HK 39: Computing II

Time: Wednesday 14:00–16:00 Location: HK-H5

HK 39.1 Wed 14:00 HK-H5

Machine Learning Algorithms for Pattern Recognition with the PANDA Barrel DIRC — •Yannic Wolf — GSI Helmholtzzentrum für Schwerionenforschung

Precise and fast hadronic particle identification (PID) is crucial to reach the physics goals of the PANDA detector at FAIR. The Barrel DIRC (Detection of Internally Reflected Cherenkov light) is a key detector for the identification of charged hadrons in PANDA. Several reconstruction algorithms have been developed to extract the PID information from the measured location and arrival time of the Cherenkov photons. In comparison to other Ring Imaging Cherenkov detectors, the hit patterns observed with DIRC counters do not appear as rings on the photosensoer plane but as complex, disjoint 3D-patterns.

Using the recent advances in machine learning (ML) algorithms, especially in the area of image recognition, we plan to develop new ML PID algorithms for the PANDA Barrel DIRC and compare the results to conventional reconstruction methods.

HK 39.2 Wed 14:15 HK-H5

Event Analysis for the FAIR Phase-0 Experiment at MAMI — •Julian Moik[1], Luigi Capozza[1], Alaa Dbeyssi[1], Alexander Greiner[1], Samet Katilmis[1,2,3], Dong Liu[1], Frank Maas[1,2,3], Oliver Noll[1,2], Peter Bernd Otte[1], David Rodriguez Pineiro[1], Christoph Rosner[1], and Sahra Wolff[1] for the PANDA-Collaboration — [1]Helmholtz-Institut Mainz, Germany — [2]Institute of Nuclear Physics, Johannes Gutenberg University, Mainz,Germany — [3]PRISMA Clus- ter of Excellence, Mainz, Germany

The PANDA experiment at the future FAIR facility requires a complex detector system, whose backward calorimeter is being developed by the EMP group at the Helmholtz Institute in Mainz. A preliminary version of this detector will be used in a PANDA FAIR Phase-0 experiment at the electron accelerator MAMI for a measurement of the electromagnetic transition form factor of the neutral pion.

Primasoft is a Geant4 based Monte Carlo simulation environment designed specifically for this experiment. By working with simulated pion events, analysis methods can be developed while the experiment is still under construction. In this context a neural network was developed to assist in the event reconstruction process. More specifically a feed forward network was implemented to improve the position reconstruction and the energy estimation of measured particles, thereby improving the error of the kinematic variables.

HK 39.3 Wed 14:30 HK-H5

Using Neural Network regression to describe the expected energy loss in the ALICE TPC in Run3 — •Christian Sonnabend for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

The ALICE experiment at CERN uses the largest Time Projection Chamber (TPC) built to date to identify particles that are created in collisions at the LHC. Particle identification is done by simultaneous measurement of the specific energy loss ($\mathrm{d}E/\mathrm{d}x$) and momentum (p) of the traversing particles, and comparison to the expected energy loss described by a Bethe-Bloch function. However, in practice, the expected $\mathrm{d}E/\mathrm{d}x$ cannot be described by a simple one-dimensional function, but several effects have to be taken into account. E.g. the inclination angle of a particle track has an effect on the charge deposited in a given region of the TPC readout, thus changing its $\mathrm{d}E/\mathrm{d}x$ signal (η-correction (pseudorapidity)). In order to correct for such effects, fits to a multidimensional parameter space consisting of e.g. p, η, multiplicity or particle mass are performed to adjust the expected $\mathrm{d}E/\mathrm{d}x$ signals of the tracks.

With the application of Machine Learning in particle physics, new methods can be exploited to extract such functional forms. Thus, a variety of neural network fits to data are conducted to investigate their performance and compare their ability to describe deviations of the expected energy loss from an input Bethe-Bloch parametrisation in a multi-dimensional space.

HK 39.4 Wed 14:45 HK-H5

Reconstruction of Photon Conversions with the ALICE Transition Radiation Detector — •Martin Kroesen for the ALICE-Collaboration — Physikalisches Institut, Universität Heidelberg

So called direct photons give us an undisturbed insight to the Quark Gluon Plasma created in relativistic heavy ion collisions. A huge statistics is needed for this analysis since the background is large and the reconstruction efficiency via the Photon Conversion Method (PCM) relatively low. Therefore the ALICE Transition Radiation Detector (TRD), which is located at a radius of about 3 m, is now employed for photon reconstruction using the PCM. It is shown that it is possible to reconstruct these photons with the TRD information only. This enables an increase of the total photon efficiency in ALICE as well as a cross check additional to the standard reconstruction of photon conversions in the Time Projection Chamber. For that purpose a full stand alone tracking algorithm using a combinatorial search was developed. Based on TensorFlow a high precision photon hypothesis test and parameter fit completes the reconstruction by exploiting topological constraints. The stand alone TRD tracks can also be used for other purposes such as calibration or nuclear interaction analyses. First results from the p-Pb run in 2018 are presented, showing a peak for $\pi^0 \to \gamma\gamma \to e^+e^-e^+e^-$.

HK 39.5 Wed 15:00 HK-H5

Analysis status of ETOF at STAR — •Yannick Söhngen — Physikalisches Institut Universität Heidelberg

In 2025/2026 the CBM-Experiment will start operation at the SIS100, currently under construction at FAIR in Darmstadt. To facilitate a smooth start of physics analysis of the experiments at the SIS100 the FAIR Phase 0 program comprises the usage of pre-series equipment in running experiments. As part of the CBM-TOF FAIR Phase 0 program an Endcap-Time-Of-Flight (ETOF) wheel consisting of 108 RPC*s designed for the CBM-TOF wall, was operated at the STAR-Experiment located at RHIC at Brookhaven. This provides on the one hand the opportunity to study the impact of long periods of operation on the system and the detectors and thus helps to streamline the decision-making process for the CBM TOF-Wall. This provides on the one hand the opportunity to explore the physics reach of the installed counters with their superb timing resolution. Of special interest is the performance in the Fixed Target BESII campaign covering the available energy in the CMS range from 3GeV to 13GeV. The status of the data-analysis chain, integrating CBM-analysis elements, and its modeling in the STAR Monte-Carlo framework will be presented and discussed. Preliminary results for the production of the Phi meson and the Lambda baryon will be shown. The project is partially funded by BMF contract 05P21VHFC1.

HK 39.6 Wed 15:15 HK-H5

The PUNCH4NFDI consortium in the NFDI - status, first results, and outlook — •Thomas Schörner for the PUNCH4NFDI-Collaboration — Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg

With the "Nationale Forschungsdateninfrastruktur" (NFDI, national research data infrastructure), a massive effort is undertaken in Germany to provide a coherent research data management, to make research data sustainably utilisable and to implement the FAIR data principles. PUNCH4NFDI is the consortium of particle, astro- and astroparticle, as well as hadron and nuclear physics within the NFDI. It aims for a FAIR future of the data management of its community and at harnessing its massive experience not least in "big data" and "open data" for the benefit of "PUNCH" sciences (Particles, Universe, NuClei and Hadrons) as well as for physics in general and the entire NFDI. In this presentation, we will introduce the work programme of PUNCH4NFDI, its connection to everyday work in the physical sciences and beyond, and in particular the idea of digital research products and the PUNCH science data platform.

HK 39.7 Wed 15:30 HK-H5

Simulation Method for Calculating the Summing Effect Correction Factor — •Yanzhao Wang, Jan Mayer, Felix Heim, and Andreas Zilges — University of Cologne, Institute for Nuclear Physics, 50937 Cologne, Germany

γ-ray spectrometers have been utilized to investigate the radioactive properties of either activation or in-beam experiments since decades. One of the main problems undermining the measurement accuracy is

called coincidence summing, which occurs when multiple γ-rays have energy depositions at the same detector almost simultaneously [1]. To offset this effect, correction factors on the initial γ-ray countings are calculated using the GEANT4-based Monte Carlo simulation of consecutive emissions from all possible γ-ray cascades in the decay scheme. Compared to traditional analytical methods, the method presented in this talk does not only simplify the calculating procedure in case of complex decay schemes, but also is more accurate with the consideration of the Compton scattering in the detector volume.
Supported by the BMBF (05P21PKFN1).
[1] T.M. Semkow *et al.*, Nucl. Instrum. Methods Phys. Res. A **290** (1990) 437

HK 39.8 Wed 15:45 HK-H5

anan — ein Debugger für Hochleistungsrechner — •Alexander Adler — Goethe-Universität Frankfurt

Das Projekt anan ist ein Werkzeug zur Fehlersuche in verteilten Hochleistungsrechnern. Die Neuheit des Beitrags besteht darin, dass die bekannten Methoden, die bereits erfolgreich zum Debuggen von Soft- und Hardware eingesetzt werden, auf Hochleistungs-Rechnen übertragen worden sind. Im Rahmen der vorliegenden Arbeit wurde ein Werkzeug namens anan implementiert, das bei der Fehlersuche hilft. Außerdem kann es als dynamischeres Monitoring eingesetzt werden. Beide Einsatzzwecke sind getestet worden.

Das Werkzeug besteht aus zwei Teilen:

1. aus einem Teil namens anan, der *interaktiv* vom Nutzer bedient wird

2. und aus einem Teil namens anand, der *automatisiert* die verlangten Messwerte erhebt und nötigenfalls Befehle ausführt.

Der Teil anan führt *Sensoren* aus — kleine mustergesteuerte Algorithmen —, deren Ergebnisse per anan zusammengeführt werden. In erster Näherung lässt anan sich als Monitoring beschreiben, welches (1) schnell umkonfiguriert werden (2) komplexere Werte messen kann, die über Korrelationen einfacher Zeitreihen hinausgehen.