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Book of Abstracts

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1

Design of an 8-Channel 40 GS/s 20 mW/Ch Waveform Sampling ASIC in 65 nm CMOS

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1-ps timing resolution is the entry point to signature-based searches relying on secondary/tertiary vertices and particle identification. We describe PSEC5, an 8-channel 40 GS/s waveform-sampling ASIC in the TSMC 65 nm process targetting 1 ps resolution at 20 mW power per channel.
Each channel consists of four fast and one slow switched capacitor arrays (SCA), allowing ps time resolution combined with a long effective buffer. Each fast SCA is 1.6 ns long and has a nominal sampling rate of 40 GS/s. The slow SCA is 204.8 ns long and samples at 5 GS/s. Recording of the analog data for each channel is triggered by a fast discriminator capable of multiple triggering during the window of the slow SCA.
To achieve a large dynamic range, low leakage, and high bandwidth, the SCA sampling switches are implemented as 2.5 V nMOSFETs controlled by 1.2 V shift registers. Stored analog data are digitized by an external ADC at 12 bits.

Specifications on operational parameters include a 4 GHz analog bandwidth and a dead time of 20 microseconds, corresponding to a 50 kHz readout rate, determined by the choice of the external ADC.
A first submission PSEC5 has been fabricated and is being tested currently.

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Characterisation of a 16-by-96 multi-anode MCP-PMT

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Owing to their single photon sensitivity and fast rise time, micro-channel-plate photomultipliers (MCP-PMTs) make a good candidate for photon detectors for the Time Of Internally Reflected Cherenkov light detector (TORCH) that is proposed as part of the phase two upgrade of the LHCb experiment. TORCH has a target time resolution per photon of approximately 70 ps, required to achieve an approximately 3 standard deviation separation of pions and kaons at 10 GeV/c over a 10 m flight

distance. A major challenge for TORCH is the high detector occupancy expected during the high-luminosity phase of the LHC, imposing a high requirement for the photon rate for the MCP detector. A new high granularity 16-by-96 channel MCP-PMT with a directly coupled anode has been developed in conjunction with Photek Ltd. This device is designed to decrease the pixel pitch to 0.55 mm giving improved spatial resolution and importantly lower per-pixel occupancies.
This talk will cover characterisation studies that have taken place on this MCP-PMT: measurements of cross-talk, to determine the spatial resolution of the device; measurements of transit-time spread when applying different biasing potentials, to determine its time resolution; and gain and QE uniformity measurements, to test the uniformity of the device across its active area. Finally, rate capability and expected lifetime were evaluated by gain vs event rate measurements and by studying ion feedback through time delay of after pluses.

3

RF PMT: A Picosecond-Resolution Timing Sensor —Current Status and Future Perspectives

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A new high-precision timing sensor —the Radio-Frequency Photo Multiplier Tube (RF PMT) —has been recently developed and tested. The detector performs circular scanning of photoelectrons or secondary electrons using a dedicated radio-frequency (RF) deflector operating at 500–1000 MHz. The scanned electrons are detected by a position-sensitive system comprising dual chevron microchannel plates and a delay-line anode. Thus, the arrival time of each electron is determined from its hit position on a circular image. A time resolution of 10 picoseconds, along with excellent stability, has been demonstrated for single electrons, and further improvements toward a few-picosecond resolution are anticipated in the near future. Current and potential applications of the detector will be discussed.

4

A Modular Test System for the PSEC5 40 GS/s waveform-sampling ASIC

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We have recently submitted for fabrication PSEC5, an 8-channel mixed-signal waveform-sampling ASIC targeting 1 ps timing resolution, 200 ns buffer length, and multi-hit capability. Here, we describe the architecture and development process of a modular test system for PSEC5. The system consists of two PCBs: a Design Under Test (DUT) Board, and a Control Board. The Control Board is based on the Kria K26 FPGA module. The DUT Board contains PSEC5. The boards are being designed in KiCad; the

FPGA firmware is being written in Vivado. The system has been designed by a team of undergraduates with guidance from experts

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Harnessing the Purcell Effect for Faster Metascintillators

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Recent advancements in scintillation detection and imaging have focused on two emerging concepts: metascintillators and nanophotonic scintillators. Metascintillators leverage an energy-sharing approach with at least two scintillator components: one with high stopping power and another with fast response characteristics. Conversely, nanophotonic scintillators integrate scintillating materials into nanophotonic structures to either enhance emission rates (Purcell-enhanced scintillators) or control the flow of emitted light toward detectors. Building upon these innovations, we propose integrating nanophotonic scintillators into metascintillator designs to enhance the performance of first-generation metascintillators, thus presenting a viable technological pathway toward achieving the 10 ps CTR limit in PET imaging.

6

Wafer-Scale CMOS Monolithic Active Pixel Sensors: Status and Future of the ALICE ITS3 Upgrade.

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In the LHC Long Shutdown 3, the ALICE experiment at the LHC will upgrade the three innermost layers of its Inner Tracking System (ITS). This next-generation tracking detector will feature wafer-scale, truly cylindrical Monolithic Active Pixel Sensors (MAPS) fabricated using a 65 nm CMOS imaging process. The sensors, thinned to 50 μm, will be flexible enough to form ultra-lightweight cylindrical layers without stiff mechanical support, achieving an unprecedented material budget of just 0.07 X/X_0 per layer. This breakthrough will enhance tracking performance and improve pointing resolution by a factor $\sim$2, particularly for low-momentum particles ($\sim$ 0.1 GeV/c).

A key milestone in this development has been the fabrication and characterization of the MOnolithic Stitched Sensors (MOSS) and MOnollithic stitches Sensors with timing (MOST), 27 cm-long stitched CMOS sensors designed to validate the feasibility of wafer-scale integration, on-chip power segmentation timing performance and on chip transmission. Since mid-2023, MOSS chips have undergone extensive testing in laboratory and beam environments. These studies demonstrated a detection efficiency above 99% with a fake-hit rate below the ITS3 requirement of 10^{-6} hits/pixel/trigger.

This presentation will summarize the key results from the MOSS studies, highlighting their impact on the ITS3 upgrade and the advancements in ultra-thin, large-area stitched MAPS sensors. These include improved charge collection, reduced material budget, and seamless curved sensor integration, setting new benchmarks for high-resolution tracking in future collider experiments. Additionally, I will provide a brief overview of the next foundry submission, which will include a set of test structures with improved implantation, aimed at further enhancing charge collection and reducing sensor capacitance.

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Timing performance studies of irradiated 65 nm CMOS imaging monolithic silicon pixel structures for the ALICE inner tracker upgrade

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During the LHC Long Shutdown 3, the ALICE Collaboration will replace the innermost three layers of the existing ALICE silicon tracker, ITS2. The upgraded inner tracker will consist of cylindrical, wafer-scale monolithic silicon sensors using a 65 nm CMOS imaging process. To evaluate the performance of the technology, test structures were fabricated on a multilayer reticle (MLR1). One such structure, the analogue pixel test structure with an operational amplifier (APTS-OPAMP), was developed to investigate the achievable time resolution of this technology.

The APTS-OPAMP chip features a 4 × 4 pixel matrix with a pixel pitch of 10 μm × 10 μm on an approximately 10 μm thick epitaxial layer with a small collection electrode. Each pixel is connected to a dedicated fast operational amplifier located outside the matrix, which buffers the signal output from the pixel front end to the analogue output pad. Characterisations of a non-irradiated sensor have demonstrated a time resolution as low as 63 ps.

To assess the impact of radiation on the time resolution of the 65 nm CMOS imaging process for use in ITS3 and future applications, the APTS-OPAMP was irradiated with neutrons up to fluences of 10^{14} and 10^{15} 1 MeV n_{eq}/cm^2. This contribution presents the latest performance results, focusing on time resolution and efficiency. It includes measurements from both laboratory and beam tests, with particular emphasis on the APTS-OPAMP performance in the most recent test beam campaign, showing an efficiency of approximately 99% and an overall time resolution comparable to that of a non-irradiated sensor.

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The ATLAS High-Granularity Timing Detector for the HL-LHC : project status and results

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The increase of the particle flux (pile-up) at the HL-LHC with instantaneous luminosities up to $L \simeq 7.5 \times 10^{34}\ \mathrm{cm}^{-2}\mathrm{s}^{-1}$ will have a severe impact on the ATLAS detector reconstruction and trigger performance. The end-cap and forward region where the liquid Argon calorimeter has coarser granularity and the inner tracker has poorer momentum resolution will be particularly affected. A High Granularity Timing Detector (HGTD) will be installed in front of the LAr endcap calorimeters for pile-up mitigation and luminosity measurement. The HGTD is a novel detector introduced to augment the new all-silicon Inner Tracker in the pseudo-rapidity range from 2.4 to 4.0, adding the capability to measure charged-particle trajectories in time as well as space. Two silicon-sensor double-sided layers will provide precision timing information for minimum-ionising particles with a resolution as good as 30 ps per track in order to assign each particle to the correct vertex. Readout cells have a size of 1.3 mm × 1.3 mm, leading to a highly granular detector with ˜3.7 million channels. Low Gain Avalanche Detectors (LGAD) technology has been chosen as it provides enough gain to reach the large signal over noise ratio needed. The requirements and overall specifications of the HGTD will be presented as well as the technical design and the project status. The R&D effort carried out to study the sensors, the readout ASIC, and the other components, supported by laboratory and test beam results, will also be presented.

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Performance Validation and Construction of the Barrel Layer of the CMS MIPs Timing Detector for the HL-LHC

Author: Alessio Ghezzi[1]

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The High Luminosity phase of the Large Hadron Collider (HL-LHC), with an integrated luminosity of approximately 3000 fb^{-1} over ten years, will enable experiments to search for rare processes and perform precision measurements. However, it will also present significant challenges for the detectors, due to high pile-up, up to 200 interactions per bunch crossing, and extremely high radiation levels. To mitigate the adverse effects of pile-up, the CMS detector will install a novel detector, the MIPs Timing Detector (MTD), designed to precisely measure the arrival time of charged particles, allowing for the separation of particles from different interactions in the same bunch crossing. The barrel section of the MTD, the Barrel Timing Layer (BTL), consists of approximately 166,000 scintillating LYSO:Ce crystals coupled to custom SiPMs. It will measure the MIP timing with a precision of around 30 ps at the start of operations, degrading to about 60 ps towards the end of its lifetime due to radiation damage to the SiPMs. After optimization and validation of the BTL performance through dedicated test beam campaigns on prototypes, BTL is now in the construction phase. In this contribution the key features of the BTL, the validation of its performance, and the current status of its assembly and qualification will be presented.

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The Endcap Timing Layer of the CMS MIP Timing Detector for HL-LHC

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The High-Luminosity Large Hadron Collider (HL-LHC) will enable a more detailed exploration of new physics phenomena by significantly increasing collision rates, leading to pileup levels of approximately 200 simultaneous interactions. Several CMS systems will undergo substantial upgrades, including the MIP Timing Detector (MTD) project to prepare for this new era. The MTD is designed to mitigate pileup effects by providing a precise timestamp, accurate to 30–40 picoseconds for each event, thereby ensuring sustained detector performance under HL-LHC conditions. The MTD is divided into two sections: the Barrel Timing Layer (BTL) and the Endcap Timing Layer (ETL), each utilizing different sensor and ASIC technologies to address the varying active surfaces, irradiation conditions, and installation requirements. The ETL, comprising two double-sided disks, utilizes Low-Gain Avalanche Diode (LGAD) sensors and the Endcap Timing Readout Chip (ETROC) to meet the unique demands of its environment. Pre-production of ETL modules is underway, with extensive validation tests including the ETROC system test and module assembly. This presentation will provide an overview of the ETL, focusing on its electronics, current achievements, and status.

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The upgrade of CMS ECAL for precise timing measurements at the High-Luminosity LHC

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The Electromagnetic Calorimeter ECAL of the CMS experiment at the Large Hadron Collider at CERN is a homogeneous calorimeter made of lead tungstate scintillating crystals. An upgrade of ECAL is in preparation to cope with the challenging conditions anticipated for the High Luminosity phase of LHC. The endcap part of the ECAL will be replaced by a new detector. In the ECAL barrel the crystals and the avalanche photodiodes (APDs) will be preserved, while the readout and trigger electronics will undergo a complete replacement. Two ASICs have been designed for the readout of the APDs. The first, CATIA, is a gain trans-impedance amplifier with two outputs with different gains. The second, LiteDTU, includes two 160 MHz ADCs, one for each CATIA output and the logic to select the gain to read out, compress, format, and serialize the data. The noise increase in the photodetectors, due to radiation-induced dark current, will be mitigated by reducing the ECAL operating temperature from 18°C to 9°C. The trigger primitive formation will be moved off-detector and handled by powerful and flexible FPGA processors. The upgrade of the ECAL electronics will greatly enhance the time resolution of the detector, which will reach around 30 ps for high energy electrons and photons. In this presentation an overview of the ECAL Upgrade project will be given, describing the final design of the full ECAL barrel readout chain together with the status of the individual component R&D. The results from recent test beam campaigns at the CERN SPS will be summarised, focusing in particular on the timing resolution performance of the latest readout electronics prototypes.

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Module assembly and testing for the HGTD ATLAS upgrade

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The High Granularity timing detector (HGTD) is one of the ATLAS upgrades and is designed to provide a per-track timing information of tens of ps over the full detector lifetime. This information will contribute to pileup mitigation in the operations of the ATLAS detector at the High-Luminosity LHC. HGTD deploys low gain avalanche silicon detectors (LGADs) with a segmentation into a 15x15 matrix with 1.3x1.3 mm2 pads.
Sensors are bump-bonded to the ALTIROC readout ASIC, and two of such hybrids are attached to a single PCB to constitute an HGTD module.
The HGTD will be instrumented with more than 8000 modules and this talk will discuss the requirements and the methods used for the assembly of modules and the procedures deployed to verify their quality and test their functionality. Finally, the recent results achieved on the module performance will be presented.

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Registration

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Welcome

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Development of 4D-trackers for future colliders

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Optimization of 3D diamond detectors with graphitized electrodes based on an innovative numerical simulation

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Photek's Fast MCP PMT Detector Performance Review

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Timing resolution of thin LGAD sensors

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HRPPD photosensors for RICH detectors with a high resolution timing capability

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Discussion: detectors

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Transmission Dynodes: Enhancing Vacuum Photodetectors

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PhotonPix for high timing accuracy single photon detection from low to high flux rates

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Discussion: Detectors

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Fast Timing ASIC design for SiPM readout'

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High resolution time measurement on the LHC with the SPIDER (Swift Pipelined Digitizer) asic

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ASIC-based fast timing acquisition system for the SAND experiment

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Discussion: electronics

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10ps Time-of-Flight PET: From Hope to Practice

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LGAD applications for cosmic ray measurements and in flash beam therapy

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LGAD Tests in a Flash Beam

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From Earth to the Cosmos: Leveraging Precision Timing Innovations in Nuclear Physics for Next-Generation Space Particle Telescopes

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Module assembly and testing for the HGTD ATLAS upgrade

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Discussion: applications

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The proposed ALADDIN experiment at LHC

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LHC and HL-LHC Precision Proton Spectrometer Setup and Proton timing processing

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Discussion: HEP applications

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Time and space structure of luminosity for different collider beam parameters

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Discussion: HEP applications

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Workshop conclusion

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Discussion: Future workshops, COST actions, etc

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A Modular Test System for the PSEC5 40 GS/s waveform-sampling ASIC

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PhotonPix for high timing accuracy single photon detection from low to high flux rates

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We present the PhotonPix™ single-photon counting detector, a plug-and-play solution optimized for high-rate applications requiring exceptional timing precision. The detector integrates a Photonis Fast Timing MCP-PMT with an 8 mm diameter active area, supporting a range of Hi-QE photocathodes optimized for high quantum efficiency, in selected spectral range of 150 nm-900 nm, and low dark count rates. In combination with the state-of-the-art electronics developed by Photonscore, the system delivers a dead time below 2 ns and supports count rates up to several hundred MHz.

Timing resolution below 30 ps full-width at half-maximum (FWHM) has been demonstrated under burst illumination up to 15 MHz and continuous operation up to 5 MHz, with near-100% pulse detection efficiency. At elevated input burst rates, timing resolution remains below 40 ps; however, detection efficiency is affected by dead time, decreasing to approximately 50% at 500 MHz. These capabilities position PhotonPix™ as a robust solution for time-correlated photon counting, ultrafast optical timing, and other high-throughput photon detection applications.

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Transmission Dynodes: Enhancing Vacuum Photodetectors

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MCP-PMT devices represent the state-of-the-art in terms of picosecond timing resolution combined with low noise, high gain, and radiation hardness. However, with experiment upgrades producing higher luminosities, there are concerns over the ability of the existing technologies to achieve sufficiently high rates and longer tube lifetime in terms of extracted charge. To overcome these limitations, we are developing a hybrid diamond/MCP photomultiplier consisting of a transmission dynode followed by an MCP.
The transmission dynode, a diamond-based composite material comprising a single crystal diamond membrane on a high open area support structure, operates at a gain of 10-20, followed by further gain in the MCP. This high first gain stage produces a low gain variance which allows operation at a lower overall gain while maintaining the tight pulse height distribution necessary for single photon counting. Since the maximum MCP signal is current-limited due to the MCP resistance, a lower overall gain allows higher maximum photon count rate to be achieved. In addition, the diamond membrane acts as an impermeable barrier to ion feedback from the MCP, a major cause of photocathode degradation which limits the effective lifetime of conventional tubes.

In the longer term, a complete replacement of MCPs with transmission dynodes is an attractive prospect. These devices would have an excellent single-photon spectrum, higher collection efficiency than MCP-PMTs and their linear geometry will give much improved timing precision over the ˜30 ps of conventional MCP-PMTs.

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The Endcap Timing Layer of the CMS MIP Timing Detector for HL-LHC

Author: CMS Collaboration[None]

The High-Luminosity Large Hadron Collider (HL-LHC) will enable a more detailed exploration of new physics phenomena by significantly increasing collision rates, leading to pileup levels of approximately 200 simultaneous interactions. Several CMS systems will undergo substantial upgrades, including the MIP Timing Detector (MTD) project to prepare for this new era. The MTD is designed to mitigate pileup effects by providing a precise timestamp, accurate to 30–40 picoseconds for each event, thereby ensuring sustained detector performance under HL-LHC conditions. The MTD is divided into two sections: the Barrel Timing Layer (BTL) and the Endcap Timing Layer (ETL), each utilizing different sensor and ASIC technologies to address the varying active surfaces, irradiation conditions, and installation requirements. The ETL, comprising two double-sided disks, utilizes Low-Gain Avalanche Diode (LGAD) sensors and the Endcap Timing Readout Chip (ETROC) to meet the unique demands of its environment. Pre-production of ETL modules is underway, with extensive validation tests including the ETROC system test and module assembly. This presentation will provide an overview of the ETL, focusing on its electronics, current achievements, and status.

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Performance Validation and Construction of the Barrel Layer of the CMS MIPs Timing Detector for the HL-LHC

Author: CMS Collaboration[None]

The High Luminosity phase of the Large Hadron Collider (HL-LHC), with an integrated luminosity of approximately 3000 fb^{-1} over ten years, will enable experiments to search for rare processes and perform precision measurements. However, it will also present significant challenges for the detectors, due to high pile-up, up to 200 interactions per bunch crossing, and extremely high radiation levels. To mitigate the adverse effects of pile-up, the CMS detector will install a novel detector, the MIPs Timing Detector (MTD), designed to precisely measure the arrival time of charged particles, allowing for the separation of particles from different interactions in the same bunch crossing. The barrel section of the MTD, the Barrel Timing Layer (BTL), consists of approximately 166,000 scintillating LYSO:Ce crystals coupled to custom SiPMs. It will measure the MIP timing with a precision of around 30 ps at the start of operations, degrading to about 60 ps towards the end of its lifetime due to radiation damage to the SiPMs. After optimization and validation of the BTL performance through dedicated test beam campaigns on prototypes, BTL is now in the construction phase. In this contribution the key features of the BTL, the validation of its performance, and the current status of its assembly and qualification will be presented.

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Timing resolution of thin LGAD sensors for very high fluences

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Timing resolution of LGAD sensors with different thicknesses, ranging from 45 down to 20 μm will be presented. The results are obtained through a β-source stimulus and electron beam test at the DESY facility. A timing resolution down to 16.6 ps has been reached by 20 mum-thick sensors, reduced to 12.2 ps by using the information from 2 different planes of 20 μm sensors. Irradiated sensors with a thickness of 30 μm have been investigated, up to a fluence of $2.5{\cdot}10^{15}$ 1 MeV equivalent n/cm^2, demonstrating no degradation in timing resolution with irradiation up to the highest fluence.

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Optimization of 3D diamond detectors with graphitized electrodes based on an innovative numerical simulation.

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Future experiments at hadron colliders require an evolution of the tracking sensor technologies to ensure sufficient radiation hardness and timing resolution to cope with unprecedented fluxes of charged particles.
3D diamond sensors with laser-graphitized electrodes, featuring strong binding energy, small atomic number and high carrier mobility, could provide an appealing option. However, currently the high resistance of the engraved electrodes delays the propagation of the induced signals towards the readout, deteriorating the precision of the timing measurements.
Historically, the contribution to the uncertainty on diamond sensors' timing measurements due to

the signal propagation through the electrodes was largely dominant, allowing to neglect contributions from field inhomogeneities and electronics jitter. Recent technological advancements in graphitization technology, however, call for a renewed effort in modeling signal generation in these devices, where all the components are considered in a comprehensive way. To this purpose, we apply an extended version of the Ramo-Shockley theorem representing the effect of signal propagation as a time-dependent weighting potential, obtained by solving numerically the Maxwell equations in a quasi-static approximation, with appropriate boundary conditions.
To this end, we developed a custom solver leveraging spectral methods and validated it against the solution obtained with the Finite Element Method implemented by the commercial software COMSOL MultiPhysics. The response of the modeled sensor to a beam of particles is then simulated using Garfiel++ and compared to the data acquired with a 3D diamond sensor in a beam test carried on in 2021 by the TimeSPOT Collaboration at the SPS, at CERN. After validation on data, the simulation pipeline is used to study the different contributions to time resolution and to draw conclusions on further sensor developments to improve their time resolution.
Reducing the resistivity of the columns remains the first priority, while improving the readout electronics design, e.g. by shortening the shaping time, appears to be at least as important as optimizing the sensor geometry.

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Latest results in the development of monolithic CMOS LGAD sensors implemented in 110 nm technology for the ALICE 3 Time Of Flight detector

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Since the spatial density of particle collisions is expected to rise significantly in the upcoming high-energy physics experiments, silicon detectors are required to provide precise timing information to perform an accurate track reconstruction and particle identification. Several experiments will face this challenge, including the next-generation heavy-ion experiment named ALICE 3, which will be installed at the Large Hadron Collider (LHC) at CERN during the Long Shutdown 4 (LS4).
In recent years, Monolithic CMOS Active Pixel Sensors (MAPS) have proven to successfully meet the requirements of tracking detectors and also to be in several cases a reliable alternative to hybrid pixels. Monolithic sensors can indeed help to decrease the production costs and to simplify the complex assembly procedures.
Currently, the time resolution of CMOS sensors needs to be pushed significantly beyond the present state-of-art and a vigorous R&D is necessary to improve it. A promising solution to increase the signal-to-noise ratio (SNR) and decrease the jitter has been found by implanting a gain layer below the collection electrode, thus providing charge multiplication by impact ionization.
To this aim, the last ARCADIA submission exploited the integration of the Low Gain Avalanche Diode (LGAD) concept in the design of fully depleted CMOS MAPS, combining the benefits of both technologies. The multiplication of the signals in MAPS has a major impact on the SNR, hence the jitter can be decreased and the power consumption of the in-pixel front-end can be lowered while maintaining the same performance. As well as possible applications in high energy physics experiments, this technology is attractive also for space applications where low power is desired.
This presentation will focus on the latest characterization results on these structures with internal gain fabricated in a standard 110 nm CMOS technology by LFoundry. An overview of these sensors will be provided, with emphasis on laboratory measurements and comparisons of experimental data with simulated ones. The promising results obtained from the analysis of the data collected during the latest two test beams at CERN PS and DESY, where a tracker was exploited to study the correlations with the particle tracks in the device, will be shown. Finally, the future perspectives and an insight into the ongoing R&D will be given.

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ASIC-based fast timing acquisition system for the SAND experiment

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The System for on-Axis Neutrino Detection (SAND), part of the Deep Underground Neutrino Experiment (DUNE), is designed to monitor the long-term stability of the neutrino beam at Fermilab. SAND reuses the lead scintillating-fiber electromagnetic calorimeter (ECAL) of the KLOE experiment with excellent time and energy resolutions. The calorimeter is read-out by approximately 5000 PMTs requiring a cost-effective, high-channel-density readout system capable of matching the stringent ECAL performance. Traditional analog electronics impose excessive dead time, while fully digital solutions present significant cost constraints. An ASIC-based approach provides a viable alternative, balancing performance and scalability. This study evaluates the Radioroc front-end ASIC for energy measurements, complemented by timing measurements performed with the FERS A5203 picoTDC unit. The tests were carried out using a signal generator producing pulses that mimic PMT signals, with a programmable attenuator enabling an amplitude sweep over a 60 dB range before reaching the Radioroc. In the final detector configuration, the Radioroc front-end, originally designed for SiPM readout, will interface with ECAL PMTs through a fast-inverting amplifier integrated into the PMT housing. Energy resolution was assessed by comparing the Radioroc ADC chain with the ToT-based estimation from FERS A5203. Results indicate that for large signals (>100 mV), the ADC provides superior resolution, whereas for smaller signals, the ToT method proves to be more effective. The complementarity of these approaches extends the dynamic range of acquired energies, enhancing measurement capabilities. These results appear very promising in satisfying both energy and time resolutions requirements for the SAND calorimeter, confirming the suitability of this ASIC-based solution for high-density readout in neutrino physics experiments.

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