AIDA - Academia meets Industry: Solid-State Position Sensitive Detectors

Monday 26 March 2012 - Tuesday 27 March 2012

Programme
and
Abstracts book

Update date: 22 March 2012

AIDA - Academia meets Industry: Solid-State Position Sensitive Detectors

from Monday, 26 March 2012 at 09:00 to Tuesday, 27 March 2012 at 14:00 (Europe/Zurich)
at DESY

Description Position-Sensitive Solid-state Detectors are being increasingly used in numerous fields, because of their versatility and various other advantageous features. In Particle Physics, they are among the most adequate technologies so far for tracking of the trajectories of the particles.

In other research disciplines, including medicine, life science, material research, security, nuclear and astroparticle physics, the exploitation of Position-Sensitive Solid-State Detectors has acquired considerable momentum, owing to their excellent position and energy resolution.

During the event, the state-of-the-art on Position-Sensitive Solid-State Detectors will be reviewed and the needs of the Particle Physics community and other research disciplines will be addressed. Discussions among industry and academia are prone to stimulate fruitful collaborations for the future.

Support AIDA-info@cern.ch

Monday, 26 March 2012

09:00 - 11:40 Registration and installation for exhibitors
Location: DESY Auditorium

11:40 - 12:20 Lunch (DESY Auditorium)

12:20 - 12:30 Welcome address
Location: DESY Auditorium

12:30 - 13:00 Topical review on major technology developments
Location: DESY Auditorium

12:30 **State of the art in Position Sensitive Solid-State Detectors** *30'*
Speaker: Hans-Günther Moser (MPI Munich)

Detectors *15'*

Systems *15'*

13:00 - 14:40 High Energy Physics community needs
Location: DESY Auditorium

13:00 **The ALICE Inner Tracking System Upgrade** *20'*
Speaker: Giacomo Contin (CERN)

13:20 **ATLAS pixel detector** *20'*
Speaker: Norbert Wermes (University of Bonn)

13:40 **CMS strip tracker** *20'*
Speaker: Marko Dragicevic (HEPHY, Vienna)

14:00 **LHCb** *20'*
Speaker: Paula Collins (CERN)

14:20 **The SuperB Silicon Vertex Tracker** *20'*
Speaker: Luciano Bosisio (University of Trieste, INFN)

14:40 - 15:10 Coffee Break (DESY Auditorium)

15:10 - 16:00 High Energy Physics community needs
Location: DESY Auditorium

15:10 **Detector Challenges at the Free-Electron Lasers** *20'*

Speaker: Heinz Graafsma (DESY)

15:30 **Silicon Tracking and Vertexing at a Linear Collider** *15'*
Speaker: Marc Winter (IN2P3)

15:45 **TALENT - Training Program for Young Scientists in the Field of Instrumentation for Radiation Detection** *15'*
Speaker: Pietari Kauttu (Helsinki Institute of Physics (FI))
Material:

16:00 - 17:00 Applications
Convener: Hartmut Hillemanns (CERN)
Location: DESY Auditorium

16:00 **Some applications of pixel sensors in life sciences imaging** *20'*
Speaker: Wasi Faruqi (MRC Laboratory of Molecular Biology, Cambridge, UK)

16:20 **Functional computed tomography using energy resolved photon counting detectors**
Speaker: Anthony Butler (University of Otago)
Material:

16:40 **Advances in the Security** *20'*
Speaker: Eamonn Cooney (KROMEK)

17:00 - 17:30 Coffee Break (DESY Auditorium)

17:30 - 18:50 Applications
Convener: Hartmut Hillemanns (CERN)
Location: DESY Auditorium

17:30 **Applications in Spectroscopy** *20'*
Speaker: Andrei Nomerotski (Univ. Oxford)

17:50 **Position Sensitive Silicon Detectors for particle beam diagnostics** *20'*
Speaker: Massimo Caccia (INFN Milano)

18:10 **Monitoring of Mixed Radiation Fields and Dosimetry with Pixel Detectors** *20'*
Speaker: Jan Jakůbek (Czech Technical University in Prague)

18:30 **DECTRIS Solid State Position Sensitive Detectors in Synchrotron Applications** *20'*
Speaker: Clemens Schulze-Briese (Dectris Ltd.)

18:50 - 20:50 Networking Finger Food Dinner

Tuesday, 27 March 2012

09:00 - 10:30 Company Presentations
Convener: Prof. Massimo Caccia (Univ. degli Studi Milano-Bicocca (IT))
Location: DESY Auditorium

09:00 **Dectris Ltd.** *15'*
Speaker: Dr. Clemens Schulze-Briese (Dectris Ltd.)

09:15 **Baltic Scientific Instruments** *15'*
Speaker: Dr. Vladimir Gostilo (Baltic Scientific Instruments)

09:30 **MARS Bioimaging** *15'*
Speaker: Dr. Anthony Butler (MARS Bioimaging)

09:45 **ISEG Spezialelektronik GmbH** *15'*
Speaker: Mr. Ludwig Christians (ISEG Spezialelektronik GmbH)

10:00 **Kromek Ltd.** *15'*
Speaker: Mr. Eamonn Cooney (Kromek Ltd.)

10:15 **Struck Innovative Systeme GmbH** *15'*
Speaker: Dr. Matthias Kirsch (Struck Innovative Systeme GmbH)

10:30 - 11:00 Coffee Break (DESY Auditorium)

11:00 - 12:30 Company Presentations

Convener: Prof. Massimo Caccia (Univ. degli Studi Milano-Bicocca (IT))

Location: DESY Auditorium

11:00 **CAEN SpA** *15'*

Speaker: Mr. Gianni Di Maio (Caen SpA)

11:15 **Philips Digital Photon Counting** *15'*

Speaker: Dr. York HAEMISCH (Philips Digital Photon Counting)

11:30 **Canberra** *15'*

Speaker: Mrs. Marijke Keters (Canberra)

11:45 **Technology Transfer Agency Techtra Sp. z o.o.** *15'*

Speaker: Mr. Piotr Bielowka (Technology Transfer Agency Techtra Sp. z o.o.)

12:00 **Ketek** *15'*

Speaker: Florian Wiest (KETEK)

12:30 - 13:00 Summary and panel Discussion: towards a roadmap for collaborative R&D

Location: DESY Auditorium

13:00 - 14:00 Lunch (DESY Auditorium)

AIDA - Academia meets Industry: Solid-State Position Sensitive Detectors

Abstracts book

Table of contents

Abstract ID : 23

Functional computed tomography using energy resolved photon counting detectors

Content :

The goal of the MARS project and its partners is to perform functional (physiological) imaging using spectral (multi-energy) computed tomography (CT). Specifically we are using preclinical CT systems equipped with spectral x-ray detectors to study the composition and function of biological tissues. This is a major advance from conventional CT systems that typically only provide anatomical (structural) information. The MARS scanners incorporates the Medipix3 energy resolved (spectral) photon counting x-ray detectors housed in a purpose built pre-clinical CT scanner. The system uses a variety of image processing techniques including compressed sensing, algebraic reconstruction methods, and material decomposition methods.

Biomedical topics being studied include atheroma (eg. heart disease), non-alcoholic fatty liver (eg. metabolic syndrome), and arthopathies (eg. osteoarthritis). Spectral CT images already obtained include:
1) excised human atheroma decomposed into Ca, Water, and Fat components correlated with specimen histology.
2) qualitative measurement of liver fat in transgenic mice,
3) measurement of glycoaminoglycans in excised bovine cartilage,
4) demonstration that functional labels such as gold nano-particles can be identified in mice.

CV :

Qualifications:
MBChB - Medicine 1998 - University of Otago 1998
GradDipSc -Physics 2006, University of Canterbury
FRANZCR -Radiology 2005, The Royal Australian and New Zealand College of Radiologists
PhD - Engineering 2007, University of Canterbury

Dr Anthony Butler is a radiologist with formal training in physics and computing. He has academic affiliations with the University of Otago Christchurch, the University of Canterbury, and CERN (European Centre for Nuclear Research). He works as a clinical radiologist at Canterbury District Health Board and is the director of the Centre for Bioengineering at the University of Otago Christchurch. He has won 10 awards for his research including awards from the Royal Society of NZ and the Royal Australian College of Radiologists. He is a named investigator on over $6m of NZ government research grants.

Primary authors : BUTLER, Anthony (Univ. Canterbury, Dept. Phys. Astro)

Co-authors :

Presenter : BUTLER, Anthony (Univ. Canterbury, Dept. Phys. Astro)

Comments :

List of authors:
Anthony Butler1,2,3,4, Mike Walsh2, Paul Ronaldson2, Nicola Scott2, Rafidah, Zainon1, Steven

Geiseg1, Tejraj Janmale1, Nick Cook3, Alex Opie1, Raja Amir1, Robert Doesburg1, Niels de Ruiter2,Hengyong Yu5, James Bennett5, Ge Wang5, Tim Woodfield1,2, Nick Cook3, Phil Bones1, Judy
Mohr2, Nigel Anderson2, Phil Butler1,4
1) University of Canterbury, Christchurch, New Zealand
2) University of Otago, Christchurch, New Zealand
3) Canterbury District Health Board, Christchurch, New Zealand
4) European Organization for Nuclear Research
5) Virginia Tech, Blacksburg, VA, USA.

Abstract ID : 24

State of the art in Position Sensitive Solid-State Detectors

Content :

The task of position sensitive detectors in particle physics is the reconstruction of charged particle tracks with high resolution. These detectors, along with their dedicated readout electronics, will be required to have a small pitch, a high degree of radiation tolerance, a large signal-to-noise ratio, a low mass to minimize particle scattering, low power dissipation, the capability of handling a very high data rate and small dead regions together with the possibility to cover large areas. Not all of these requirements can be satisfied together, hence a large variety of different concepts exists or is being developed. The various concepts including new ideas and trends will be reviewed. Furthermore possible applications of these detectors in other fields, like x-ray imaging will be discussed.

CV :

In his early career he worked in collider experiments at CERN (UA1, ALEPH) specializing in the physics of beauty-mesons. Besides work on lifetime measurements of b-mesons he made major contributions in the analysis of B0-oscillations. Furthermore he worked on the search of exotic particles. One of his major contributions to the ALEPH experiment was the construction of the silicon vertex detector, which was the decisive instrument for the successful measurements of b-lifetimes and oscillations.
Later he had a central role in the design and construction of the ATLAS silicon tracker (SCT). This included the design of the basic module, the R of radiation hard silicon detectors, module construction and management tasks.
Since 2005 he is head of the semiconductor laboratory of the MPP (together with Lothar Strüder from MPE), leading the development and fabrication of novel silicon sensors for use in future particle and x-ray detectors. Presently the development focuses on active pixel detectors to be used in the vertex detector of the Belle II experiment at KEK and avalanche pixel arrays for photon counting in astroparticle experiments (MAGIC) and imaging calorimeters. Another research topic is 3D integration, which will have a major impact on future pixel sensor. Here he is leading (together with Valerio Re, INFN) a work package in the EU funded AIDA project.

Primary authors : MOSER, Hans-gunther (Werner-Heisenberg-Institut)

Co-authors :

Presenter : MOSER, Hans-gunther (Werner-Heisenberg-Institut)

Abstract ID : 25

DECTRIS Solid State Position Sensitive Detectors in Synchrotron

Content :

The PILATUS pixel and MYTHEN strip detectors have revolutionized synchrotron radiation data collection by combining noise-free counter properties with highest data acquisition rates. These features enable optimized data acquisition modes and new experimental techniques. The PILATUS detector is a modular two-dimensional hybrid pixel array detector, which operates in single-photon counting mode (Brönnimann et al., 2006). The system achieves frame rates up to 300 Hz and its surface area ranges from 84 x 33 mm2 up to 448 x 431 mm2 with a pixel size of 0.172 x 0.172 mm2. The gaps between modules in large area systems correspond to 7 and 17 pixel, respectively. The MYTHEN detector is a one-dimensional strip detector (Bergamaschi et al., 2010). A module consists of 1280 strips with a pitch of 50 µm and a width of 8 mm. Both systems were developed at the Paul Scherrer Institut in Switzerland.

These detectors offer several distinct advantages compared to current state-of-the-art CCD, imaging plate or gas detectors. The main features include: no readout noise and no dark current, a point-spread-function corresponding to one pixel or strip, high detective quantum efficiency as well as the possibility to suppress fluorescence by means of an adjustable lower energy threshold (Kraft et al., 2009). The readout times are 2.3 and 0.3 ms for PILATUS and MYTHEN and the depth of the counter is equivalent to 20 and 24 bits, respectively. Pixels are physically distinct in so far as an overexposure of a pixel or strip does not influence the neighboring ones. Local count rates of up to 1 Mcps and average global count rates of 105 cps are supported.

Because of the specified properties, these detectors are especially suited for the study of weak diffraction phenomena, time-resolved experiments and accurate, high redundancy measurements of Bragg intensities. Moreover, they enable previously impractical data acquisition protocols such as scanning-SAXS and X-ray ptychography. The short readout and fast framing time allow collection of diffraction data in fine-phi-slicing mode with continuous sample rotation.

Results from various x-ray experiments are presented, including protein crystallography, SAXS/WAXS, powder diffraction, surface diffraction, as well as results from diffuse scattering experiments.

CV :

Clemens Schulze-Briese, male, physicist, graduated from physics department, University of Hamburg in 1990. PhD thesis at the European Synchrotron Radiation Facility in 1994. He worked at the Paul Scherrer Institut in Villigen Switzerland from 1995-2010. As the head of the Macromolecular Crystallography group of the Swiss Light Source he was responsible for the design, construction and operation of the SLS MX beamlines. In 2009 he became the head of the Laboratory for Macromolecules and Bioimaging of the SLS. In 2010 je joined the company Dectris in Baden, Switzerland, to become the Head of Marketing and Sales and CSO. His main interests are X-ray instrumentation, crystallographic methods development and radiation damage to biological samples.

Primary authors : SCHULZE-BRIESE, Clemens (DECTRIS)

Co-authors :

Presenter : SCHULZE-BRIESE, Clemens (DECTRIS)

Last modified on : Wednesday 21 March 2012

Comments :

References:

Bergamaschi, A., Cervellino, A., Dinapoli, R., Gozzo, F., Henrich, B., Johnson, I., Kraft, P., Mozzanica, A., Schmitt B. Shi, X., J. Synchrotron Rad. (2010). 17, 653–668

Broennimann, Ch., Eikenberry E. F., Henrich B., Horisberger R., Huelsen G., Pohl E., Schnitt B., Schulze-Briese C., Suzuka M., Tomizaki T., Toyokawa H., Wagner A. (2006). J. Synchrotron Rad. 13, 120-130.

Kraft, P., Henrich B., Eikenberry E. F., Schlepuetz C. M., Kobas M., Graafsma H., Broennimann Ch., J. Synchrotron Rad. (2009). 16, 368–375

Abstract ID : 26

Some applications of pixel sensors in life sciences imaging

Content :

Life sciences cover a wide range of topics so we need to concentrate on a specific area in which pixel detectors have made a large impact or are likely to do so in the near future; such an area is that of high resolution structure determination of large biological macromolecules using either electron cryo-microscopy (cryo-EM) or X-ray crystallography. For the latter technique hybrid detectors, particularly those developed at the Paul Scherrer Institute (PILATUS) have dramatically improved data collection in protein crystallography and have also been successfully commercialized. Due to time restrictions, it will not be possible to cover this part in any detail but will probably be covered in other talks. My talk will concentrate on the use of and potential of pixel detectors in cryo-EM, which has been discussed in a recent review (1).

By way of introduction a few examples of large biological structures, which have been solved to near-atomic resolution recently with cryo-EM, will be shown to illustrate the power of the technique. Almost all previous studies have relied on photographic film for data acquisition. Possible benefits and advantages to be expected from pixel detectors with improved performance will be discussed.

What properties do we look for in detectors for cryo-EM? As all biological specimens are susceptible to radiation damage it is important to minimise the dose during data acquisition. It is therefore vital to use the most efficient detectors so that every electron, which enters the detector is recorded. Additionally, in order to capture high resolution features in the image, it is necessary to have good spatial resolution. Both these requirements can be combined in a single property, defined as the detective quantum efficiency (DQE) as a function of spatial frequency.

We discuss two types of silicon pixel detectors, viz. hybrid pixel detectors and CMOS-based detectors that have been applied to electron microscopy. For cryo-EM applications CMOS detectors have been shown to give excellent performance both theoretically and confirmed experimentally. Basic detector properties will be discussed to bring out the key requirements for the detectors and illustrate with results. Lessons learnt from academic studies have been instrumental in a commercial detector to be developed (2) and this will be discussed briefly.

1. Electronic detectors for electron microscopy
A. R. Faruqi and G. McMullan
Quarterly Reviews of Biophysics 44, 3 (2011), pp. 357–390.
2. A high frame rate, 16 Million pixels, radiation hard CMOS sensor
N. Guerrini, R. Turchetta, G. Van Hoften , R. Henderson, G. McMullan, A. R. Faruqi
J. Inst. 2011 (http://dx.doi.org/10.1088/1748-0221/6/03/C03003)

CV :

Having completed a Ph.D. in Particle Physics from Imperial College in 1965, Wasi Faruqi spent the following three years developing spark chambers for experiments on the proton synchrotron (NIMROD) at Rutherford Laboratory, near Oxford. Switching to Structural Biology in 1969, he moved to the MRC Laboratory of Molecular Biology in Cambridge, where he is still based. His involvement with detectors continued in Structural Biology as it was found that adapted Multiwire Proportional Chambers were ideal for a number of X-ray experiments, particularly those which investigated structural changes in contracting muscle using time-resolved diffraction. Such experiments could not be performed using laboratory-based X-ray sources and required the team in the MRC Laboratory to develop faster cameras using synchrotron radiation at NINA, Daresbury (later experiments done at DORIS, Hamburg). More recently, he have been involved in developing electronic detectors for electron cryo-microscopy. Starting with CCDs, there has been a progression to hybrid pixel detectors (Medipix2) and CMOS. The last detector has been commercialized by FEI as the Falcon, which is fitted in many top-range electron microscopes.
(More detailed CV, including publications, etc are available at: http://www2.mrclmb.cam.ac.uk/personal/arf/index.html)

Primary authors : FARUQI, Abdul Raffey (MRC, Laboratory Molecular Biology (GB))

Co-authors :

Presenter : FARUQI, Abdul Raffey (MRC, Laboratory Molecular Biology (GB))

Primary authors : FARUQI, Abdul Raffey (MRC, Laboratory Molecular Biology (GB))

Abstract ID : 35

The ALICE Inner Tracking System Upgrade

Content :

The main physics motivation for the upgrade of the Inner Tracking System of the ALICE experiment is to perform new measurements on charm and beauty production in heavy-ion collisions, dealing with the challenge of expected Pb-Pb interaction rates of up to 50 kHz. For this purpose, a new silicon tracker is needed with greatly improved features in terms of determination of the distance of closest approach to the primary vertex, standalone tracking efficiency at low transverse momentum, momentum resolution and readout rate capabilities.
The ITS upgrade foresees to replace the present ITS detector with a new seven layer silicon vertex detector. Two layouts are being considered: Layout 1 foresees to equip all layers with monolithic silicon pixel detectors; Layout 2 will consist of 3 layers of hybrid silicon pixel detectors and 4 layers of double sided silicon strip detectors.
The first layer will be located at an average radius of 22 mm, benefiting from the installation of a smaller radius beampipe. Both hybrid and monolithic pixels are under consideration for the innermost layers. The reduction of the pixel size down to 20-30 um x 20-50 um allows one to improve the pointing resolution and the tracking efficiency in the bending plane and the background rejection capability.
The material budget is another key parameter for the innermost layers, where it defines the ultimate limit of the achievable pointing resolution. A material budget of 0.3% of X0 for monolithic and of 0.5% of X0 for hybrid pixel detectors is considered as a feasible target. The expected radiation levels for the innermost layer (685 krad TID, 1013 neq per year) will require a careful validation of the different technologies in terms of radiation resistance.
The layers at larger radii can only be equipped with monolithic pixel detectors or strip detectors due to the high cost of fine pitch flip chip bonding. The need to preserve good granularity and pointing resolution requires a strip detector geometry with a small cell size (95 um strip pitch, 22 mm strip length) and a small strip inclination with respect to the beam direction. The information on the signal amplitude will be preserved for the strip sensors for particle identification purposes. The strip readout chip will incorporate a low power ADC with 10 bits resolution. In case of a full monolithic implementation of the new ITS, the pixel sensors might be also equipped with high resolution charge read-out to maintain the particle identification capability.
The present status of the technology development for the considered options will be reported.

CV :

Being member of the Trieste University and INFN research group within the ALICE Collaboration, he participated in the development, the construction and the commissioning of the Silicon Strip Detector (SSD), which is part of the ALICE Inner Tracking System (ITS). Since 2010 he is involved in the ALICE detector operations, as SSD Run Coordinator and later as ITS Run Coordinator. He has been designated to be ALICE Period Run Coordinator for April 2012.
Since 2011 he joined the ALICE ITS Upgrade project as one of the Conveners of the Detector Technical Implementation working group.

Primary authors : CONTIN, Giacomo (Universita e INFN (IT))

Co-authors :

Presenter : CONTIN, Giacomo (Universita e INFN (IT))

Abstract ID : 39

The SuperB Silicon Vertex Tracker

Content :

The experimental apparatus at the Super-B-Factory to be built in Tor Vergata, near Rome, will include a Silicon Vertex Tracker (SVT) similar in layout to that of BaBar. The main differences will be an increased polar angle acceptance (to ± 300 mr) and the addition of an innermost layer (Layer 0) very close to the beam (≈1.5 cm radius).
The five Layers 1-5 will have the same radius as in BaBar, but will be about 50% longer. They will be made of 300 µm thick, double-sided, AC-coupled microstrip sensors with polysilicon bias resistors, for a total silicon area of 1.5 m^2. The strip pitch will vary between 50 and 200 µm. In order optimize the design, to simplify the assembly and to reduce the cost, fabrication on 150 mm wafers will be required.
Eight different sensor models will be needed, for a total of 288 sensors on 254 wafers, not including the yield factor and the spare sensors (≈ 15%).
In the first operational phase of the machine the innermost Layer 0 is foreseen to be made out of eight 200 µm thick 'striplet' sensors, 105 mm long and 15 mm wide. They will have 50 µm pitch strips tilted at + - 45 degrees on the two sides, so that all strips will be about 2 cm long. These sensors will require double-sided processing of 200 µm thick, 150 mm diameter wafers, which may be a challenge for the manufacturers.
In later operation, the striplet detector is foreseen to be replaced by a very finely segmented pixel detector, with 50 µm X 50 µm pixels. Two options are being developed: hybrid pixels with a readout chip implemented on a two-tier vertical integration technology, and monolithic sensors (MAPS) also exploiting vertical integration or the INMAPS process.
Besides the detectors, the flex circuits needed to bring the signals from the sensors to the readout chips will also pose a technological challenge. In particular those for the Layer 0 striplet detector will have to be very thin and light, with aluminum traces at a pitch down to 50-60 µm over distances of several cm.
The overall SVT design will be illustrated, with emphasis on the requirements for the silicon microstrip and pixel sensors and for the fanout circuits.

CV :

Luciano Bosisio is associate professor of physics at the University of Trieste, Italy. He has been involved since the beginnings in the development of silicon microstrip detectors, in particular double-sided ones, and in their use in High Energy Physics experiments, including ALEPH, BaBar, ALICE. At present he participates in the design of the Silicon Vertex Tracker for the experimental apparatus at the Super-B-Factory machine to be built near Rome.

Primary authors : BOSISIO, Luciano (Universita e INFN (IT))

Co-authors :

Presenter : BOSISIO, Luciano (Universita e INFN (IT))

Abstract ID : 40

CMS strip tracker

Content :

The talk will review the general requirements for silicon strip sensors to be used in the upgrade of the CMS Tracker. Important material and process specific properties will be discussed and the procedures to electrically characterize and qualify production sensors will be explained briefly. Furthermore, the design and construction of lightweight and highly integrated detector modules will require advanced materials and production techniques. The presentation will briefly summarize where help from the industry is greatly appreciated.

CV :

Marko Dragicevic is a staff scientist at the Institute of High Energy Physics in Vienna. He has been working with the CMS Tracker collaboration since his diploma thesis and is now actively involved in the design of the sensors and modules for the upgrade of CMS Tracker for HL-LHC operation.

Primary authors : DRAGICEVIC, Marko (Austrian Academy of Sciences (AT))

Co-authors :

Presenter : DRAGICEVIC, Marko (Austrian Academy of Sciences (AT))

Abstract ID : 41

ATLAS Pixel Detector

Content :

The ATLAS pixel detector is a 1.8 m2 high resolution detector with 80 Million individually amplified channels.
The pixel technology has been developed in the 90s until about 2005. The detector has then been built and moved into ATLAS from 2006 - 2008. It is currently upgraded by an insertable innermost layer (IBL) which has been developed based on newer technologies, regarding sensors and electronics to cope with the higher demands at the LHC.
Based on this current upgrade project, research and development is going on towards even more advanced pixel technologies to be made into a further pixel detector upgrade in the next or next to next ATLAS upgrade phase.
The talk will explain the technology of the ATLAS pixel detector and its future directions and potential.

CV :

Norbert Wermes has carried out research in high energy physics experiments at accelerators in Bonn (1976-78), Desy (1978-1982), SLAC/Stanford (1982-1985) and CERN (LEP, 1985-1989 and 1993-2001; SPS, 1989-1992; and LHC since 1992). From 1989 - 1992 he was professor at the University of Heidelberg. Since 1992 he is full professor at the University of Bonn. Main fields of interest: new phenomena in particle physics at highest energies, e.g. Higgs physics, and detector development (eg pixel detectors)

Primary authors : WERMES, Norbert (Universitaet Bonn (DE))

Co-authors :

Presenter : WERMES, Norbert (Universitaet Bonn (DE))

Abstract ID : 42

Detector Challenges at the Free-Electron Lasers

Content :

Free-Electron-Lasers produce XUV and X-ray pulses that are so intense that a full scattering or diffraction pattern can be recorded in a single shot. This is not only an opportunity but also an obligation since in many cases the sample will be destroyed due to the high incident intensity. This means that single-photon counting, now widely used at Storage Ring Synchrotrons to reach low noise, cannot be used. Instead integrating detectors are mandatory. At the same time the noise per pixel and per shot has to be significantly lower than one photon, while certainly pixels will have to record in access of 10^4 photons per shot. This means that one needs low-noise, large dynamic range, integrating area detectors. Another challenge is the frame rate. For the non-superconducting accelerators, this ranges from 60 to 120 Hz, while for the super conducting European XFEL a repetition rate of 4.5 MHz(!) is required. Whereas, pixel sizes of the order of 200 microns are acceptable, albeit not ideal, for many experiments, a certain class of experiments requires significantly less than 50 microns. Finally the energy range spans from 100 eV to 100 keV.
An overview of the various requirements, as well as the ongoing projects, will be given.

CV :

Heinz Graafsma is the head of the Photon-Science Detector Group at DESY, and has 25 years of experience in X-ray crystallography and Synchrotron instrumentation. After studying applied physics in the Netherlands, he obtained his PhD in 1992, at the State University of New York at Buffalo working at the NSLS synchrotron at Brookhaven National Laboratory. From 1992 until 2006 he worked at the European Synchrotron Radiation Facility in Grenoble, first as Beamline Scientist and later as the head of the Instrumentation Group. In 2006 Graafsma moved to DESY to create and build up the Photon Science Detector group, as well as to define the detector program for the European XFEL, as work-package leader detectors. His group is now leading one of the main detector development projects (AGIPD) for the European XFEL, and is deeply involved in others (CAMP, DSSC). He has also been involved in the first experience at LCLS.

Primary authors : GRAAFSMA, Heinz ()

Co-authors :

Presenter : GRAAFSMA, Heinz ()

Abstract ID : 43

Applications in Spectroscopy

Content :

Recent progress in silicon technologies is bringing to life a new generation of fast imagers with nanosecond scale time resolution, sensitive to single particles (ions, electrons, photons etc). This kind of performance can be achieved with hybrid or monolithic pixel sensors based on a planar CMOS process, which allow a considerable intelligence at the pixel level and flexible architectures tailored to application. This talk will review their applications in the field of time-of-flight mass spectrometry with imaging capabilities. For each mass, the sensors can image with high precision the complete velocity or spatial distribution of the ions at their point of formation. This will take mass spectrometry from its current role as a one-dimensional 'weighing' technique into a multi-dimensional world, in which spatial, velocity, and even coincidence information is provided as a function of mass. Some other spectroscopic applications will be discussed as well.

CV :

Prof Andrei Nomerotski is the head of Silicon Detector R group in the sub-department of Particle Physics which develops silicon pixel detectors (mostly monolithic active pixels based on submicron CMOS and CCD processes) for tracking of particles and also for imaging. He took his undergraduate degree in 1985 from Novosibirsk State University, Russia, and his graduate degree in 1996 from the Università di Padova, Italy. Since then he has worked at the Fermi National Accelerator Laboratory, Batavia, USA, carrying out research in Particle Physics, before he joined the Physics Department of the Oxford University in 2005. See also the web site http://www.physics.ox.ac.uk/users/nomerotski/whereabouts.htm

Primary authors : Dr. NOMEROTSKI, Andrey (University of Oxford (GB))

Co-authors :

Presenter : Dr. NOMEROTSKI, Andrey (University of Oxford (GB))

Abstract ID : 44

Monitoring of Mixed Radiation Fields and Dosimetry with Pixel Detectors

Content :

The advantages of semiconductor pixel detectors present high sensitivity, low noise and zero dark signal. Historically the pixel detectors were designed mostly for applications in high energy physics. Later the development focused also to imaging applications. Currently it is more and more frequently seen that good properties of pixel detectors can be successfully applied also in completely different fields.
This contribution is focused to ability of pixel detectors to record tracks of individual ionizing particles. Shapes of these tracks and amount of deposited energy allow in many cases to identify types of particles interacting with detector. This feature can be nicely used for monitoring of unknown radiation field and particularly in dosimetry. In contrast to standard dosimeters the pixel detectors allow to record more complete information about each particle of incident radiation such as particle type, direction of flight and linear energy transfer (LET). This capability allows proper assignment of quality factor to each particle resulting in more precise estimation of the radiation dose.
The instant development in the field of semiconductor pixel detectors and their readout electronics allows construction of highly miniaturized and portable devices which can be easily installed in monitored areas and which could even serve as personal dosimeters.
In this contribution we will show three different examples where pixel detector Timepix is being used as radiation monitor: Radiation monitoring and beam position reconstruction in hadron therapy, measurement of composition of radiation field in ATLAS detector in CERN and radiation monitoring for astronauts in international space station (ISS).

CV :

Jan Jakubek
October 22, 1969, Nový Jičín, Czech Republic.

Education:
1993 Graduated in Mathematical Engineering at Faculty of Nuclear Science and Physical Engineering (FNSPE) of the Czech Technical University in Prague (CTU)
2001 PhD degree in Nuclear Physics at FNSPE CTU
Former positions:
1997-2000 Faculty of nuclear science and physical engineering, CTU, teacher.
2001-2001 Neovision ltd., development of optical measurement methods.
2001-2002 miniRAD ltd., development of a software and hardware for small DAQ systems.
2002- now Institute of Experimental and Applied Physics CTU, senior researcher, head of department of applied physics and technology.
Main research activities and interests:
Nuclear imaging (Medipix),
Study of semiconductor detection structures and their practical applications,
Spectroscopy, multiparametric coincidence spectroscopy,
Mathematical analysis of data taken from physical experiments,
Instrumentation for nuclear experiments.

Primary authors : JAKŮBEK, Jan (Institute of Experimental and Applied Physics, CTU in Prague)

Co-authors :

Presenter : JAKŮBEK, Jan (Institute of Experimental and Applied Physics, CTU in Prague)

Abstract ID : 45

Advances in the Security

Content :

Kromek Ltd is an innovator in the field of digital colour multi spectral x-ray imaging and Gamma ray spectrometry. This enables materials identification in the Nuclear, Medical, Defence, Security and Industrial markets. Products and solutions are based on CZT (Cadmium Zinc Telluride) including: ASICs and electronics, detectors, Arrays, assemblies and instrumentation. Kromek's range of Gamma ray spectrometry includes the groundbreaking GR1 (CZT based) compact spectrometer with KSpect analytical software.

CV :

Eamonn Cooney is the Sales and Business Development Manager of Kromek Ltd. A Chemistry graduate, he has over twenty years business and applications experience within X-ray and Analytical instrumentation for the Medical , Life sciences, Security, Defence and scientific Industrial markets. He was a former Sales Director of Nucletron Ltd and Sales & Operations Director of Analytical Nanotechnologies Plc.

Primary authors : COONEY, Eamonn (Kromek Ltd)

Co-authors :

Presenter : COONEY, Eamonn (Kromek Ltd)

Abstract ID : 46

Position Sensitive Silicon Detectors for particle beam diagnostics

Content :

Quality assurance (QA) of accelerated particle beams is of utmost importance for scientific experiments and beyond, notably in the medical field.
Position sensitive silicon detectors offer the possibility to image beams and have a full characterization in terms of spatial profile, intensity and energy. However, being interceptive, their use is likely to be limited to QA before & after the physics run/planned irradiation.
A few exemplary illustrations are presented, together with a perspective for future developments.

CV :

Massimo Caccia is currently Full Professor of Experimental Physics at Universita' dell'Insubria, Dept. of Science and Technology.
Particle physicist with a focus on Silicon Detectors, he was part of the DELPHI experiment at CERN, Geneva (1986-2000). At CERN, he worked essentially on the design, qualification, commissioning and optimization of the DELPHI Vertex detector, based on microstrip and pioneering pixel technology.
As Associate Professor at Uni. Insubria, he diverted on more applied projects based on the Silicon Technology inherited from High Energy Physics. He was Principal Investigator of 2 EC funded projects (SUCIMA and RAPSODI), approved within the Framework Programs 5 and 6. SUCIMA was focused on high granularity dosimetry and beam profiling, based on monolithic active pixel sensors. RAPSODI focused on silicon photo-multipliers and their application in dosimetry, environmental physics and homeland security.
Currently, he is partner of an FP7 project on the development of a novel instrument for Homeland Security.

Massimo Caccia is member of the Technology Transfer Board at INFN and Chief Science Officer of the technology Transfer Network of CERN linked institutes.

Primary authors : Prof. CACCIA, Massimo (Univ. degli Studi Milano-Bicocca (IT))

Co-authors :

Presenter : Prof. CACCIA, Massimo (Univ. degli Studi Milano-Bicocca (IT))

Abstract ID : 48

Silicon Tracking and Vertexing at a Linear Collider

Content :

High precision, thin, low power and cost effective silicon based detectors are essential for achieving the research programme at the Linear Collider, a world accelerator project calling for a new generation of experiments fixing new standards in detection sensitivity.

The talk will provide an overview of the silicon based tracking and vertexing sub-systems composing the experimental concepts under development. It will highlight those technical aspects which are currently most limiting the experimental sensitivity and on which most of the on-going R activity is concentrating.

CV :

Marc Winter is a particle physicist at CNRS-IPHC (Strasbourg). He has contributed to several particle physics experiments at CERN, among which the DELPHI experiment at LEP. Since the end of LEP he
is involved in the International Linear Collider (ILC) project, focusing on the high precision pixelated vertex detector composing the experiment. He coordinates for this purpose a research team
developing CMOS pixel sensors (CPS) and low power ultra-light systems based on CPS at IPHC.

Primary authors : WINTER, Marc (IN2P3)

Co-authors :

Presenter : WINTER, Marc (IN2P3)

Abstract ID : 50

TALENT

Content :

TALENT is a 4-year multi-site training network aiming at career development of young researchers in the field of instrumentation for radiation detection. The project focuses on piloting new state-of-the-art technologies on the new precision pixel detector ATLAS Insertable B-Layer detector (IBL) and for future precision tracking detectors. The project will strengthen the co-operation between research and multidisciplinary industry in the fields of advanced radiation sensors, fast and low power consumption read-out and data acquisition electronics, new cooling technologies and ultra-light mechanical support structures.

During the next years, completely new technical solutions are required to enable the construction of new or upgrading the existing high energy particle physics research infrastructures and detectors at CERN Large Hadron Collider (LHC). Aims for running the research facilities on increased intensity levels, pose a need to significantly improve the detector technologies mainly due to the 10 fold increased radiation level and data volume. Answering the hostile environment challenges and increased data acquisition needs will require vigorous industry collaboration and research on:

- Radiation-hard precision pixel sensors
- Radiation-hard high-density electronics and interconnection technologies
- New mechanical integration methods for light-weight support and cooling systems
- Detector performance and system integration
- Dissemination, knowledge transfer and external research funding

The aim of TALENT is to enhance interaction between European stakeholders to significantly increase the RTD efficiency by finding new technical solutions for future scientific infrastructures. The outcome will be to create the means to produce affordable high performance detector modules in European industry and thus answer to the forthcoming needs of research infrastructures and industry application demand.

TALENT is currently recruiting 15 Early Stage Researchers and 2 Experienced Researchers!

CV :

Mr. Pietari Kauttu (M.Sc. Econ, PMP) has broad experience in establishing and managing international R projects. He works in industry relations between Big Science centers, companies and academic institutions. Mr. Kauttu presents the TALENT Initial Training Network program on behalf of project Coordinator, Dr. Heinz Pernegger from CERN ATLAS Collaboration.

Primary authors : KAUTTU, Pietari (Helsinki Institute of Physics (FI))

Co-authors :

Presenter : KAUTTU, Pietari (Helsinki Institute of Physics (FI))

Abstract ID : 52

LHCb

Content :

LHCb is a forward spectrometer situated around one of the four collision points of the LHC, which searches for physics beyond the standard model using precision measurements of CP violation and rare decays. The upgrade of the LHCb experiment, planned for 2018, will transform the entire readout to a triggerless system operating at 40 MHz. All data reduction algorithms will be executed in a high level software farm, with access to complete event information. This will enable the detector to run at luminosities of above 2x10^33 cm-2s-1 and explore New Physics effects in the beauty and charm sector with unprecedented precision. The technical challenges associated with this upgrade require close collaboration with industrial partners to achieve the performances required. All the silicon sensors and modules will be replaced with new electronics and sensor designs, and all the photon detectors must be replaced.
The vertex detector will have to cope with radiation levels of up to 10^16 1 MeV neutron equivalents / cm^2, more than an order of magnitude higher than those expected at the current experiment, and transmit data at 3000 Gbit/s over ~1000 data links. The module must be lightweight and radiation hard, and integrate evaporative CO2 cooling to maintain the silicon at the desired temperatures. The cooling solutions currently under investigation include microchannel cooling, or innovative heat spreading planes using diamond or TPG substrates. These developments are being carried out in close collaboration with industry. The sensor designs, both for the vertex detectors and the downstream tracking detectors, have various design requirements, including radiation hardness, fine pitches, and custom designed patterns and cuts. The upgraded RICH detectors will use ~ 3500 new photon detectors, which require excellent active area coverage and close packing, as well as efficient single photon response, gain uniformity and minimal cross talk. In a specialised development for time of flight tagging, photon detectors with time resolutions of below 30 ps would be used. The technological needs of the LHCb upgrade for position sensitive detectors will be described highlighting those areas where collaboration with industry is particularly desired.

CV :

Paula Collins is a CERN physicist working on the LHCb experiment and in particular on the silicon vertex locator (VELO). She is leading the VELO upgrade project, designing a new silicon detector capable of 40 MHz readout, which will be installed together with the rest of the LHCb upgrade in 2018.
She is active in silicon radiation damage studies, in particular for what concerns the VELO and its upgrade. In the past she has acted as project leader of the VELO, during its installation phase, and previously project leader of the DELPHI Vertex detector and its upgrade. She was educated at Oxford
University, where she obtained her undergraduate and postgraduate degrees working on the DELPHI experiment, and has held fellowships at CERN and in the UK. She is involved in education and outreach, having served in several organising committees for conferences and workshops, such as the EDIT 2011
School of Excellence at CERN.

Primary authors : COLLINS, Paula (CERN)

Co-authors :

Presenter : COLLINS, Paula (CERN)