22nd RD50 Workshop (Albuquerque, USA)

Report of Contributions

https://indico.cern.ch/e/209612

Contribution ID: **0** Type: **not specified**

Simulation of Double Junction in Irradiated Detectors Using Silvaco TCAD

Tuesday 4 June 2013 09:00 (20 minutes)

A simulation of a simple pad silicon detector and strip detector containing two defects: deep donor (Ev+0.48 eV) and deep acceptor (Ec-0.595 eV) was performed using Silvaco TCAD software package. The sensor modeling parameters were taken from the RD50 Detector Simulation Group task. The electric field distributions at different reverse bi-ases, fluences and detector operational temperatures are simulated. The predicted beha-vior of detector after irradiation has been achieved. The results of the simulation are compared with modelled data provided by V.Eremin.

Author: Mrs GOLOVLEVA, Maria (Lappeenranta Univ. of Technology)

Co-author: Prof. TUUVA, Tuure (Lappeenranta Univ. of Technology)

Presenter: Mrs GOLOVLEVA, Maria (Lappeenranta Univ. of Technology)

Session Classification: Session 3:

Contribution ID: **1** Type: **not specified**

Test beam results from CMS strip sensor upgrade studies

Wednesday 5 June 2013 09:20 (20 minutes)

There are a number of plausible candidates for sensor types in the outer regions of HL-LHC trackers, where issues of cost and ease of construction must also be taken into consideration given the very large number of sensors that are required. Over the last couple of years, the CMS experiment has undertaken 4 beam tests to probe the radiation hardness of prototype strip sensors procured from a single vendor and using a single mask design. The sensor types include both Float Zone and Magnetic Czochralski fabrication processes, n- and p-type bulk properties, and a number of variations in strip parameters. The beam test results, which will be reviewed in this presentation, are part of a wider effort on the part of the CMS Sensor Upgrade group to identify a preferred candidate for the HL-LHC upgrade of the CMS strip tracker.

Author: SPIEGEL, Leonard (FNAL)

Presenter: SPIEGEL, Lenny (Fermi National Accelerator Lab. (US))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **2** Type: **not specified**

Radiation damage induced by 800 MeV protons in silicon pad diodes

Monday 3 June 2013 11:00 (20 minutes)

Pad sensors made of n-type Magnetic Czochralski (MCz), FLoat Zone (FZ) and Epitaxially (Epi) grown silicon of different thicknesses (150 um to 300 um) were irradiated with 800 MeV protons at the LANSCE proton facility (Los Alamos). The change of the effective doping concentration resulting from the radiation damage was analyzed and Space Charge Sign Inversion (SCSI) to a p-type-like sensor was observed. The influence of the beneficial annealing on the effective doping concentration and the sign of the space charge were investigated in detail. Electrical properties were characterized before and after irradiation and during a subsequent isothermal annealing treatment at 80 C. Depletion voltages and leakage currents were extracted from Capacitance-Voltage and Current-Voltage (CV-IV) measurements and the results were analyzed by means of the "Hamburg Model".

Author: SAGIR, Sinan (Brown University (US))

Co-authors: GARABEDIAN, Alex Edward (Brown University (US)); JUNKES, Alexandra (Brown University); NARAIN, Meenakshi (Brown University (US)); HEINTZ, Ulrich (Brown University (US)); MAO, Zaixing (Brown University (US))

Presenter: SAGIR, Sinan (Brown University (US))

Session Classification: Session I

Contribution ID: **3** Type: **not specified**

Long-term Charge Collection Efficiency (CCE) measurements on multi-geometry strip sensors

Wednesday 5 June 2013 09:40 (20 minutes)

CMS plans to increase both its luminosity and center of mass energy in future upgrades. As such, more radiation hard silicon must be used for the inner tracker. The HPK campaign aims to determine which sensor material, polarity and geometries will work best under these high radiation conditions. One of Brown Universities' contributions to this project includes charge collection efficiency (CCE) measurements using a Sr-90 beta source and the ARC read out system in both non-irradiated and irradiated Float Zone (FZ) and Magnetic Czochralski (MCZ) multi-geometry sensors.
An overview of our setup, data analysis, and results from Long-Term (1 week) CCE and Voltage ramp measurements on non-irradiated sensors (n- and p-type with 200um thickness) will be presented.

Author: GARABEDIAN, Alex Edward (Brown University (US))

Co-authors: JUNKES, Alexandra (Brown University); NARAIN, Meenakshi (Brown University (US)); SAGIR, Sinan (Brown University (US)); HEINTZ, Ulrich (Brown University (US)); MAO, Zaixing (Brown University (US))

Presenter: GARABEDIAN, Alex Edward (Brown University (US))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **4** Type: **not specified**

Simulation and Technology developments of Low Gain Avalanche Detectors (LGAD) for High Energy Physics applications

Tuesday 4 June 2013 10:30 (15 minutes)

We will present the first measurements and the technology developed for the fabrication of Low Gain Avalanche Detectors (LGAD) for tracking applications.

Author: Dr HIDALGO, Salvador (Centro Nacional de Microelectrónica (IMB-CNM-CSIC))

Co-authors: Dr QUIRION, David (Centro Nacional de Microelectrónica (IMB-CNM-CSIC)); PELLEGRINI, Giulio (Centro Nacional de Microelectrónica (IMB-CNM-CSIC)); BASELGA BACARDIT, Marta (Centro Nacional de Microelectrónica (IMB-CNM-CSIC)); Mr FERNANDEZ, Pablo (Centro Nacional de Microelectrónica (IMB-CNM-CSIC))

Presenter: Dr HIDALGO, Salvador (Centro Nacional de Microelectrónica (IMB-CNM-CSIC))

Session Classification: Session 3:

Contribution ID: **5** Type: **not specified**

Evolution of carrier lifetime characteristics in Si structures during and post-irradiated by neutrons and protons

Monday 3 June 2013 10:40 (20 minutes)

Motivation: to predict signal changes and to foresee possible modifications of the detector performance
Comparison of variations of carrier drift and recombination characteristics during neutron and proton irradiations in situ and afterwards.
Comparative analysis of evolution of the carrier recombination characteristics

Authors: Dr GAUBAS, Eugenijus (Vilnius University); Prof. VAITKUS, Juozas (Vilnius University)

Co-authors: Mr TEKORIUS, Audrius (Vilnius University); CORTINA GIL, Eduardo (Université catholique de Louvain); Prof. RAISANEN, Jyrki (Helsinki University); GLASER, Maurice (CERN); MOLL, Michael (CERN); MILITARU, Otilia (Universite Catholique de Louvain (BE)); Dr CEPONIS, Tomas (Vilnius University)

Presenter: Prof. VAITKUS, Juozas (Vilnius University)

Session Classification: Session I

Contribution ID: **6** Type: **not specified**

Investigation of charge multiplication in silicon strip detectors

Tuesday 4 June 2013 14:00 (20 minutes)

N-in-p Micron sensors provided by the RD50 collaboration have been irradiated with protons or neutrons up to a fluence of 5e16neq/cm2. After irradiation, an annealing study of signal, signal to noise and leakage current has been performed with the ALiBaVa setup at different annealing steps up to 500 days at room temperature.
A sample irradiated with neutrons to 5e15neq/cm2 and narrow strip width showed a higher charge collection than comparable sensors with other geometries or irradiation particle type.
To investigate the influence of the dependence of collected charge on the oxide charge induced by irradiation, samples with neutron irradiation have been exposed additionally to gamma irradiation.
The results will be presented.

Author: ALTAN, Lokman (KIT)

Co-authors: DIERLAMM, Alexander (KIT - Karlsruhe Institute of Technology (DE)); EBER, Robert (KIT - Karlsruhe Institute of Technology (DE)); DE BOER, Wim (KIT - Karlsruhe Institute of Technology (DE))

Presenter: EBER, Robert (KIT - Karlsruhe Institute of Technology (DE))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **7** Type: **not specified**

Simulation of CV, TCT and CCE with an effective 2-defect model (moved to Wednesday)

Tuesday 4 June 2013 09:20 (5 minutes)

An effective 2-defect model for HPK sensors currently under investigation for the upgrade of the CMS tracker has been develped on the basis of the EVL model. With this model it is possible to describe not only the basic parameters as leakage current and depletion voltage, but also the time evolution of transient pulses as well as charge collection efficiency. The parameters for this model are discussed. A comparison between simulation and measurement data is presented.

Author: EBER, Robert (KIT - Karlsruhe Institute of Technology (DE))

Co-authors: DIERLAMM, Alexander (KIT - Karlsruhe Institute of Technology (DE)); MUELLER, Thomas (Institut fuer Experimentelle Kernphysik); DE BOER, Wim (KIT - Karlsruhe Institute of Technology (DE))

Presenter: EBER, Robert (KIT - Karlsruhe Institute of Technology (DE))

Session Classification: Session 3:

Contribution ID: **8** Type: **not specified**

Irradiation study of different silicon materials for the CMS tracker upgrade

Wednesday 5 June 2013 09:00 (20 minutes)

The aim of the CMS tracker upgrade campaign is to find a new radiation hard sensor material for the HL-LHC upgrade of the CMS tracker. Different test structures and sensors were implemented on a variety of silicon materials with different thicknesses by Hamatsu Photonics, Japan. Samples have been irradiated to fluences up to 3E15 with protons at Karlsruhe and the CERN PS and with reactor neutrons at Ljubljana.

To find a radiation hard sensor material we investigated current characteristics (I-V), capacitance characteristics (C-V) and characteristics of charge collection (TCT).

This talk will present the results concerning dark current, effective doping concentration and charge collection efficiency and their annealing, key parameters in defining a material well suited for the upgrade of the CMS tracker.

Author: ERFLE, Joachim (Hamburg University (DE))

Presenter: ERFLE, Joachim (Hamburg University (DE))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **9** Type: **not specified**

Studies on n-type silicon after electron irradiation

Monday 3 June 2013 10:20 (20 minutes)

The work focuses on the study of radiation damage in n-type silicon diodes induced by electrons of different kinetic energies, from 1.5 MeV to 15 MeV, in order to study the differences between point and cluster-related defects. For the characterization of the radiation induced defects the Thermally Stimulated Current (TSC) and Deep Level Transient Spectroscopy (DLTS) methods were used. The introduction rates of vacancy-related point defects and of defects in so-called disordered regions as function of electron energy are shown. While the irradiation with 1.5 MeV electrons leads to creation of only point defects the formation of cluster defects starts already at 3.5 MeV. The obtained results will be presented and discussed.

Author: RADU, Roxana (University of Hamburg)

Co-authors: Dr FRETWURST, Eckhart (Institute for Experimental Physics, University of Hamburg, Hamburg, Germany); Dr LINDSTRÖM, Gunnar (Institute for Experimental Physics, University of Hamburg, Hamburg, Germany); Dr PINTILIE, Ioana (National Institute of Materials Physics NIMP, Bucharest, Romania); Dr KLANNER, Robert (Institute for Experimental Physics, University of Hamburg, Hamburg, Germany)

Presenter: RADU, Roxana (University of Hamburg)

Session Classification: Session I

Contribution ID: **10** Type: **not specified**

A Systematic 3D Simulation Study Comparing BNL's 3D-Trench Electrode Detectors with Conventional 3D Detectors and Initial Electrical Test Results of the First Prototype Batch

Tuesday 4 June 2013 15:10 (20 minutes)

With the need for very radiation hard semiconductor devices for the High Luminosity upgrade at the Large Hadron Collider, new types of silicon pixel detectors have been proposed. Since 3D Si pixel detectors have been shown to be more radiation hard than the planar ones, scientists at Brookhaven National Laboratory have chosen to design a novel type of 3D Si pixel detectors. Systematic full 3D simulations using Silvaco's TCAD programs have been done to compare the characteristics of this novel 3D pixel design which features at least one trench electrode in a single pixel cell (3D-Trench Electrode pixel) with the conventional 3D pixel with all column electrodes in a single pixel cell. In order to optimize the electric field's uniformity while maintaining the effectiveness in space packing, we have chosen a hexagonal shape in our simulation. The 3D simulations show much lower depletion voltage and a more uniform electric field in the new 3D-Trench Electrode pixel detectors as compared to conventional 3D pixel detectors with column electrodes. We've created two sizes of this pixel, a small one (short electrode spacing in a single cell) for High Energy physics applications for high radiation environments and a much larger one for Photon Science applications at the National Synchrotron Light Source II at Brookhaven National Laboratory. The first prototype 3D-Trench Electrode pixel detectors have been manufactured at the National Microelectronics Centre, and are currently being tested. The preliminary electrical measurements will be presented.

Author: MONTALBANO, Alyssa (State University of New York (US))

Co-authors: BASSIGNANA, Daniela (CNM); Dr LYNN, David (Brookhaven National Laboratory (US)); Dr TSYBYCHEV, Dmitri (Stony Brook University (US)); PELLEGRINI, Giulio (Universidad de Valencia (ES)); Dr LIU, Shuhuan (Brookhaven National Laboratory); CHEN, Wei (Brookhaven National Laboratory); LI, Zheng (BNL)

Presenter: MONTALBANO, Alyssa (State University of New York (US))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **11** Type: **not specified**

Silicon Sensors Irradiation Study for ILC Extreme Forward Calorimetry

Wednesday 5 June 2013 11:30 (20 minutes)

We are working on the proposed "BeamCal" project. Its goal is to detect scattered incoming beams at ILC at small angles, to prevent the background from two-photon processes to mimic signatures of new discoveries. The detector, which is envisioned as a tungsten sandwich calorimeter, will be subject to high fluences EM radiation that will shower in the tungsten radiator. We plan to do studies that will explore the effects of radiation damage on candidate sensors at shower-max within the induced shower. As well as electrons, positrons and photons, these showers will contain a flux of neutrons from the de-excitation of the giant dipole resonance that may significantly contribute to radiation damage. The anticipated fluence of the order of 100 MRad/year instigated studies of exotic sensor materials, such as GaAs. Instead, we are studying conventional silicon sensors as an alternative.

A major part of our efforts is upcoming test beam at SLAC electron beam facility in June of 2013. The beam setup features tungsten pre- and post-radiators for the purposes of modeling the shower maximum, spreading the beam and capturing neutron component of the radiation. Silicon strip sensors of different types will be irradiated. Sensor handling is designed for a quick connection to the charge measuring station to avoid annealing effects during wirebonding. This will allow us to study the same sensors repeatedly during the dose accumulation over up to four weeks of running time. We will run with the radiator both surrounding and remote from the sensor sample, in order to separate the effects of the ballistic EM shower from those of the isotropic neutron flux. We will describe the status and the irradiation plan.

Author: FADEYEV, Vitaliy (University of California,Santa Cruz (US))

Co-authors: SCHUMM, Bruce Andrew (University of California,Santa Cruz (US)); Mr TIMLIN, Conor (UCSC); Mr MARTINEZ-MCKINNEY, Forest (UCSC); Mr MISTRY, Khilesh (UCSC); Mr WILDER, Max (UCSC); SPENCER, Ned (University of California,Santa Cruz (US)); Mr NIDUMOLU, Ravi (UCSC); Mr BAND, Reyer (UCSC); KIM, Tae Sung (UCSC); Dr MARUYAMA, Takashi (SLAC); MARKIEWICZ, Thomas (SLAC)

Presenter: FADEYEV, Vitaliy (University of California,Santa Cruz (US))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **12** Type: **not specified**

Status of Scribe-Cleave-Passivate (SCP) Slim Edge Technology

Tuesday 4 June 2013 16:20 (20 minutes)

We are pursuing a "slim edge"technology which allows a drastic reduction of inactive region along the perimeter of silicon detectors. Such reduction would benefit construction of large-area tracker and imaging systems. Key components of this method are surface scribing, cleaving, and passivation of the resulting sidewall. We will give a short overview of the project and describe recent progress. A particular emphasis will be given to device performance physics: charge collection near the edge and irradiation studies.

Author: FADEYEV, Vitaliy (University of California,Santa Cruz (US))

Co-authors: Mr PARKER, Colin (UCSC); Prof. DALLA BETTA, Gian-Franco (INFN and University of Trento); PELLEGRINI, Giulio (Universidad de Valencia (ES)); SADROZINSKI, Hartmut (SCIPP, UC santa Cruz); Mr NGO, Jeffrey (UCSC); Dr ULLAN COMES, Miguel (Universidad de Valencia (ES)); Mr ELY, Scott (UCSC); BENITEZ CASMA, Victor Hugo (Universidad de Valencia (ES))

Presenter: FADEYEV, Vitaliy (University of California,Santa Cruz (US))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **13** Type: **not specified**

Pulse shapes of alpha particles in CNM diodes with and without gain

Tuesday 4 June 2013 11:20 (20 minutes)

We recorded the pulse shapes of Am(241) alpha particles in CNM diodes with and without gain, to understand the time structure of the charge collection in diodes optimized for gain.

Presenter: ELY, Scott (SCIPP)

Session Classification: Session 3:

Contribution ID: **15** Type: **not specified**

Status of radiation effects of the ATLAS SCT detector

Monday 3 June 2013 14:30 (30 minutes)

The Silicon micro-strip tracker (SCT) of the ATLAS experiment at LHC has been running for physics at 7 and 8 TeV over 3 years. The integrated delivered luminosity to ATLAS is 29.5 fb-1 and the fluence at the inner most SCT modules corresponds to about 5e12 1MeV-equivalent neutrons/cm** 2, the level below the type inversion. More than 99% of 4088 modules areactive with very high efficiency. During the beam time, all modules are cooled uniformly and stably within 2 degree C of their specified temperatures. The HV current drawn has been steadily increasing from 100 nA to 100 uA per module. The current increase observed in the barrel region is in very good agreement with predictions of the silicon bulk leakage current models with self-annealing effects without any parameter adjustment. Calibration runs have been performed frequently to monitor the noise and gain, both of which have been fairly stable with some exceptions. Modules with CiS sensors have been showing mysterious beam-associated behavior in the HV current and some of these modules were kept below nominal bias voltage of 150V.

Presenter: KONDO, Taka (High Energy Accelerator Research Organization (JP))

Session Classification: Session 2: Radiation Damage in LHC detectors

Contribution ID: **16** Type: **not specified**

Radiation damage effects in the LHCb Vertex Locator

Monday 3 June 2013 15:30 (30 minutes)

The LHCb experiment is dedicated to searching for New Physics effects in the heavy flavour sector, precise measurements of CP violation and rare heavy meson decays. The LHCb VELO (VErtex LOcator) silicon micro-strip detector is the highest precision vertex detector at the LHC and is located at only 8 mm from the proton beams. Consequently the sensors receive a large and non uniform radiation dose. In this presentation, many interesting radiation damage effects such as (a) current as a function of time and voltage (b) charge collection efficiency and (c) noise behavior will be reported for the VELO sensors.

Author: XING, Zhou (Syracuse University (US))

Presenter: XING, Zhou (Syracuse University (US))

Session Classification: Session 2: Radiation Damage in LHC detectors

Contribution ID: **18** Type: **not specified**

Summary of the session

Monday 3 June 2013 16:00 (30 minutes)

Presenter: TOMS, Konstantin (University of New Mexico (US))

Session Classification: Session 2: Radiation Damage in LHC detectors

Contribution ID: **19** Type: **not specified**

Progress on the Low Resistance Strip Sensors and Slim Edges Combined RD50 Project

Tuesday 4 June 2013 16:40 (20 minutes)

A status report will be presented on the Common RD50 Project "Low Resistance Strip Sensors". Three RD50 institutes are collaborating in this project (CNM-Barcelona, IFIC-Valencia, and SCIPP-Santa Cruz), in which a new method to enhance the sensor hardness to beam-loss damage is studied. The key feature of the method is implementation low-resistance implants. The fabrication has been combined with new experiments related to another RD50 Common Project involving Slim Edges.

Low Resistance Strip Sensors have been electrically tested. Initial IV measurements indicate that we need to modify some fabrication/design parameters in order to achieve better Punch-Through protection. We have started another fabrication batch with the improved parameters. In the meantime, we are performing a series of available tests on the new type of sensors. We will present results from the tests and an updated schedule.

Author: BENITEZ CASMA, Victor Hugo (Universidad de Valencia (ES))

Co-authors: Dr GRILLO, Alex (University of California,Santa Cruz (US)); SADROZINSKI, Hartmut (SCIPP, UC santa Cruz); DEFILIPPIS, Jacob (University of California, Santa Cruz (US)); Dr ULLAN COMES, Miguel (Universidad de Valencia (ES)); SHUMKO, Mike (University of California, Santa Cruz (US)); FADEYEV, Vitaliy (University of California,Santa Cruz (US))

Presenter: BENITEZ CASMA, Victor Hugo (Universidad de Valencia (ES))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **20** Type: **not specified**

A Portable Telescope Based on the Alibava System for Test Beam Studies

Wednesday 5 June 2013 11:10 (20 minutes)

A test beam telescope has been built using the ALIBAVA system to drive its data acquisition. The basic telescope planes consist in four XYT stations. Each station is built from a detector board with two 80-micron-pitch sensors, mounted one in each side and their strips crossing at 90 degrees. The ensemble is coupled to an ALIBAVA daughter board. These stations act as reference frame and allow a precise track reconstruction. The system is triggered by the coincidence signal of the two scintillators located up and down stream. The telescope can hold several devices under tests. Those may be mounted on detector boards coupled to the ALIBAVA daughter board.
Each ALIBAVA daughter board (either linked to XYT station or a device under test) is subsequently read by its corresponding mother board. The acquisition system can hold up to 16 mother boards. The whole system is controlled by a master board that synchronizes all the mother boards and collects all the data.
The off-line analysis software has been developed to study the charge collection, cluster width, tracking efficiency, resolution, etc, of the devices under test. Moreover, the built-in ALIBAVA TDC allows the analysis of the time profile of the device signal.
The ALIBAVA Telescope has been successfully operated in two test runs at the DESY and CERN-SPS beam lines. The complete telescope system will be described and the preliminary results will be presented.

Authors: FORSHAW, Dean Charles (University of Liverpool (GB)); CASSE, Gianluigi (University of Liverpool (GB)); MARTI I GARCIA, Salvador (IFIC-Valencia (UV-CSIC))

Co-authors: TSURIN, Ilya (University of Liverpool (GB)); WONSAK, Sven (University of Liverpool (GB))

Presenter: FORSHAW, Dean Charles (University of Liverpool (GB))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **21** Type: **not specified**

Combined Measurement Results of dedicated RD50 Charge Multiplication Sensors

Tuesday 4 June 2013 12:00 (20 minutes)

In this talk the combined results of dedicated charge multiplication sensors, produced by MICRON (UK) within the CERN RD50 framework, and measured at Freiburg and Liverpool are presented. The sensors vary in device thickness, in strip pitch and width as well as in diffusion times and energies for the implantation process. Some of the sensors have additional intermediate strips (biased or floating) between the readout strips. They were irradiate with neutrons to fluences of 1E15 and 5E15 1 MeV neq/cmˆ2. The collected charge is measured with the ALiBaVa setup to investigate the effect of charge multiplication for the different sensor geometries/properties.

Author: WONSAK, Sven (University of Liverpool (GB))

Co-authors: BETANCOURT, Christopher (Albert-Ludwigs-Universitaet Freiburg (DE)); FORSHAW, Dean Charles (University of Liverpool (GB)); CASSE, Gianluigi (University of Liverpool (GB)); JAKOBS, Karl (Albert-Ludwigs-Universitaet Freiburg (DE)); HAUSER, Marc Manuel (Albert-Ludwigs-Universitaet Freiburg (DE)); DERVAN, Paul (University of Liverpool (GB)); KODYS, Peter (Charles University (CZ)); KUEHN, Susanne (Albert-Ludwigs-Universitaet Freiburg (DE)); BARBER, Tom (Albert-Ludwigs-Universitaet Freiburg (DE)); PARZEFALL, Ulrich (Albert-Ludwigs-Universitaet Freiburg (DE))

Presenter: WONSAK, Sven (University of Liverpool (GB))

Session Classification: Session 3:

Contribution ID: **22** Type: **not specified**

First measurements of 3D strip detectors irradiated at 10*17 n/cm2

Tuesday 4 June 2013 14:50 (20 minutes)

We will present the first results of n-on-p 3D strip detectors irradiated in Ljubljana at 10*17 n/cm2.

Author: Dr GRECO, Virginia (Centro Nacional Microelectronica (IMB-CNM-CSIC))

Co-authors: PELLEGRINI, Giulio (CNM (ES)); BASELGA BACARDIT, Marta (CNM (ES))

Presenter: Dr GRECO, Virginia (Centro Nacional Microelectronica (IMB-CNM-CSIC))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **23** Type: **not specified**

Ultra-Fast Silicon Sensors based on Charge Multiplication, an Update

Tuesday 4 June 2013 12:20 (20 minutes)

A review of the UFSD prospects taking into account the new charge collection data taken with CNM diodes with gain.

Author: SADROZINSKI, Hartmut (SCIPP, UC santa Cruz)

Presenter: SADROZINSKI, Hartmut (SCIPP, UC santa Cruz)

Session Classification: Session 3:

Contribution ID: **24** Type: **not specified**

Radiation Damage of the ATLAS Pixel Sensors Using Leakage Current Measurement System

Monday 3 June 2013 14:00 (30 minutes)

The current measurement system probes directly the leakage current in pixel sensors. The system is integrated with the ATLAS Pixel high voltage delivery system. The system runs as a monitor of a radiation damage of the pixel sensors. The leakage current data collected for the completed data taking period are analyzed. The recent status of the sensor's radiation damage and a comparison with the theoretical predictions are presented.

Authors: GORELOV, Igor (University of New Mexico (US)); HOEFERKAMP, Martin (Department of Physics and Astronomy)

Presenter: GORELOV, Igor (University of New Mexico (US))

Session Classification: Session 2: Radiation Damage in LHC detectors

Contribution ID: **25** Type: **not specified**

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

Monday 3 June 2013 11:40 (20 minutes)

Edge-TCT is a transient current technique in microstrip detectors where charge carriers are injected from the side of the detector, instead of from the top or bottom. Current transients are measured as a function of depth, therefore charge collection efficiency and instant drift velocity can be profiled. Studying the collection time of the carriers as a function of depth we can extract information on the electric field and the capacitance of the detector. This information is then used as starting values for the fit of measured drift velocity, and the electric field finally computed. We present results of this method on non-irradiated Micron detectors (n-bulk, p-bulk) and MCZ n-type detectors produced by HIP.

Author: FERNANDEZ GARCIA, Marcos (Universidad de Cantabria (ES))

Co-authors: GALLRAPP, Christian (CERN); NEUGEBAUER, Hannes (Hamburg University (DE)); GABRYSCH, Markus (CERN); MOLL, Michael (CERN)

Presenter: FERNANDEZ GARCIA, Marcos (Universidad de Cantabria (ES))

Session Classification: Session I

Contribution ID: **27** Type: **not specified**

Recent Results of the 3D-Stripixel Si Detectors

Tuesday 4 June 2013 16:00 (20 minutes)

First prototype of the new 3D-Stripixel Detectors has been fabricated by CNM of Spain. TCT test results using lasers of various wavelengths (660 to 1.06um) have shown good 2D-position sensitivity with one-sided processing. CCE test by ALIBAVA using the laser with um-beam size have shown sub-pixel (80 um)2D position resolution. Recent BNL ALIBAVA tests using a 1.06 um laser with mm-beam size have shown clear 2D-position sensitivity as well. The 2D-position sensitivity has been measured as a function of detector bias voltages and laser intensity.

Summary

Recent Results of the 3D-Stripixel Si Detectors
Zheng Li1, D. Bassignana2, Wei Chen1, Shuhuan liu1,3, David Lynn1, G. Pellegrini2
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2 Centro Nacional de Microelectrónica (IMB-CNM-CSIC), Campus Univ. Autónoma de Barcelona, 08193 Bellaterra, Barcelona (Spain)
3 Permanent address: Xian Jiaotong University, Xian, China

First prototype of the new 3D-Stripixel Detectors has been fabricated by CNM of Spain. TCT test results using lasers of various wavelengths (660 to 1.06um) have shown good 2D-position sensitivity with one-sided processing. CCE test by ALIBAVA using the laser with um-beam size have shown sub-pixel (80 um)2D position resolution. Recent BNL ALIBAVA tests using a 1.06 um laser with mm-beam size have shown clear 2D-position sensitivity as well. The 2D-position sensitivity has been measured as a function of detector bias voltages and laser intensity.

Author: Dr LI, Zheng (BNL)

Co-authors: Dr BASSIGNANA, Daniela (CNM); Dr LYNN, David (BNL); Dr PELLEGRINI, Giulio (CNM); Dr LIU, Shuhuan (BNL); Ms CHEN, Wei (BNL)

Presenter: Dr LI, Zheng (BNL)

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **28** Type: **not specified**

Studies of CNM diodes with gain

Tuesday 4 June 2013 11:40 (20 minutes)

A diodes with implantation profile designed to provoke avalanche multiplication were produced by CNM withing the framework of RD50 project. Charge collection properties of non-irradiated and neutron irradiated diodes were measured with 90Sr electrons and investigated with Transient current technique. Dependence of gain, current and noise on fluence and voltage will be presented.

Author: KRAMBERGER, Gregor (Jozef Stefan Institute (SI))

Co-authors: QUIRION, David (CNM); PELLEGRINI, Giulio (Universidad de Valencia (ES)); MANDIC, Igor (Jozef Stefan Institute (SI)); MIKUZ, Marko (Jozef Stefan Institute (SI)); Dr ZAVRTANIK, Marko (Jozef Stefan Institute (SI)); BASELGA BACARDIT, Marta (Universidad de Valencia (ES)); FERNANDEZ, Pablo (CNM); HIDALGO, Salvador (CNM); CINDRO, Vladimir (Jozef Stefan Institute (SI))

Presenter: KRAMBERGER, Gregor (Jozef Stefan Institute (SI))

Session Classification: Session 3:

Contribution ID: **29** Type: **not specified**

Radiation-Induced Trap Spectroscopy in Si Bipolar Transistors and GaAs Diodes

Monday 3 June 2013 09:20 (30 minutes)

We have used deep level trap spectroscopy (DLTS) to study neutron, ion and electron induced traps in Si bipolar transistors and in GaAs diodes. We are specifically interested in the effects of defect clustering on transistor gain as well as correlation of specific defects with device gain.

Author: Dr FLEMING, Robert M. (Sandia National Laboratories, , Albuquerque, NM 87185)

Presenter: Dr FLEMING, Robert M. (Sandia National Laboratories, , Albuquerque, NM 87185)

Session Classification: Session I

Contribution ID: **30** Type: **not specified**

Workshop opening

Monday 3 June 2013 09:00 (20 minutes)

Presenters: MOLL, Michael (CERN); SEIDEL, Sally (University of New Mexico (US)); RUDOLPH, Wolfgang (Chair, Dept. of Physics and Astronomy, University of New Mexico)

Session Classification: Session I

Contribution ID: **31** Type: **not specified**

Discussion on Defects and Material Characterization

Monday 3 June 2013 12:00 (30 minutes)

Presenter: MOLL, Michael (CERN)

Session Classification: Session I

Contribution ID: **32** Type: **not specified**

Systematic investigation of p-irradiated Micron pad detectors of different silicon materials

Monday 3 June 2013 11:20 (20 minutes)

For the evaluation of a detector in high energy physics the deep understanding of the underlying physics is essential. Micron detectors of different silicon types (FZ, MCz, n-bulk, p-bulk) provided by the RD50 collaboration have been irradiated with 24GeV protons at CERN PS up to fluences of 3e16 neq/cm2. After a first annealing of 80min at 60℃ characteristics of the leakage current (IV), the capacitance (CV) and the effective doping concentration (Neff) were systematically analysed dependent on the fluence and the temperature. Furthermore signals of the transient current technique (TCT) are used to investigate the charge collection efficiency (CCE). Results of these studies will be presented in the talk.

Author: NEUGEBAUER, Hannes (Hamburg University (DE))

Co-authors: GALLRAPP, Christian (CERN); FERNANDEZ GARCIA, Marcos (Universidad de Cantabria (ES)); GABRYSCH, Markus (CERN); MOLL, Michael (CERN)

Presenter: NEUGEBAUER, Hannes (Hamburg University (DE))

Session Classification: Session I

Contribution ID: **33** Type: **not specified**

Simulation of Gain-Optimized Sensors

Tuesday 4 June 2013 11:00 (20 minutes)

Currently in development, 4D sensors with fast timing and fine spatial resolution rely on short charge collection times in thin devices. They will benefit from signal gain made possible by a region with high electric field inside the device. The region is created by two layers of implant doping stacked on top of each other. As a result, sensor IV and CV characteristics deviate from those of standard sensors without gain. TCAD device simulations give insight into these new characteristics, and in addition provide doping density and electric field maps that are helpful in analyzing regions of charge multiplication. We present a comparison of simulation results with experimental data of gain-optimized diodes fabricated at CNM-Barcelona, Spain.

Author: PARKER, Colin (University of California, Santa Cruz (US))

Co-authors: SADROZINSKI, Hartmut (SCIPP, UC santa Cruz); ELY, Scott (UCSC); FADEYEV, Vitaliy (University of California,Santa Cruz (US))

Presenter: PARKER, Colin (University of California, Santa Cruz (US))

Session Classification: Session 3:

Contribution ID: **34** Type: **not specified**

Discussion on Charge Multiplication

Tuesday 4 June 2013 14:30 (20 minutes)

Presenter: PELLEGRINI, Giulio (Universidad de Valencia (ES))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **35** Type: **not specified**

Discussion on 3D sensors and slim edges

Tuesday 4 June 2013 17:20 (20 minutes)

Presenter: PELLEGRINI, Giulio (Universidad de Valencia (ES))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **36** Type: **not specified**

Bus leaving from Popejoy Hall

Tuesday 4 June 2013 18:00 (20 minutes)

Session Classification: Banquet

Contribution ID: **37** Type: **not specified**

Banquet at Los Poblanos Historic Inn

Tuesday 4 June 2013 18:20 (5 hours)

Session Classification: Banquet

Contribution ID: **38** Type: **20 min**

Simulations of edge-TCT and 2-defect model CCE

Tuesday 4 June 2013 09:40 (20 minutes)

Edge-TCT provides a method for the measurement of the drift velocity of the charge carriers as a function of depth. This could make it possible to extract electric field distribution in the detector. Comparison of edge-TCT simulations with measurements will be presented.
Interstrip resistance can be measured by Induced Current Method, where DC voltage is applied to one strip and the current flowing to another strip is measured. Simulations using this method will be presented.
Interstrip resistance behaviour as a function of oxide charge and different p-stop parameters will be studied and comparison between simulation packages will be made.
The simulation of charge collection efficiency (CCE) of proton-irradiated detectors has been studied. For the simulations an effective 2-defect model based on the EVL model was used. Results from the simulations and measurements from the Silicon Beam Telescope (SiBT) will be compared.

Author: PELTOLA, Timo Hannu Tapani (Helsinki Institute of Physics (FI))

Co-author: HAERKOENEN, Jasu (Helsinki Institute of Physics (FI))

Presenter: PELTOLA, Timo Hannu Tapani (Helsinki Institute of Physics (FI))

Session Classification: Session 3:

Contribution ID: **39** Type: **not specified**

TCT measurements with SCP slim edge strip detectors

Tuesday 4 June 2013 17:00 (20 minutes)

In this contribution, TCT measurements with p-type strip detectors in which one edge was cut with Scribe Cleave Passivate (SCP) technique will be presented. CCE measurements were made with focused infrared laser beam. The beam was scanned across the detector surface near the SCP edge. Measurements were performed also with focused red laser beam. The red laser light was directed to the cleaved edge of the detector. TCT signals induced by laser pulses on different locations on the cleaved edge were measured. Measurements were done before and after irradiation of detectors with reactor neutrons.

Presenter: MANDIC, Igor (Jozef Stefan Institute (SI))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **40** Type: **not specified**

Studies of thin irradiated n-in-p planar pixel sensor at different beam incidence and characterization of the new CiS n-in-p pixel production

Wednesday 5 June 2013 10:00 (20 minutes)

Silicon pixel modules employing n-in-p planar sensors with an active thickness of 150μm were assembled with the new FE-I4 ATLAS readout chips an irradiated up to a fluence of 4e16 n_eq cmˆ-2
These thin sensors are designed as candidates for the ATLAS pixel detector upgrade at HL-LHC, as they ensure radiation hardness at high fluences.
High precision beam test measurements of the hit efficiency have been performed on these devices both at the CERN SpS and at DESY, Hamburg. We studied the behavior of these sensors at different voltage and different beam incident angles up to the maximum one expected in ATLAS for the new Insertable B-Layer and at HL-LHC.
N-in-p silicon pixel sensors with an active thickness ranging from 100μm to 300μm have been produced at CiS and interconnected to FE-I4 ATLAS chips at IZM.
We present the results of the characterization of this new production before irradiation with both test-beam measurements and laboratory measurement, using radioactive sources.

Author: TERZO, Stefano (Max-Planck-Institut fuer Physik (Werner-Heisenberg-Institut) (D)

Presenter: TERZO, Stefano (Max-Planck-Institut fuer Physik (Werner-Heisenberg-Institut) (D)

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **41** Type: **not specified**

Characterization of active edge planar pixels produced at VTT before and after irradiation

Wednesday 5 June 2013 10:50 (20 minutes)

We will report about the characterization of FE-I3 and FE-I4 active edge planar n-in-p pixels produced at VTT, Finland. The sensor thickness is 100 um and different geometries of the sensor edges have been implemented, down to an inactive width of only 50 um. The charge collection properties before and after irradiation have been studied with radioactive sources and analysis of beam tests at CERN-SPS and
DESY

Presenter: MACCHIOLO, Anna (Max-Planck-Institut fuer Physik (Werner-Heisenberg-Institut) (D)

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **42** Type: **not specified**

Performance of capacitively coupled active pixel sensors in 180 nm HV CMOS technology irradiated to HL-LHC fluences

Wednesday 5 June 2013 11:50 (20 minutes)

We explore the concept of using a deep-submicron HV CMOS process to produce a drop-in replacement for traditional radiation-hard silicon sensors. Such active sensors contain simple circuits, e.g. amplifiers and discriminators, but still require a traditional (pixel or strip) readout chip. This approach yields most advantages of MAPS (improved resolution, reduced cost and material budget, etc.), without the complication of full integration on a single chip.

After outlining the basic design of the HV2FEI4 test ASIC, results after irradiation with protons, x-rays and neutrons up to 1e16 neq/cm2 or 100MRad will be presented. Subsequently, design changes towards the optimised HV2FEI4_v2 are discussed and first results are shown before elaborating on future plans and general prospects of active sensors within ATLAS.

Co-author: ON BEHALF OF ATLAS HV-CMOS R&D ACTIVITIES

Presenter: MUENSTERMANN, Daniel (Universite de Geneve (CH))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **43** Type: **not specified**

Semiconductor Detectors as Radiation Monitors

Wednesday 5 June 2013 12:10 (20 minutes)

The Real Time Wide Area Radiation Surveillance System (REWARD) is a novel mobile system for radiation detection and monitoring based on the integration of two new miniaturized solid-state radiation sensors. One sensor is a Cadmium-Zink-Telluride ((Cd,Zn)Te or CZT) detector for gamma radiation with precise energy measurement to identify the emitting isotope. The CZT detector unit is made in Freiburg. The other sensor is a highly efficient neutron detector based on 3D silicon detector technologies made by CNM Barcelona and a converter material.
These detectors form the core of a sensing unit (the tag) which also includes a wireless communication interface to send the data remotely to a monitoring base station as well as a GPS unit. REWARD will be operated as a network of individual mobile units mounted e.g. on vehicles. The system is modular in the sense that virtually any number of sensing modules in a network is feasible, allowing the flexible adaption of the scale of the system to the end user needs.
The use cases of REWARD are a number of scenarios ranging from nuclear terrorism threats and lost radioactive sources to nuclear accidents.
REWARD tags are small, mobile portable units. They can be installed in patrol vehicles, emergency units and in general in any type of mobile equipment. Stationary installations inside buildings or infrastructure are also feasible.
This presentation will introduce the REWARD project, funded within the 7th Framework Program of the EU. Particular emphasis will be placed on the novel radiation detectors of REWARD, and the performance of these detectors in realistic deployment scenarios.

Author: PARZEFALL, Ulrich (Albert-Ludwigs-Universitaet Freiburg (DE))

Presenter: PARZEFALL, Ulrich (Albert-Ludwigs-Universitaet Freiburg (DE))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **44** Type: **20 min**

Red TCT measurements of Low Gain Avalanche Diodes (LGAD) produced at CNM-Barcelona

Tuesday 4 June 2013 10:45 (15 minutes)

LGAD produced at CNM-Barcelona were measured at IFCA-Santander using red-TCT. The gain factor is estimated for these measurements. A toy simulation was used to qualitatively explain the results.

Authors: VILA ALVAREZ, Ivan (Universidad de Cantabria (ES)); JARAMILLO ECHEVERRIA, Richard (Universidad de Cantabria (ES))

Co-author: FERNANDEZ GARCIA, Marcos (Universidad de Cantabria (ES))

Presenter: FERNANDEZ GARCIA, Marcos (Universidad de Cantabria (ES))

Session Classification: Session 3:

Contribution ID: **45** Type: **not specified**

Status of RD50 Common projects coordinated by CNM

Tuesday 4 June 2013 14:20 (10 minutes)

Presenter: PELLEGRINI, Giulio (Universidad de Valencia (ES))

Session Classification: Session 4: Charge multiplication and 3D sensors

Contribution ID: **46** Type: **not specified**

Discussion on Full Detector Systems

Wednesday 5 June 2013 12:30 (30 minutes)

Presenter: KRAMBERGER, Gregor (Jozef Stefan Institute (SI))

Session Classification: Session 5: Detectors and Full Detector Systems

Contribution ID: **47** Type: **20 min**

Taka Kondo, High Energy Accelerator Research Organization (KEK)

The Silicon micro-strip tracker (SCT) of the ATLAS experiment at LHC has been running for physics at 7 and 8 TeV over 3 years. The integrated delivered luminosity to ATLAS is 29.5 fb-1 and the fluence at the inner most SCT modules corresponds to about 5e12 1MeV-equivalent neutrons/cm** 2, the level below the type inversion. More than 99% of 4088 modules areactive with very high efficiency. During the beam time, all modules are cooled uniformly and stably within 2 degree C of their specified temperatures. The HV current drawn has been steadily increasing from 100 nA to 100 uA per module. The current increase observed in the barrel region is in very good agreement with predictions of the silicon bulk leakage current models with self-annealing effects without any parameter adjustment. Calibration runs have been performed frequently to monitor the noise and gain, both of which have been fairly stable with some exceptions. Modules with CiS sensors have been showing mysterious beam-associated behavior in the HV current and some of these modules were kept below nominal bias voltage of 150V.

Author: KONDO, Taka (High Energy Accelerator Research Organization (JP))

Presenter: KONDO, Taka (High Energy Accelerator Research Organization (JP))

Contribution ID: **48** Type: **not specified**

p-n-n+ diode CV characteristics changes at various contract and body doping concentrations. TCAD simulations

Tuesday 4 June 2013 09:25 (15 minutes)

Author: Prof. VAITKUS, Juozas (Vilnius University (LT))

Presenter: Prof. VAITKUS, Juozas (Vilnius University (LT))

Session Classification: Session 3: