T 89: Experimentelle Methoden 3

Zeit: Mittwoch 16:45–19:00 Raum: JUR 253

T 89.1 Mi 16:45 JUR 253

Optimierung der Zeitauflösung eines endoskopischen TOF-PET-Systems — •Ole Brandt, Bastian Lunow, Milan Zvolsky und Erika Garutti — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

Im Rahmen des EndoTOFPET-US-Projekts wird ein neuartiges multimodales Gerät zur Ultraschall-Endoskopie und Positronen-Emissions-Tomographie (PET) von Prostata- und Pankreas-Karzinomen entwickelt. Das Gerät besteht aus einem miniaturisierten PET-Kopf, installiert auf einem komerziellen Ultraschall-Endoskop und einer externen Detektor-Platte, die in unmittelbarer Nähe zum Körper positioniert wird. Dieses nutzt die Flugzeit (TOF)-Information der detektierten Photonen, um Untergrund von naheliegenden Organen zu unterdrücken. Dazu soll eine Koinzidenz-Zeitauflösung von unter 300 ps FWHM erreicht werden. Die Detektion der Photonen erfolgt mittels Szintillationskristallen, ausgelesen durch Silizium-Photomultiplier (SiPM). Die Verarbeitung der SiPM-Signale erfolgt durch den STiC-Chip (SiPM Timing Chip, Uni Heidelberg). Dieser nutzt die time-over-threshold-Methode, um Energie- und Zeitinformation der eintreffenden Photonen zu extrahieren. Um die bestmögliche Zeitauflösung des Systems zu erreichen, werden die relevanten Parameter des Chips sowie die angelegte Bias-Spannung optimiert.

T 89.2 Mi 17:00 JUR 253

Track Based Alignment for the Mu3e Detector — •Ulrich Hartenstein for the Mu3e-Collaboration — JGU Mainz

The Mu3e experiment searches for the lepton flavor violating decay $\mu \rightarrow e^+e^-e^+$ with a sensitivity goal for the branching fraction of better than 10^{-16}. This process is heavily supressed in the standard model of particle physics ($\mathcal{BR} < 10^{-50}$) which makes an observation of this decay a clear indication of new physics. For track reconstruction, four barrel shaped layers consisting of about 3000 high-voltage monolithic active pixel sensors (HV-MAPS) are used. The position, orientation and possible deformations of these sensors must be known to greater precision than the assembly tolerances. A track based alignment via the General Broken Lines fit and the Millepede-II algorithm will be used to achieve this precision in the final detector.
The talk will discuss preparations for aligning the detector using a detailed simulation. A set of alignment parameters that not only describe the position and rotation but also deformations of individual pixel sensors will be introduced. An alignment for these kind of parameters is - due to the very thin ($50\mu m$) pixel sensors - essential for the Mu3e detector.

T 89.3 Mi 17:15 JUR 253

Photon rejection for the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ measurement and search for the $\pi^0 \rightarrow$ invisible decay at the NA62 experiment — •Letizia Peruzzo — Johannes Gutenberg University Mainz

In June 2015 the NA62 experiment at CERN began its physics data taking with the aim to collect in three years around 100 $K^+ \rightarrow \pi^+\nu\bar{\nu}$ events and measure the branching ratio with a precision about 10%. Well predicted inside the Standard Model, $Br(K^+ \rightarrow \pi^+\nu\bar{\nu}) = (9.11 \pm 0.72) \cdot 10^{-11}$, this decay is closely related to the CKM matrix elements $|V_{td}|$ and $|V_{ts}|$ and any deviation from the theoretical Br could open many scenarios of physics beyond the Standard Model. The suppression of the main K^+ decays, which have Br several order of magnitude higher than the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ signal, is the primary task of NA62. In particular two types of decays are very crucial to suppress: $K^+ \rightarrow \mu^+\nu$ and $K^+ \rightarrow \pi^+\pi^0$. For this reason good particle identification and photon veto systems are needed for the experiment. A directly spin-off of the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ measurement is the search for the $\pi^0 \rightarrow$ invisible decay where the π^0 comes from $K^+ \rightarrow \pi^+\pi^0$ events. The same signature of $\pi^0 \rightarrow$ invible with respect the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ signal allows to perform the two measurements using the same dataset and analysis pillars. This talk describes the NA62 photon rejection performance reached in the 2016 run and the perspective for the measurement of $\pi^0 \rightarrow$ invisible.

T 89.4 Mi 17:30 JUR 253

Comparison of Methods to analyze Crosstalk of Silicon Photomultipliers — •Lukas Maderer, Patrick Hufschmidt, Judith Schneider, Michael Wagenpfeil, Tobias Ziegler, and Thilo Michel — ECAP Uni Erlangen

Silicon Photomultipliers are devices for detection of low light intensities. An important parameter when characterizing these devices is the probability for correlated avalanches. Especially Crosstalk can be a problem for single photon measurements. Since there are multiple methods of analyzing Crosstalk present in literature leading to different results, we compare several of them based on the same data. One method measures the probability that a Crosstalk occurs, while the other one focuses on the mean number of Crosstalk events per initial avalanche. The first method yields to a linear dependency on the overvoltage, the second one to a quadratic dependency.

T 89.5 Mi 17:45 JUR 253

Instrumentation of the Guard Ring Electrode of Coplanar-Grid CdZnTe Detectors for the COBRA Experiment — •Jan-Hendrik Arling for the COBRA-Collaboration — TU Dortmund, Experimentelle Physik IV, Dortmund — now at Deutsches Elektronen-Synchrotron DESY, Hamburg

A novel method to suppress alpha induced background in the COBRA experiment is presented here. The experiment's aim is to search for neutrinoless double beta-decay ($0\nu\beta\beta$) using CdZnTe semiconductor detectors with a coplanar-grid (CPG) readout. The next phase of COBRA will be the installation of the extended demonstrator (XDEM) consisting of CdZnTe detectors with a volume of $(2 \times 2 \times 1.5)\,\text{cm}^3$ and applying an adjusted coplanar quad-grid (CPqG) readout. The CPqG anodes are surrounded by an outer electrode called guard ring. It is used to reduce leakage currents as well as to increase the homogeneity of the weighting potential. In the standard case, the guard ring is left on a floating potential. Recent results from laboratory measurements showed that setting the charge-collecting ground potential to it can lead to a great suppression of alpha induced events in the order of 99.9 %. Current recorded physics data indicate that the main background contribution is due to alpha contaminations on the detector surfaces. Therefore, the instrumentation and readout of the guard ring electrode can be highly beneficial in terms of background reduction for the COBRA experiment.

T 89.6 Mi 18:00 JUR 253

Muon Pion Separation for the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ Measurement at the NA62 Experiment — •Riccardo Aliberti — Johannes Gutenberg University Mainz

The ambitious goal of the NA62 experiment is to achieve a direct measurement of the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ branching ratio with an accuracy around 10%. This decay has a theoretical BR of 0.85×10^{-10} with a single track detectable: the π^+.
The main decay channels of charged kaons have rates several orders of magnitude larger than those for the signal. For this reason the presence of a very efficient veto system to reject background events is mandatory.
The discrimination between muons and pions represents one of the central topics for the measurement of the $K^+ \rightarrow \pi^+\nu\bar{\nu}$ decay. This talk presents the latest results on the muon pion separation achieved in the NA62 2016 run.

T 89.7 Mi 18:15 JUR 253

Pulse Shape Discrimination mit dem DRS4 Evaluation Board — John Kettler[2], Oliver Pooth[1], Achim Stahl[1], Simon Weingarten[1] und •Christian Dziwok[1] — [1]III. Physikalisches Institut B, RWTH Aachen University, D-52056 Aachen — [2]NET, RWTH Aachen University, Elisabethstr. 16, D-52056 Aachen

In Zusammenarbeit mit dem Institut für Nukleare Entsorgung und Techniktransfer (NET) entwickelt das III. Physikalische Institut B ein Detektorkonzept zur Tomographie mit schnellen Neutronen.Im Detektor werden szintillierende Kristalle und Silizium-Photomultiplier (SiPM) verwendet. Die Auslese erfolgt über den FPGA des DRS4 Evaluation Boards (Paul Scherrer Institute), eine programmierbare Ringspeicher-ADC Einheit. Die Herausforderung liegt in der Unterscheidung zwischen Neutronen- und Photonensignalen. Derzeit wird offline eine Analyse der Pulsform (Pulse-Shape-Discrimination) durchgeführt. Dazu müssen die einzelnen Pulse vollständige zeitintensiv übermittelt werden.

Ziel dieser Arbeit ist es, die Pulse-Shape-Discrimination in die FPGA-Logik des DRS4 Evaluation Boards zu integrieren um die zu sendende Datenmenge zu reduzieren, dabei die aufwendige Offline-Analyse zu ersetzen und die maximale Ausleserate zu steigern. In einer weiteren Ausbaustufe soll die Möglichkeit eruiert werden, das Kamerabild einer Kamera aus Stilbenkristallen mit vier mal vier Pixeln ebenfalls online auf dem DRS4 Board zu erstellen.

T 89.8 Mi 18:30 JUR 253

Momentum transfer reconstruction for the P2 Experiment — •Alexey Tyukin for the P2-Collaboration — Institute for Nuclear Physics, Johannes Gutenberg University, Mainz

The P2 experiment at the future MESA accelerator in Mainz is designed to determine the Weinberg angle, a core parameter of the weak force, with great precision. It will require measuring a parity violating asymmetry of elastically scattered electrons from a liquid hydrogen target for different beam polarisations, which depends heavily on the momentum transfer Q^2. Therefore a reconstruction of the electron tracks in the inhomogeneous magnetic field of the P2 detector is essential. For this, the detector will have four tracking planes of thin high voltage monolithic active pixel sensors (HV-MAPS).

In this talk the method of Q^2 reconstruction will be shown. A Geant4 simulation is used to produce electron tracks and hits in the detection planes. For track reconstruction the General Broken Lines fit is used, which requires propagating seed parameters to all planes in order to determine a good approximation of the real parameters at the first plane, which can then be extrapolated back to the target. The propagation is done by solving the equation of motion numerically with a Runge-Kutta method. In each step also the track parameter error matrix needs to be calculated by the Bugge-Myrheim method. Systematical effects producing offsets in the reconstructed values must be kept under control. The average Q^2 value of $0.006\,\mathrm{GeV}^2/c^2$ can be reconstructed with about 4% uncertainty for a single event, leading to a high overall precision due to large electron rates in the experiment.

T 89.9 Mi 18:45 JUR 253

Parameterization-based tracking for the P2 experiment — •Iurii Sorokin for the P2-Collaboration — Prisma Excellence Cluster — Institute for Nuclear Physics, JGU Mainz

The P2 experiment in Mainz aims to determine the weak mixing angle θ_W at low momentum transfer by measuring the parity-violating asymmetry of elastic electron-proton scattering. In order to achieve an unprecedented measurement accuracy within the planned 10 000 hours of data taking, the experiment has to run at event rates on the order of 10^{11} per second. Whereas the tracking system is not required to operate at the full beam rate, every attempt is made to achieve the highest possible rate capability.

At the full beam rate every reconstruction frame (45 ns long) will contain about 800 signal tracks, and 16 000 background hits from Bremsstrahlung photons. In order to cope with the extreme combinatorial background on-line, a parameterization-based tracking is considered as a possible solution. The idea is to determine the optimal hit search windows in every tracking plane for every possible positions of hits in the previous planes. Currently, the position and the size of the hit search windows are expressed as polynomial functions of hit coordinates. The coefficients of the polynomials are evaluated from a sample of reference tracks, reconstructed with a simple, exhaustive-search tracking in low-rate data.

The implementation, as well as the estimated performance of the parameterization-based tracking is going to be presented.