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Sala Convegni della Cassa di Risparmio di Firenze

Book of Abstracts

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Welcome address

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Useful Information

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Performance and operation experience of the Atlas Semiconductor Tracker

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After more than 3 years of successful operation at the LHC, we report on the
operation and performance of the ATLAS Semi-Conductor Tracker (SCT) functioning in a high luminosity, high radiation environment. The SCT is constructed of 4088 silicon detector modules, for a total of 6.3 million strips. Each module is designed, constructed and tested to operate as a stand-alone unit, mechanically, electrically, optically and thermally. The modules are mounted into two types of structures: one barrel (4 cylinders) and two end-cap systems (9 disks on each end of the barrel). The SCT silicon micro-strip sensors are processed in the planar p-in-n technology. The signals are processed in the front-end ABCD3TA ASICs, which use a binary readout architecture. Data is transferred to the off-detector readout electronics via optical fibers. We find 99.3% of the SCT modules are operational, noise occupancy and hit efficiency exceed the design specifications; the alignment is very close to the ideal to allow on-line track reconstruction and invariant mass determination. We will report on the operation and performance of the detector, including an overview of the issues encountered. We will report the expected observation of significant increases in leakage currents from bulk damage due to non-ionizing radiation and make comparisons with the predictions.
We will also cover the time evolution of the key parameters of the strip tracker, including the evolution of noise and gain, the measurement of the Lorentz angle and the tracking efficiency in the harsh LHC environment. Valuable lessons for future silicon strip detector projects will be presented.

Summary:

The proposed talk is a status report of the operation of one of the largest Silicon detectors presently in function. A long shutdown period has just started for the LHC and we can now show the performance over the entire range of this initial period of data taking.
We have a new and updated determination of the radiation damage, also for the end-cap, for the entire 2010-2013 data-taking period, updating the partial result shown last year.
We can show the performance (efficiency) as a function of instant luminosity;
Measurements of backplane resistance and electronic gain may also be shown.
During this shutdown the SCT will remain unchanged, with the addition of off-detector read-out cards to increase the bandwidth, to cope with the increased instantaneous luminosity of the LHC. This plan

will also be detailed in the talk.

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Operation of CMS silicon tracker

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The CMS silicon tracker is the largest silicon detector ever built. It consists of a hybrid pixel detector with 66 million channels and a 200 m2 silicon strip detector with 10 million read out channels. The presentation describes the operation of this detector during data taking years before the current LHC shutdown, both during proton-proton as well as heavy ion collisions. Results on the operational performance are presented including alignment, calibration, S/N, timing, etc.

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Status of the ATLAS Pixel Detector at the LHC and its performance after three years of operation.

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The ATLAS Pixel Detector is the innermost detector of the ATLAS experiment at the Large Hadron Collider at CERN. The detector provides hermetic coverage with three cylindrical layers and three layers of forward and backward pixel detectors. It consists of approximately 80 million pixels that are individually read out via chips bump-bonded to 1744 n-in-n silicon substrates. In this talk, results from the successful operation of the Pixel Detector at the LHC and its status after three years of operation will be presented, including monitoring, calibration procedures, timing optimization and detector performance. The record breaking instantaneous luminosities of 7.7 x 10^33 cm-2 s-1 recently surpassed at the Large Hadron Collider generate a rapidly increasing particle fluence in the ATLAS Pixel Detector. As the radiation dose accumulates, the first effects of radiation damage are now observable in the silicon sensors. A regular monitoring program has been conducted and reveals an increase in the silicon leakage current, which is found to be correlated with the rising radiation dose recorded by independent sensors within the inner detector volume. In the longer-term crystal defect formation in the silicon bulk is expected to alter the effective doping concentration, producing type-inversion and ultimately an increase of the voltage required to fully deplete the sensor. The fourth pixel layer at the radius of 3.5 cm will be added during the long shutdown 2013-2014 together with the replacement of pixel services. Letter of Intent is in preparation for the completely new pixel detector after 2023, capable to take data with extremely high instantaneous luminosities of 5 x 10^34 cm-2 s-1 at High Luminosity LHC.

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Tracking performances in CMS

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The CMS tracker is the largest silicon detector ever built, covering 200 square meters and providing an average of 14 high-precision measurements per track. Tracking is essential for the reconstruction of objects like jets, electrons and tau leptons. Track reconstruction is widely used also at trigger level as it improves lepton and jet resolution and allows to pre-identify tau leptons and b-jets.
Tracking algorithms used in CMS will be described. The resolution and efficiency of the track, vertex, and beam line reconstruction, as measured in data, are compared to the results from simulation. The impact of tracking on CMS physics program will be discussed.

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The Alignment of the CMS Silicon Tracker

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he CMS all-silicon tracker consists of 16588 modules, embedded in a solenoidal magnet providing a field of B = 3.8 T. The targeted performance requires that the alignment determines the module positions with a precision of a few micrometers. Ultimate local precision is reached by the determination of sensor curvatures, challenging the algorithms to determine about 200k parameters simultaneously, as is feasable with the Millepede II program. The main remaining challenge are global distortions that systematically bias the track parameters and thus physics measurements. They are controlled by adding further information into the alignment workflow, e.g. the mass of decaying resonances or track data taken with B = 0 T. To make use of the latter also to integrate the determination of the Lorentz angle into the alignment procedure, the alignment framework has been extended to treat position sensitive calibration parameters. This is relevant since due to the increased LHC luminosity in 2012, the Lorentz angle exhibits time dependence. Cooling failures and ramping of the magnet can induce movements of large detector sub-structures. These movements are now detected in the CMS prompt calibration loop to make the corrections available for the reconstruction of the data for physics analysis. The geometries are finally carefully validated. The monitored quantities include the basic track quantities for tracks from both collisions and cosmic muons and physics observables.

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GigaTracker, a Thin and Fast Silicon Pixels Tracker

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GigaTracker, the NA62's upstream spectrometer, plays a key role in the kinematically constrained background suppression. It is made of three independent stations, each of which is a six by three cm2 hybrid silicon pixels detector. In order to meet the physics goals of NA62 the pixel hit time resolution must be better than 200 ps. The material budget must be kept less than 0.5 % X0.
The 200µm thick sensor is divided into 18000 300µm × 300µm pixels bump-bounded to ten independent read-out chips. The chips use an end-of-column architecture and rely on time-over-threshold discriminators. A station can handle a crossing rate of 750MHz. Microchannel cooling technology will be used to cool the assembly. It allows us to keep the sensor close to 0◦C with 130µm of material in the beam area.
The sensor and read-out chip performance were validated with a 45 pixels demonstrator with a laser

test setup and during a test beam. The time resolution was found to be better than 175 ps, well within the specifications.

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Radiation performance of new semiconductor power devices for the LHC experiment upgrades

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GaN and SiC power devices were extensively tested under different types of radiation, in the framework of the APOLLO R&D collaboration, aiming to use these new technologies for designing power supplies for the future LHC experiments upgrades.
SiC power MOSFETs were irradiated with gamma-rays, neutrons, protons and heavy ions (Iodine, Bromine) at different energies (20MeV - 550MeV). They showed very good performances in terms of Total Ionizing Dose (TID) sensitivity, but exhibited a quite poor Safe Operating Area (SOA) with respect to Single Event Effects (SEEs).
Enhancement-mode GaN transistors manufactured by EPC, with blocking voltage ranging from 40V to 200V, were irradiated with gamma-rays, heavy ions (Iodine, Bromine), high and low energy protons. They showed a very good SOA toward SEE. After the irradiation with 3-MeV protons at the highest fluence (4·10^14 p/cm^2), the devices exhibited an increase of up to one order of magnitude in gate leakage, almost 1 V of threshold voltage reduction, degradation of the subthreshold slope, and drop in transconductance. The reduction in threshold is in contrast with the increase normally observed in GaN devices irradiated with protons, and is likely due to radiation effects in the layers introduced to engineer the positive threshold voltage

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Radiation-Hard/High-Speed Parallel Optical Engine

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The LHC at CERN is now the highest energy and luminosity collider in the world. Upgrades to the accelerator are currently being planned to further increase the energy and luminosity. The detectors must be upgraded to take advantage of the planned accelerator upgrades. This requires the optical

links to transmit data at much higher speed to handle the much increased luminosity. We will present the results from three R&D projects. The goal of the R&D is to develop an ASIC that contains an array of 12 high-speed drivers to operate an array of 12 VCSELs (Vertical Cavity Surface Emitting Lasers). With the spacing of 250 µm between two VCSELs, the width of an optical array is only 3 mm. High speed VCSEL arrays operating at 10 Gb/s are now readily available and have been proven to be radiation-hard in our previous studies. This allows the deployment of a compact 120 Gb/s parallel optical engines at a high radiation location close to the interaction region where space is at a premium.

We incorporate the experience gained from the fabrication and operation of the optical link system of the current ATLAS pixel detector into the design of the new ASICs. For the first R&D project, the ASIC is a 12-channel VCSEL array driver operating at 5 Gb/s per channel. Each channel has an LVDS receiver, an 8-bit DAC, and a VCSEL driver. The 8-bit DAC is used to set the VCSEL modulation current. There is also a single 8-bit DAC to set the bias currents of all channels simultaneously. A scheme for redundancy has also been implemented to allow bypassing of a broken VCSEL. To enable operation in case of a failure in the communication link to the ASIC, we have included a power on reset circuit that will set the ASICs to a default configuration with no signal steering and the VCSEL modulation current to 10 mA. The ASIC was designed using a 130 nm CMOS process to enhance the radiation-hardness. The performance of the fabricated ASIC at 5 Gb/s is satisfactory. We are able to program the bias and modulation currents and to bypass a broken VCSEL channel. The power-on reset circuits have been successfully implemented.

For the second R&D project, we modify the design of the ASIC to operate at 10 Gb/s. The 5 Gb/s VCSEL driver uses thick oxide transistors in order to provide sufficient voltage to drive the VCSEL. This is not practical for the high speed operation. We therefore modify the architecture to use thin oxide transistors and add a negative VCSEL bias voltage. We simulate the extracted layout with parasitic capacitance, inductance, and resistance from the VCSEL itself and the wire bonds and pads used for connecting the VCSEL to the ASIC. The simulated eye diagram is open, indicating that it is possible to design an ASIC to operate at 10 Gb/s using a 130 nm CMOS process.

For the third R&D project, we plan to export the design to a 65 nm CMOS process to further increase the operating margin at 10 Gb/s. This will allow us to compare this design to the 130 nm design which is not as expensive. We will present the preliminary results from this design.

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Development and Test of a 3D Diamond Detectors for Ionizing Radiation

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We report on the fabrication, electrical characterization and particle detection performance of the first prototype of a 3D diamond detector for applications in particle physics. The 3D detector geometry has the advantage of small carrier drift paths, which allows in diamond for nearly full charge collection after large doses of radiation. Polycrystalline and single-crystal CVD diamond samples have been processed wit a femto-second laser to create arrays of conductive micro-channels with a diameter of a few microns. In our implementation of the 3D geometry the drift paths are of the order of 100um compared to conventional planar detector drift path of 500um. The properties of the graphitic columns have been characterized by optical and electrical methods. To answer the question whether such devices perform as well as conventional planar diamond detectors a complete prototype single-crystal 3D diamond detector with multi-channel charge integrating read-out has been tested with minimum ionizing radiation in a test beam at CERN.
The results from the 3D prototype are compared to a planar electrode configuration on the same diamond sensor. We observed that the 3D configuration collects the same amount of charge as the planar operated with much smaller bias voltage.

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Pulsed laser fabrication of 3D diamond sensors

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3D detectors whose electrodes extend perpendicularly to the sensor surface are one of the solution proposed for the challenges of radiation-harsh environments in high energy physics.
We report on the fabrication and characterization of prototypes of 3D diamond sensors, which add to the 3D architecture the advantages of diamond as a sensor for tracking purposes.
Two different laser sources, a Nd:YAG 1064 nm Q-switched laser with an 8 ns pulse-width and a Ti:Sa 800 nm laser source with a 30 fs pulse duration were used to create arrays of graphitic columns in the bulk of polycrystalline and single crystal diamond samples. The columns are staggered and connected to graphitic combs which have been fabricated as well by laser irradiation, used for bias contact and readout. On each sample an identical pattern of graphitic combs, without columns (2D structure) has been also fabricated as a reference. The charge collection efficiency of each 3D sensor has been measured at different voltages and compared with that of the corresponding 2D structures. The much lower saturation voltage of the 3D sensors in comparison with the planar ones confirm that charge collection takes place at the columnar electrodes, but a lost in efficiency up to 30% is observed, depending on the laser source used and on the substrate. Possible reasons of the lost of efficiency are discussed.

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The Phase-1 upgrade of the CMS silicon pixel detector

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In 2017 the current CMS pixel detector will be replaced with an upgraded version due to the following reasons: increased luminosity at reduced bunch spacing (from 7 x 1033 cm-2 s-1 at 50 ns bunch spacing to 2 x 1034 cm-2 s-1 at 25 ns bunch spacing) in the LHC and radiation damage effects that will significantly degrade the present detector. The new upgraded detector will have higher efficiency and lower mass with four barrel layer and three forward/backward disks to provide higher hit pixel coverage out to pseudorapidities of ±2.5. In this talk we will give an overview on the Pixel upgrade project and expected performances, with focus on the barrel detector design and status of construction and qualification.

Summary:

The talk is a presentation of the Pixel Tracker design and the production plans for the 3rd layer to be built by the italian consortium of the CMS tracker collaboration.

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Overview of the ATLAS Insertable B-Layer (IBL) Project

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The upgrades for the ATLAS Pixel Detector will be staged in preparation for high luminosity LHC. The first upgrade for the Pixel Detector will be the construction of a new pixel layer which is currently under construction and will be installed during the first shutdown of the LHC machine, in 2013-14. The new detector, called the Insertable B-layer (IBL), will be installed between the existing Pixel Detector and a new, smaller radius beam-pipe at a radius of 3.3 cm. The IBL required the development of several new technologies to cope with increased radiation and pixel occupancy and also to improve the physics performance through reduction of the pixel size and a more stringent material budget. Two different silicon sensor technologies, planar n-in-n and 3D, will be used, connected with the new generation 130nm IBM CMOS FE-I4 readout chip via solder bump-bonds. 32 FEs with sensors are glued to a light weight carbon-carbon structure which incorporates a titanium cooling tube for a CO2 cooling system. In total the IBL barrel layer will consist of 14 support structures and will cover 0.2m2 active area with 12 million pixels.
A production quality control test bench was setup in the ATLAS inner detector assembly clean room to verify and rate the performance of the detector elements before integration around the beam pipe. Bias voltage sensor measurements as well as new 130nm IBM CMOS front end chip functionality measurements are complemented with 241Am and 90Sr sources as well as cosmic muon measurements to rate the bump bond quality and charge measurement calibration. During the integration process these measurements are repeated to spot integration issues and optimize the final operation performance. A realistic CO2 cooling plant will allow to perform quick warm and cold tests to verify the electrical functioning integrity of the sensors and readout front-ends.

An overview of the IBL project, of the module design, the qualification for these sensor technologies, the integration quality control setups and recent results in the construction of this full scale new concept detector will be presented and discussed.

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The Associative Memory system for the FTK processor at ATLAS

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Modern experiments search for extremely rare processes hidden in much larger background levels. As the experiment complexity, the accelerator backgrounds and luminosity increase we need increasingly complex and exclusive selections. We present results and performances of a new prototype of Associative Memory system, the core of the Fast Tracker processor (FTK). FTK is a real time tracking device for the Atlas experiment trigger upgrade.
The AM system provides massive computing power to minimize the online execution time of complex tracking algorithms. The time consuming pattern recognition problem, generally referred to as the "combinatorial challenge", is beat by the Associative Memory (AM) technology exploiting parallelism to the maximum level: it compares the event to pre-calculated "expectations" or "patterns" (pattern matching) at once looking for candidate tracks called "roads". The problem is solved by the time data are loaded into the AM devices. We report on the tests of the integrated AM system, boards and chips. The prototype has an impressive network of high speed, long serial links, successfully tested for their task solving the huge data distribution problem. We report also about the cooling tests and the expectations of power consumption of the system.

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Variable resolution Associative Memory optimization and simulation for the ATLAS FastTracker project

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ATLAS is planning to use a hardware processor, the Fast Tracker (FTK), to perform tracking at the level1 event rate (100 KHz).
The most recent prototype of the Associative Memory (AM) chip developed for the ATLAS Fast Tracker includes ternary logic that can store the "don't care" (DC) value. This feature allows enormous flexibility tuning to the precision of the match for each pattern and each detector layer.
We have studied different methods of building the pattern bank exploiting don't care bits.
We show how merging similar precision patterns into coarser ones achieves the goal of having few enough patterns to fit in the hardware, while maintaining good efficiency and the required rejection against random combinations of hits.
We finally present a detailed preliminary study that shows how with just up to 2 DC bits in each layer in the pixel sensor and 1 DCbit in the strips detector it is possible to build a bank that will allow the system to be fully functional at the luminosities and pileup conditions expected for the LHC after Phase-I upgrades.

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Performance of different silicon materials for the upgraded CMS tracker

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The CMS Collaboration has launched an extensive R&D program to explore the new generation semiconductor detector technologies capable to face the radiation hardness challenges waiting in the near future. This HPK campaign aims to determine which sensor material, polarity and geometries will work best under the foreseen conditions. The presented beam test results help determining the best suited material for the upgrade of the CMS tracker.

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The upgrade of the ALICE Inner Tracking System

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The upgrade of the ALICE apparatus, particular the installation of an upgraded Inner Tracking System (ITS) is under development. The upgrade strategy is formulated under the assumption that, after the second long shutdown in 2018, the LHC will progressively increase its luminosity with Pb beams eventually reaching an interaction rate of about 50 kHz, i.e. instantaneous luminosities of L = 6 × 1027 cm−2s−1.

The new ITS will consist in seven layers of silicon detectors starting at 2.2 cm radial distance from the interaction region. The use of Monolithic Active Pixel Sensors (MAPS) will allow the silicon material budget per layer to be reduced by a factor of 7 in comparison to the present ITS (50 μm instead of 350 μm), possibly reaching the goal of 0.3% radiation length for each of the three inner layers. The Upgraded ITS will have greatly improved performances in terms of determination of the distance of closest approach to the primary vertex, of standalone tracking efficiency at low pT, of momentum resolution and of readout capabilities. In this talk a description of the different technologies considered for the new ITS and the detector layout will be presented.

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First results of beamtests of a MAPS based ElectroMagnetic calorimeter

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A prototype of an Si-W EM calorimeter was built with Monolithic Active Pixel Sensors as the active elements. With a pixelsize of 30 um it allows digital calorimetry, i.e. the particle's energy is determined by counting pixels, not by measuring the energy deposited. Although of modest size, only 4 Moliere radii wide, it has 39 million pixels and its calibration appears far from trivial.
The calorimeter has been tested at DESY (electrons) and at CERN PS and SPS (mixed beams) with energies from 2 to 200 GeV. We'll present the shape of showers caused by electrons and pions, as well as tracks by pions and cosmic muons in unprecedented detail. Preliminary results for energy and position resolution will also be given

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The strip detector of the PANDA MVD

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PANDA is a key experiment of the future FAIR facility. It will study the collisions between an antiproton beam and a fixed proton or nuclear target. The Micro Vertex Detector (MVD) is the innermost detector of the appa- ratus and is composed of four concentric barrels and six forward disks, instrumented with silicon hybrid pixels and double-sided silicon microstrips; its main task is the identification of primary and secondary vertices. The main requirements include high spatial and time resolution, trigger-less readout with high rate capability, good radiation tolerance and low material budget.
The design of the strip detector and some recent developments of its components will be presented. Prototypes of double-sided strip sensors were thoroughly characterized with a probe station, during beam tests and with proton and neutron irradiations. The sensors will be read out with a self-triggering ASIC, employing the Time-over-Threshold technique for energy loss measurement. The sensors and readout chips will be supported by a carbon fiber stave, embedding an active cooling system; a flexible multilayer bus will be used to route the signals on the stave towards the DAQ system.
Supported by BMBF and HGS-HIRe.

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Development of a Proton Computed Tomography system based on silicon microstrip detectors and YAG:Ce scintillating crystals

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Proton Computed Tomography (pCT) is a medical imaging technique based on the use of proton beams with energies above 200MeV to directly measure stopping power distributions inside the tissue volume. Prima (PRoton IMAging) is an italian collaboration working on the development of a pCT scanner based on a tracker and a calorimeter to measure single protons trajectory and residual energy. The tracker is composed by four planes of silicon microstrip detectors to measure entry and exit positions and angles.
Residual energy is measured by a calorimeter composed by YAG:Ce scintillating crystals. A first prototype of pCT scanner, with an active area of about 5x5 cm2, has been constructed and characterized with 60 MeV protons at the INFN Laboratori Nazionali del Sud Catania (Italy) and with 180 MeV protons at Svedberg Laboratory Uppsala (Sweden). A new pre-clinical prototype with an extended active area up to 5x20 cm2, real time data acquisition and a data rate up to 1 MHz is under development. A description of the two prototypes will be presented together with first results concerning tomographic image reconstruction.

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The Silicon Tracker of the DAMPE satellite mission

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DAMPE (DArk Matter Particle Explore) is a satellite mission of the Chinese Academy of Science dedicated to high energy particle detections in space. The main scientific objective of DAMPE is to detect electrons and photons in the range of 5 GeV-10 TeV with excellent energy resolution. It will also measure the flux of nuclei up to 100 TeV with excellent energy resolution.
The DAMPE detector consists of a plastic scintillator strips detector (PSD) that serves as anti-coincidence detector, a silicon-tungsten tracker-converter (STK),a BGO imaging calorimeter of about 31 radiation lengths, and a neutron detector.
The STK is made of 6 tracking double layers, each consists of two layers of single-sided silicon strip detectors measuring the two orthogonal views perpendicular to the pointing direction of the apparatus. Three layers of Tungsten plates with thickness of 1mm, 2mm and 2mm are inserted in front of tracking layer 2, 3 and 4 for photon conversion. The sensors that will be used is 9.5 cm by 9.5 cm in size, 320µm thick, and segmented into 768 AC coupled strips with a 121µm pitch. Only every other strip will be readout with expected position resolution better than 80µm. The front end readout electronics is an high range analog amplifier that will allow to measure the charge of the incident nuclei.
In this contribution, performance and design of the STK, as well as the status of the project will be described in detail.

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Development of a homogeneous, isotropic, and high dynamic range calorimeter for the study of primary cosmic rays in space experiments

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The concept of a homogeneous, isotropic, and high dynamic range calorimeter has been developed and a prototype has been built and tested. The most suitable geometry was found to be cubic and isotropic, so as to detect particles arriving from every direction in space, thus maximizing the acceptance; granularity is achieved by subdividing the cubic volume in smaller cubic crystals. A dual readout of each crystal with two independent photodiodes ensures the high dynamic range.
The prototype calorimeter consists of cubic CsI(Tl) crystals with a 36 mm edge. Each is coupled to two photodiodes. One with a large area for small signals and a second of much smaller area for large signals from showers. For the preliminary tests only the large area diodes have been used coupled to a CASIS chip especially developed for high dynamic range applications. Two prototypes have been built and preliminary tests with high energy ions and muon beams are reported.

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A silicon array for cosmic-ray particle identification in space

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A new generation of space experiments with very large geometric factors (of the order of 3 - 4 m2sr) are being designed to perform precision studies of the elemental composition of VHE cosmic nuclei and of their spectral features. In the current concept of the Gamma-400 experiment, the charge identification of the incoming particle is performed by a two-layered array of pixelated silicon sensors. Given the orbital parameters of the mission, the isotropic distribution of the incoming cosmic rays can be sampled on the 4 lateral sides of the instrument. The conceptual design of the array, covering a seamless sensitive area of the order of 1 m2, will be presented together with results obtained with reduced-scale prototypes at relativistic ion beams.

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Single event effects irradiation tests at INFN-LNS

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At Laboratori Nazionali del Sud of INFN in Italy, a Tandem Van De Graaf
and a Superconducting Cyclotron are in operation since several years, in order to produce ion beams with energy respectively up to 7 MeV/amu and 80 MeV/amu. The "0 degree" multidisciplinary beam line has been set up for irradiation measurements both in air and in vacuum. For radiation damage of electronic devices, to be used for aerospace applications, a multi axis remote micro positioning system and on-line monitoring of relative and absolute dose absorption have been developed and employed in single event effects tests.

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On-line remote monitoring of radioactive waste repositories

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We propose an innovative system for real time monitoring of short and
medium term radioactive waste repositories. Such a system behaves like a cheap scintillating Geiger-Muller counter and it is based on a new kind of gamma mini-sensor, developed at INFN-LNS, assembled with low-cost components: Silicon PhotoMultipliers and scintillating fibers. Front-end electronics and an FPGA-based counting system were developed to handle the field data and transmit them to the remote control system, able to show real-time and historical data in a graphical user interface. A new cheap neutron detector 3He-free (patent pending) was developed to extend the monitoring also to neutrons.

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Extraction of electric field of non-irradiated microstrip detectors using the edge-TCT technique

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Edge-TCT (where TCT stands for Transient Current Technique) is a new experimental method for segmented detectors where a focused laser beam is injected from the side of the device. Using a beam much smaller than the thickness of the device under study, the drift of the induced charge carriers can be studied as a function of the injection position. Intrinsic properties of the devices can be profiled along this coordinate, namely the charge collection efficiency and drift velocity. We show in this contribution a new method to extract the electric field from the measured drift velocity

profiles. We have applied this method to microstrip detectors of both N and P-bulk type, produced by 3 different manufacturers: Micron, VTT-Helsinki and Hamamatsu.

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Single Electron Interference and Diffraction Experiments with a High Energy Physics Detector

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A Young-Feynman two-slit interference experiment for single electrons was carried out by placing two nanometric slits inside a transmission electron microscope and using a monolithic CMOS detector developed for HEP collider experiments. The fast readout of the sensor allows recording single-electron frames with a maximum time resolution of 0.4 microseconds and obtaining high statistics samples of single electron events, within a time interval short enough to guarantee the stability of the system and the coherence conditions of illumination. The latest results on interference and diffraction phenomena in conceptually clean experiments will be shown.