NEWSLETTER
January 2010
Issue 2

DITANET

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The LHC is Back

Particle beams were once again circulating in the world's most powerful particle accelerator, CERN's Large Hadron Collider (LHC) on November, 20th 2009. The machine ended its first full period of operation in style on Wednesday, December 16th. With collisions recorded at energies of up to 2.36 TeV the accelerator has set a new energy world record.

The LHC pushes accelerator science and technology in many different fields, including a number of beyond state-of-the-art developments in beam instrumentation. This requires close collaboration between partners, the exploitation of synergies wherever possible, and a long term R&D planning.

DITANET directly contributes to some of the LHC installations such as the synchrotron light telescope for the measurement of the longitudinal beam profile. For an instrumentation expert it is always a reward to measure beam properties for the first time with a new installation and we can only congratulate our CERN colleagues on their great work.

Besides its contributions to optimizing existing particle accelerators, the network is also involved in central developments for future facilities, such as the Facility for Antiproton and Ion Research (FAIR) in Germany.
By bringing together early stage and experienced researchers from all over the world in its first topical workshop on low energy, low intensity beam diagnostics, DITANET follows its goal of encouraging knowledge exchange between partners and driving new developments.

2010 promises to be another very exciting year for our community with many interesting events such as the BIW and IPAC in May. DITANET will organize a number of training events and I would like to use this opportunity to encourage you checking our web page on a regular basis.

Carsten P. Welsch, Coordinator

DITANET Prize 2009: Applications still open

Applications are still open for the Network's first *Prize in Beam Diagnostic Techniques.*
A 1,000 euros cash prize is awarded for an outstanding contribution to the field of beam instrumentation for particle accelerators by a researcher in the first five years of his/her professional career.
The deadline for applications is 31st January 2010 and full information on how to apply can be found on the DITANET website:

www.liv.ac.uk/ditanet

Recent Events

First DITANET Topical Workshop
Low Energy, Low Intensity Beam Diagnostics

This event marks the beginning of a series to be organised by DITANET

The first DITANET topical workshop took place on November, 24th and 25th in Hirschberg-Großsachsen near Heidelberg in Germany. It focused on the diagnostics of low energy and low intensity ion beams and brought together around 40 scientists and engineers from all over the world. Its particular aim was to join early stage researchers, both from within the network and from the wider community, with renowned experts allowing the establishment of important contacts for both their careers and for reviewing the status of different R&D activities.

Day one began with an introduction to the future Facility of Antiproton and Ion Research, where many of the monitors presently under development in different groups will be used to monitor all beam characteristics with a high precession. It then stretched to the beam instrumentation used at different storage ring and cyclotron facilities around the world.

The second day concentrated on electrostatic storage rings which are the ideal tool for lowest beam energies down to a few tens of keV and intensities as low as 10^4 pps. Presentations were given on the ELISA (ISA, Arhus), DESIREE (MSL, Stockholm), CSR (MPI-K, Heidelberg), and USR (FAIR, Darmstadt) facilities and triggered interesting discussions on these challenging developments.

This workshop was organized by Peter Forck, Rainer Haseitl (GSI) and Andreas Peters (HIT) and made possible though the support by the DITANET project. It marked the beginning of a workshop series – information on future events will be posted on the Network’s homepage.

All contribution can be accessed via the project's home page.

Forthcoming Events

Second DITANET Topical Workshop
Longitudinal Beam Profile Measurments in High Energy Accelerators
July, 12th/13th 2010

The Cockcroft Institute will host DITANET's second Topical Workshop on longitudinal beam profile measurements in high energy accelerators. This event is still in the planning stages, however, further details and a draft programme will be posted on the DITANET web site shortly.

Early stage researchers and experienced colleagues are invited to contact the project coordinator to discuss their participation.

News from DITANET Partners

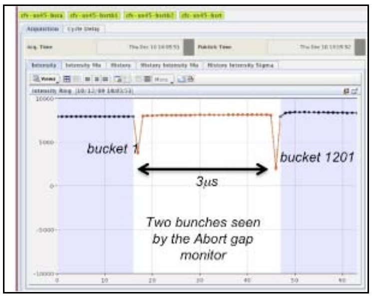
CERN, Switzerland *(A. Jeff and T. Lefèvre)*

The commissioning of the Large Hadron Collider restarted successfully at CERN in November 2009. DITANET is involved in the development of beam profile measurements using Synchrotron Radiation. Unlike electrons, protons do not radiate synchrotron radiation 'easily'. Depending on the beam energy, different synchrotron light sources must be used. A dedicated superconducting undulator has been built for low beam energies (450 GeV to 3 TeV), while edge and centre radiation from a beam-separation dipole magnet are used respectively for intermediate and high energies (up to 7 TeV). The emitted visible photons are collected 27m downstream using a retractable mirror that sends the light into an optical system, which requires a very careful pre-alignment. At the moment two different detectors have been installed and commissioned. The first one relies on the use of an intensified camera, which will provide the continuous monitoring of the transverse sizes of the LHC beams.

The second system is providing the monitoring of the Abort Gap. The LHC beam-dump system relies on extraction kickers that need 3 microseconds to rise to their nominal field. Since particles transiting the kickers during the rise will not be dumped properly, the proton population in this interval must always remain below quench and damage limits. A specific monitor designed to measure the particle population of this gap detects synchrotron radiation using a gated photomultiplier. Since the quench and damage limits change with the beam energy, the acceptable population in the abort gap and the settings of the monitor must adapt accordingly. The calibration of the monitor is performed by adjusting the trigger in order to observe the first pilot bunch. An example of a typical signal collected by the Photomultiplier (shown to the left), with two pilot bunches on each side of the abort gap.

In addition to these existing detectors, a study has been initiated to provide longitudinal density profiles of the LHC beams with a high dynamic range and a 50 ps time resolution. This would allow for the precise measurement both of the bunch shape and the number of particles in the bunch tail or drifting into ghost bunches. A solution is proposed based on counting synchrotron light photons with two fast avalanche photo-diodes (APD) operated in Geiger mode.

A first prototype of the system will be tested in 2010.



News from DITANET Partners (Continued)

HIT, Germany *(M. Ripert and A. Peters)*

By using a pepper-pot emittance device it is possible to improve the beam quality by retuning the ion source conditions. In November 2009, in collaboration with the DITANET Associate Partner, Max Planck Institute for Nuclear Physics in Heidelberg, the screen material for the on-line emittance device was investigated. The main interest of this experiment is to determine which material can withstand a high current of 10 mA light ions without any damage. Qualitative results of ion luminescence measurements are presented for candidate materials.

As a reminder, in a pepper-pot device, the scintillator is used to create a photographic image of the beamlets with pixel intensity corresponding to the charge concentration of beam particles striking the scintillator. A CCD camera records multi-shots.

The materials used were selected because of their availability, transparency, radiation hardness, fast response, prior use in beam diagnostics, or spectral matching to CCD detectors are Inorganic Doped Crystal (for example : YAG:Ce), Inorganic Undoped Crystal (Sapphire, YAG) and Quartz and Borosilicate glass.

Irradiation was carried out using 8 keV /u H^+ beams with flux up to $3 \cdot 10^{13}$ particles per pulse. The energy of the incoming ions was transferred to the host material by electronic and nuclear energy-loss processes and leads to the creation of several types of defects. Inorganic Doped crystal, quartz material and borosilicate glass are qualitatively good candidates with satisfactory light output and low damage. As envisaged, the doped YAG crystal enhances its light output due to an efficient energy transfer from the ionization track to the doped sites (Ce). This transfer, in which electronic defects (vacancies, interstitials…) play a major role, is necessary to achieve a good light output. However, the presence of defects could ultimately reduce the light output. In this test, after 1.3 seconds of total irradiation time of 10 μA proton beam, the doped YAG crystal displayed a blackened area which does not qualitatively reduce the light output. On the other hand, the undoped YAG crystal, showing a lower and constant light output, had a significant reduction (~ 97 %) of its light output due to the blackening of the material.

Although self-restoring of the structure is expected to occur in the undoped material, a significant fraction of these defects will be retained in the structure and will inhibit the undoped material luminescence.

In order to find solutions such as the final choice of the target, quantitative investigations on all materials will be performed in the near future.

CNA/University of Seville, Spain *(Z.A. Haidar and J.G. Camacho)*

CNA received an award from the Forum of Social Councils of Andalusian universities.

The award, entitled "Social Implication on Public Universities in Andalusia" was associated to the general activities in the Center, with a special mention of the DITANET project.

Congratulations !

More information:

http://www.comunicacion.us.es/?q=node/2212

News from DITANET Partners (Continued)

Royal Holloway, University of London, UK *(T. Aumeyr and G. Blair)*

Laser-wire systems use a finely focused beam of laser-light to scan across the particle beam in order to measure the transverse beam profiles; measurement of the transverse beam profile is an essential input into determining the transverse beam emittance. Laser-wires can be employed at electron machines using the Compton Effect, where the laser photons are scattered by the electrons and can be detected downstream as gamma rays in a calorimeter; alternatively the scattered electrons can be detected because they are over-focused by downstream magnets. A laser-wire can also be used at H^- machines, where the fundamental process is photo-ionization of the H^- ion to form neutral H-atoms; the neutralised H-atom and/or the released electron can be detected downstream. Both techniques are under study as part of an ESR project within DITANET.

The electron machine under study is the newly-completed PETRAIII accelerator at DESY, Hamburg. PETRAIII is a new synchrotron light source and is the world's most brilliant source of synchrotron light in the wavelengths it offers. Understanding the emittance of PETRAIII is very important to achieving its ultimate performance; the electron beam size is typically of order ten microns. The laser-wire experiment at PETRAIII was installed in early 2009, using green laser-light, and within a week was producing first data; this was a remarkable achievement, building on experience at the previous PETRAII system. Using a vertical optical table, laser light can be directed so as to scan in either the vertical or horizontal directions. Thomas Aumeyr, a DITANET ESR, was heavily involved in testing the system at RHUL before it was shipped to DESY and he was also heavily involved in its commissioning. The current emphasis is on automation and on integrating the laser-wire data acquisition into the PETRA system so that the laser-wire will become a central diagnostic tool for the machine operators. Once this is complete, the emphasis will shift to data taking and analysis in the context of PETRAIII optimisation.

More recently, Thomas has been working with the Front End Test Stand team at RAL and Imperial College to look at the use of laser-wires for H^- beams. In this case the laser operates in the infra-red and the beam sizes are of order mm, rather than microns. The main challenges here are the signal to noise ratio, because the initial location of the laser-wire is close to the ion source, where the backgrounds are large. Together with the laser-experts at RHUL and the FETS team, Thomas is looking at how to increase the laser power and is also looking at novel methods of signal detection, including the use of diamond detectors in collaboration with Diamond Detectors Ltd, a DITANET adjunct partner.

News from DITANET Partners (Continued)

University of Liverpool, UK *(J. Harasimowicz and C.P. Welsch)*

Future atomic and nuclear physics experiments place challenging demands on the required beam instrumentation. Low energy (<1 MeV), low intensity (<10^7 pps) beams will require highly sensitive monitors. This is especially true for the Facility for Low-energy Antiproton and Ion Research (FLAIR) where antiproton beams are decelerated down to 20 keV and as few as $5 \cdot 10^5$ particles per second will be slowly extracted for external experiments.

In order to investigate the limits of scintillating screens for beam profile monitoring in the low energy, low intensity regime, a structured analysis of several screen materials has been carried out under different irradiation conditions. The first experiments were realized in October 2009 at the Nuclear Physics Laboratory INFN-LNS in Catania, Italy (a DITANET Associate Partner) with the invaluable help of Paolo Finocchiaro, Luigi Cosentino and Alfio Pappalardo. The tests were based on irradiation of the screens with continuous beam of protons in the keV range with the intensities down to a few fA. The scintillating materials used during the investigation included CsI:Tl, YAG:Ce and a Tb-glass-based Scintillating Fibre Optic Plate (SFOP). In order to reduce the initial beam currents of a few pA to only a few fA, the pepper-pot-like attenuators were used, producing multi-peak images. This allowed resolution testing of the screens at the same time.

The preliminary results exhibited great sensitivity of CsI:Tl and SFOP to low intensity, low energy beams required by facilities like FLAIR.
For 200 keV protons, the beam was still visible at approx. 10 fA and only a few seconds of averaging. The resolution achieved was very high and better than 0.5 mm as depicted in the figure to the right. On the other hand, the YAG screen, despite its better radiation hardness, responded only in a very limited range.

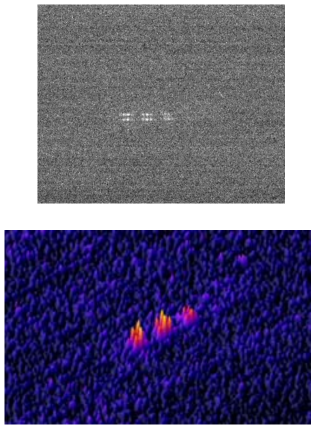


Image of 50 keV protons taken with CsI:Tl (left) and the light intensity map for the selected region (right).

New to the Network

Alessio Bocci

Alessio Bocci joined the Nuclear Physics Group of Seville in October 2009 as an Experienced Researcher within DITANET at the Centro National de Aceleradores (CNA), University of Seville. His main activities are the development of novel detectors, electronic equipment, and data acquisition, relevant for beam tracking, beam diagnosis, charged particle detection, and medical applications. Alessio's past research activities include instrumentation, detectors and electronics in different fields of physics. He graduated with a degree Laurea in Physics specializing in Astrophysics from the University of Roma "La Sapienza" in 2004. He gained his PhD in 2008 in Astronomy at the University of Florence in Italy, at the XUVLab, working on the R&D of diamond detectors for spectroscopical applications in the detection of photons at Soft and Hard X-rays energies. Moreover, during this time Alessio was involved in the research and development of fast un-cooled IR HgCdTe photo-detectors dedicated to particle beams diagnostics, in collaboration with the DAΦNE-Light facility at the Laboratori Nazionali di Frascati (LNF) of the National Institute of Nuclear Physics (INFN) in Italy. Within the Accelerator Division of LNF he was involved in the framework of the Time Resolved Positron Light Emission (3+L) experiment: a project devoted to the diagnostics of the e^+ beam of DAΦNE. At present Alessio's main scientific interests lie in the field of accelerator physics, beam diagnostic techniques and experimental applied physics.

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New to the Network (Continued)

Jan Egberts

Jan began studying physics in Heidelberg, Germany in April 2003. After he received his pre-diploma at the end of 2004 he was accepted for the Baden Wuerttemberg - North Carolina exchange programme and spent one year at the University of North Carolina. In 2006 he returned to Heidelberg University to complete his studies with a focus on atomic physics, particle physics and applied accelerator physics.

Whilst attending one of the Heidelberg Graduate Days, Jan became acquainted with accelerator research and started his diploma thesis on accelerator beam diagnostics. The diploma thesis titled 'Investigations on transverse beam profile measurements with high dynamic range' was carried out at the Max Planck Institute for Nuclear Physics. Jan graduated in July 2009.

In October 2009, Jan began his PhD at CEA Saclay as a DITANET trainee on the beam diagnostics of the IFMIF-EVEDA accelerator and in particular R&D into a residual gas ionization monitor. The main objective of this work is to develop up a radiation hard, non-interceptive transverse beam profile monitor for high beam currents of 125 mA.

ViALUX

Product News from ViALUX: (DITANET Associate Partner)

Spatial Light Modulators with High Resolution and High Speed

DMD micro mirror arrays have been widely used in projector devices and TVs and are famous for the current Pico™ Projectors embedded in mobile phones. There is much more potential of these SLM devices when used with a freely controllable interface: DLP® Discovery™. Typical applications can be found in dynamic pattern control for: diffractive optical elements, adaptive masking, light mixing, spectroscopy, holographic applications, direct imaging maskless and rapid prototyping.

ViALUX is pleased to inform you that the new **Chipset and Starter Kit series** Discovery™4100 has been made available now for the general use of the Digital Micromirror Device (DMD) in research and development as well as for product design. The new generation is a further improved platform with outstanding specifications; Discovery™4100 Starter Kits and Chipsets provide customers the full performance potential of latest DLP® technology.

ViALUX has also released the new **ALP-4.1 Controller Suite for Discovery™4100.** ALP-4.1 drives the new chipset to the full extent of the 2x LVDS Discovery™4100 data rate specification and provides outstanding **22,727 fps** (i.e. 22,727 full global array switches per second for the .55 and .7 XGA DMD – instantly available by just loading and calling a sequence of patterns using the ALP API. In addition, the ALP-4.1 on-board SDRAM capacity is increased to **32Gbit** for holding pre-loaded data).

There are six Discovery™4100 Starter Kit models available including the UV and NIR options for three different DMD formats. All DMD types of the former Discovery™4000 series are supported and upgrade options are available at ViALUX to drive the same DLP® chips with the new platform. The product line will support customers in various applications with the performance of latest DLP® technology.

The mirrors are aluminium coated so that the usable light spectrum is mainly controlled by the DMD window transmittance.

Further information and detailed specifications can be found at:

http://www.vialux.de.

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Examples of Recent Publications/Presentations

Publication resulting from collaboration between CNA/U Seville and CEA Saclay:

J. Pancin, et al., "Secondary Electrons Detectors for beam tracking: Micromegas and wire chamber", JINST **4** P12012 (2009).

Presentation: Alessio Bocci (CNA, Seville) participated and presented a talk at the 1st CARAT workshop which took place at GSI, 13th-15th December 2009.

Events 2010:

DITANET Events	
March 15th-19th	Complementary Skills School, University of Liverpool, UK
April 11th and 12th	European Commission Mid-Term Review Meeting, Brussels, Belgium
April 13th	DITANET Steering Committee Meeting, Brussels, Belgium
July 12th and 13th	2nd Topical Workshop: Longitudinal Beam Profile Measurements in High Energy Accelerators, Cockcroft Institute, UK
Other Interesting Events	
May 1st – 5th	Beam Instrumentation Workshop, Santa Fe, USA
May 24th – 28th	International Particle Accelerator Conference, Kyoto, Japan
July 2nd-7th	ESOF, Torino, Italy
August 23rd – 27th	FEL, Lund-Malmö, Sweden
September 12th-17th	LINAC, Tsukuba, Japan
September 12th-17th	ECAART, Athens, Greece

NOTICE BOARD

MID TERM REVIEW
This event is drawing closes and DITANET partners and trainees are reminded to send their travel details to the project manager as a matter of urgency, as accommodation needs to be set.

DEADLINE FOR THE NEXT NEWSLETTER
29th March 2010.

About DITANET

The development of novel Diagnostic Techniques for future particle Accelerators is the goal of the European Network (DITANET) which is installed within the Marie Curie ITN scheme. Several major research centers, leading universities, and partners from industry are developing beyond-state-of-the-art diagnostic techniques for future accelerator facilities, whilst jointly training students and young researchers within this unique European structure.

This project is funded by the European Commission as part of the FP7 Marie Curie Actions under contract number PITN-GA-2008-215080.