T 39: Detectors 4 (calorimeters)

Time: Tuesday 16:00–18:00 Location: Geb. 30.23: 2/1

T 39.1 Tue 16:00 Geb. 30.23: 2/1

Hadron Calorimeter for the HIKE Experiment — •Letizia Peruzzo and Rainer Wanke — Johannes Gutenberg University, Mainz

The High Intensity Kaon Experiments (HIKE) is a new proposed project for the ECN3 experimental hall in the North Area of CERN SPS. The long-term, fixed-target experiment would continue the long-standing experience of kaon experiments at CERN after LS3 (2031). The experimental programme will reach an unprecedented sensitivity in kaon physics, from rare and ultra-rare kaon decays to precision measurements and searches for new-physics phenomena, with a staged approach involving charged and neutral beams, as well as operation in beam-dump mode.

The Hadron Calorimeter (HCAL) for HIKE will be one of the main detectors for π/μ identification and separation, with the requirement of achieving an average muon mis-identification probability of $\mathcal{O}(10^{-6})$ or less while preserving at least 85% of the pion efficiency. To achieve the requirements and, at the same time, to sustain the high-intensity environment a cellular design of alternating scintillator and absorber planes has been proposed for the new HIKE HCAL.

The talk will report on the preliminary studies on the concept and design of the HIKE HCAL.

T 39.2 Tue 16:15 Geb. 30.23: 2/1

Energy calibration of the SND@LHC hadronic calorimeter — •Eduard Ursov, Andrew Conaboy, Heiko Lacker, and Anupama Reghunath — Humboldt University of Berlin, Berlin, Germany

SND@LHC (Scattering & Neutrino Detector at the LHC) is a compact and stand-alone experiment measuring neutrinos produced in proton-proton collisions at the LHC. The experiment aims to study all three neutrino flavours in the yet unexplored pseudo-rapidity region of $7.2 < \eta < 8.4$, specifically electron neutrinos that are mainly coming from charmed hadron decays. In July 2023, the SND@LHC collaboration reported observation of 8 muon neutrino charged-current candidates with a significance of 6.8σ. To reconstruct the neutrino energy and filter out background from neutral hadrons that are produced from muons downstream of the detector, the energy calibration of the hadronic calorimeter is required. To calibrate the detector, a test beam experiment with 100-300 GeV pion beams has been performed and is compared to a corresponding Geant4-based simulation. The results of the test beam analysis and the simulation are presented in this work.

T 39.3 Tue 16:30 Geb. 30.23: 2/1

Neutron and Gamma Particle Identification in Compact Plastic Scintillators — •Sebastian Ritter — Johannes-Gutenberg Universität, Mainz

Particle identification (PID) using pulse shape discrimination (PSD) is a commonly used concept in scintillation detectors to differentiate between gammas and neutrons. Considering highly granular plastic scintillator based calorimeters in development, performing this separation on signals with increasingly small photon statistics constitutes a real challenge.

This setup features small 30x30x3mm scintillator tiles readout by small SiPMs representing a proven readout concept for a large-scale calorimeter. Coincidence gamma and neutron emissions from an AmBe source are used for tagging. In addition, the setup includes cosmic tagging which allows for the identification and rejection of the permanent cosmic background.

To show the feasibility of such an analysis the late light single photon peaks are extracted from the data using different methods such as peak counting and integration and comparing them to the initial signal peak.

This technology could be used in various future detectors to provide tagging information and energy reconstruction for neutrons.

T 39.4 Tue 16:45 Geb. 30.23: 2/1

ATLAS Tile Calorimeter signal reconstruction in Phase-II — •Thomas Junkermann — Kirchhoff-Institut für Physik, Heidelberg, Deutschland

The Phase-II Upgrade of the ATLAS Tile Calorimeter remodels it's data read-out to cope with the higher amount of simultaneous proton-proton collisions of future LHC runs. To provide precise information to downstream components like the Phase-II digital trigger new back-end electronics are designed. These process the calorimeter data and prepare it for the trigger as well as buffering them for permanent storage. The energy reconstruction and bunch crossing identification, previously calculated by the trigger itself, are now being performed on the tile electronics. The calorimeter signals properties, energy and time, are reconstructed from digital samples being send from on-detector components to an off-detector pre-processing stage. The upgraded back-end offers various possibilities to reconstruct the cells signal energies and timings. The usage of neural networks is studied as a new approach at the preprocessing stage as it can learn differently than previously used classical reconstruction algorithms like optimal filters. The performance of a neural network will be presented in comparison to an optimal filter based on simulated Phase-II detector signals.

T 39.5 Tue 17:00 Geb. 30.23: 2/1

Multi-Tilemodule test system using cosmic rays for the CMS HGCAL upgrade — •Jia-Hao Li — Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany

The CMS experiment plans to upgrade its calorimeter endcap for the high luminosity phase of the LHC with the High Granularity Calorimeter (HGCAL). The Tilemodule is one of the basic elements in the hadronic calorimeter part of the HGCAL. It uses small scintillator tiles directly coupled to SiPMs (SiPM-on-tile technology) for particle detection. The Tilemodule is equipped with one or two HGCROC ASICs for data readout. To test and calibrate the Tilemodules, a cosmic ray setup with multiple Tilemodules synchronised with each other is established for quality control and a better understanding of the property of the Tilemodule. The presentation will discuss the idea and current status of the cosmic test setup at DESY.

T 39.6 Tue 17:15 Geb. 30.23: 2/1

System Validation of the SiPM-on-Tile Section of the CMS High Granularity Calorimeter — •Gabriele Milella — DESY — University of Hamburg

Calorimetry at the High Luminosity Large Hadron Collider (HL-LHC), especially in the forward regions, encounters two significant challenges: to cope with high radiation levels and manage an unprecedented number of simultaneous events. To address these issues, the CMS Collaboration is planning to replace the endcap calorimeters with a high-granularity calorimeter (HGCAL). This innovative sampling calorimeter uses as active materials silicon sensors and scintillator tiles, which are read out by silicon photomultipliers (SiPMs). The fundamental component of the SiPM-on-tile system is the tile module, which includes a printed circuit board (PCB) equipped with one or two HGCROC ASICs, capable of reading a high number of SiPMs. The tile modules have been studied at the DESY-II test beam and undergone various laboratory trials. The production of the tile modules for the upgrade is scheduled to commence next year. This presentation presents the current status and plans for future production of the SiPM-on-tile region of the CMS HGCAL.

T 39.7 Tue 17:30 Geb. 30.23: 2/1

Reconstruction of test beam data for the CheapCal prototype detector using Machine Learning — Alessia Brignoli[1], Andrew Picot Conaboy[1], Valery Dormenev[2], Christian Dreisbach[3], Karl Eichhorn[3], Jan Friedrich[3], Heiko Markus Lacker[1], Martin J. Losekamm[3], Anupama Reghunath[1], •Christian Scharf[1], Ben Skodda[1], Valerian von Nicolai[1], Ida Wöstheinrich[1], and Hans-Georg Zaunick[2] — [1]Humboldt-Universität zu Berlin — [2]Justus-Liebig-Universität Gießen — [3]Technische Universität München

The CheapCal prototype detector is an extruded plastic scintillator detector with wavelength-shifting (WLS) fibers embedded in perpendicular grooves on the front and the back of the 25×25 cm^2 scintillator plate. The WLS fibers are read out on both ends by Silicon Photomultipliers. Due to the short light attenuation length of the scintillator material, photons couple only to the nearest WLS fibers, allowing for reconstruction of the positions of passing particles.

We will present the reconstruction of 100 GeV muon test beam data using Machine Learning. The impact of different read-out schemes on the position resolution of the detector will be evaluated.

We acknowledge the support from BMBF via the High-D consor-

tium.

T 39.8 Tue 17:45 Geb. 30.23: 2/1

Optimizing the design for a Noble-Liquid-based calorimeter for FCC-ee — •Martina Koppitz[1,2], Nikiforos Nikiforou[2], Arno Straessner[1], Brieuc Francois[2], and Martin Aleksa[2] — [1]TU Dresden (Germany) — [2]CERN (Switzerland)

The Future Circular Collider (FCC) is currently the most promising candidate for flagship experiments for the era after the LHC. With a circumference of 91 km, it promises unprecedented performance for potentially a lepton collider (FCC-ee) implementation followed by a hadron collider stage (FCC-hh). The broad physics program of the FCC-ee, spanning from high precision measurements around the Z-pole to direct Higgs production, relies strongly on the performance of calorimeters with a focus on highly-granular devices optimized for particle flow methods. Due to the outstanding operation in various previous and current experiments, noble liquid calorimetry solutions have been adapted for the electromagnetic calorimeter of the FCC-ee. The current design of the ALLEGRO (A Lepton coLlider Experiment with highly Granular calorimetry Read-Out) detector involves a sampling calorimeter comprising 1536 cylindrically-stacked lead absorbers and readout electrodes with liquid argon as active material. The baseline geometry is being tested in simulations to optimize the energy and angular resolution as well as the particle identification performance. Special focus is given to the pi0 and photon identification capabilities as a function of the number of layers in the radial direction and the cell granularity in the theta and phi directions.