T 40: Detektorsysteme I

Zeit: Dienstag 16:30–19:00 Raum: Z6 - SR 2.007

T 40.1 Di 16:30 Z6 - SR 2.007

Performance of the KATRIN detector system — •Florian Fränkle for the KATRIN-Collaboration — Institute for Nuclear Physics, Karlsruhe Institute of Technology (KIT)

The KArlsruhe TRItium Neutrino (KATRIN) experiment is a largescale experiment with the objective to determine the effective electron anti-neutrino mass with an unprecedented sensitivity of 0.2 eV/c^2 at 90% CL in a model-independent way, based on precision β-decay spectroscopy of molecular tritium. The experimental setup consists of a high luminosity windowless gaseous tritium source, a magnetic electron transport system with differential and cryogenic pumping for tritium retention, and an electro-static spectrometer section for energy analysis, followed by a detector system for counting transmitted β-electrons.

The focal-plane detector system for KATRIN consists of a multi-pixel silicon p-i-n-diode array, custom readout electronics, two superconducting solenoid magnets, an ultra high-vacuum system, a high-vacuum system, calibration and monitoring devices, a scintillating veto, and a custom data-acquisition system. It is designed to detect the low-energy electrons selected by the KATRIN main spectrometer. This talk will describe the system and summarize its performance after its final installation.

This work was supported by the U.S. Department of Energy under award numbers DE-FG02-97ER41020, DE-FG02-97ER41041, DE-FG02-97ER41033, BMBF (05A17VK2), and the HGF.

T 40.2 Di 16:45 Z6 - SR 2.007

The detector model for the Compact Linear Collider and its implementation in DELPHES — •Ulrike Schnoor for the CLICdp-Collaboration — European Organisation for Nuclear Research CERN

The Compact Linear Collider CLIC is a high-energy electron-positron accelerator being studied as an option for the post-LHC era. Detector and physics studies after the Conceptual Design Report have resulted in an updated detector model for CLIC. Its design and performance are presented in this talk. The detector model has been implemented in a publicly available parameter card for the DELPHES fast simulation tool, which can be used for studies of CLIC's physics potential. Its performance is validated based on the Higgsstrahlung process ($e^+e^- \to HZ$), which constitutes the dominant Higgs production channel and hence a strong physics case for the anticipated first stage of CLIC with a center-of-mass energy of 380 GeV.

T 40.3 Di 17:00 Z6 - SR 2.007

Contributions to the ATLAS New Small Wheel Upgrade by the Würzburg University — •Thorben Swirski, Deb Sankar Bhattacharya, and Raimund Ströhmer — Universität Würzburg

One of the prime motivations for the luminosity upgrade of the Large Hadron Collider (LHC) is to get a deeper insight into the Higgs sector. The luminosity upgrade will result in a very high particle rate up to 15 kHz/cm^2, for which the forward muon tracking station (Small Wheel or SW) must be upgraded. The detector upgrade is also a necessary step to ensure better muon trigger and more precise tracking than the present scenario. As the primary precision tracker, the New Small Wheel (NSW) will include Micromegas, which is a fast detector with intrinsic spatial resolution of the order of 100 μm. The construction of NSW has already been started. The responsibility for the development of the small sectors (SM2) of the Micromegas quadruplets have been partially distributed in four German Universities of Freiburg, Mainz, Munich and Würzburg, which is supported by the BMBF. In this presentation we are giving a detailed report on the contribution from the Würzburg group to the next ATLAS upgrade.

T 40.4 Di 17:15 Z6 - SR 2.007

Entwicklung eines Controllers für das Detektor-Kontroll-System (DCS) des ATLAS Pixeldetektors — •Sebastian Scholz[1], Susanne Kersten[1], Niklaus Lehmann[1], Christian Zeitnitz[1], Rizwan Ahmad[2], Tobias Fröse[2], Michael Karagounis[2] und Alexander Walsemann[2] — [1]Bergische Universität Wuppertal — [2]FH Dortmund

Für das geplante Upgrade des LHC zum HL-LHC (High Luminosity Large Hadron Collider) ist als innerste Komponente ein neuer Pixeldetektor für das ATLAS Experiment geplant. Die einzelnen Pixelmodule sollen durch eine serielle Spannungsversorgung versorgt werden, welche durch bereits entwickelte DCS Chips überwacht werden wird. Zur Kommunikation mit diesen Chips wird aktuell ein Controller-Chip entwickelt, der bis zu 64 DCS Chips auslesen und steuern kann. Die Kommunikation des Controllers mit einem PC erfolgt über das CANopen-Standard. Es wird der aktuelle Entwicklungsstand des Controllers präsentiert.

T 40.5 Di 17:30 Z6 - SR 2.007

Serial powering implementation and Readout for the ATLAS ITk Outer Barrel Demonstrator — Matthias Hamer[1], •Florian Hinterkeuser[1], Fabian Huegging[1], Jens Janssen[1], Niklaus Lehmann[2], Susanne Kersten[2], Susanne Kuehn[3], and Klaus Desch[1] — [1]Universität Bonn — [2]Universität Wuppertal — [3]CERN

The high luminosity upgrade for the Large Hadron Collider at CERN requires a complete overhaul of the ATLAS detector. The current tracking detector will be replaced by an all-silicon tracking detector, the ITk. It will occupy the same volume as the current ATLAS tracker and will cover a significantly larger phase space.

The new ITk pixel detector will consist of multichip modules produced in 65 nm CMOS technology. Due to the significantly higher number of modules and the increased power consumption of the new FE chips, a parallel powering scheme is not feasible, such that a serial powering scheme will be implemented. In this scheme, modules are powered in series and supplied by a constant current source, reducing the amount of service cables needed to power the detector.

While the concept of serial powering has already been proven, a prototype for the ITk Pixel Outer Barrel with a representative support structure, services and number of modules per serial powering chain is currently being assembled at CERN. This talk will present an overview of the implementation of the serial powering scheme as well as the commissioning of that demonstrator using a USBPix based readout system.

T 40.6 Di 17:45 Z6 - SR 2.007

CLAWS in the SuperKEKB commissioning Phase 2: Monitoring of Beam Backgrounds — •Daniel Heuchel, Miroslav Gabriel, Hendrik Windel, Naomi van der Kolk, and Frank Simon — Max Planck Institute for Physics

The SuperKEKB accelerator in Tsukuba, Japan, is currently undergoing an extensive commissioning campaign, split in three phases. During the second phase, which started in September 2017, the vertex detector of Belle II will be replaced by a detector system called Beam Exorcism for a Stable ExperimenT II(BEAST II), specifically designed to measure background rates at the interaction point (IP) for different operation parameters of the accelerator.

One of the subsystems of this commissioning detector are the sCintillation Light And Waveform Sensors (CLAWS), consisting of two ladders with 8 scintillator tiles, each individually read out by a silicon photomultiplier. CLAWS is specifically designed to study the time evolution of background originating from the continuous top-off injection of the accelerator. Thus, the system features sub-ns time resolution combined with continuous sampling over millisecond time scales. In this contribution, we will present the design of the CLAWS phase 2 ladders, discuss the basic performance of the detector elements and present results from the commissioning in the laboratory and in a test beam at DESY. Furthermore, the integration into BEAST II and results from first data acquisition runs, scheduled for February 2018, will be discussed.

T 40.7 Di 18:00 Z6 - SR 2.007

Development of intelligent Photomultipliers — Florian Kiel, •Jochen Steinmann, and Achim Stahl — III. Physikalisches Institut B, RWTH Aachen University

For the next generation of large neutrino detectors, for example JUNO, a novel concept for the readout of the Photomultiplier-Tubes has been developed. The idea is to build an intelligent PMT, which has all neccessary electronics mounted at the back of the PMT. This electronics is able to digitise and analyse the measured data, using the VULCAN-ASIC designed by the FZ-Jülich and an FPGA. Due to the high computing power of the selected FPGA the electronics is even able to do a low level waveform reconstruction. Based on the analysed data, the operational parameters of the PMT, e.g. applied voltage, can be regulated autonomous. Since the PMT will be connected via digital signals only, the performance does not decrease with long analog cables. This concept can be easily adapted from the laboratory to any size of detector. A first demonstration will be done using a 20" Hamamatsu PMT. In this contribution the concept and the road to the first prototype will be presented.

T 40.8 Di 18:15 Z6 - SR 2.007

Building a Tracking Detector for the P2 Experiment — •Marco Zimmermann for the P2-Collaboration — Institute for 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 asymmetry 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 145 MeV electrons.

While the main asymmetry measurement is performed with integrating Cherenkov detectors, the tracking system is developed in order to determine the momentum transfer in the target and for systematic studies. The high signal and background particle rates are the main challenge, in particular because of bremsstrahlung photons produced in the liquid hydrogen target. The particle rates are analysed in a Geant4-based Monte Carlo simulation. Measurements of the sensor response to photons were performed and compared to the simulation.

The detector will be built using High Voltage Monolithic Active Pixel Sensors (HV-MAPS) made of silicon thinned to 50 μm. Four tracking planes will be arranged as two double layers. For each double layer, four modules are built to cover together about one sixth of azimuthal space. Every module consists of about 600 sensors, of which each has 2x2cm^2 area and an expected power consumption of about 1W. The main mechanical setup of one module will be shown together with simulations of the gaseous helium cooling system.

T 40.9 Di 18:30 Z6 - SR 2.007

FANGS: Radiation monitoring during the commissioning phase of the Belle II detector — •Patrick Ahlburg, Jochen Dingfelder, Andreas Eyring, Jens Janssen, Hans Krüger, Carlos Marinas, David-Leon Pohl, and Norbert Wermes — University of Bonn

The SuperKEKB accelerator has been upgraded with the goal of an instantaneous luminosity 40 times higher compared to KEKB. Before the installation of the Belle II vertex detector in 2018, the BEAST II experiment has been developed for the study of machine induced backgrounds during the commissioning phase of the SuperKEKB accelerator. The experiment will measure the expected radiation for the components of the inner detectors and support the tuning of the accelerator beam optics and collimator system.

The FANGS (FE-I4 ATLAS Near Gamma Sensors) detector is part of the BEAST II experiment and with its hybrid pixel sensors from the ATLAS IBL modules sensitive to low keV X-rays and high particle rates. The scope of this talk revolves around the production of the FANGS detector, the final performance tests and the recent installation in the BEAST II experiment in November 2017.

T 40.10 Di 18:45 Z6 - SR 2.007

Charakterisierung großflächiger Silizium-Photomultiplier für den Einsatz im SHiP-Experiment — •Julian Schliwinski für die SHiP LScin SBT-Kollaboration — HU Berlin, Berlin, Deutschland

SHiP ist ein Vorschlag, mit einem Beamdump-Experiment am CERN SPS-Beschleunigerkomplex nach sehr schwach wechselwirkenden, neutralen Teilchen im Massenbereich von 0,1 GeV - 10 GeV zu suchen. Hadronen aus den Proton-Proton-Kollisionen werden absorbiert und Myonen durch ein Magnetsystem ausgelenkt, so dass neben Neutrinos nur noch andere neutrale Teilchen in einem etwa 50m langen Volumen vorhanden sind und in diesem zerfallen können. Dieses Zerfallsvolumen soll mit Flüssigszintillator umgeben sein (Surrounding Background Tagger = SBT), um Untergrund unterdrücken zu können. Die Szintillationsphotonen sollen mit sogenannten Wavelength Shifting Optical Modules (WOMs), die an Photosensoren angekoppelt werden, nachgewiesen werden. Der mögliche Einsatz von Silizium-Photomultiplier (SiPMs) als Photosensoren im SBT ist Gegenstand aktueller Untersuchungen.

Im Vortrag wird die Analyse von Ladungsintegrationsspektren unterschiedlicher SiPMs und die resultierenden, charakteristischen Parameter vorgestellt und diskutiert.