T 46: Detector systems III

Time: Wednesday 16:30–18:50 Location: H-HS II

Group Report T 46.1 Wed 16:30 H-HS II

Implementation of a Background Tagger used in SHiP (search of hidden particles) experiments — •Jan Zimmermann — Humboldt Universität Berlin

SHiP is a proposed beam dump experiment at CERN to search for very weakly interacting new particles with a mass between 0.1GeV - 10GeV. Hadrons from proton-proton collisions are absorbed and muons redirected through a magnet system. This leaves only neutrinos and other neutral particles to decay in the 50m long decay volume. This decay volume will be surrounded by scintillating liquid (Surrounding Background Tagger = SBT) to reduce background. The scintillation photons will be detected using wavelength-shifting optical modules coupled to an array of silicon photomultipliers.

This talk will analyse and discuss the detector-response of a new and improved liquid-scintillator detector, tested at the DESY II accelerator in 2019, and compare the results to previous measurements performed in 2018 with an improved fixation and covering setup.

A general introduction to the SBT will be given in a dedicated presentation by P. Deucher.

T 46.2 Wed 16:50 H-HS II

Tracking detector for the P2 experiment — •Carsten Grzesik for the P2-Collaboration — Institut für Kernphysik, Mainz

The upcoming P2 experiment at the Institute for Nuclear Physics in Mainz aims to measure the parity violating asymmetry in elastic electron-proton scattering to determine the weak mixing angle. It will be performed at low momentum transfer Q^2 and with high precision enabled by the new Mainz Energy Recovering Superconducting Accelerator (MESA).

For the measurement of the average Q^2 a tracking detector utilizing High Voltage Monolithic Active Pixel Sensors (HV-MAPS) is installed, while the asymmetry measurement is conducted by integrating Cherenkov detectors. The high particle rate needed to reach the envisaged precision and large area at a low material budget pose challenges to the design of the tracking detector.

In this talk the current design for the tracking layers and testbeam results of HV-MAPS prototypes are presented. It focuses on high rate capabilities of the pixel sensors, the cooling and mechanical setup, as well as the data acquisition system for the P2 tracking detector.

T 46.3 Wed 17:05 H-HS II

A multi-pixel camera for fast neutron radiography — Christoph Günther, •Nina Höflich, and Oliver Pooth — III. Physikalisches Institut B, RWTH Aachen University

The neutron radiography group at the Physics Institute III B, RWTH Aachen University, develops a multi-pixel camera for fast neutron radiography. Fast neutron radiography has the aim to resolve structures in heterogeneous test objects that cannot be well investigated by common gamma or X-ray radiography.

An Americium-Beryllium radioactive source or a neutron generator can be used as a mobile neutron source. For neutron detection, the organic scintillator Stilbene is used, which allows for neutron-gamma signal discrimination on an event-by-event basis.

So far, two prototypes were built: a single-pixel detector and a 16-pixel camera with a scintillator pixel volume of $5 \times 5 \times 25\,\mathrm{mm}^3$. The scintillators are coupled to SiPMs for scintillation light detection. To optimize the detector setup and to study applications, a Geant4 simulation of the whole measurement setup is under development.

The talk will focus on recent results with the 16-pixel camera and simulation results concerning possible detector improvements.

T 46.4 Wed 17:20 H-HS II

Use of poly(ethylene naphthalate) as a self-vetoing structural material for low-background experiments — •Felix Fischer — Max-Planck-Institut für Physik

Poly(ethylene naphthalate), PEN, is a widely used industrial polyester which intrinsically scintillates in the blue wavelength region. This, combined with measurements of a high intrinsic radiopurity, has sparked interest in the material for use in low-background experiments. The entire process from commercially available granulate to an active support-structure for the next generation $0\nu\beta\beta$-search experiment LEGEND is presented. In addition, new measurements on radiopurity are presented as well as first characterisation studies important for the performance in a low-background experiment.

T 46.5 Wed 17:35 H-HS II

Tracking of charged particles using an FE-I4B pixel telescope and moving emulsion films — •Nikolaus Owtscharenko[1], Vadim Kostyukhin[1,2], Matei Climescu[1,3], Fabian Hügging[1], Jens Janssen[1], David-Leon Pohl[1], and Markus Cristinziani[1] — [1]Physikalisches Institut, Universität Bonn — [2]now at Departement of Physics and Astronomy, University of Sheffield — [3]now at Institut für Physik, Universität Mainz

The SHiP collaboration plans a general purpose fixed-target experiment to search for hidden particles at a new beam-dump facility at the CERN SPS.
To estimate the total charm cross-section in the final experiment, which includes hadronic cascade production, a dedicated measurement was performed in summer of 2018. $15 \cdot 10^5$ Protons at 400 GeV from the SPS interact with a thick multilayer target, interleaved with tracking emulsion films.
A 6 plane telescope made of ATLAS IBL double-chip modules was positioned behind this target and complements the high spatial resolution of emulsion with a high timing resolution.
Telescope efficiency, comparison of results to simulation and reconstruction of first events are presented.

T 46.6 Wed 17:50 H-HS II

Designing a quality assurance setup for the production of PEN scintillator tiles — •Isabelle Schilling, Jens Weingarten, and Kevin Kröninger — TU Dortmund, Lehrstuhl für Experimentelle Physik IV, 44227 Dortmund

The commercially available plastic polyethylene naphthalate (PEN) is interesting for applications in a wide variety of fields of physics due to its emission of easily detectable blue scintillation light without the use of wavelength shifters and its high mechanical stability. The production of PEN samples based on injection molding at the TU Dortmund enables the individual manufacture of different sample sizes and shapes, depending on the requirements on the scintillator.
Besides, the produced PEN samples have comparable stability to copper, which pulls them in the focus of interest for experiments like LEGEND. The tiles could be a part of the detector holder that could simultaneously act as an active signal background veto. To validate the production of scintillator tiles by the injection molding process, the scintillation properties of the produced PEN tiles must be investigated. The use of the tiles as a radiation detector can be validated in various measurements. Based on these measurement results, a quality assurance system for monitoring the production is developed and will be presented in this report.

T 46.7 Wed 18:05 H-HS II

Tests for the Demonstrator of the High-Granularity Timing Detector — Peter Bernhard[2], Andrea Brogna[2], Lucia Masetti[1], Marisol Robles[1], •Jens Söngen[1], and Quirin Weitzel[2] — [1]Johannes Gutenberg-Universität, Staudingerweg 7, 55128 Mainz — [2]PRISMA Detector Lab, Staudingerweg 9, 55128 Mainz

The high-luminosity upgrade of the LHC (HL-LHC) is foreseen to start operating in 2026 and will boost the sensitivity of the Standard Model measurements and searches for new particles substantially. However, the increased instantaneous luminosity of up to $7.5 \times 10^{34}\,\mathrm{cm}^{-2}\,\mathrm{s}^{-1}$ also implies rising requirements to the ATLAS detector. In order to guarantee the correct assignment of particles from hard-scattering events, a silicon-based High-Granularity Timing Detector (HGTD) is planned to mitigate the effect of pile-up, in the endcaps. The next major R&D step is the building of a demonstrator, which serves two essential purposes. First, it offers the oppurtunity to study the performance of all detector components (e.g. sensors and electronics) under realistic conditions. Second, it tests the practicability of the production process and helps to optimize it. This talk presents the basic design of the HGTD demonstrator to test mechanical and thermal conditions as well the total detector capability. Furthermore, it reports on the validation of assembly and quality assurance procudures.

T 46.8 Wed 18:20 H-HS II

DIRC Options for SCTF — •Mustafa Schmidt[1], Michael Düren[1], Avetik Hayrapetyan[1], Alexander Yu. Barnyakov[2], and Sergey A. Kononov[2] — [1]II. Physikalisches Institut, Justus Liebig University Giessen — [2]Budker Institute of Nuclear Physics, Novosibirsk

The proposed future e^+e^- collider Super Charm Tau Factory (SCTF) in Novosibirsk is designed to address fundamental questions in the field of particle and hadron physics. In order to guarantee an excellent PID at SCTF, two different types of Cherenkov counters are proposed as one possible design option. Both types, the barrel and the endcap counters use the principle of detection of internally reflected Cherenkov light (DIRC). The main purpose of these DIRCs is to separate charged pions and muons in the momentum range between 0.2 and 1.5 GeV/c by covering the full solid angle.

Two endcap DIRCs are proposed to be installed in the forward and backward regions. They consist of a thin fused silica radiator plate each, of attached focusing optics and sensors for photon detection. The concept of these detectors is based on existing models that have already been developed for the PANDA experiment at FAIR.

This talk will cover the ongoing simulation studies to optimize the performance of these detectors with respect to the Cherenkov angle resolution and timing information and the related readout systems. According to the actual plan, silicon photomultipliers (SiPMs) with a high granularity are going to be used to measure single Cherenkov photons.

T 46.9 Wed 18:35 H-HS II

Decoding of SciFi detector raw data in the Allen GPU-based High Level Trigger for the LHCb Upgrade experiment — •Lars Funke and Holger Stevens — Experimentelle Physik 5, TU Dortmund

In the coming LHC run, the LHCb experiment will take data without a hardware trigger stage, increasing the input rate to the software-based High Level Trigger (HLT) by a factor of 30. Additionally, the number of pp interactions per bunch crossing will increase fivefold. Both of those facts pose a challenge to the HLT, as the projected throughput implies the need for a large amount of computing power.

The Allen project implements the first stage of the HLT on Graphics Processing Units (GPUs), which offer a considerable performance-per-price advantage over CPUs, if used with suitable algorithms. A significant time share of the trigger sequence is used by raw data decoding, as for some of the subdetectors, non-trivial transformations are necessary.

In this talk, the algorithms and challenges of the Scintillating Fibre Tracker (SciFi) raw data decoding are outlined.