.

Hauptautor: PATTNAIK, Snehankit (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Co-Autoren: Dr. MESSCHENDORP, Johan (GSI); Prof. RITMAN, James (GSI)

Vortragende(r): PATTNAIK, Snehankit (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **82** Typ: **nicht angegeben**

Λ(1405) reconstruction in $\Sigma^0\pi^0$ decay channel with HADES detector

Donnerstag, 26. September 2024 10:15 (20 Minuten)

The structure of $\Lambda(1405)$ resonance challenges hadron physicists for more than forty years. Its structure is controversially debated as either: an antikaon-nucleon bound state, a dynamically generated baryon resembling a meson-baryon molecule, or a resonance with $\pi\Sigma$ and $\bar{K}N$ poles. Experimental results vary in line shape and peak position, depending on reaction type, making their interpretation very challenging.

The $\Sigma^+\pi$ and $\Sigma^-\pi^+$ decay channels of the $\Lambda(1405)$ had already been studied by HADES in $p+p$ collisions at 3.5 GeV, revealing a peak position below 1400 MeV/c^2 [1]. The new HADES electromagnetic calorimeter (ECAL) enables separation of the $\Lambda(1405)$ from $\Sigma(1385)$ by measuring the decay channel $\Sigma^0\pi^0$, which is not allowed for the latter. The exclusive analysis in the channel $p+K^+ +\Lambda(1405) \rightarrow \Sigma^0(\Lambda(p+\pi^-)+\gamma)+\pi^0(\gamma+\gamma)$ with missing π^0 is the most promising for HADES because of the largest acceptance. The main goal is to measure the line shape of $\Lambda(1405)$ and peak position. In my presentation, I will present the analysis strategy and show preliminary results. The strategy and its verifications are confronted with simulation results.

I will stress the importance of a new Forward Detector covering the very forward region ($0.5^\circ < \theta < 6^\circ$). Although it covers only a small fraction of the solid angle, it significantly increases acceptance for the hyperons.

An intermediate results of my analysis is inclusive Σ^0 production reconstructed via $\Sigma^0 \rightarrow \Lambda+\gamma$ and $\Lambda \rightarrow p+\pi^-$. The results of this analysis will be presented, too.

[1] G. Agakishiev et al. Baryonic resonances close to the anty-KN threshold: The case of Λ(1405) in pp collision. Phys. Rev. C87:025201, 2013.

Hauptautor: WŁADYSZEWSKA, Anna (Jagellonian University Krakow(JUK))

Vortragende(r): WŁADYSZEWSKA, Anna (Jagellonian University Krakow(JUK))

Sitzung Einordnung: Session

Beitrag ID: **83** Typ: **nicht angegeben**

A Look Inside mRICH: Exploring Timing and Performance of a RICH Prototype

Mittwoch, 25. September 2024 16:30 (20 Minuten)

The CBM (Compressed Baryonic Matter) experiment to be built at the future FAIR facilities in Darmstadt, Germany aims to investigate the QCD phase diagram at high-net baryon densities and moderate temperatures. The FAIR accelerator will provide high-intensity heavy-ion beams for this fixed target experiment. To ensure the best operability of CBM at day one, a prototype of CBM is set up already now, including scaled-down versions of almost all the detectors later to be employed in the final CBM setup. One main goal of this prototype, called mini-CBM (mCBM), is to establish the free-streaming readout scheme envisioned for CBM. To test this scheme a dedicated test beam time was carried out at the beginning of 2024.

This contribution will focus on the mRICH detector, being part of mCBM. The mRICH is a proximity focusing RICH detector using the same read-out electronics as the RICH detector in the final CBM experiment. Special focus is given to its timing performance which is crucial for a free streaming read-out setup. Additionally discussed will be its general performance mainly dependent on the installed aerogel radiator being in operation already for more than four years.

This work is supported by BMBF (05P21PXFC1)

Hauptautor: Herr DESHMUKH, Abhishek Anil (Bergische Universität Wuppertal(BUW))

Vortragende(r): Herr DESHMUKH, Abhishek Anil (Bergische Universität Wuppertal(BUW))

Sitzung Einordnung: Session

Beitrag ID: **84** Typ: **nicht angegeben**

Partial Wave Analysis for Pion-Induced Resonance Studies in the HADES Experiment

Mittwoch, 25. September 2024 09:35 (20 Minuten)

The High Acceptance Di-lepton Spectrometer (HADES) collaboration at GSI employs a pion beam to examine the characteristics of baryonic resonances and their decay channels. This pion-beam facility enables the generation of baryonic resonances at a fixed center of mass energy ($\sqrt{s}$), i.e. in the S-channel. Consequently, these beams possess a significant advantage over proton-induced reactions and are complementary to photo-induced studies conducted elsewhere. Partial Wave Analysis (PWA) techniques are used to study the coupling of the resonances to different final states. HADES has a particular interest in studying the role and medium modification of vector mesons in heavy-ion collisions in baryon-dense matter. Elementary pion-induced studies on the proton combined with a PWA will provide insights into the couplings of baryonic resonances to ρN and ωN final states in greater detail will provide insights into the impact of the melting of the ρ meson in heavy ion collisions and the involvement of intermediary vector mesons in dilepton emissions.

In anticipation of conducting a more comprehensive exploration of the resonance regions in pion-proton collisions, a new implementation of the K-Matrix & N/D frameworks is currently under development. This updated implementation aims to offer a refined mapping of these regions. Example fits will be presented showing current status and the potential of the new framework.

Hauptautor: FODA, Ahmed Marwan Abdelrahman (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Vortragende(r): FODA, Ahmed Marwan Abdelrahman (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **85** Typ: **nicht angegeben**

Production and electromagnetic structure studies of the $\triangle$ resonance in proton-proton collisions at 4.5 GeV with HADES

Mittwoch, 25. September 2024 11:25 (20 Minuten)

Radiative transitions and decays of hadrons provide valuable information on their electromagnetic structure. The electromagnetic structure of the lowest lying excitation of the nucleon, the Δ resonance, remains of particular interest. This is accessible via radiative transitions such as $\Delta \rightarrow \Delta\gamma$ with real or, preferably, virtual photons . The first challenge is to understand the production mechanism of the Δ baryons in proton-proton collisions and the second challenge lies in the identification of (mostly) low-mass dilepton pairs. The High Acceptance Di-Electron Spectrometer (HADES) at GSI Darmstadt is a versatile magnetic spectrometer designed for measuring wide range of charged particle final states across large angular acceptance. It has excellent e^+/e^- reconstruction and is ideal for performing these studies. The main aim of this analysis is to extract differential cross-sections for the exclusive Δ channels in proton-proton collisions at 4.5 GeV, which will serve as a good basis for comparison to theory for understanding the internal structure through radiative transitions and can also be used as a reference for heavy ion reactions. This presentation will focus on the initial results of the analysis of proton-proton scattering data collected in February 2022 by the HADES collaboration with the ambition to extract valuable information on the production mechanisms of Δ resonances in exclusive reactions.

Hauptautoren: SAHU, Saket Kumar; MESSCHENDORP, Johan (GSI Helmholtzzentrum für Schwerionenforschung GmbH); RITMAN, James (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Vortragende(r): SAHU, Saket Kumar

Sitzung Einordnung: Session

Beitrag ID: **86** Typ: **nicht angegeben**

Determining the reaction volume with CBM

Donnerstag, 26. September 2024 11:05 (20 Minuten)

The main goal of the Compressed Baryonic Matter (CBM) Experiment at FAIR is to probe the QCD phase diagram at high net-baryon densities and moderate temperatures with nucleus-nucleus collisions, in order to locate the possible first order phase transition from hadronic to partonic matter and its critical end point (CEP). The higher moments (cumulants) of conserved quantities, such as baryon number, strangeness and electrical charge, are suggested to be sensitive to the proximity of the CEP. In order to assess the behavior of these cumulants, it is crucial to determine the reaction volume. Indeed, different procedures for centrality selection, based on participant multiplicity with the STS detector or on spectator multiplicity with the new FSD detector, allow us to study reaction volume fluctuations and their impact on net-baryon cumulants. In this work, we explore these different procedures using the hadronic transport models SMASH and PHQMD.

Hauptautor: ARTUR, Beatriz (IFK)

Vortragende(r): ARTUR, Beatriz (IFK)

Sitzung Einordnung: Session

Beitrag ID: **87** Typ: **nicht angegeben**

Critical dynamics of non-equilibrium phase transitions

Freitag, 27. September 2024 10:15 (20 Minuten)

In context of the search for the QCD critical endpoint in heavy-ion collisions, a deep understanding of the out-of-equilibrium dynamics of the system is necessary to make well-grounded predictions for signatures in final states. To this end, we investigate the dynamic critical behavior of a classical scalar field theory with symmetry in the dynamic universality class of Model A in two and three spatial dimensions. The critical dynamics of the system are studied under a linear quench protocol, in which the external symmetry breaking field is changed at a constant rate through the critical point. We discuss the connection to the Kibble-Zurek mechanism and determine the dynamic critical exponent as well as universal scaling functions. These fully describe the non-equilibrium evolution of the system near the critical point for all quench rates under consideration. We find that, while the scaling functions are non-trivial, the corresponding scaling exponents are fully determined by the static critical exponents and the dynamic critical exponent. Finally, we perform a finite-size scaling analysis and observe good collapse of the data onto universal finite-size scaling functions.

Hauptautoren: HARHOFF, Mattis (Bielefeld University); Herr SIEKE, Leon (Justus-Liebig-Universität Gießen); Prof. VON SMEKAL, Lorenz (Justus-Liebig-Universität Gießen); Prof. SCHLICHTING, Soeren (Universität Bielefeld)

Vortragende(r): HARHOFF, Mattis (Bielefeld University)

Sitzung Einordnung: Session

Beitrag ID: **88** Typ: **nicht angegeben**

Di-Muon cocktail reconstruction using Machine learning technique in CBM experiment at FAIR SIS100 energies

Mittwoch, 25. September 2024 17:10 (20 Minuten)

The CBM experiment at FAIR-SIS100 will investigates strongly interacting matter at high baryon density and moderate temperature. One of proposed key observable is the measurement of the low mass vector mesons(LMVMs), which can be detected via their di-lepton decay channel. As the decayed leptons leave the dense and hot fireball without further interactions, they can provide unscathed information about the fireball, produced in energetic nuclear collisions.

We will report, simulation for the reconstruction of di-muon continuum spectra for AuAu 8AGeV central collisions using machine learning techniques for selection of muon track candidates. We compared the results from various ML models and with the traditional selection cuts for omega(ω), eta(η), phi(ϕ), rho (ρ)mesons and full di-muon cocktail spectra.

We have attempted to reconstruct LMVM (ω, η, ϕ, ρ) in the event by event mode following standard reconstruction software. Background of central Au-Au collisions at 8 AGeV was generated using UrQMD event generator, whereas for low mass vector mesons signals PLUTO event generator was used. Single LMVM decaying into μ^+ + μ^- was embedded into each background event. The particles are then transported through the upgraded detector setup using the GEANT3 transport engine. Various ML algorithams like Gradient boosted decision trees (BDTG), KNN, MLP, HMatrix etc. from the TMVA class have been employed for the present study.
From the simulation results, improvement in di-muon performance is reported. For comparable S/B ratio, the pair reconstruction efficiency and significance is seen to be increased significantly for ω, η, ϕ mesons using various ML models.

Hauptautoren: SHARMA, Pawan Kumar (Variable Energy Cyclotron Center (VECC)(VECC)); Herr MUKERJEE, Raktim (VECC Kolkata); Dr. BHADURI, Partha Pratim (VECC Kolkata); Herr AGARWAL, Apar (VECC Kolkata); Dr. DUBEY, Anand K. (VECC Kolkata)

Vortragende(r): SHARMA, Pawan Kumar (Variable Energy Cyclotron Center (VECC)(VECC))

Sitzung Einordnung: Session

Beitrag ID: **89** Typ: **nicht angegeben**

Performance Evaluation of Plastic Scintillator-Based Calorimeter Modules for Neutron Detection in the CBM Experiment

Donnerstag, 26. September 2024 16:50 (20 Minuten)

To enhance the neutron detection capabilities of the CBM experiment, the use of existing calorimeter modules based on plastic scintillators with photomultiplier tubes (PMTs) has been proposed. These modules are designed to be placed behind the Forward Spectator Detector (FSD), with expected neutron detection efficiencies of approximately 30%. Each module has a hexagonal shape, with a length of 45 cm and a side length of about 8 cm. The complete detector, comprising 86 modules, covers an area of approximately 1.3 m^2.

A test setup consisting of a package of 7 modules, along with two veto scintillator plates for charged particle separation, has been prepared and installed at the mCBM setup. This configuration aims to investigate the performance of the proposed neutron detector. During the mCBM test beam times in 2024, the detector was operational, utilizing the DiRICH readout system to feed data into the mCBM data acquisition (DAQ) system.

This presentation will discuss the beamtime results in comparison with Monte Carlo simulations, focusing on the detector's performance in proton-induced reaction channels with hydrogen and deuteron targets.

Hauptautor: OKROPIRIDZE, Dachi (Ruhr-Universität Bochum(RUB))

Vortragende(r): OKROPIRIDZE, Dachi (Ruhr-Universität Bochum(RUB))

Sitzung Einordnung: Session

Beitrag ID: **90** Typ: **nicht angegeben**

Self-consistent 3D radiative transfer for kilonovae

Dienstag, 24. September 2024 16:30 (20 Minuten)

We computed three-dimensional radiative transfer calculations for the ejecta from a neutron star merger with line-by-line opacities for tens of millions of atomic transitions, composition from an r-process nuclear network, and time-dependent thermalization of decay products from individual and – decay reactions. In contrast to expansion opacities and other wavelength-binned treatments, a line-by-line treatment enables us include fluorescence effects and associate spectral features with the emitting and absorbing lines of individual elements. We find variations in the synthetic observables with both the polar and the azimuthal viewing angles. The spectra exhibit blended features with strong interactions by Ce III, Sr II, Y II, and Zr II that vary with time and viewing direction. We demonstrate the importance of wavelength-calibration of atomic data using a model with calibrated Sr, Y, and Zr data, and find major differences in the resulting spectra, including a better agreement with AT2017gfo. The synthetic spectra for near-polar inclination show a feature at around 8000 Angstrom, similar to AT2017gfo. However, the spectra evolve on a more-rapid timescale, likely due to the low ejecta mass (0.005 M) as we take into account only the early ejecta. The comparatively featureless spectra for equatorial observers gives a tentative prediction that future observations of edge-on kilonovae will appear substantially different from AT2017gfo. We also show that 1D models obtained by spherically averaging the 3D ejecta lead to dramatically different direction-integrated luminosities and spectra compared to full 3D calculations. Going beyond the paper, I will also show some recent unpublished results for low-noise virtual-packet spectra using newly-available atomic data that have been calibrated to match known transition wavelengths.

Hauptautoren: Dr. SHINGLES, Luke (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); Dr. COLLINS, Christine (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); VIJAYAN, Vimal (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); FLÖRS, Andreas (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); JUST, Oliver (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); LECK, Gerrit; XIONG, Zewei (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); BAUSWEIN, Andreas (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); MARTINEZ PINEDO, Gabriel (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI)); Dr. SIM, Stuart (Queen's University Belfast)

Vortragende(r): Dr. SHINGLES, Luke (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **91** Typ: **nicht angegeben**

Hypernuclei studies in heavy-ion collisions with the CBM experiment

Donnerstag, 26. September 2024 16:30 (20 Minuten)

Under the extreme conditions of relativistic heavy-ion-collisions hypernuclei are created with large abundancies. Hypernuclei measurements provide insights into the equation-of-state of hadronic matter at high net-baryon densities, as well as into hyperon-nucleon and hyperon-hyperon-interactions. The Compressed Baryonic Matter (CBM) experiment at the future Facility for Anti-Proton and Ion Research (FAIR) in Darmstadt offers the perfect conditions to explore the production of hypernuclei. The excitation function of hypernucleus production is predicted to exhibit a maximum in the FAIR energy range. In combination with the foreseen high interaction rates of up to 10 MHz, an exceptionally high amount of hypernuclei will be created and even very rare double hypernuclei like ${}^{6}_{\Lambda\Lambda}$He are expected with sizeable statistics.

The reconstruction of the hypernuclei-3-body-decay was implemented into the CBM reconstruction software and optimized with respect to important performance indicators. In addition, the reconstruction was performed with a neural network. Expected efficiencies and signal-to-background-ratios were calculated with both approaches for a reliable estimation of the number of reconstructable hypernuclei and systematic uncertainties were studied. The experimental sensitivity to properties of hypernuclei, such as their lifetime, was evaluated. Results for ${}^{3}_{\Lambda}\mathrm{H}\rightarrow \mathrm{d+p+}\pi^{-}$ as a case study for the rare 3-body-decay of ${}^{6}_{\Lambda\Lambda}$He will be discussed in detail. The Parton-Hadron-Quantum-Molecular-Dynamics (PHQMD) approach, which includes the production of nuclei and hypernuclei, was employed as input for the detector simulations. The established PHSD model has been extended by a QMD approach which allows to propagate n-body correlations. This is essential for the cluster formation based on attractive potentials between baryons, providing valuable predictions for the upcoming CBM experiment. (Work supported by DFG-grant BL 982/3-1 and BMBF-grant 05P21RFFC3.)

Hauptautoren: GLAESSEL, Susanne (Goethe-Universität Frankfurt(UFfm-IKP)); BLUME, Christoph (Goethe-Universität Frankfurt(UFfm-IKP))

Vortragende(r): GLAESSEL, Susanne (Goethe-Universität Frankfurt(UFfm-IKP))

Sitzung Einordnung: Session

Beitrag ID: **92** Typ: **nicht angegeben**

Investigating Proton-Proton Elastic Scattering with the Upgraded HADES Spectrometer

Mittwoch, 25. September 2024 11:05 (20 Minuten)

An experiment focused on hyperon production was carried out in 2022 with the upgraded HADES spectrometer. The upgrade includes a new Forward Detector system (FD) consisting of two PANDA-type Straw Tracking Stations, and an RPC. The measurements were performed with a T = 4.5 GeV proton beam impinging onto a LH_2 target.
Proton-proton elastic scattering events were selected based on kinematic observables, and demanding that one proton was detected in the FD ($\theta_{FD} < 6°$), and the other proton was measured in the main HADES acceptance (70° $< \theta_H <$79°). The number of elastic events, corrected for acceptance and reconstruction efficiency, determines the time-integrated luminosity recorded during this experiment. The measured differential cross-section $d\sigma$ as a function of the square of the 4-momentum transfer t is well described by a function of the form $d\sigma/dt = Ae^{-B|t|}$, from which the optical point $A = d\sigma/dt\big|_{t=0}$ and the nuclear slope parameter B are obtained. In this talk, the proton-proton elastic scattering event selection will be explained, and preliminary results of A and B will be presented and compared with existing data from other experiments.

Hauptautor: PEREZ ANDRADE, Gabriela (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Vortragende(r): PEREZ ANDRADE, Gabriela (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **94** Typ: **nicht angegeben**

Recent highlights from the STAR Experiment

Dienstag, 24. September 2024 18:00 (20 Minuten)

This talk will delve into the latest correlation and fluctuation measurements derived from the RHIC Beam Energy Scan-II (BES-II) data, collected by the STAR experiment. We will focus the recent results on higher-order net-proton cumulants ($C_1 - C_6$) and transverse momentum correlations and fluctuations from BES-II data.

Specifically, for the higher order proton cumulants, we will discuss findings from two sets of results from the BES-II data. Firstly, for 3.0 GeV Au+Au collisions, proton cumulants ($C_1 - C_6$) and their corresponding ratios across various centrality classes, building upon previously published results. Secondly, in the energy range of 7.7 to 27 GeV Au+Au collisions, collision energy dependence of cumulants ($C_1 - C_4$) and their ratios.

Furthermore, we will present measurements of transverse momentum correlations and fluctuations, particularly focusing on 2-particle correlators and their dependency on centrality at 3.0 and 3.2 GeV
Au+Au collisions.

Hauptautor: MANIKANDHAN, Rutik (University of Houston)

Vortragende(r): MANIKANDHAN, Rutik (University of Houston)

Sitzung Einordnung: Session

Beitrag ID: **96** Typ: **nicht angegeben**

The rho-pi puzzle and vector glueball mixing

Freitag, 27. September 2024 11:45 (20 Minuten)

The $\Psi(2S)$ is identified as the radial excitation of the J/Ψ. Based on perturbative QCD, the branching ratio of the $\Psi(2S)$ into some final hadron state should be approximately 12% of the branching ratio of the J/Ψ to that same hadron final state. This is called the "12% rule". However, certain decay channels such as the $\rho\pi$ severely violate this 12% rule. Using the extended Linear Sigma Model, we study the effect a small mixing angle between the $\Psi(2S)$ and the vector glueball can have on the 12% rule.

Hauptautoren: VEREIJKEN, Arthur (Jan Kochanowski University); GIACOSA, Francesco (Frankfurt University)

Vortragende(r): VEREIJKEN, Arthur (Jan Kochanowski University)

Sitzung Einordnung: Session

Beitrag ID: **98** Typ: **nicht angegeben**

Development of a gas system for the Transition Radiation Detector of the CBM experiment

Donnerstag, 26. September 2024 18:00 (20 Minuten)

The Compressed Baryonic Matter (CBM) experiment at the Facility for Antiproton and Ion Research (FAIR) in Darmstadt, Germany, aims to explore the QCD phase diagram at high baryon densities through high-energy nucleus-nucleus collisions and explore new states of matter. One of the crucial components of the CBM experiment is the Transition Radiation Detector (TRD), which is essential for identifying electrons with a momentum above ⍰>1 GeV/c. A high detection efficiency of better than 90% is required.
The TRD is composed of two parts: the Read-Out Chamber (ROC) and the radiator. Transition Radiation (TR) photons are generated in the radiator by electrons with a certain probability, while heavier pions pass through without producing any TR. The TRD uses a mixture of the noble gas xenon and the quenching gas CO2. Xenon is chosen because of its high absorption cross-section for photons in the TR spectral range.
Since xenon is an expensive gas, a critical part of the TRD is its gas system, which must maintain a stable and optimal mixture in a closed circuit. The design of this gas system also involves considerations of gas purity, flow rates, and pressure stability to ensure efficient charged particle and transition radiation detection, thereby maximizing the detector resolution and efficiency. To accurately identify electrons amidst a high background of other particles. The gas overpressure in the TRD must be precisely controlled and kept in a range of about 0.2 –0.6 mbar.
This report discusses the gas system requirements. The status of a gas system prototype and plans for its development into a full-size system will be presented. This includes the design of the gas distribution and circulation system and the implementation of monitoring systems.

Hauptautor: PODGORNOV, Nikolai

Co-Autoren: RITMAN, James (Forschungszentrum Jülich(FZJ)); WINTZ, Peter (Forschungszentrum Jülich)

Vortragende(r): PODGORNOV, Nikolai

Sitzung Einordnung: Session

Beitrag ID: **99** Typ: **nicht angegeben**

Physical Riemann surfaces of the lambda baryon's form factors ratio

Freitag, 27. September 2024 11:25 (20 Minuten)

Recently, the BESIII collaboration has produced new data for the Λ baryon electric and magnetic form factor's ratio G_E^Λ/G_M^Λ in the time-like region with high accuracy. By assuming the analyticity of the baryon form factors, a dispersive procedure can be used to analyze the data under a set of theoretical constraints. The dispersive procedure allows to determine behaviour of the modulus and the phase of the form factor's ratio in the time-like and space-like regions. Different classes of solutions are taken into account, and the results shed new light on interesting properties, such as the presence of zeroes of the form factor's ratio in the space-like region. The new data, alongside the ones previously obtained by the collaboration, are used to eliminate the uncertainty on the ratio's phase showing new aspects of the Λ form factors which were unaccessible until now.

Hauptautor: Dr. ROSINI, Francesco (Università degli Studi di Perugia)

Co-Autor: Prof. PACETTI, Simone (Università degli Studi di Perugia)

Vortragende(r): Dr. ROSINI, Francesco (Università degli Studi di Perugia)

Sitzung Einordnung: Session

Beitrag ID: **101** Typ: **nicht angegeben**

The QCD phase diagram: a theoretical overview

Mittwoch, 25. September 2024 09:00 (35 Minuten)

The phase diagram of nuclear matter is one the most fundamental pieces of knowledge in modern physics, reflecting how QCD governs the thermodynamics of matter under extreme conditions. Not only related to the understanding of the early Universe, or used to describe the evolution of the system created in relativistic heavy-ion collisions, it has gained even more insights in the past years through the observation of neutron star mergers with gravitationnal waves. In this talk, I will review the main theories, models and approaches used to explore this phase diagram at finite temperature and densities, as well as the most recent updates in this regard.

Hauptautor: Dr. JAHAN, Johannes (University of Houston)

Vortragende(r): Dr. JAHAN, Johannes (University of Houston)

Sitzung Einordnung: Session

Beitrag ID: **102** Typ: **nicht angegeben**

ϕ meson production from K^+K^- decay channel in p(4.5 GeV)+p with HADES at GSI

Dienstag, 24. September 2024 16:50 (20 Minuten)

The High Acceptance Di-Electron Spectrometer (HADES) at GSI, Darmstadt, Germany, is an experimental setup designed to investigate the hadronic matter in regions of large net baryon densities and moderate temperatures. It achieves this through fixed-target heavy-ion collisions with incident energies in the range of a few GeV/nucleon. This program is associated with proton and pion-induced reactions that provide important references. One of the recent endeavors by the HADES collaboration, in February 2022, involves the measurement of proton-proton reactions with an incident beam energy of 4.5 GeV. ϕ meson production is one of the intriguing channels that this experiment can measure, either through its decay into an e^+e^- pair or a K^+K^- pair. It remains an open question how this meson, primarily composed of $s\bar{s}$ pairs according to the quark model, is produced in a proton-proton collision. This work primarily focuses on examining the ϕ meson via its K^+K^- decay channel in the p(4.5 GeV)p $\rightarrow$ ppK^+K^- reaction.
This talk will provide an overview of the current analysis status of the ϕ meson channels. This analysis encompasses data collected from various detectors, including the tracking system, Mini Drift Chamber (MDC), Inner time-of-flight (iTOF), and FORWARD detector. It involves several crucial steps: tracking, and identifying kaons and protons through correlations between momentum and energy loss and velocity, subtracting background, and applying efficiency and acceptance corrections. This talk will also include preliminary results of the ϕ meson's angular distribution and cross-section. A very primitive hint of ϕ meson polarisation will also be discussed.

Hauptautor: DEB, Suman (Lab de Physique des 2 infinis Irène Joliot-Curie(IJCLab))

Vortragende(r): DEB, Suman (Lab de Physique des 2 infinis Irène Joliot-Curie(IJCLab))

Sitzung Einordnung: Session

Beitrag ID: **104** Typ: **nicht angegeben**

CP violation tests in hyperon decays at BESIII

Donnerstag, 26. September 2024 09:00 (35 Minuten)

The hyperons are produced with a non-zero spin polarization that is straight-forward to parameterize in processes involving virtual photons or vector mesons, enable direct and precise CP violation tests. These CP tests can be performed on e.g. $J/\psi, \psi' \to \Lambda\bar{\Lambda}$, $\Xi\bar{\Xi}$ and $\Sigma\bar{\Sigma}$. For the cascade hyperon decay the exclusive measurement of the final state particles allows for three independent CP-symmetry tests and the determination of the strong and weak phase differences. Thanks to the world's largest data samples at the J/ψ and ψ' resonances collected at the BESIII experiment, the multi-dimensional analyses making use of polarization and entanglement have been performed for these processes.

Hauptautor: BATOZSKAYA, Varvara (IHEP, NCBJ)

Vortragende(r): BATOZSKAYA, Varvara (IHEP, NCBJ)

Sitzung Einordnung: Session

Beitrag ID: **105** Typ: **nicht angegeben**

High-Resolution Dielectronic Recombination of Berylliumlike Gold Ions at the Electron Cooler of the CRYRING@ESR Storage Ring

Dienstag, 24. September 2024 09:55 (20 Minuten)

Electron-ion collision spectroscopy is a very successful approach for studying the properties of highly charged ions [1-3], in particular if low-energy dielectronic recombination (DR) resonances are scrutinized. The heavy-ion storage ring CRYRING@ESR of the international FAIR facility in Darmstadt,Germany, is particularly attractive for DR studies, since it is equipped with an electron cooler that provides an ultra-cold electron beam promising highest experimental resolving power and precision. Due to its high precision, DR spectroscopy at the CRYRING will allow us to sensitively probe higher-order contributions to state-of-the-art quantum-electrodynamical (QED) calculations of binding energies in strong fields.

At the FAIRNESS, we will report on the results from an DR experiment with highly charged gold ions, which were injected into CRYRING@ESR from the full chain of GSI accelerators consisting of the linear accelerator UNILAC, the heavy-ion synchrotron SIS18, and the high-energy storage ring ESR. The Be-like gold ions (Au75+) were produced by stripping at an energy of about 12 GeV and injected into ESR, where they were cooled and decelerated to an energy of 12 MeV/u. Finally, an average of 5×106 ions per cycle were injected into the CRYRING where the beam lifetime was about 30 s, mainly limited by collisions with residual gas particles.

DR spectra in the collision-energy range 0 –300 eV were measured, where among others the 2s2p (3P1) 19l, 2s2p (3P1) 26l and 2s2p (3P1) 32l resonances occur that are associated with 2s2 1S0 ⟶2s2p 3P1 excitations of the Be-like ion core. The analysis of the data is currently in progress. We will present preliminary comparisons of our experimental DR spectra with corresponding theoretical results.

References:
[1] S. Schippers, Nucl. Instrum. Methods Phys. Res B 350, 61 (2015)
(DOI:10.1016/j.nimb.2014.12.050).
[2] C. Brandau, C. Kozhuharov, M. Lestinsky, A. Müller, S. Schippers, and T. Stöhlker, Phys. Scr. T166,
014022 (2015) (DOI : 10.1088/0031-8949/2015/T166/014022).
[3] A. Müller, Adv. At. Mol. Opt. Phys. 55, 293 (2008) (DOI: 10.1016/S1049-250X(07)55006-8).

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Sitzung Einordnung: Session

Beitrag ID: **106** Typ: **nicht angegeben**

Laser cooling of intense relativistic beams of heavy highly charged ions

Dienstag, 24. September 2024 09:00 (35 Minuten)

Vortragende(r): Dr. WINTERS, Danyal (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **107** Typ: **nicht angegeben**

Topical review on neutron star mergers

Dienstag, 24. September 2024 11:10 (35 Minuten)

Vortragende(r): COLLINS, Christine (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **108** Typ: **nicht angegeben**

Nuclear structure related to NUSTAR and FAIR

Freitag, 27. September 2024 09:00 (35 Minuten)

Vortragende(r): MENENDEZ, Javier (University of Tokyo)

Sitzung Einordnung: Session

Beitrag ID: **109** Typ: **nicht angegeben**

TBD

Vortragende(r): RUSTAMOV, Anar (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session

Beitrag ID: **110** Typ: **nicht angegeben**

Status of the FAIR project

Dienstag, 24. September 2024 10:15 (20 Minuten)

Vortragende(r): WINTERS, Natalya (GSI Helmholtzzentrum für Schwerionenforschung GmbH(GSI))

Sitzung Einordnung: Session