T 99: Detektorsysteme IV

Zeit: Donnerstag 16:45–19:00 Raum: VMP8 SR 205

T 99.1 Do 16:45 VMP8 SR 205

Building a Tracking Detector for the P2 Experiment — •Marco Zimmermann for the P2-Collaboration — Institute of Nuclear Physics, Johannes Gutenberg University, Mainz — PRISMA Cluster of Excellence

The P2 Experiment aims to measure the weak mixing angle at low Q^2 via the parity violating assymetry in elastic electron-proton scattering. It will be located at the new Mainz Energy Recovery Superconducting Accelerator (MESA), which will provide a 150 μA beam of alternatingly polarized 150 MeV electrons.

While the main asymmetry measurement is performed with integrating Cherenkov detectors, the tracking system is developed in order to determine the average momentum transfer of the electron and to reconstruct individual electron tracks for systematic studies. It will be built using the new technology of High Voltage Monolithic Active Pixel Sensors (HV-MAPS) made of silicon thinned to 50 μm.

The main challenge for the tracking system are very high expected particle rates. The expected rate of electrons that are scattered in the liquid hydrogen target and hit the tracking system is of the order $10^5 \mathrm{mm}^{-2}\mathrm{s}^{-1}$ and is overwhelmed by more than 10^7 $\mathrm{mm}^{-2}\mathrm{s}^{-1}$ bremsstrahlung photons.

Each of the tracking layers is envisaged to have a disc-like geometry. They are arranged as two double layers. Since only limited sensor area is affordable, each layer is divided into four segments with about 15 degree azimutal coverage. This layout is presented and motivated by investigations on the expected hit rates and the sensor response.

T 99.2 Do 17:00 VMP8 SR 205

The Dortmund Low Background Facility — Current Status and Recent Developments — Claus Gössling, Kevin Kröninger, and •Christian Nitsch — Experimentelle Physik IV, TU Dortmund, 44221 Dortmund

The Dortmund Low Background Facility (DLB) is a low-background gamma ray spectrometry system with an artificial overburden. The overburden of ten meters of water equivalent, in combination with a multi-layer lead castle and an active muon veto are shielding a high-purity germanium detector of 60 % relative efficiency. The background level is remarkably low compared to a conventional spectrometer system without special shielding and enables sensitivities well below 1 Bq/kg. Thus, material screening measurements as well as environmental monitoring measurements are possible on an easy-accessible location above ground at the campus of the Technische Universität Dortmund. The integral background count rate between 40 keV and 2700 keV is 2.528±0.004 counts/kg/min, which is comparable to systems that are situated below ground.

In the talk, an overview of the current status of the DLB is given and recent developments are presented.

T 99.3 Do 17:15 VMP8 SR 205

Track Parameter Resolution Study of a Pixel Only Detector for LHC Geometry and Future High Rate Experiments — Michele Piero Blago, •Tamasi Rameshchandra Kar, and Andre Schöning — Physikalisches Institut, Universität Heidelberg, Germany

Recent progress in pixel detector technology, for example using High Voltage-Monolithic Pixel Sensors (HV-MAPS), makes it feasible to construct an all-silicon pixel detector for large scale particle experiments like ATLAS and CMS or other future collider experiments. Preliminary studies have shown that nine layers of pixel sensors are sufficient to reliably reconstruct particle trajectories. The performance of such an all-pixel detector is studied based on a full GEANT simulation for high luminosity conditions at the upgraded LHC.

Furthermore, the ability of an all-pixel detector to form trigger decisions using a special triplet pixel layer design is studied. Such a design could be used to reconstruct all tracks originating from the proton-proton interaction at the first hardware level at 40 MHz collision frequency.

T 99.4 Do 17:30 VMP8 SR 205

Simulation of an all silicon tracker for CLIC — •Magdalena Muenker[1,2] and Andreas Nuernerg[1,2] — [1]CERN — [2]University of Bonn

CLIC is a proposed future electron-positron linear collider with a centre-of-mass energy up to 3 TeV. The aim of high precision measurements at CLIC is driving the design of the detector for CLIC. To perform a precise measurement of the Higgs recoil mass a momentum resolution of $\sigma_{\mathrm{p_T}}/\mathrm{p_T^2} \sim 2 \cdot 10^{-5}\mathrm{GeV}^{-1}$ is required. This imposes a single point tracking resolution of $\sim 7\,\mu$m. To reach this aim an all silicon tracker is foreseen for CLIC. A simulation chain has been set up to study the performance of different silicon sensor designs. This simulation chain consists of a GEANT4 simulation to model the energy deposit in silicon, a finite element simulation of the charge drift and signal formation with TCAD and a fast parametric modelling of the front-end electronics. By that energy fluctuations, electronic noise and the digitalisation of the readout signal are taken into account. Furthermore this tool is used to predict the sensor performance in terms of efficiency, cluster-size and resolution. This framework is used to study the performance of e.g. sensors with different pitch and thickness. Various incident angles of charged particles with respect to the sensor surface and the effect of a magnetic field are taken into account. The simulation chain is validated with data.

T 99.5 Do 17:45 VMP8 SR 205

The MuPix Telescope - Tracking Low Momentum Particles at High Rates — •Lennart Huth for the Mu3e-Collaboration — Physikalisches Institut Universität Heidelberg

New physics beyond the Standard Model as predicted by several models includes charged lepton flavor violation (cLFV). The search for cLFV decays requires high statistics to be sensitive to small branching ratios (BRs). The Mu3e experiment will search for the cLFV decay $\mu^+ \rightarrow e^+ e^- e^+$ with a sensitivity in BR of 10^{-16}. The required high rate and the low momentum of the decay particles are the biggest challenges. To reduce multiple Coulomb scattering, the dominant measurement uncertainty thin detectors are needed. For Mu3e, the novel concept of **H**igh **V**oltage **M**onolithic **A**ctive **P**ixel **S**ensors (HV-MAPS) is chosen.
To test the scalability, data acquisition, control and online monitoring of Mu3e and for sensor characterization at test beams, a particle tracking telescope has been developed. It is optimized to handle high rates of low momentum particle of over 1 MHz.
This talk introduces the concept and setup of the telescope. Efficiency, timing and noise results from test beam campaigns at PSI and DESY are also shown.

T 99.6 Do 18:00 VMP8 SR 205

A CAD Based Geometry Model for Simulation and Analysis of Particle Detector Data — •Michael Milde, Martin Losekamm, Thomas Pöschl, Daniel Greenwald, and Stephan Paul — Technische Universität München, 85748 Garching, Deutschland

The development of a new particle detector requires a good understanding of its setup. A detailed model of the detector's geometry is not only needed during construction, but also for simulation and data analysis. To arrive at a consistent description of the detector geometry a representation is needed that can be easily implemented in different software tools used during data analysis. We developed a geometry representation based on CAD files that can be easily used within the Geant4 simulation framework and analysis tools based on the ROOT framework. This talk will present the structure of the geometry model and show its implementation using the example of the event reconstruction developed for the Multi-purpose Active-target Particle Telescope (MAPT). The detector consists of scintillating plastic fibers and can be used as a tracking detector and calorimeter with omnidirectional acceptance. To optimize the angular resolution and the energy reconstruction of measured particles, a detailed detector model is needed at all stages of the reconstruction. This research was supported by the DFG cluster of excellence "Origin and Structure of the Universe".

T 99.7 Do 18:15 VMP8 SR 205

Characterization of a large CdZnTe coplanar quad-grid semiconductor detector — •Robert Theinert, Claus Gössling, and Kevin Kröninger — TU Dortmund, Experimentelle Physik IV, 44221 Dortmund, D

The COBRA collaboration aims to search for the neutrinoless double beta-decay of ^{116}Cd. For this purpose, it operates a demonstrator setup with 64 CdZnTe detectors, each with a volume of $1\,\mathrm{cm}^3$, at the LNGS underground laboratory in Italy. Double beta-decays are associated with half-lifes of more than 10^{25} years. To be sensitive to those half-lifes, a high detection efficiency and an ultra low-background setup are, among other aspects, important requirements.

The usage of larger detectors is expected to improve the sensitivity. Detectors with a larger volume have a higher detection efficiency than the smaller ones. In addition, the background is reduced due to the lower surface-to-volume ratio.

A large $(2 \times 2 \times 1.5)\,\mathrm{cm}^3$ CdZnTe detector with a new coplanar-grid design is characterized for applications in γ-ray spectroscopy and low-background operation. The four coplanar-grids on the anode side offer the possibility of separating the detector in four single sectors. The electric properties as well as the spectrometric performance, like energy response and resolution, are investigated in several measurements. Furthermore, studies concerning the operational stability and the possibility to identify multiple-scattered photons, are conducted.

T 99.8 Do 18:30 VMP8 SR 205

Discrimination of Alpha Particles in CdZnTe Detectors with Coplanar Grid for the COBRA Experiment — •Henning Rebber for the COBRA-Collaboration — Universität Hamburg, Institut für Experimentalphysik, Luruper Chaussee 149, 22761 Hamburg

The aim of the COBRA experiment is the search for neutrinoless double beta decay using CdZnTe semiconductor detectors. A background rate in the order of 10^{-3} counts per keV, kg and year is intended in order to be sensitive to a half-life larger than 10^{26} years. Measurements from a demonstrator setup and Monte Carlo simulations indicate that a large background component is due to alpha particles. These generate charge clouds of only few μm in diameter in the detector, leading to characteristic pulse features.

Parameter-based cut criteria were developed to discriminate alpha events by means of their pulse shapes. The cuts were tested on data from alpha and beta irradiation of a $(1 \times 1 \times 1)\,\mathrm{cm}^3$ CdZnTe detector with coplanar grid. The pulse shapes of all event signals were read out by FADCs with a sampling rate of 100 MHz. The signals were reproduced by a detector simulation which hence was used to study the cuts for energies up to 3 MeV and different detector regions.

T 99.9 Do 18:45 VMP8 SR 205

Germanium Detektor Entwicklung: SegBEGe — •Martin Schuster — Max Planck Institut für Physik, München, Deutschland

Hochreine Germanium Detektoren (HPGe) spielen seit einiger Zeit eine fundamentale Rolle in der Teilchenphysik, vor allem bei der Suche nach neutrinolosem Doppelbetazerfall und nach dunkler Materie. Im Bezug auf die Energieauflösung und die Erkennung von Untergrundstrahlung - dies sind Schlüsselfaktoren für derartige Experimente - wurden in den letzten Jahren zwei neue Typen von HPGes entwickelt, der Broad Energy Range Germanium Detektor (BEGe) und der segmentierte HPGe. Beide Typen stellen eine Verbesserung im Bezug auf die Untergrunderkennung dar, indem sie es ermöglichen zwischen sogenannten single-site Ereignissen und multi-site Ereignissen zu unterscheiden. Das Schwellenverhalten des BEGe wird zudem durch die viel kleinere Detektorkapazität verbessert. Der segmentierte HPGe ist dagegen im Stande die Phi-Entartung für multi-site Ereignisse zu brechen. Mit dem Ziel beide Technologien zu vereinen hat die GeDet Gruppe am MPI einen neuartigen segmentierten BEGe entworfen, der in Folge von CANBERRA France hergestellt wurde. Mit den Signalen aus den Segmenten wird ein besseres Verständnis der Ereignistopologie erwartet, inklusive des präzisen Ereignisortes sowie der physikalischen Prozesse und somit eine verbesserte Untergrunderkennung. Die Segmentierung wird auch dazu beitragen die Pulseigenschaften des BEGe wie zum Beispiel die Ladungsdrift besser zu verstehen. Vorgestellt werden erste Ergebnisse des Betriebs des segmentierten BEGe.