T 97: Calorimeter / Detector Systems IV

Time: Wednesday 17:30–19:00 Location: WIL/C133

T 97.1 Wed 17:30 WIL/C133

Evaluation of the Performance of SiPM-on-Tiles at the End of Life of the CMS HGCAL Upgrade — •Malinda de Silva — Deutsches Elektronen-Synchrotron (DESY), Hamburg

For the HL-LHC phase, the calorimeter endcap of the CMS detector will be upgraded with a High Granularity Calorimeter (HGCAL), a sampling calorimeter that will use silicon sensors as well as scintillator tiles read out by silicon photomultipliers (SiPMs) as active material (SiPM-on-tile). The design of the SiPM-on-tile section was inspired by the CALICE AHCAL. The complete HGCAL will be operated at $-30°C$.

The basic detector unit in the SiPM-on-tile section is the tile module, consisting of a PCB with one or two HGCROC ASICs, reading out up to 96 SiPM-on-tiles. Signals from MIPs passing through the SiPM-on-tiles are used to quantify the performance of SiPM-on-tiles. With irradiation, their performance degrades while increasing the noise. The ratio between the MIP signal and noise is known as the signal-to-noise ratio (SNR). In order to maintain an SNR>3 at end of the detector lifetime, SiPMs will be used in areas where the expected radiation dose during the lifetime of the detector is less than $5 \times 10^{13} n_{eq}/cm^2$.

A series of tests were conducted to quantify the performance of SiPM-on-tiles mounted on tile modules including beam tests and cold tests at $-30°C$. These tests were also repeated using irradiated SiPMs mounted on the tile modules. These tests were then used to extrapolate the performance expectations at the detector's end of life.

T 97.2 Wed 17:45 WIL/C133

Quality control for SiPM-on-tile section of the CMS HGCAL at DESY — •Daria Selivanova — Deutsches Elektronen-Synchrotron (DESY), Hamburg

The new High-Luminosity era of the LHC challenges the detector development field to implement technology in a new way. A detector under construction, the High Granularity Calorimeter (HGCAL) for CMS, is based on two detection technologies: silicon sensors and SiPM-on-tile boards. The highly segmented structure of the two will allow both electromagnetic and hadronic showers to be utilised in the energy reconstruction and the identification of particles.

The SiPM-on-tile component of the HGCAL consists of scintillator tiles wrapped in a reflective foil and photodetectors (SiPMs), mounted on a board with HGCROC readout electronics. The ability of each individual scintillator component (a tile) to fulfil the performance requirements stands on a choice of methods of production, wrapping and placement. That is why quality control (QC) measures have been implemented in the Tile Assembly Center (TAC) at DESY to monitor parameters at every stage. Two test stands have been developed to measure the size of the wrapped tile and to measure its light yield. Several tests have been performed using the setups with a variety of tiles to ensure consistency of measurements and to measure tile-to-tile wrapping variation and light output.

T 97.3 Wed 18:00 WIL/C133

Results of the Megatile prototype for the CALICE AHCAL — •Anna Rosmanitz for the CALICE-D-Collaboration — Johannes Gutenberg-Universität Mainz

The CALICE collaboration develops several highly granular calorimeter concepts for a future e^+e^- collider, that are designed for Particle Flow Algorithms. The current design for the Analog Hadronic Calorimeter (AHCAL) consists of 3x3 cm^2 scintillator tiles read out by silicon photomultipliers (SiPM). Each tile is individually wrapped in reflective foil and glued to the boards. The final AHCAL detector would countain 8 million channels.

To facilitate the assembly process, the Megatile design is developed at the University of Mainz. It is made from a large scintillator plate which houses 12x12 channels at once. The channels are separated by tilted trenches filled with a mixture of glue and TiO_2 for reflectivity and optical insulation. Optical tightness is achieved by gluing reflective foil on both faces and varnishing the edges. Until now, ten prototypes have successfully been built, continuously monitored in a cosmic test-stand in Mainz and tested in several test beam campaigns at DESY and CERN.

This talk presents the latest technical developments, the results from long-term monitoring and measurements with cosmic rays and with beam, focusing in particular on light yield and cross talk performance of the Megatiles.

T 97.4 Wed 18:15 WIL/C133

Characterization of a wavelength-shifter coated polystyrene plastic scintillator detector — Alessia Brignoli, Constantin Eckardt, Heiko Lacker, •Christophe Mullesch, Christian Scharf, and Ben Skodda — Humboldt-Universität zu Berlin, Berlin, Germany

Plastic scintillator detectors are widely used in particle physics for detecting charged particles crossing the scintillating material, converting the excitation energy into fluorescence radiation. It has been recently shown that a pure polystyrene plate that is coated with a wavelength-shifting dye can be used as an easy-to-build cheap scintillator with a decent light output. In this work, we further studied the light-yield response of a rectangular polystyrene tile coated with a wavelength-shifting dye. It was coupled to a photomultiplier at each end of the strip and exposed to beta particles from a Sr-90 source. By analyzing the light-yield and signal arrival times as a function of the beta source position along the tile, we determined the time and spatial resolution of the detector, as well as the light signal speed and the effective attenuation length in the scintillator.

T 97.5 Wed 18:30 WIL/C133

Simulation studies for tomography with fast neutrons and gammas with a multi-pixel detector — •Aenne Abel, Nina Höflich, and Oliver Pooth — III. Physikalisches Institut B, RWTH Aachen University

Combined neutron and gamma tomography enables a new, non-destructive imaging procedure showing further material properties than a common CT scan.

At the RWTH Aachen University a portable measuring setup for fast neutrons is developed, which uses an Americium Beryllium source and 16 stilbene crystals coupled to an SiPM for detection. The organic scintillator stilbene allows the simultaneous detection and separation of neutrons and gammas. The detector pixels are arranged in a 4 x 4 grid with a pixel size of 6.2 x 6.2 mm.

In this talk the simulation procedure of the experimental setup using GEANT4 along with methods to determine the quality of the tomographic images is presented.

T 97.6 Wed 18:45 WIL/C133

Simultaneous fast neutron and gamma tomography with a stilbene-based multi-pixel detector — Aenne Abel, •Nina Höflich, and Oliver Pooth — III. Physikalisches Institut B, RWTH Aachen University

The neutron detectors group at the Physics Institute III B, RWTH Aachen University, develops a multi-pixel detector for a compact fast neutron imaging setup. Since the interactions of fast neutrons in matter differ from those of X-rays and gamma rays, imaging with fast neutrons in addition to X- or gamma ray imaging can provide complementary information about the object of interest.

Our current detector prototype uses cuboids of the organic scintillator stilbene as active material, coupled to a SiPM array. The pixel size is 6.2×6.2 mm^2 . The usage of stilbene allows to distinguish neutron- and gamma-induced signals in the detector. An Americium-Beryllium neutron source delivers fast neutrons of up to 11 MeV and gamma rays of 4.44 MeV for our measurements.

In this talk, tomographic measurements of different test objects will be discussed, combining information from neutron and gamma attenuation. The main focus will be on the spatial resolution and the material distinction capability of our setup. Furthermore, possible improvements of our setup and the tomographic reconstructions will be briefly discussed.