NEWSLETTER
October 2010
Issue 5

DITANET

Special Interest Articles:

- **Final call for the DITANET Prize**
- Stockholm School March 2011
- International Conference November 2011 announced.

Individual Highlights:

Diagnostics: More challenging than ever

Free Electron Lasers (FELs) have emerged as an exceptionally exciting tool for new scientific discoveries.

New results from the FLASH facility at DESY in Hamburg (Germany) on biological imaging, X-ray interaction physics and light source science are revealing prospects for remarkable future impact.

The Linac Coherent Light Source (LCLS) in Stanford (USA) produces ultrafast pulses of X-rays, millions of times brighter than even the most powerful synchrotron sources — pulses powerful enough to make images of single molecules.

In addition, next-generation light sources, based for example on very bright and ultra-cold electron beams with electron bunch charges of 1-10 pC, a pulse duration of 10 fs, 10^{-7} mrad normalized transverse emittance and 1 μm longitudinal emittance in a 1-2 GeV linac, together with a compact undulator with a period of 1 cm or less, have recently been proposed. Such compact machines are very interesting tools as they would provide light in the 1 nm wavelength range at moderate facility costs.

These light sources provide ultra-short pulses in beams with very high brilliance and urgently require the development of new beam diagnostics tool as present techniques and technologies reach their limits.

Novel instrumentation to monitor longitudinal beam profiles with femtosecond time resolution, alternatives to OTR screens that can no longer be used for profile measurements due to the emitted coherent radiation, and methods to measure and control halo formation and propagation in such beams urgently need to be developed and will be a challenge for our community.

Close collaboration, one of the key concepts of DITANET, as well as the continuous exchange of knowledge and researchers between institutions and countries will be an important basis for tackling these challenging problems and thus entering new diagnostics territory.

Onwards and upwards !

Carsten P. Welsch, Coordinator

DITANET Prize 2011 : FINAL CALL FOR APPLICANTS

This is the final call for applications for the 2011 DITANET Prize. The Network ***will award a 1,000 euro cash prize*** for outstanding contribution the field of beam instrumentation for particle accelerators by a researcher in the first 5 years of their professional career.

The deadline for applications is

31/10/2010.

Full information on the application process can be found on the DITANET web site.

www.liv.ac.uk/ditanet

Recent Events

Meeting of DITANET Trainees

HIT, Heidelberg
10th September 2010

A number of DITANET Trainees met at HIT, Heidelberg on 10th September 2010. This informal meeting allowed trainees to discuss their experiences of working within a Marie Curie Training Network, critically review progress in the respective research projects and to share good practice within the network. The network provides its trainees with such opportunities to feel part of a wider community and to network with peers on a regular basis.

Meeting of the DITANET Steering Committee

CERN, Geneva
15th October 2010

The fifth meeting of the DITANET Steering Committee took place on Friday 15th October and was hosted by CERN, Geneva. Members from France, Germany, Romania, Spain, Switzerland and the UK attended in order to critically review the recent activities of the network and plan future events. Plans were approved for a DITANET school in Stockholm and an international conference in Seville, in March and November 2011 respectively.
In addition, suggestions were put forward to future Topical Workshops within the network.
Announcements and details will be forthcoming over the next few months and will be posted on the DITANET web pages.

The Steering Committee consists of senior scientists elected at the beginning of the DITANET project. It is responsible for the implementation of the overall network strategy and oversees all decisions regarding the network.

"Plans were approved for a DITANET school in Stockholm and the network's conference in Seville."

Forthcoming Events

DITANET School on Beam Diagnostic Techniques

Stockholm
7th-11th March 2011

This DITANET School will be organised and hosted by Manne Siegbahn Laboratory/Stockholm University and held in Stockholm, 7th-11th March 2011.
The School will cover beam instrumentation at an advanced level, targeting PhD students and postdocs in addition to experienced scientists and research staff. Basic techniques, such as beam profile, position or current measurement, will be revised before the details of beam diagnostics systems for specific applications, such as for example particle colliders, state-of-the-art light sources and low energy accelerators will be covered. A scientific poster session, contributions from industry partners and several tutorials throughout the week will complement the broad program.
Several scholarships are available for outstanding young researchers. Further information is available from the web site.

www.liv.ac.uk/ditanet

Forthcoming Events (continued…)

DITANET Topical Workshop: Detection Techniques

Seville, Spain
7th and 8th November 2011

Planning has begun for a DITANET Topical Workshop on Detection Techniques that will take place on the 7th and 8th November 2011 in Seville, Spain.
This workshop will be hosted by the Universiy of Seville/CNA. The purpose of the workshop is to discuss the state-of-the-art in particle detection techniques and sensors, as used for example in Particle and Nuclear Physics, as well as in various applications such as for medical or security purposes.
The scope of the workshop includes beam tracking detectors, charged particle detectors, gamma ray detectors and neutron detectors.

The workshop will be held as a satellite event to the DITANET international conference on diagnostics techniques.

Further details will be announced in the New Year.

DITANET International Conference on Diagnostic Techniques

Seville, Spain
9th - 11th November 2011

The DITANET Consortium will organize a three day international conference on diagnostic techniques for particle accelerators and beam instrumentation in Seville, Spain between November 9.-11. next year.

The conference will bring together all beneficiary, associated and adjunct partners from the DITANET consortium, but is also open to participants from the world-wide diagnostics community, in particular to researchers at the early career stage.

The latest developments and trends in our exciting research field will be presented in both, oral and poster sessions.

Invited talks given by research leaders from around the world will form the core of this interdisciplinary event. They will be complemented by contributed talks that will be selected from all contributions to the conference.

The conference will provide ample opportunities for critical discussions of research outcomes, exchange of knowledge and for meeting friends from the diagnostics community.

The conference will be held at DITANET partner centro nacional de aceleradores (CNA). The centre offers excellent facilities and is ideally suited for hosting such large meeting.

A number of scholarships will be made available for early stage researchers from outside the network.

Further details will be announced soon on the network's web page.

www.liv.ac.uk/ditanet

The DITANET conference will provide a comprehensive overview of the latest trends in beam diagnostics R&D.

News from DITANET Partners

irfu

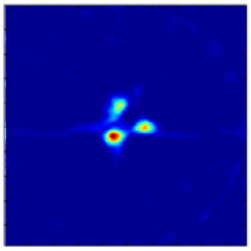
cea

saclay

CEA, France *(J. Egberts, C-M. Mateo and J. Marroncle)*

Project Update

Since the 90's, CEA/Saclay is involved in the development of HPPA (High Power Proton Accelerators) mainly with the SILHI (High Intensity Light Ion Source) source and the IPHI (High Intensity Proton Injector) front end. Since then Saclay teams are involved in several projects like Spiral 2 (Ganil, Caen in France), FAIR (GSI, Darmstadt in Germany) and IFMIF in Japan (for the EVEDA phase). Such facilities are planned to produce and accelerate high intensity proton or deuteron beams in pulsed or continuous mode.



The International Fusion Materials Irradiation Facility (IFMIF) aims at producing an intense flux of 14 MeV neutrons, in order to characterize materials envisaged for future fusion reactors. The primary mission of IFMIF is to provide a materials irradiation database for the design, construction, licensing and safe operation of the Fusion Demonstration Reactor (DEMO)[1]. In such a reactor, high neutron fluxes may generate up to 30 dpa/fpy (displacements per atom/full power year). The IFMIF facility is based on two high power cw drivers (175 MHz) each delivering a 125 mA deuteron beam at 40 MeV and having them collide with a liquid lithium target. The produced neutrons will interact with material samples at different conditions (irradiation rates, temperature…) to study their behaviour. In the framework of the "Broader Approach", the IFMIF-EVEDA (Engineering Validation and Engineering Design Activities) project includes the construction of an accelerator prototype with the same characteristics as IFMIF, but with 9 MeV instead of 40 MeV for the incident deuteron energy. Most of the components of the accelerator are developed by France (CEA Saclay), Italy (INFN Legnaro) and Spain (CIEMAT Madrid). The commissioning of this accelerator at Rokkasho (Japan) is foreseen for 2013-2014.

At CEA Saclay, two DITANET students have joined us: Cherry May Mateo who is involved in the injector group and Jan Egberts who works on beam instrumentation devoted to the high energy part of the accelerator (5 to 9 MeV).

For the low energy part of the HPPA (High Power Proton Accelerators), the beam characteristics like beam profile have to be fully known at the entrance of the 1st accelerating cavity (i.e. the RFQ). Due to the very high power density at this location, important diagnostics development has been in progress for several years. In this framework, a specific study is presently done to reconstruct the effective beam profile using the tomography technique.

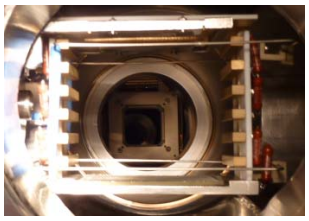
In a first step, Cherry May developed an algorithm that performs mathematical processing of available images or projections taken from different angles around the beam of interest to reconstruct the beam profile. The goal is to reconstruct the profile with at most six projections. In parallel, a preliminary experiment close to that of an ion beam interaction with residual gas is performed with an expanded He-Ne laser beam directed to an experimental chamber filled with fluorescent gas, and to better define the beam, a mask with three holes is placed along the beam line before the experimental chamber. Results showed that a reconstruction with six projections does not result in an effective beam profile reconstruction even with numerous iterations. The figure shows streak artefacts which can be removed if the number of projections will be increased. As a consequence, the construction of the already designed vacuum chamber dedicated for measurements on the CEA Saclay beam lines (BETSI test bench or SILHI source) is postponed.

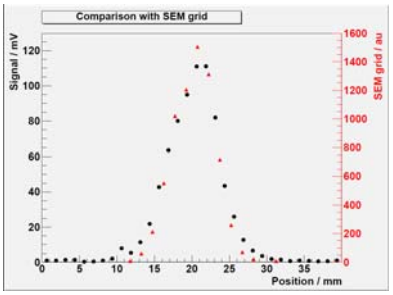
News from DITANET Partners (continued)…

CEA, France – *Project Update* (continued)...

For the high energy section of the accelerator, beam profile monitors based on residual gas ionisation for three different beam settings have been designed. It was the primary objective of the design to achieve the best electric field homogeneity possible, given the limited space available for diagnostics at the IFMIF-EVEDA accelerator. A prototype based on these designs has been successfully tested at GSI (Germany) in May 2010. To the right, a photo of the prototype mounted at the GSI X2 beam line is given. On both sides, there are voltage degraders made of copper to reduce fringe field effects. On top and on bottom, wires can be seen that are used as compensation electrodes for an improved field homogeneity. The acquired profiles are in good agreement with SEM-grid profiles which indicates the functionality of the prototype. A plot with our IPM profile (black) and a SEM-grid profile (red) is given to the right. The electric field homogeneity has also been tested and was found to be highly linear. Conclusively, almost all properties of the detector are well understood by now. The results of the test at GSI have been presented at the Preliminary Design Review (PDR) for the instrumentation of IFMIF-EVEDA. At the PDR, an international expert committee has evaluated the technical feasibility and advised on steps for further improvements. Additional tests of the prototype are scheduled at GSI and the high intensity proton source IPHI at CEA Saclay.

Our group is also in charge of the beam loss monitoring, for which LHC ion chambers (IC) are envisaged. Two calibration campaigns have been performed: for γ at COCASE at CEA Saclay (60Co source) and for neutrons at CEA Valduc. The IC experimental responses match simulations performed at CERN nicely. Improvements of particle losses calculations will be the next step, as well as an optimization of neutrons and γ IC responses. That will be done using GEANT4 for simulating different IC configurations. In parallel, beam intensity measurements with current transformer monitors have to be studied.





As it can be seen, DITANET is a very good opportunity for our project, bringing new young and highly motivated persons in the field of diagnostics and sharing with them our knowledge and their skills to study our research and development more deeply, using also the possibilities for collaboration across the network.

News from DITANET Partners (continued)…

Royal Holloway University of London, UK *(K. Lekomtsev)*

Simulation Studies for Longitudinal Beam Profile Monitor at CTF3

A setup for the investigation of Coherent Diffraction Radiation from targets with various configurations as a tool for non-invasive longitudinal electron beam profile diagnostics has been designed and installed in the CRM line of the CLIC Test Facility 3 (CTF3) at CERN [1,2].

Recently the system has been upgraded by installing a second target to suppress synchrotron radiation background. Simulations of CDR spatial distribution from a two target configuration have been performed.

Royal Holloway University of London

News from DITANET Partners (continued)...

Royal Holloway University of London, UK - *Simulation Studies for Longitudinal Beam Profile Monitor at CTF3 (continued)...*

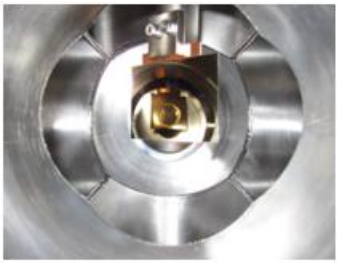


Figure 1

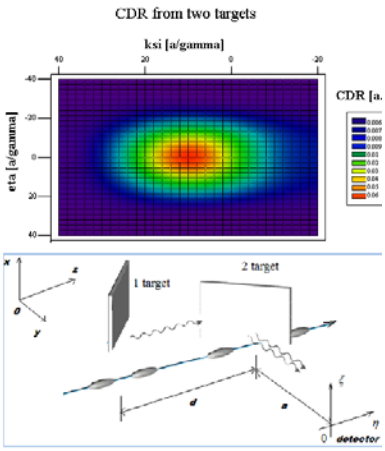


Figure 2

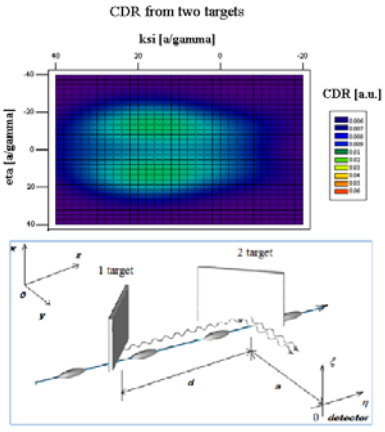


Figure 3

A novel scheme for a drive beam generation has been proposed for the future Compact Linear Collider (CLIC), in which a long bunch train with low bunch repetition frequency will be accelerated with low RF frequency [3]. The optimization and monitoring of the longitudinal charge distribution in a bunch is crucial for the maximization of luminosity and for an optimal performance of the CLIC drive beam.

Diffraction radiation (DR) is widely used as a tool for transverse [4] and longitudinal [5] beam parameter monitoring. DR arises when a charged beam passes by in the vicinity of a target, the effect of the beam interaction with the target material is minimal and a smaller perturbation to the beam is produced compared with other diagnostics, such as transition radiation. Coherent Diffraction Radiation (CDR) was suggested as a mechanism for the coherent radiation generation due to its non-invasive nature and is utilised in this experiment.

Recent upgrade of the experimental setup included installation of the second target in the upstream cross of the system, Fig. 1. Installation of the second target required in depth studies of the new two target configuration.

For calculations a classical theory of Diffraction Radiation (DR), based on Huygens principle of plane wave diffraction, was utilized. In reality classical DR theory describes backward DR only. However for a metallic foil and millimetre wavelengths we can use an ideal conductor approximation. In this case BDR characteristics coincide with FDR ones [6]. A particle field is introduced as a superposition of its pseudo-photons and when they are scattered off a target surface they are converted into real ones and propagate either in the direction of a specular reflection (BDR) or along the particle trajectory (FDR).

In Fig. 2 and 3, calculated CDR distributions are presented for the two main configurations of the setup. The first configuration is when the impact parameter of the upstream target is three times larger than the impact parameter of the downstream target. Second configuration is when both targets are positioned at the same distance from the beam. In Fig.3 the radiation distribution is more dispersed in comparison to Fig. 2 and also significant intensity suppression is observed. The distribution in Fig. 3 is converted into a dual-mode one; however the distribution in Fig. 2 is single-mode. By integrating these distributions over the detector aperture, the single electron spectrum can be obtained.

Simulation studies for the two target configuration have been performed. Optimal target configuration studies have been done as well. The process of CDR emission was considered in several steps. Simulations were based on the classical theory of Diffraction Radiation. The ultimate goal of the simulations is reconstruction of the single electron spectrum, which is utilized in the interferometric measurements at the experimental setup, for the beam form factor reconstruction.

REFERENCES

[1] M. Micheler et al., Proc. IPAC, Kyoto, Japan (2010).

[2] K. Lekomtsev et al., Proc. LINAC10, Tsukuba, Japan (2010).

[3] G. Geschonke et al., CTF3 Design report, CERN /PS 2002-08 (2002).

[4] P. Karataev et al., Phys. Rev. Lett. 93 (2004) 244802.

[5] M. Castellano et al., Phys. Rev. E 63 (2001) 056501.

[6] M.L Ter-Mikaelyan, High Energy Electromagnetic Processes in Condensed Media, Wiley-Interscience, New York (1972).

News from DITANET Partners (continued)...

University of Liverpool, UK

Trainee News

It has been a summer of celebrations for the University of Liverpool's DITANET trainees.

Janusz Harasimowicz and his wife Anna were happy to announce the birth of their son Filip on 25th July.

Also celebrating was Massimiliano Putignano who married Angela Intermite, a PhD student at the University of Liverpool. Their wedding took place on the 10th of August in Grottaglie, Taranto, Italy.

Congratulations !

Janusz and Filip

Massimiliano and Angela

Position Vacancies

Horia Hulubei National Institute of Physics and Nuclear Engineering (IFIN-HH), Romania have a vacancy for a 12-18 months training contract available to either an Early Stage Researcher (ESR) or an Experienced Researcher (ER).

The successful applicant will work on the development of a 'Zero Time Detector' for future particle accelerators and be based in Romania and will have access to the broad training program the DITANET network provides.

Further information can be obtained by contacting the lead scientist Dr. Horia Petrascu, hpetr@nipne.ro.

Details on the Marie Curie eligibility rules and an outline of the project can be found on the DITANET web site:

http://www.liv.ac.uk/ditanet/projects/ifin-hh.html

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Examples of Recent Publications/Presentations:

Publications:

A. Jeff et al., "Design for a longitudinal density monitor for the LHC", Proc. IPAC, Kyoto, Japan (2010)
M. Putignano et al., "Optimization Studies of Planar Supersonic Gas-jets for Beam Profile Monitor Applications", Proc. IPAC, Kyoto, Japan (2010)
K. Lekomtsev et al., "Coherent Diffraction Radiation Longitudinal Beam Profile Monitor for CTF3", Proc. LINAC, Tsukuba, Japan (2010)
J. Harasimowicz, et al., "Scintillating Screens Sensitivity and Resolution Studies for Low Energy, Low Intensity Beam Diagnostics", Rev. Sci. Instr. **81** (9)

DITANET Events 2011	
March 7th – 11th	DITANET advanced School on Beam Diagnostics Stockholm, Sweden
March 10th	Meeting of the Steering Committee Stockholm, Sweden
March 11th	Meeting of the Supervisory Board Stockholm, Sweden
November 7th – 8th	Topical Workshop on Detector Technologies Seville, Spain
November 9th – 11th	DITANET Conference on Beam Diagnostics Seville, Spain
Other Interesting Events	
March 28th – April 1st	PAC Conference, New York City, USA
May 16th - 18th	DIPAC workshop, Hamburg, Germany
September 4th - 9th	IPAC Conference, San Sebastian, Spain

NOTICE BOARD

DEADLINE FOR THE NEXT NEWSLETTER
10th December 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.