T 28: Silicon Detectors IV (SiPMs, HG timing)

Time: Tuesday 16:15–17:45 Location: VG 1.101

T 28.1 Tue 16:15 VG 1.101

Electrical and mechanical tests of Flexible Printed Circuit cables for the ATLAS High Granularity Timing Detector — •Frederic Fischer[1], Lucia Masetti[1], Hendrik Smitmanns[1], Jessica Höfner[1], Annika Stein[1], Jan Ehrecke[1], Theodoros Manoussos[1], Andrea Brogna[2], Atila Kurt[2], Fabian Piermaier[2], Steffen Schönfelder[2], Antonin Zeman[2], and Quirin Weitzel[2] — [1]Johannes Gutenberg-Universität Mainz, Institut für Physik — [2]Johannes Gutenberg-Universität Mainz, PRISMA+ Detector Lab

The High Granularity Timing Detector (HGTD) for the ATLAS upgrade is under construction to meet the challenges of the HL-LHC. The silicon detectors along with the electronics are installed in two double-sided disks per end-cap and consist of modules connected to the peripheral electronics by flexible printed circuit cables (flex tails), which serve as interconnections for power, communication signals and HV bias. Their final version has been designed and several prototypes have been produced with mechanical as well as electrical tests offering promising results so far. The results of the latest tests both in the lab and at a demonstrator with the full readout chain will be presented. Mechanical aspects towards integration in the final detector are also considered.

T 28.2 Tue 16:30 VG 1.101

Gluing proceedings for the module assembly and the DU loading for the ATLAS High-Granularity timing detector — •Jessica Höfner[1], Annika Stein[1], Frederic Fischer[1], Lucia Masetti[1], Hendrik Smitmanns[1], Steffen Schönfelder[2], Jan Ehrecke[1], Theodorus Manoussos[1], Andrea Brogna[2], Atila Kurt[2], Fabian Piermaier[2], Antonin Zeman[2], and Quirin Weitzel[2] — [1]University Mainz, Insitute for physics — [2]University Mainz, PRISMA+ Detector Lab

One of the challenges of the high luminosity upgrade for the LHC (HL-LHC) is the increase of pileup interactions. The way to address this challenge is to exploit the time spread of the interactions to distinguish between collisions occurring very close in space but well separated in time. For this the ATLAS detector needs to be upgraded. One of the updates will be the installation of the High-Granularity Timing Detector (HGTD). The device will provide a timing resolution of 30-50 ps for minimum ionizing particles and therefore will improve significantly the performance in the forward region of the detector. The active area consists of 2 double sided disks per end-cap filled with modules made of two 2x2 cm^2 Low Gain Avalanche detectors dump-bounded to two ASICs and glued to a flexible PCB. Several modules will be glued onto a support unit to form a detector unit. The Mainz ATLAS group contributes to the assembly of modules and their loading onto DU's. Therefore, the gluing procedure needs to be set up. The current setup for the gluing and the loading procedure itself will be presented in this talk.

T 28.3 Tue 16:45 VG 1.101

The ATLAS High Granularity Timing Detector: Test-Beam and Test-Bench Results — •Theodoros Manoussos[1,2], Xiao Yang[1], Giulia Di Gregorio[1], Stefano Manzoni[1], Dominik Dannheim[1], Stefan Guindon[1], and Lucia Masetti[2] — [1]CERN — [2]Johannes Gutenberg-Universität Mainz, Germany

The increase of the instantaneous luminosity at the HL-LHC will be a challenge for the ATLAS detector. The pile-up is expected to increase up to 200 interactions per bunch crossing, resulting in poorer performance of the currently used reconstruction algorithms, in particular in the forward region. To mitigate these effects, a High Granularity Timing Detector (HGTD) will be integrated in the end-cap regions of ATLAS, covering a pseudo-rapidity range of $2.4 < |\eta| < 4.0$. HGTD, which also serves as a luminosity monitor, aims for a single-track time resolution for MIPs of 30 ps at the beginning of the lifetime, up to 50 ps after a maximum fluence of $2.5 \times 10^{15}\ \frac{\mathrm{neq}}{\mathrm{cm}^2}$. The high-precision timing information improves the correct assignment of tracks to vertices. HGTD sensors are based on the novel Low Gain Avalanche Detector (LGAD) technology. They provide a moderate gain, resulting in fast rise time and large signal-to-noise ratio, required for excellent time resolution. Each sensor is a 15×15 array of $1.3 \times 1.3\,\mathrm{mm}^2$ LGAD pads. A dedicated read-out ASIC, ALTIROC, was developed. ASICs are bump-bonded to sensors forming hybrids. Sensors and hybrids have been extensively tested in test-beam campaigns and with radioactive sources. The recent test-beam and test-bench results for sensors and hybrids before and after irradiation are presented in this talk.

T 28.4 Tue 17:00 VG 1.101

Optimizing Silicon Photomultiplier Readout for Particle Physics Detectors — •Johannes Wenk — ALU Freiburg, Physikalisches Institut,79104 Freiburg (DE)

To optimize the performance of silicon photomultiplier (SiPM) detectors and their readout electronics, we have developed a robust, light-tight calibration and test setup providing a reproducible environment for precise SiPM measurements. This system features a pulsed laser with adjustable intensity to simulate a wide range of experimental light conditions, critical for evaluating the linearity and dynamic range of SiPMs. The setup also enables measurements of SiPM response at variable bias voltages, intrinsic noise characteristics through dark count analysis, and temperature stability during operation. Its modular design accommodates diverse SiPM geometries and configurations, facilitating systematic comparisons of different types and designs. By providing a controlled, versatile testing environment, this calibration setup supports the optimization of detectors for high-energy physics experiments such as AMBER and SHiP at CERN, where SiPM performance is critical for achieving precise measurements. * Gefördert durch das BMBF

T 28.5 Tue 17:15 VG 1.101

MIP detection on a plastic scintillator and SiPM system in very noisy environments — •Katjana Neumann, Massimiliano Antonello, Erika Garutti, and Jörn Schwandt — Universität Hamburg, Hamburg, Germany

A system consisting of a plastic scintillator tile directly couple to a SiPM is used to detect minimum ionizing particles (MIP) from a Sr90 source. The design of the single channel in inspired by the tiles for the CMS HGCAL calorimeter upgrade.

The signal to noise (S/N) separation provided by the system is well above 10 at the beginning of the detector lifetime. Radiation damage of the SiPM, as that experienced during the lifetime of the HGCAL detector, increase the dark current and degrade the S/N separation and by that the MIP detection efficiency.

We investigate the degradation as a function of the dark current increase. The increase of dark current after irradiation can be mitigated by cooling the SiPM or lowering its operation voltage. The systematic dependence of S/N separation on these parameters will be discussed in the presentation.

T 28.6 Tue 17:30 VG 1.101

Correction of Non-Linear Response of Silicon Photomultipliers — •Lukas Brinkmann, Massimiliano Antonello, Erika Garutti, and Jörn Schwandt — Universität Hamburg, Hamburg, Germany

The finite number of pixels in a silicon photomultiplier (SiPM) limits its dynamic range. The SiPM response deviates from linear by more than 5% already for signals comparable to 50-60% of the total number of pixels. Correcting the non-linear response is essential to extend the SiPMs dynamic range. One challenge in determining the non-linear response correction is providing a reference linear light source. Instead, the single-step method used to calibrate PMTs is applied, based on the difference in responses to two light sources. With this method, the response of various SiPMs with different pixel geometries was measured and corrected. The study shows that the response function does not depend on the operation voltage in the range $2 - 4\,\mathrm{V}$ overvoltage and it is only mildly dependent on temperature over a range of 40 K. Linearity within 1% can be restored by applying a single correction function in a range of $\pm 5\,\mathrm{K}$ and $\pm 2\,\mathrm{V}$ around the original conditions of the measurement.